ANNUAL REPORT
2019-20

जैविक खेती पर अखिल भारतीय नेटवर्क कार्यक्रम
All India Network Programme on Organic Farming

ICAR-Indian Institute of Farming Systems Research
Modipuram, Meerut – 250 110, India

ICAR-IIFSR

ICAR Indian Institute of Farming Systems Research (IIFSR) formerly Project Directorate for Farming Systems Research (PDFSR) was established by Indian Council of Agricultural Research New Delhi in April 1989 at Modipuram Meerut Uttar Pradesh.

Vision

Management of natural source of holistic improvement of small and marginal farmers through Integrated Farming Systems

Mission

Improve food, nutrition, livelihood and financial security of small and marginal households through climate smart Integrated Farming Systems (to make marginal and small households as bountiful)

Mandate

- Research in integrated farming Systems on production technologies for improving productivity and resource use efficiencies
- Develop efficient, economically viable and environmentally sustainable integrated farming system models for different farming situations.
- On-farm testing, verification and refinement of system-based farm production technologies.
- Co-ordinate and monitor integrated farming system research in the country

All India Coordinating Coordinated Research Project on Integrated Farming System (AICRP on IFS) is an integral part of ICAR-IIFSR with 74 centres to undertake on-station main (25 no's.) on-station sub (11 no's.) on-station voluntary (6 no's) and on-farm research (32 no's) spread across length and breadth of the country. The institute is also leading an All India Network Programme on Organic Farming (AI-NPOF) with 20 centres

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Correct citation : All India Network Programme on Organic Farming. Annual Report 2019-20, ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut- 250 110, pp.xi+276.

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Important Notes :

- This compilation is a joint contribution of all the scientists involved in All India Network Programme on Organic Farming (AI-NPOF) at 20 centres including 7 new centres started from 2015-16 and ICAR-IIFSR, Modipuram (report writing, compilation, editing and printing).
- The Annual Report 2019-20 is based on experimental data generated during *kharif*, *rabi* and summer seasons of 2018-19. The other details are relevant up to 31 March 2020.
- The report includes both processed and semi-processed data, generated in different experiments under All India Network Programme on Organic Farming (AI-NPOF) and as such no material/ data should be reproduced in any form without prior written permission of the Director, ICAR-Indian Institute of Farming Systems Research and due credit to the concerned scientist (s).

ACKNOWLEDGEMENT

All India Network Programme on Organic Farming (AI-NPOF) initiated during 2004 having mandate to develop package of practices and technologies for organic production system is currently operating with 20 co-operating centres covering 16 states by involving 11 State Agricultural Universities, 7 ICAR institutes and 1 deemed (special heritage) university. Results of the study, experiments and demonstrations conducted during 2017-18 at 20 co-operating centres are processed, compiled, and published as Annual Report 2019-20. I take this opportunity to record my sincere thanks to **Dr Trilochan Mohapatra**, Former Secretary, Department of Agricultural Research and Education and Director General, Indian Council of Agricultural Research, New Delhi for his technical guidance and administrative support in shaping the scheme to serve better and meeting the aspirations of policy makers. I also extend my gratitude to **Dr Himanshu Pathak**, Secretary, Department of Agricultural Research and Education and Director General, Indian Council of Agricultural Research, New Delhi for the support being extended to the scheme. I extend my gratitude to **Dr. S.K. Chaudhari**, Deputy Director General (Natural Resource Management) for his constant technical and administrative besides mentoring the scheme to develop solutions for the field oriented problems related to organic farming. Valuable methodological inputs received from **Dr S. Bhaskar**, Assistant Director General (Agronomy, Agroforestry and Climate Change) for improving the performance and output of the scheme is duly acknowledged. Scientific inputs received from **Quinquennial Review Team (QRT), Research Advisory Committee (RAC)** and **Institute Management Committee (IMC)** is thankfully acknowledged as the issues raised and inputs shared were of immense value in taking new initiatives.

I am highly thankful to each one of the scientists and research fellows involved in the scheme at 20 centres for setting the painstaking effort to conduct the field experiments, lab analysis and generating data. The sincere efforts put forth by **Dr. N. Ravisankar**, Principal Scientist and National Principal Investigator for overall coordination of technical, administrative and financials of the scheme and super vision of preparing the report. I extend my gratitude and appreciation to **Dr Vipin Kumar**, Chief Technical Officer and **Dr Gautam Veer Chauhan**, Research Associate and all others who have helped to shape the report by compiling the data, its statistical analysis, report drafting and proof correction. Administrative assistance to the scheme given by **Mrs. Jailata Sharma**, Personal Assistant, Coordination Unit is also duly acknowledged.

The contributions of all the other scientific, technical, administrative, and skilled supporting staff either directly or indirectly at various levels during preparation of this report are duly acknowledged. Findings from the scheme especially package of practices, varietal identification and insect-disease-weed management will pave way for improving the organic production system in the country.

(A.S. Panwar)
Director

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सारांश

अखिल भारतीय जैविक खेती नेटवर्क कार्यक्रम के अंतर्गत वर्ष 2019–20 के दौरान किए गए मुख्य शोध निष्कर्ष नीचे दिये गये है।

1. जैविक, अजैविक और एकीकृत (जैविक की ओर) उत्पादन प्रणालीयों का मूल्यांकन

बजौरा: (हिमाचल प्रदेश) में सब्जी आधारित फसल प्रणालियों का मूल्यांकन किया गया जिसमें टमाटर, फूलगोभी, उड़द, समर स्क्वॉश और भिंडी की उपज एकीकृत पैकेज के अंतर्गत अधिकतम पाई गई। खरीफ और ग्रीष्म में फ्रेंचबीन की अधिकतम उपज जैविक प्रबंधन के अंतर्गत दोनों तरह से 100 प्रतिशत जैविक या 75% जैविक और 25% अभिनव प्रयोग से प्राप्त हुई थी। टमाटर की अधिकतम उपाय 7330 किग्रा./हे. एकीकृत प्रबंधन (75% जैविक और 25% रासायनिक) प्रबंधन के अंतर्गत प्राप्त हुई। एकीकृत प्रबंधन के अंतर्गत रासायनिक की तुलना में फूल गोभी, टमाटर, उड़द, भिंडी और समर स्क्वॉश की उपज क्रमशः 115.3, 66.3, 42.1, 56.4 और 92.6 प्रतिशत अधिक प्राप्त हुई जबकि फ्रेंच बीन और मटर की उपज जैविक उत्पादन पद्धति के साथ क्रमशः 113.5 और 104.2 प्रतिशत रासायनिक की तुलना में अधिक पाई गई। प्रणाली समतुल्य उपज के संबंध में, उड़द–फूलगोभी–समर स्क्वॉश में अधिकतम फूलगोभी समतुल्य उपज 21230 किग्रा./हे. अन्य सभी प्रणालियों फसल प्रणालियों की तुलना में दर्ज की । विभिन्न उत्पादन पद्धतियों में एकीकृत उत्पादन पैकेज (50% जैविक और 50% रासायनिक खाद) ने 20178 किलोग्राम की फूलगोभी समतुल्य उपज दर्ज की। एकीकृत पैकेज के साथ जैविक और रासायनिक पैकेज की तुलना में क्रमशः 47.1 और 74.6 प्रतिशत की वृद्धि दर्ज की गई।

भोपाल (मध्य प्रदेश): मे सोयाबीन आधारित फसल प्रणालियों का मूल्यांकन किया गया जिसमें सोयाबीन के बाद रबी में गेहूं, सरसों, चना और अलसी की फसल उगाई गई। सोयाबीन की अधिकतम औसत उपज जैविक प्रबंधन के साथ 1467 किग्रा./हे. दर्ज की गई जो कि रासायनिक पैकेज और राज्य समर्थित की तुलना में जैविक के साथ क्रमशः 18.3% और 36.7% अधिक थी। एकीकृत पोषक प्रबंधन 75% जैविक + 25% जैविक खाद के साथ गेहूं, सरसों, चना, और अलसी की अधिकतम उपज क्रमशः 3853, 1654, 1850 और 1587 किग्रा./हे. दर्ज की गई जो रासायनिक की तुलना में 24.0, 20.7, 22.1 और 16.6% अधिक थी। सोयाबीन समकक्ष उपज के संबंध में सभी फसल कर्मों में से सोयाबीन–गेहूं फसल क्रम ने सबसे अधिक सोयाबीन समतुल्य उपज 3663 किग्रा/हे. प्राप्त की उसके बाद सोयाबीन–सरसों फसल क्रम ने 3614 किग्रा./हे. दर्ज की। विभिन्न पोषक तत्वों में से जैविक खाद के माध्यम से 75% पोषक तत्व + 25% रासायनिक उर्वरक (एकीकृत) देने पर अधिकतम समतुल्य उपज 3695 किग्रा./हे. दर्ज की उसके बाद जैविक उत्पादन पैकेज के साथ सोयाबीन समतुल्य उपज प्राप्त हुई जो 3564 किग्रा./हे. थी दोनों उत्पादन पैकेज में 3.7% का अंतर पाया गया।

कालीकट (केरल): मे हल्दी का मूल्यांकन अलग–अलग पोषण प्रबंधन के अंतर्गत किया गया जहां हल्दी की अधिकतम उपाय 13900 किग्रा./हे. जैविक पैकेज 75% जैविक खाद+ 25% इन्नोवेटिव प्रैक्टिस के साथ दर्ज की गई। इसके बाद एकीकृत पैकेज (75% जैविक + 25% रासायनिक) ने 13800 किग्रा./हे. की पैदावार दी।

कोयम्बटूर (तमिलनाडु): मे विभिन्न प्रबंधन पैकेज के बीच खरीफ में, बैंगन, मिर्च, टमाटर की उपज क्रमशः 25476, 12263 और 17562 किग्रा./हे., रबी के दौरान बाजरा और रागी की उपज क्रमशः 1896 और 2906 किग्रा./हे. या तो जैविक पोषक उत्पादन पैकेज (75% जैविक पोषक तत्व+ पंचगव्य पर्ण छिड़काव 3% की दर से+एज़ोफोस 2 किलोग्राम बेसल प्रयोग के रूप मे) या एकीकृत पोषक पैकेज (75% जैविक + 25% अजैविक) के साथ पाई गई । जबकि बार्नयार्ड बाजरा की अधिकतम उपज राज्य समर्थित पैकेज के साथ 1982 किग्रा./हे. दर्ज की गई।

धारवाड़ (कर्नाटक): मे मूंग, कुसुम , ज्वार और मूंगफली जैसी सभी फसलों ने या तो 100% अजैविक उत्पादन प्रबंधन या राज्य सिफारिश पैकेज के साथ उच्चतम उपज प्राप्त की जबकि मक्का, ज्वार और चना ने जैविक (75%जैविक और 25% अभिनव प्रयोग) के साथ उच्चतम उपज दी। अरहर, कुसुम उड़द और मूंगफली की उपज रसायनिक की तुलना में क्रमशः 13.1, 30.2, 24.6 और 40.1% जैविक के साथ कम पाई गई।मक्का ज्वार और चने की फसल ने जैविक एवं एकीकृत उत्पादन प्रबंधन के अंतर्गत बेहतर प्रदर्शन किया तथा अजैविक की तुलना में जैविक के साथ क्रमशः 20, 28.3, और 20.9% अधिक पैदावार दी। विभिन्न फसल प्रणालियों में उड़द ज्वार प्रणाली ने अन्य प्रणालियों की तुलना में अधिकतम मूंगफली समतुल्य उपज दर्ज की वहीं विभिन्न पोषक उत्पादन प्रबंधन में से जैविक उत्पादन प्रबंधन के अंतर्गत अधिकतम उपज 2520 किग्रा./हे. दर्ज की गई।

जबलपुर (मध्य प्रदेश): मे विभिन्न पोषक तत्वों के प्रबंधन से प्रभावित बासमती धान और अन्य फसलों की औसत अनाज उपज रसायनिक प्रबंधन पैकेज के साथ अधिक पायी गयी जो

जैविक पोषक प्रबन्धन के साथ क्रमशः 9.6 प्रतिशत बासमती धान के लिए घटी। जैविक उत्पादन प्रबंधन पैकेज के साथ गेहूं, चना, मक्का (चारा), बरसीम (चारा एवं बीज), सब्जी मटर और ज्वार (चारा) की उपज अजैविक पोषक तत्व प्रबंधन की तुलना में क्रमशः 16.7, 11.1, 11.0, 39.9, 12 और 18.6% कम हुई। विभिन्न पोषण उत्पादन प्रणालियों में, अधिकतम बासमती धान समतुल्य उत्पादकता 100 प्रतिशत रसायनिक पोषक तत्व प्रबंधन (6230 किग्रा./हे) के साथ दर्ज की गई, इसके बाद एकीकृत पैकेज (6085 किग्रा./हे) साथ पाए गयी। फसल क्रमों में, बासमती धान–बरसीम (चारा एवं बीज) द्वारा बासमती धान समतुल्य उच्चतम पैदावार (7745 किग्रा./हे.) अधिकतम दर्ज की गई। इसके बाद धान–गेहूं प्रणाली द्वारा 5883 किग्रा./हे. की समतुल्य उपज दर्ज की गई।

कर्जट (महाराष्ट्र): मे धान की अधिकतम पैदावार (4631 किग्रा./हे.) एकीकृत प्रबन्धन के तहत दर्ज की गई जो जैविक प्रबंधन के बराबर पाई गई। चना और प्याज ने भी एकीकृत पैकेज के साथ अच्छी उपज प्राप्त की जो रसायनिक की तुलना में क्रमशः 16.7 और 18.6 प्रतिशत अधिक थी। जैविक पैकेज के साथ फील्डबीन की उपज अधिकतमदर्ज की गई। जो मात्र बीस किग्रा./हे. अजैविक की तुलना में अधिक थी। जबकि बैगन की अधिकतम उपज 49705 किग्रा./हे. अकार्बनिक पैकेज के साथ रही। प्रणाली उत्पादकता के सदर्भ में धान–बैंगन प्रणाली ने अन्य प्रणाली की तुलना में अधिकतम धान समतुल्य उपज (52295 किग्रा./हे.) प्राप्त की। विभिन्न उत्पादन पैकेज में से जैविक पैकेज के साथ अधिकतम घान समतुल्य उपज दर्ज की गई जो 22% रासायनिक तुलना में अधिक थी।

लुधियाना (पंजाब): मे जैविक प्रबंधन में 75 प्रतिशत जैविक खाद+ अभिनव प्रयोग के द्वारा खरीफ की फसलों सोयबीन और मूंग की अधिकतम उपज (1250 और 800 किग्रा./हे.) दर्ज की गई। जबकि खरीफ में ही बासमती धान की अधिकतम उपज 4030 किग्रा./हे. प्राप्त की गई तथा यह अजैविक पैकेज की तुलना में मात्र (110 किग्रा./हे.) का उपज में अंतर पाया गया। चनें की फसल ने भी अधिकतम उपज (1170 किग्रा./हे.) जैविक पैकेज के साथ (75 प्रतिशत जैविक+इन्नोवेटिव प्रैक्टिस) दर्ज की जो रासायनिक की तुलना में 129 प्रतिशत अधिक थी। हालांकि, गेहूं और ग्रीष्म मूंग ने एकीकृत पैकेज के साथ उच्च उपज (5660 और 870 किग्रा./हे.) दर्ज की, जो जैविक प्रबंधन से लगभग 8.01 और 8.75 प्रतिशत अधिक थी। विभिन्न उत्पादन पैकेज में से गेहूं की समतुल्य उपज या तो जैविक (100 प्रतिशत या 75 प्रतिशत जैविक +इन्नोवेटिव प्रैक्टिस) के साथ प्राप्त हुई। विभिन्न फसल प्रणालियों में, गेहूं समतुल्य उपज मूंग (खरीफ)–गेहूं–मूंग(ग्रीष्म) में सांख्यिकीय रूप से बराबर पाई गई।

मोदीपुरम (उत्तर प्रदेश): में जैविक प्रबन्धन के साथ बासमती धान और आलू की अधिकतम उपज (क्रमशः 3876 और 24700 किग्रा./हे.) पाई गई जो क्रमशः 25 और 28 प्रतिशत रासायनिक पोषक तत्व प्रबन्धन की तुलना में अधिक थी, हालांकि मोटा धान, गेहूं, जौ और भिंडी में क्रमशः 11.8, 24.2, 9.6 और 6.0 प्रतिशत की कमी जैविक के साथ एकीकृत पैकेज की तुलना में देखी गई। विभिन्न उत्पादन पेकेज में से जैविक ने अधिकतम धान समतुल्य उपज (13297 किग्रा./हे.) दर्ज की।

पंतनगर (उत्तराखंड): में विभिन्न पोषक तत्व प्रबन्धन पैकेज के अन्तर्गत बासमती धान आधारित फसल प्रणालियों का मुल्यांकन किया गया। एकीकृत पैकेज के साथ बासमती धान की अधिकतम उपज (4926 किग्रा./हे.) पायी गयी जो जैविक पैकेज के लगभग बराबर रही (4915 किग्रा./हे.) जो क्रमशः15. 2 और 15.5 प्रतिशत रासायनिक प्रबंधन पैकेज की तुलना में अधिक थी। रबी की विभिन्न फसलों में गेहूँ की अधिकतम उपज (4946 किग्रा./हे.) एकीकृत पोषण प्रबन्धन (50 प्रतिशत जैविक और अजैविक) में पायी गयी जो लगभग रासायनिक से मात्र 114 किग्रा./हे. अधिक थी। धनिया को अन्य फसल जैसे चना एवं मटर के साथ 4:2 के अनुपात में उगाया गया। धनिया की उपज को समतुल्य उपज में परिवर्तित किया गया है जिसके अन्तर्गत चना और मटर समतुल्य उपज क्रमशः 2205 और 9173 किग्रा./हे. जैविक प्रबन्धन (100 प्रतिशत जैविक खाद) में अधिकतम पायी गयी। आलू की उपज उल्लेखनीय रुप से जैविक पेकेज के साथ अधिक रही जो अजैविक की तुलना में 16 प्रतिशत अधिक थी। विभिन्न उत्पादन पेकेज में से एकीकृत पोषण अपनाने पर बासमती धान समतुल्य उपज (9206 किग्रा./हे.) अधिकतम पाई गई जो अजैविक की तुलना में 13 प्रतिशत अधिक थी। सभी फसल प्रणालियों में से, बासमती चावल–चना+धनिया–*सेसबनिया* ने उच्च समकक्ष उपज (10615 किग्रा./हे.) प्राप्त की उसके बाद बासमती धान–आलू (8218 किग्रा/हे) रही।

रायपुर (छत्तीसगढ़): मे सोयाबीन की अधिकतम उपज (2006 और 2088 किग्रा./हे.) जैविक प्रबन्धन के अन्तर्गत क्रमशः या तो 100 प्रतिशत जैविक खाद या 75 प्रतिशत जैविक + 25 प्रतिशत इन्नोवेटिव प्रैक्टिस (10 प्रतिशत वर्मीवॉस का स्प्रे 20 दिनों के अन्तराल पर) के साथ दर्ज की गई। अजैविक की तुलना में सोयाबीन की उपज में अन्तर क्रमशः11.9 और 16.4 प्रतिशत जैविक (100% जैविक खाद का प्रयोग एवं इन्नोवेटिव प्रैक्टिस) के साथ अधिक पाया गया। अन्य फसले जैसे मक्का (मीठी मक्का), मटर और मिर्च की अधिकतम उपज (14566, 7668 एवं 9013 किग्रा./हे.) भी जैविक प्रबन्धन के अर्न्तगत 75 प्रतिशत जैविक+25 प्रतिशत इन्नोवेटिव प्रैक्टिस (10 प्रतिशत वर्मीवॉस का स्प्रे 20 दिनों के अन्तराल पर) जबकि प्याज कदं की अधिकतम उपज (16082 किग्रा./हे.) राज्य सिफारिश प्रबंधन पैकेज के साथ पाई जो जैविक पैकेज से 17.1 प्रतिशत अधिक थी। इसी तरह जैविक ओर अजैविक के बीच उपज वर्षद्वि का अतंर 17.8, 48.4 और 5.2 प्रतिशत क्रमशः मक्का, मटर और मिर्च में पाया गया था। सोयाबीन के समुतल्य उपज के संदर्भ में फसल प्रणाली की उत्पादकता 75 प्रतिशत जैविक पोषक तत्व इन्नोवेटिव प्रैक्टिस (7324 किग्रा./हे.) के साथ जैविक प्रबंधन के तहत उच्चतम दर्ज की गई और यह रासायनिक की तुलना में 13.4 प्रतिशत अधिक थी। सोयाबीन–मक्का फसल प्रणाली ने उच्च सोयाबीन समकक्ष उपज (7417 किग्रा./हे.) विभिन्न प्रणालियों के बीच में से अधिकतम दर्ज की।

रांची (झारखंड): में धान (बिरसामती) की अधिकतम उपज (क्रमशः 3611 और 3407 किग्रा./हे.) 75 प्रतिशत जैविक+25 प्रतिशत अभिनव प्रयोग (अजोला के साथ वर्मीवाश स्प्रे) के साथ

दर्ज की गई थी। जो क्रमशः 18.9 और 26 प्रतिशत रासायनिक की तुलना में अधिक थी। दूसरी फसल प्याज, आलू फसल ने भी जैविक पैकेज के साथ अच्छा प्रर्दशन किया और अजैविक की तुलना में जैविक के साथ इन फसलो में 10.4 और 120 प्रतिशत की वृद्वि होना पाया गया। गेहूँ की अधिकतम उपज 2875 किग्रा./हे. रासायनिक पैकेज के साथ दर्ज की गई थी जो 100 प्रतिशत जैविक प्रबन्धन के साथ रसायनिक की तुलना में 12.1 प्रतिशत कम थी। भिन्डी की फसल ने अधिकतम उपज (9334 किग्रा./हे.) एकीकृत पैकेज के साथ दर्ज की जहां पर 75 प्रतिशत खाद जेविक और 25 प्रतिशत उर्वक का प्रयोग किया गया। फसल प्रणालियों में, धान–आलू ने उच्चतम प्रणाली समतुल्य उपज (11781 किग्रा./हे.) दर्ज की, जबकि धान–प्याज ने उसके बाद 11431 किग्रा./हे. के साथ अगले स्थान पर रही। विभिन्न उत्पादन पैकेज के मध्य जैविक उत्पादन पैकेज में अधिकतम प्रणाली समतुल्य उपज (10912 किग्रा./हे.) दर्ज की।

उमियम (मेघालय): में ब्रोकली की अधिकतम उपज (15220 किग्रा./हे.) विभिन्न उत्पादन पैकेज के मध्य अधिक पायी गई इसके बाद एकीकृत प्रणाली 15141 किग्रा./हे. में प्राप्त हुई। तथा रासायनिक की तुलना में ब्रोकली की उपज 6.5 प्रतिशत अधिक दर्ज हुई। अन्य सब्जियों की फसलें, जैसे–गाजर, और टमाटर ने भी क्रमशः 15950 और 17500 किग्रा./हे. की अधिकतम उपज जैविक प्रबन्धन के अर्न्तगत प्राप्त की। जबकि आलू और फ्रेंच बीन की अधिकतम उपज एकीकृत उत्पादन पैकेज के साथ दर्ज की गई जो क्रमशः 19500 और 7120 किग्रा./हे. रही। सब्जी फसलें गाजर, आलू, फ्रेंचबीन और टमाटर ने क्रमशः 14.1, 20.9, 16.3 और 12.5 प्रतिशत अधिक उपज जैविक या एकीकृत के साथ रासायनिक की अपेक्षा प्राप्त की। विभिन्न धान की प्रजातियों में से शाहशरंग–1 ने 4670 किग्रा./हे. का अधिकतम उपज उत्पादन संकन बेड में किया। इसके बाद क्रम में प्रजाति लाम्न्ताह (4430 किग्रा./हे.), मेघा सुगंधित (4330 किग्रा./हे.) और नागोवा (4250 किग्रा./हे.) रही। विभिन्न उत्पादक पोषण पैकेज में से एकीकृत पैकेज (4720 किग्रा./हे.) अग्रणी रहा उसके बाद जैविक पोषण प्रबंधन रहा जिसके अंतर्गत (4650 किग्रा./हे.) की उपज प्राप्त हुई।

अजमेर (राजस्थान): में एकीकृत पैकेज के तहत 75 प्रतिशत जैविक + 25 प्रतिशत अजैविक उर्वरक के एकीकरण के साथ मूगं, ग्वारफली, धनिया और सौंफ का प्रदर्शन जैविक की ओर बेहतर पाया गया। पोषक पोषण प्रबंधन में से, रासायनिक की तुलना में मूगं, ग्वारफली, धनिया और सौंफ की उपज क्रमशः 20.5, 20.9, 18.7 और 32.8 प्रतिशत अधिक थी। वही यह क्रमशः 28.7, 17.9, 22.2, और 13.0 प्रतिशत जैविक पैकेज से भी अधिक पाई गई।

अल्मोड़ा (उत्तराखंड): में विभिन्न उत्पादन प्रबंधन पैकेज मे सें, जैविक खाद के माध्यम से फसल की 100 प्रतिशत नत्रजन की आपूर्ति जैविक सौत्र द्वारा करने पर गेहूँ समतुल्य उपज क्रमशः 4825 और 8059 किग्रा/हे. बाजरा+काली सोयाबीन–गेहूं+तोरिया और चौलाई–गेहूं+मसूर में अधिकतम पाई गई। दोनों प्रणालियों में रासायनिक की तुलना में जैविक के साथ क्रमशः 68.0 और 107 प्रतिशत ज्यादा गेहूं समतुल्य अनाज की उपज प्राप्त हुई।

गंगटोक (सिक्किम): में अंतर फसल जैसे अदरक, हल्दी, सोयाबीन और उड़द के साथ मक्का ने जैविक प्रबंधन पैकेज के अंतर्गत अधिकतम पैदावार दी इसी तरह फ्रेंच बीन, कुट्टू, राजमा और तोरिया ने भी जैविक पैकेज के तहत 100 प्रतिशत नत्रजन जैविक स्रोतों से देने पर जिसमें 25% खाद+25% केंचुए की खाद+25% नीम केक+25% सरसों की खली का प्रयोग करने पर उल्लेखनीय रूप से उच्च उपज दर्ज की।

नरेन्द्रपुर (पि□चम बंगाल): में धान (बासमती और मोटा) ने जैविक पोषक तत्व प्रबंधन (75 प्रतिशत जैविक + 25 प्रतिशत इन्नोवेटिव प्रैक्टिस) के अर्न्तगत अधिकतम उपज दर्ज की। रासायनिक पोषक पैकेज की तुलना में बासमती धान और मोटा धान की उपज का अंतर 14.0 और 4.0 प्रतिशत जैविक के साथ अधिक होना पाया गया। रबी के दौरान अन्य फसलों जैसे ब्रोकोली, शिमला मिर्च, मूंग और तिल की पैदावार रासायनिक की तुलना में जैविक के साथ क्रमशः 16.3, 14.1, 7.9 और 6.5 प्रतिशत अधिक रही जबकि सरसों की अधिकतम उपज 75 प्रतिशत जैविक+ 25 प्रतिशत इन्नोवेटिव प्रैक्टिस के साथ पाई गई। इसी तरह, फ्रेंचबीन ने अधिकतम उपज (6278 किग्रा/हे.) एकीकृत पोषण प्रबन्धन के साथ दर्ज की।

सरदारक्रुर्शीनगर (गुजरात): में सामान्यतया खरीफ में मूंगफली और मूंग, रबी में गेहूं , धनिया और और सौंफ तथा ग्रीष्म में लोबिया की उपज विभिन्न पोषक तत्व प्रबंधन पैकेज के बीच में राज्य संस्तुति पैकेज के अंतर्गत अच्छी पाई गई। रासायनिक प्रबंधन पैकेज के मुकाबले मूंगफली, मूंग, गेहूं धनिया, सौंफ और लोबिया को जैविक पैकेज के अंतर्गत उगाए जाने पर उपज में क्रमशः 6.2, 3.7, 8.5, 28.3, 13.6 और 5.2 प्रतिशत की गिरावट दर्ज की गई। प्रणाली उत्पादकता मूंगफली समकक्ष उपज जैविक उत्पादन उत्पादन पैकेज के साथ 100 प्रतिशत जैविक आगत अपनाने पर अथवा 75% जैविक और 25% इन्नोवेटिव प्रैक्टिस (जीवामष्त एवं पंचगव्य 2 प्रतिशत स्प्रे) के साथ 4492 किग्रा/हे. प्राप्त हुई जो 22.1 प्रतिशत रासायनिक की तुलना में अधिक रही। विभिन्न फसल प्रणालियों में से मूंगफली–गेहूं–मूंग प्रणाली ने सबसे अधिक मूंगफली समतुल्य उपज दर्ज की जो अन्य प्रणालियों की तुलना में 15 से 70.4% अधिक थी।

तिरुवनंतमपुरम (केरल): मे कंद फसल ने एकीकृत प्रबंधन पैकेज के अंतर्गत बेहतर प्रदर्शन किया जो लगभग जैविक उत्पादन के बराबरी पर रहा। कसावा के कंद की उपज 25750 किग्रा/हे. एकीकृत पैकेज के अंतर्गत 50% जैविक 50% अजैविक के साथ, जबकि अरबी की उपज 100 प्रतिशत जैविक के साथ अधिक पाई गई। कसावा की उपज में अंतर रासायनिक से जैविक में 7.5 प्रतिशत रहा हालांकि अरबी में यह रासायनिक की तुलना में जैविक के साथ 63.1 प्रतिशत अधिक था। लोबिया मे उपज 75% जैविक और 25% इन्नोवेटिव प्रैक्टिस में अधिक थी जबकि मूंगफली और उडद की पैदावार एकीकृत एकीकृत पैकेज में अधिक पायी गई। मूगंफली की पैदावार एकीकृत पैकेज के साथ 216 प्रतिशत रासायनिक के मुकाबले और 38.7 प्रतिशत जेविक के मुकाबले अधिक पायी गई।

उदयपुर (राजस्थान): मे मक्का, स्वीटकार्न और उसमें अन्तः फसल उड़द की अधिकतम उपज (क्रमशः 2786, 3057 और 200 किग्रा./हे.), एकल फसल उडद की उपज (554 किग्रा./हे.), सोयाबीन (616 किग्रा./हे.), और गेहूं (3929 और 4214 किग्रा./हे. ड्यूरम और एस्टीवम) और चना और मेंथी (857 और 2071 किग्रा./हे.) इन सब फसलों की उपज या तो रासायनिक अथवा राज्य संस्तुति पैकेज में अधिकतम दर्ज की गई। जैविक के साथ उपज में गिरावट मक्का (15.4 प्रतिशत), सोयाबीन (29.2 प्रतिशत), एकल फसल के रुप में उडद (18.8 प्रतिशत), गेहूं (20 और 21.1 ड्यूरम और एस्टीवम), चना (33. 4 प्रतिशत) और मेंथी (17.2 प्रतिशत) में दर्ज की गई। विभिन्न उत्पादन पेकेज में से मक्का समतुल्य उपज राज्य संस्तुति पैकेज के बाद रासायनिक पैकेज के साथ उच्चतम पायी गई। चार विभिन्न फसल प्रणालियों में से मक्का+उडद (2:2)–गेहूं (ड्यूरम)–*सेसबनिया* (जीएम) फसल प्रणाली ने अधिकतम मक्का समकक्ष उपज 9095 किग्रा/हे. की पैदावार दी।

2. जैविक खेती के लिए प्रमुख फसलों की विभिन्न किस्मों का मूल्यांकन

बजौरा (हिमाचल प्रदेश): सबसे अच्छा प्रदर्शन करने वाली किस्म, पार्किंसन लॉन्ग ग्रीन ने उल्लेखनीय रूप से उच्च फल उपज (8520 किग्रा/हे.), शुद्ध प्रतिफल (रू.1,44,608/हे) और लाभ लागत अनुपात (1.63) सांख्यिकीय रूप से पूसा मखमली के बराबर दर्ज किया। विभिन्न फ्रेंचबीन की किस्मों में, किस्म कंटेंडर ने उल्लेखनीय रूप से फली की लंबाई (13.7 सेमी), उपज (4100 किग्रा/हे), शुद्ध लाभ (74,633 रुपये/हे) और लाभ लागत अनुपात (1.39) दर्ज किया और पूसा पार्वती के बाद सबसे अच्छा प्रदर्शन करने वाली किस्म पाई गई। मटर की किस्म आजाद पी–1 ने फली/पौधे (25.0) के साथ उच्चतम हरी फली उपज (7700 किग्रा/हे), साथ ही अधिकतम शुद्ध प्रतिफल भी रु. 1,30,391/हे. दर्ज किया। किस्म लिनकॉन ने सबसे कम उपज (2890 किग्रा/हेक्टेयर) का उत्पादन किया। हालांकि किस्म यूएस–178 मे फूल का आकार (260.0 सेमी2) सबसे अधिक प्राप्त किया गया था, लेकिन एक फूलगोभी का अधिकतम वजन (513.3 ग्राम), विपणन योग्य फूल (85.6:), और उपज (9930 किग्रा/हे) के परिणामस्वरूप उच्चतम शुद्ध रिटर्न रु 82,139/हे के साथ बीसी अनुपात (0.79) चंद्रमुखी में पाया गया, उसके बाद यूएस–178 रही जिसमें उपज (9430 किग्रा/हे), फूल का वजन (506.3 ग्राम), शुद्ध रिटर्न (रुपये 76,207/हे) और बी सी अनुपात (0.75)दर्ज किया गया। टमाटर की विभिन्न किस्मों में, हाइब्रिड रेड गोल्ड ने 11210 किग्रा/हे की अधिक्तम उपज, शुद्ध लाभ (रुपये 1,75,104 /हे) और बीसी अनुपात (1.66) दर्ज कराया। आरके 123 अगली सर्वश्रेष्ठ प्रदर्शन करने वाली किस्म थी जिसने 9900 किग्रा/हे की पैदावार दी।

भोपाल (मध्य प्रदेश): मे सोयाबीन–गेहूं और मक्का–चना फसल प्रणालियों में खरीफ में सोयाबीन और मक्का, रबी में गेहूं और चना की बारह किस्मों का मूल्यांकन किया गया। सोयाबीन की किस्मों में, किस्म आरवीएस–2002–4 ने 1363 किग्रा./हे के अधिक्तम पैदावार दी। आरवीएस–2002–6 दूसरी सबसे अच्छा प्रदर्शन करने वाली किस्म रही, जबकि जेएस–97–52 ने सोयाबीन की सबसे कम उपज (650 किग्रा. /हे) दर्ज की। मक्का कि किस्मों मे हालांकि कंचन ने अधिकतम कोब/पौधा (1.5) और अनाज पंक्ति/कोब (11.7) दर्ज किया, लेकिन प्रोएग्रो–4212 ने उच्चतम उपज (3540 किग्रा./हे) दर्ज की, उसके बाद कंचन और प्रताप–5 पाई गई। रबी के दौरान, गेहूं की विभिन्न किस्मों मे से किस्म GW̃–366 ने स्पाइक्स/मीटर पंक्ति लंबाई (108.0), बीज/स्पाइक (77.0) की संख्या के साथ उल्लेखनीय रूप से बेहतर प्रदर्शन किया, जिसके परिणामस्वरूप अनाज और बायोमास की अधिकतम उपज (4240 और 8877 किग्रा./हे) प्राप्त हुई, उपज की दृष्टि से इसके बाद मे किस्म GW–322 और मालवा षक्ति का स्थान रहा। चने की किस्मों में, किस्म JG–130 ने अधिकतम उपज (2003 किग्रा./हे), तदनुसार उच्च बीज/फली (2.2) और फली/पौधे (100) दर्ज की, उसके बाद JG–63 (1907 किग्रा./हे) और RVG–202 (1770 किग्रा. /हे) रही।

कालीकट (केरल): मे हल्दी की 12 किस्मों में से, अधिकतम उपज किस्म प्रगति (18200 किग्रा/हे.) और उसके बाद सुगुना (17000 किग्रा/हे.) द्वारा दर्ज की गई। हल्दी की गुणवत्ता के संदर्भ में, किस्म प्रगति में अधिकतम करक्यूमिन सामग्री (6.3 प्रतिशत) दर्ज की गई, लेकिन यह केदारम, सुगना और प्रभा के सांख्यिकीय रूप से बराबर थी।

कोयम्बटूर (तमिलनाडु): मे जैविक उत्पादन प्रणाली के तहत उपयुक्तता के प्रदर्शन के लिए धान की बारह किस्मों का मूल्यांकन किया गया इसमें मपिल्लई सांबा ने उच्चतम अनाज उपज (4930 किग्रा/हे) दर्ज की, सीओ–43 अगली बेहतर उत्पादन देने वाली किस्म थी जिसने 4720 किग्रा/ हेक्टेयर की पैदावार दी, जबकि सीओ–51 में सबसे कम धान की उपज (2070 किग्रा/हेक्टेयर) आई थी।

धारवाड़ (कर्नाटक): मे बारानी खेती की स्थिति के तहत जैविक खेती के लिए चना और गेहूं की विभिन्न किस्मों की प्रतिक्रिया का मूल्यांकन किया गया। चने की किस्म जाकी–9218 (4119 किग्रा/ हे) ने बीजीडी–103, एमएबीसी–37, एमएबीसी–27 और ए–1 की किस्मों की तुलना में क्रमशः 7.3, 41.5, 33.8 और 17.6 प्रतिशत अधिक बीज उपज का उत्पादन किया। गेहूं की किस्मों में, यूएएस 446 (3517 किग्रा/हे) किस्म ने बीजागा येलो, डीडब्ल्यूआर 2006, यूएएस–347, एनआईएडब्ल्यू–1415 की किस्मों की तुलना में क्रमशः 34.4, 17.3, 8.2 और 26.4 प्रतिशत अधिक बीज उपज का उत्पादन किया।

जबलपुर (मध्य प्रदेश): मे अधिकतम पौधे की ऊंचाई (75.1 सेमी), प्रभावी किल्ले (13.2 संख्या), बाली की लंबाई (26.1 सेमी), अनाज/बाली (68.7 संख्या) और भरे हुए अनाज की न्यूनतम बाँझपन (6.6:) के परिणामस्वरूप उच्चतम अनाज उपज 3299 किग्रा/हेक्टेयर पूसा सुगंध–3 में पाई गयी इसके बाद पूसा सुगंधा 5 (3082 किग्रा/हेक्टेयर) रही। सबसे कम उपज मधुमती (2536 किग्रा/हेक्टेयर) द्वारा दर्ज की गई। गेहूं की किस्मों में, हालांकि प्रभावी किल्ले/वर्ग मीटर (527 संख्या) और बाली की लंबाई (12 सेमी) एचआइ–1531 में सबसे अधिक दर्ज की गई, लेकिन दानें/बाली (48.9 संख्या) और 1000–दानो का वजन एचडी–2004 में अधिकतम दर्ज किए गए। उल्लेखनीय रूप से गेहूं की उच्च पैदावार एचआइ–1500 (4850

किग्रा/हेक्टेयर) के साथ रही। एचआइ–1418 (4575 किग्रा/हेक्टेयर) दूसरी प्रमुख किस्म थी जो सी–306 (4438 किग्रा/ हेक्टेयर) और एचडी–2967 (4392 किग्रा/हेक्टेयर) के बराबर थी। जेडब्लू 3020 ने गेहूं की न्यूनतम अनाज और पुआल उपज (2745 और 4010 किग्रा/हेक्टेयर) दर्ज की।

कर्जट (महाराष्ट्र): मे चावल की किस्मों को तीन श्रेणियों में बांटा गया है, जिसके अंतर्गत चावल की किस्म कर्जत–3 (जल्दी पकने वाली) जो किसानों के बीच लोकप्रिय है, कर्जत –5 (मध्य–देर से पकने वाली) और रत्नागिरी–3 (देर से पकने वाली) ने क्रमशः 5766, 6004 और 5562 किग्रा/ हेक्टेयर की उच्च अनाज उपज दर्ज की। कर्जत 4 ने चावल की किस्मों में सबसे कम उपज (3869 किग्रा/हेक्टेयर) दर्ज की। मूंगफली की किस्मों में, टीजी–26 (3110 किग्रा/हेक्टेयर) ने मूंगफली की फली की उपज अधिकतम दर्ज की है, जो कोंकण गौरव, टीएजी 24, फुले–6021 के सांख्यिकीय रूप से बराबर है। कोपरगांव–1 ने (1977 कि.ग्रा./हेक्टेयर) का सबसे कम उपज का उत्पादन किया।

लुधियाना (पंजाब): मे जैविक उत्पादन प्रबंधन के तहत चावल–गेहूं प्रणाली में चावल की बारह किस्मों और गेहूं की नौ किस्मों का मूल्यांकन उनकी उपयुक्तता के लिए किया गया था। बासमती चावल की अनाज की उपज 1830 से लेकर 3920 किग्रा/हेक्टेयर पाई गयी, जिसमें 53.3 प्रतिशत अधिकतम अंतर रहा । बासमती की किस्म आरवायीटी 3677 ने उच्चतम अनाज उपज (3920 किग्रा/हेक्टेयर) दी जो पंजाब बासमती 5, सीएसआर 30, बासमती 386 और बासमती 370 की तुलना में काफी अधिक थी, लेकिन अन्य सभी किस्मों के बराबर थी। सबसे कम अनाज की उपज (1830 किग्रा/हेक्टेयर) बासमती 370 द्वारा दर्ज की गई थी। गेहूं की किस्मों में, उन्नत पीबीडब्ल्यू 550 द्वारा उल्लेखनीय रूप से उच्चतम अनाज उपज (3770 किग्रा/हेक्टेयर) प्राप्त की गई थी, और यह सांख्यिकीय रूप से बीडब्ल्यूएल 3498, उन्नत पीबीडब्ल्यू 343 के बराबर थी। और बी डब्लू 3504 लेकिन अन्य सभी किस्मों की तुलना में अधिक थी। सबसे कम अनाज उपज पीबीडब्ल्यू 1 Zn (2210 किग्रा/हेक्टेयर) द्वारा दी गई थी।

मोदीपुरम (उत्तर प्रदेश): मे मक्का–सरसों प्रणाली में मक्का और सरसों की बारह आशाजनक किस्मों का मूल्यांकन किया गया। मक्का की उच्च अनाज की उपज पीएमएच–5 (9475 किग्रा/हेक्टेयर) में पाई गई थी, इसके बाद हाइब्रिड पायनियर 3396 (9187 किग्रा/हेक्टेयर) मे रही थी, जबकि सबसे कम उपज 5067 किग्रा/हेक्टेयर) पीएमएच–4 में दर्ज की गई थी। सभी किस्मों के लिए खेती की लागत समान थी, हालांकि विवेक पीएमएच–5 ने अधिकतम सकल रिटर्न, शुद्ध रिटर्न और लाभ लागत अनुपात क्रमशः रुपये 1,66,760, 1,29,494 प्रति हेक्टेयर और लाभ लागत अनुपात (3.47) प्राप्त किया उसके बाद पायनियर 3396 (हाइब्रिड) और श्री सीड 5455 (हाइब्रिड) का स्थान रहा। सरसों की विभिन्न किस्मों में से, पूसा बोल्ड ने सबसे अधिक उपज (2748 किग्रा/हेक्टेयर) दर्ज की थी। इसके बाद पूसा तारक (2282 किग्रा/हेक्टेयर) का स्थान आता है। किस्म एनपीजे 112 ने न्यूनतम 1190 किग्रा/हेक्टेयर की पैदावार दी। उच्चतम उपज वाली किस्म से सबसे कम उपज वाली किस्म की तुलना में उपज अंतर 131: पाया गया। अधिकतम सकल रिटर्न, शुद्ध रिटर्न और लाभ लागत अनुपात (क्रमशः रुपये 1,15,430,000, 84,498/हेक्टेयर और 2.73) पूसा बोल्ड के साथ दर्ज किया गया था, इसके बाद पूसा तारक में रुपये 64,898 का शुद्ध प्रतिफल और 2.10 बीसी अनुपात दर्ज किया गया था।

पंतनगर (उत्तराखंड): में धान की कुल चौदह किस्मों का मूल्यांकन किया गया, जिसमें खरीफ के दौरान सात महीन बासमती चावल और सात किस्में मोटे अनाज की इसी तरह रबी में भी गेहूं की चौदह किस्मों का मूल्यांकन किया गया। यद्यपि धान की किस्मों के बीच 1000–दानों का वजन पंत सुगंध धान–21 में (27.4 ग्राम) अधिक पाया गया, जो पंत बासमती–2, पंत सुगंध–4 और पूसा–1509 (क्रमशः 27.1,27.0 और 26.0 ग्राम) के सांख्यिकी रूप से बराबर था, लेकिन पंत सुगंध धान–27 ने धान की सबसे अधिक पैदावर (4477 किग्रा/हे.) दी, जो पंत सुगंधा–25 (4389 किग्रा/हे.) के सांख्यिकी रूप से बराबर थी और पंत बासमती–1 की तुलना में 78 प्रतिशत अधिक भी थी। गेहूं की किस्मों में, एचडी 2967 ने अधिकतम बालियों की संख्यां प्रति वर्ग मीटर दर्ज की, उसके बाद डीपीडब्ल्यू 62150 (309 सेमी), जबकि न्यूनतम पैदावर यूपी 2425 (2390 किग्रा/ हेक्टेयर) में रही। गेहूं की विभिन्न किस्मों के दरमियान उच्चतम अनाज भार यूपी–2425 (50.4 ग्राम) में दर्ज किया गया, जो कि बाकी किस्मों की तुलना में काफी अधिक था, लेकिन डीपीडब्ल्यू–62150 मे सबसे कम दानों का वजन (39.3 ग्राम) देखा गया। उल्लेखनीय रूप से अनाज की अधिक्तम उपज (4316 किग्रा/हेक्टेयर) एचडी–2967 में दर्ज की गई थी जो यूपी –2565 के बराबर थी। गेहूं की सबसे कम उत्पादकता वाली किस्म यूपी–2684 (3543 किग्रा/ हे.) थी।

रायपुर (छत्तीसगढ़): में पंद्रह पारंपरिक/सुगंधित सुगंधित धान की किस्मों और 15 उन्नत चने की किस्मों का मूल्यांकन किया गया। विभिन्न पारंपरिक पतले अनाज वाली सुगंधित चावल किस्मों में, विष्णुभोग सेल–01 मे सबसे अधिक पैदावार (4236 किग्रा/हेक्टेयर) दर्ज की गई, इसके बाद गोपाल भोग का स्थान रहा जिसने 4222 किग्रा/हेक्टेयर के उपज दी जो बाकी की तुलना में काफी बेहतर रही। सुगंधित चावल की उन्नत किस्मों में से, सी.जी. सुगंधी भोग ने सबसे अधिक किल्ले प्रति पौधा (10.53), दानें प्रति बाली (208.33), बाली की लंबाई (29.02 सेमी) दर्ज की जिसके परिणामस्वरूप अधिक्तम उपज हुई (5515 किलोग्राम/हेक्टेयर) इसके बाद सुगंधमती (4611 किलोग्राम/हेक्टेयर) का स्थान रहा। उपज स्थिरता सूचकांक के आधार पर, बादशाह भोग सेल.01 का परिणाम चावल की किस्मों में सबसे अच्छा (0.84 उपज स्थिरता सूचकांक) रहा, जिसके बाद विष्णु भोग सेल. 01, गोपालभोग और दुबराज सेल .01 का स्थान रहा (0.75 उपज स्थिरता सूचकांक)। शुद्ध मौद्रिक प्रतिफल अधिकतम सीजी सुगंधित भोग के साथ (रु. 91,468/हेक्टेयर) दर्ज किया गया। काबुली चने की किस्म आरजी–2003–28 के पौधे की लम्बाई अधिकतम (48.55 सें.मी.) पाई गई। शाखाओं की संख्या/पौधे, फली की संख्या/पौधा, और बीज की संख्या/पौधे (क्रमशः 5.11, 65.2 81.1) अधिक

होने के परिणामस्वरूप अधिकतम उपज (2000 किग्रा/हेक्टेयर) प्राप्त हुई जो सांख्यिकीय रूप से आरजी 2009–01, विजय, जेजी–130, पीकेवी काबुली, जेजी–226, विशाल और वैभव के बराबर थी।

रांची (झारखंड): मे चावल और गेहूँ की बारह किस्मों का मूल्यांकन उनकी उपयुक्तता के लिए किया गया। चावल की किस्म बीवीडी –110 सब्से लम्बी किस्म पाई गई (117.7 सेमी)। प्रभावी किल्ले प्रति वर्ग मीटर, दानें/पैनिकल और 1000–दानों का वजन क्रमशः 278संख्या, 110 संख्या और 24.48 ग्राम चावल की किस्म एमटीयू 1010 में अधिकतम पाया गया था परिणामस्वरूप अनाज की उपज 4467 किग्रा/हेक्टेयर भी अधिकतम प्राप्त हुई। बिरसा विकास धान 110 ने सबसे कम उपज (3067 किग्रा/हेक्टेयर) का उत्पादन किया। गेहूं की किस्मों में, हालांकि गेहूं की किस्म राज 4229 (346.7) में किल्ले प्रति वर्ग मीटर की संख्या अधिक रही, लेकिन के–0307 के साथ गेहूं की अधिकतम उपज (3276 किग्रा/हेक्टेयर) दर्ज की गई, जो सांख्यिकीय रूप से राज 4229 (3144 किग्रा/हेक्टेयर), डीबीडब्ल्यू 39 (2962 किग्रा/हेक्टेयर) और जीडब्ल्यू 366 (2911 किग्रा/ हेक्टेयर) के बराबर थी।

उमियम (मेघालय): मे परीक्षण में तीन प्रमुख फसलें मक्का, फ्रेंचबीन और टमाटर को शामिल किया गया था। मक्का की कुल 11 किस्मों से मे से आठ मिश्रित, एक संकर और दो स्थानीय किस्में थीं, फ्रेंच बीन की 10 किस्मों में 8 उन्नत और 2 स्थानीय किस्में षामिल थीं और टमाटर की फसल के लिए, 20 किस्मों का मुल्यांकन किया गया था. मक्का की किस्मों में, सबसे लंबी भुट्टा (14.8 सेमी), भुट्टा का वजन (231.1 ग्राम), हरा भुट्टा उपज (6300 किग्रा/हेक्टेयर), कर्नेल उपज (3700 किग्रा/ हेक्टेयर) और स्टोवर उपज (8900 किग्रा/हेक्टेयर) किस्म डीए–61–ए के साथ दर्ज की गई जो सभी लक्षणों के लिए आरसीएम–75 के बराबर है । फ्रेंच बीन किस्मों में, नागा लोकल ने उच्चतम पौधे की ऊंचाई (244.3 सेमी), फली की लंबाई (16.20), औसत फली वजन (11.30 ग्राम), हरी फली उपज (9100 किग्रा/हेक्टेयर), बीज उपज (5100 किग्रा/हेक्टेयर) और स्टोवर उपज (7900 किग्रा/हेक्टेयर) प्राप्त की। उसके बाद आरसीएम–एफबी–18 रही (क्रमशः 240. 3 सेमी, 16.2 सेमी, 10.60 ग्राम, 8400, 4000 और 6400 किग्रा/हेक्टेयर)। सबसे कम हरी फली और बीज उपज (1500 और 1200 किग्रा/हेक्टेयर) मरम में दर्ज की गई थी।

अजमेर (राजस्थान): मे प्रत्येक फसल की कुल आठ किस्मों अर्थात धनिया, सौंफ, हरा चना और कलस्टर का मूल्यांकन जैविक खेती के लिए उनकी उपयुक्तता के लिए किया गया था। हरे चने की किस्मों में, मम–2 ने पौधे की ऊंचाई (57.8 सेमी), प्राथमिक शाखाओं की संख्या (4.3), गांठ/पौधे की संख्या (27.2), बीज/फली की संख्या (10.9) और उपज (798 किग्रा/हेक्टेयर) के साथ काफी अच्छा प्रदर्शन किया। जबकि एसएमएल 668 और गंगा –1 ने क्रमशः 630 और 617 किग्रा/हेक्टेयर का उत्पादन किया। क्लस्टर बीन किस्मों में से 'आरजीसी–1038' ने उच्चतम संख्या के साथ बेहतर प्रदर्शन किया। प्राथमिक शाखा/पौधे (7.6), फली/पौधे (70.1), बीज/फली (8.4) के परिणामस्वरूप 1515 किग्रा/हेक्टेयर की उच्च उपज हुई और यह आरजीसी–1055 के बराबर थी। फली/पौधे की संख्या (29.9), बीज/फली की संख्या (7.5), प्रति हेक्टेयर बीज उपज (647 किग्रा) के मामले में किस्म आरजीसी–986 ने सबसे कम प्रदर्शन किया। धनिया की किस्मों में, आज़ाद धनिया–1 श्रेष्ठ पायी गयी, जिसने अधिकतम पौधे की ऊंचाई (115.9 सेमी), प्राथमिक और माध्यमिक शाखाएं/पौधे (7.7 और 22.7), umbels/पौधे की संख्या (41.9), umbelets/umbels संख्या (6.2) और बीज उपज (1671 किग्रा/हेक्टेयर) दर्ज की के बाद एसीआर–1 और हिसार आनंद रही जबकि आरसीआर–446 सबसे कम प्रदर्शन करने वाली किस्म है, जिसमें 1297 किग्रा/हेक्टेयर की बीज उपज दर्ज की है। सौंफ की किस्मों में, जीएफ–12 ने सभी उपज विशेषताओं और उपज के साथ बेहतर प्रदर्शन किया, इसने उच्चतम पौधे की ऊंचाई (162.1 सेमी), प्राथमिक और माध्यमिक षाखाओं की संख्या (12.7 और 22.4), प्रति पौधे umbels (41. 5), umbellets प्रति umbel (27.5) के परिणामस्वरूप प्रति हेक्टेयर (3235 किग्रा) काफी अधिक बीज उपज दर्ज की, जो ए एफ–1, राजेंद्र सौरभ के बराबर थी। जीएफ–2।, आर एफ–101 किस्म बीज उपज के मामले में सबसे कम प्रदर्शन करने वाली किस्म (2817 किग्रा/हेक्टेयर) थी।

गैगटॉक (सिक्किम): मे मक्का और कुट्टु प्रत्येक की 12 किस्मों का मूल्यांकन किया गया। मक्का की किस्मों में, विवेक संकुल–35 ने 2890 किग्रा/हेक्टेयर की पैदावर दी साथ ही साथ, शुद्ध प्रतिफल रुपये 72900/हेक्टेयर और निवेशित प्रति रुपये प्रतिफल (2.71) के मामले में भी अग्रणी रही, जिसके बाद आरसीएम–75 और विवेक संकुल –31 का स्थान रहा। जबकि सबसे कम उपज और शुद्ध प्रतिफल कालोमक्काई (उपज 1420 किग्रा/हेक्टेयर और प्रतिफल रुपये 14,000/हेक्टेयर दर्ज किया गया। कुट्टू की किस्मों में, आई सी 49671 सबसे अधिक उपज देने वाली किस्म थी जिसने 1600 किग्रा/हेक्टेयर की उपज दी जबकि सांगला बी 1 सबसे कम उपज वाली किस्म पाई गयी।

सरदार कृशीनगर (गुजरात): में प्रत्येक फसल की आठ किस्में जैविक खेती के तहत मूंगफली–गेहूं–मूंग प्रणाली प्रणाली में उनके मुल्यांकन करने के लिए उगाई गईंरू हालांकि प्रति पौधे फली और फली वजन (क्रमशः 25.3 और 10.8) और षाखाओं/पौधों की संख्या (8.4) जीजी 20 में सबसे ज्यादा थी। लेकिन, फली उपज (1549 किग्रा/हेक्टेयर), शुद्ध रिटर्न (56,178/ हेक्टेयर) और निवेशित प्रति रुपये शुद्ध रिटर्न (1. 42) के साथ–साथ नोड्यूल्स/पौधों की अधिक संख्या (50 डीएएस पर 103.8) जीआईजी–17 के साथ अधिकतम पाया था। अधिकतम उपज जी–451 (3964 किग्रा/हेक्टेयर) किस्म में पाई गई जो कि अन्य किस्मों की तुलना में अधिक है, इसके बाद जीडब्ल्यू 496, जीडब्ल्यू –273 और जीडीडब्ल्यू–1255 गेहूं की किस्मों में अधिक है। उच्चतम शुद्ध रिटर्न और एनआरपीआरआई भी (37,976 रुपये प्रति हेक्टेयर और 0.55) जीडब्ल्यू 451 के साथ प्राप्त किया गया था। मूंग की किस्म जी एम–4 ने उच्च बीज और भुसा उपज (487 और 904 किग्रा/हेक्टेयर), शुद्ध रिटर्न (4,577 रुपये/हेक्टेयर) और एनआरपीआरआई (0.16) के साथ सबसे अच्छा प्रदर्शन करने

वाली किस्म पाई गयी, लेकिन यह जीएएम–5 के बराबर रही।

तिरुवनंतमपुरम (केरल): मे जैविक प्रबंधन के तहत उगाई जाने वाली कसावा किस्मों में, श्री जया में औसत कंद वजन (428 ग्राम) अधिक था, लेकिन अधिकतम उपज (23210 किग्रा/हेक्टेयर) सीआर–24–4 के साथ दर्ज की गई थी जो अन्य की तुलना में काफी अधिक थी। मूल्यांकन की गई किस्मों में, किस्म, सीआर–24–4 (श्री रेक्षा) ने उच्च शुद्ध रिटर्न (1,79,839 प्रति हेक्टेयर) और बीरू सी अनुपात (2.07) उत्पन्न किया, इसके बाद श्री विजया (रुपये 45,161 प्रति हेक्टेयर) का स्थान शुद्ध लाभ और 1.27 बीसी अनुपात के साथ रहा।

उदयपुर (राजस्थान): में मक्का–गेहूं प्रणाली में उगाई गई मक्का और गेहूं की बारह किस्मों का मूल्यांकन किया गया। मक्का की किस्मों की विभिन्न श्रेणियों में, प्रताप हाइब्रिड मक्का–3 मक्का अनाज किस्मों के बीच, चीनी–75 स्वीटकॉर्न किस्मों में, पीएम–3 बेबी कॉर्न, वीएल एम्बर पॉपकॉर्न किस्मों में और नवजोत स्थानीय किस्मों में उपज विशेषताओं के लिए तुलनात्मक रूप से पायी गयी है। मक्के की विभिन्न किस्मों में, पीएचएम–3 ने अन्य की तुलना में चीनी–75 किस्म के बाद अधिक मक्के की उपज (6500 किग्रा/हेक्टेयर) दर्ज की। गेहूं की किस्मों को तीन समूह ट्रिटिकम एस्टिवम, ट्रिटिकम ड्यूरम और स्थानीय गेहूं में उगाया गया, उनमें से, किस्म भ्म–8713 में दानें/ बाली (53.2), उपज (5900 किग्रा/हेक्टेयर), शुद्ध रिटर्न (41,844/हेक्टेयर) और शुद्ध रिटर्न प्रति निवेसित रुपये (3. 10) भी अधिक्तम दर्ज किया गया। ट्रिटिकम एस्टीवम किस्मों में, दानें/बाली, बाली की लंबाई, अनाज की उपज, शुद्ध रिटर्न और शुद्ध रिटर्न प्रति निवेसित रुपये (क्रमशः 50.0, 10. 45 सेमी, 4460 किलोग्राम/हेक्टेयर, 99,634/हेक्टेयर और 2. 18 रुपये) किस्म एमपी–3288 में दर्ज की गई। ट्रिटिकम ड्यूरम कि विभिन्न किस्मों में, एचआई –8713 में स्पाइकलेट/बाली की संख्या, दानें/बाली, अनाज की उपज, शुद्ध रिटर्न और एनआरपीआरआई (क्रमशः 18.3, 53.2, 5900 किग्रा/हे., रु.1,41,844/हेक्टेयर और 3.10) अधिकतम दर्ज की गई। अन्य स्थानीय गेहूं की किस्मों में, सी–306 में स्पाइकलेट्स/बाली, बाले की लंबाई (सेमी), दानें/बाली, दानों का वजन, अनाज उपज, शुद्ध रिटर्न और निवेश प्रति रुपये शुद्ध रिटर्न (क्रमशः 15.5, 9.5, 44.4, 48.4, 4000 किग्रा/हेक्टेयर, रु.83,763/हेक्टेयर और 1.83 सेमी) लोक–1 की तुलना में अधिकतम दर्ज किये गये।

3. समेकित जैविक कृषि प्रणाली ¼IOFS½ मॉडल का विकास

चेलावूर (केरल): में मसाले, चारा और सब्जियों के संयोजन वाला मॉडल भाकृअनुप–भारतीय मसाला अनुसंधान संस्थान, कोझीकोड (कालीकट, केरल) के चेलावूर फार्म में स्थापित किया गया था। फसलों में काली मिर्च, हल्दी, चारा घास (कांगो सिग्नल घास, CO–3, CO–4), टैपिओका, केला, लोबिया, अरारोट, नारियल, एलेफंट फूट याम, रतालू, मक्का और अनानास स्थापित किए गए। भारतीय मसाला अनुसंधान संस्थान फार्म में तीन गाय और उनके बछड़े पाले जा रहे है। फार्म उत्पाद जैसे हल्दी 480 किलो, केला 100 किलो, टैपिओका 75 किलो, एलेफंट फूट याम और रतालू 20 किलो प्रत्येक, अनानास 10 किलो, अरारोट 17 किलो, मक्का 19 किलो और लोबिया 10 किलो, नारियल 2200 नग की पैदावर प्राप्त हुई । एक एकड़ के समेकित जैविक कृषि प्रणाली मॉडल से रुपये 1 लाख 23 हजार का लाभ प्राप्त हुआ इसके साथ साथ 415 मानव दिवस/वर्ष रोजगार सृजित भी हुआ है। मॉडल के सभी घटको मे से सबसे अधिक योगदान 86% दूध घटक का रहा।

कोयम्बटूर (तमिलनाडु): में हरी खाद (ढ़ैंचा)+मक्का प्रणाली के साथ उगाई गई भिंडी से अधिकतम उपज 13025 किग्रा./हे. प्राप्त हुई। प्रति हेक्टेयर भिंडी उगाने की लागत रुपये 68,730 हुई और 2.32 के लाभःलागत अनुपात के साथ शुद्ध प्रतिफल रुपये 61,520/हे. प्राप्त हुआ। आईओएफएस मॉडल में कपास की किस्म सुरभि ने 1825 किलो की उपज के साथ सकल आय और शुद्ध प्रतिफल क्रमशः रु. 73,604 और रु। 24,344/हेक्टेयर दर्ज किया । गाय के गोबर जो मात्रा मे १८२५ किलोग्राम था से एक साल में मात्र 3650 रुपये की आमदनी हुई । आईओएफएस मॉडल क्षेत्र में 0.10 हेक्टेयर के तहत कम्बू नेपियर सीओ (सीएन) 5 को उगाया गया था। चारा घास को नियमित अंतराल पर काटा जाता है और मवेशियों को खिलाया गया तथा तीन कटाई में पशुओं के चारे के लिए कुल 95.4 टन/हेक्टेयर प्राप्त किया गया। मवेशियों के लिए प्रोटीन की आवश्यकता को पूरा करने के लिए, डेसमैन्थस (डीमेंथस वेरिगेटस) को मेंढ पर उगाया गया, और मवेशियों को खिलाया गया। चार कटाई में कुल 42.5 टन/हेक्टेयर हरा चारा काटा गया। आईओएफएस मॉडल में किचन गार्डन (200 वर्गमी.) को अतिरिक्त राजस्व उत्पन्न करने और खेतहर परिवार की पोषण आवश्यकता को पूरा करने के लिए बनाए रखा गया है जिसके अंतर्गत किचन गार्डन से 2480 रुपये के अतिरिक्त राजस्व के साथ कुल 248 किलोग्राम फूलगोभी की पैदावार प्राप्त हुई। पेड़ का नाम और प्रजातियां, जैसे मलाइवेम्बु (मेलिया डुबिया) 9 नग, पुंगम (पोंगामिया पिन्नाटा) 1 नग, पेरुमारम (ऐलेन्थस एक्सेलसिया) 2 नग, नीम (अजादिराछा इंडिका) 1 नग और कुमिल (गमेलिना अर्बोरिया) 2 नग को मॉडल के किनारो पर उगाया गया तथा वर्मीकम्पोस्ट, जैव–उर्वरक के साथ निषेचित किया गया था।

सरदार कृशीनगर (गुजरात): में विभिन्न घटकों अर्थात फसलों (0.24 हेक्टेयर), हरे चारे की फसलों (0.15 हेक्टेयर), सीमा वष्कारोपण, डेयरी और वर्मी–कम्पोस्ट (0.01 हेक्टेयर) से युक्त एक समेकित जैविक कृषि प्रणाली मॉडल विकसित किया गया। 0.24 हेक्टेयर में फसल घटक से रू. 27,721 का शुद्ध लाभ प्राप्त किया गया और जबकि चारा इकाई (0.15 हेक्टेयर) से रू. 25,551 प्राप्त हुए। वर्ष 2018–19 के दौरान 0.4 हेक्टेयर क्षेत्र के मॉडल के सभी घटकों से कुल शुद्ध लाभ रू. 48,9953 प्राप्त हुई।

तिरुवनंतपुरम (केरल): में भाकृअनुप–केन्द्रीय कंद फसलों अनुसंधान संस्थान में एक एकीकृत जैविक खेती प्रणाली मॉडल विकसित किया गया है जिसमें खाद्य फसल, कसावा, अरबी, सब्जी लोबिया, मक्का और चारा घास षामिल हैं। मॉडल से फसल कसावा और सब्जी लोबिया की उपज क्रमशः 850 और 22 किग्रा/हे. दर्ज की गई, जिससे शुद्ध आय रुपये 23,005 प्राप्त हुई। गया है।

उदयपुर (राजस्थान): में 0.45 हेक्टेयर के लिए एक एकीकृत कृषि प्रणाली जिसमें 0.25 हेक्टेयर में फसलें (खरीफ के दौरान स्वीट कॉर्न+उड़द और रबी मे गेहूं), चारा फसलें 0.05 हेक्टेयर (खरीफ के दौरान चारा मक्का+लोबिया और रबी में बरसीम और जायद के दौरान सेसबनिया (हरी खाद), सब्जियां 0.10 हेक्टेयर में (खरीफ में टमाटर और बैंगन, रबी में बंदगोभी और फूलगोभी और जायद में भिंडी), फल फसल 0.04 हेक्टेयर में (अमरूद) और 0.01 हेक्टेयर में कम्पोस्ट इकाई का 2018–19 के दौरान मूल्यांकन किया गया। कुल मक्के की समतुल्य उपज 5536 किग्रा/हेक्टेयर और शुद्ध प्रतिफल रु. 49649/हेक्टेयर कृषि प्रणाली से प्राप्त किया गया था

उमियाम (मेघालय): में 0.43 हे. के समेकित जैविक कृषि प्रणाली मॉडल से रूपये 56,835/वर्ष का खर्च होना पाया गया। मॉडल में कुल खेती की लागत का 46.68% व्यय अधिकतम फसल घटक के साथ पाया गया। खेती की कुल लागत का 37.29% हिस्सा एक वयस्क गाय और एक बछड़े वाली डेयरी फार्म का रहा था, जबकि मत्स्य घटक की खेती मे कुल लागत का 8.62% हिस्सा था। इस आईओएफएस मॉडल से कुल शुद्ध रिटर्न रु. 78,950/– प्रति वर्ष हासिल हुये जो इस क्षेत्र के किसान द्वारा अपनायी गई धान की मोनो–क्रॉपिंग या धान–सब्जियों की फसल प्रणाली की तुलना में बहुत बेहतर है। मॉडल की कुल शुद्ध उपज में सबसे अधिक योगदान फसल घटक (67.21%) के बाद डेयरी (23.24%) और मत्स्य घटक (15.20%) का रहा और मछली उत्पादन भी 132 किलो तक प्राप्त हुआ।

4. बासमती धान–गेहूं प्रणाली में प्राकृतिक खेती में प्रयोग होने वाले जैविक मिश्रणों का मूल्यांकन

लुधियाना (पंजाब): में प्राकृतिक कृषि प्रथाओ के विभिन्न मिश्रणों में, एकीकृत पोषक प्रबंधन और कीटनाशक मुक्त उपचार के अंतर्गत एकीकृत फसल प्रबंधन ने बेहतर प्रदर्शन किया, जिसमें बासमती धान की उच्चतम अनाज उपज (क्रमशः 3250 और 3240 किग्रा/हेक्टेयर) दर्ज की गई। गेहूं के मामले में, एकीकृत फसल प्रबंधन के तहत गेहूं की अधिकतम उपज (4460 किग्रा/हेक्टेयर) प्राप्त की गई थी, जो सांख्यिकीय रूप से एकीकृत पोषक तत्व प्रबंधन + कीटनाशक मुक्त के बराबर थी, लेकिन प्राकृतिक आगत प्रबंधन प्रथाओं के अन्य सभी तरीकों से काफी अधिक थी। जीरो बजट प्राकृतिक खेती (ZBNF) उपचार के तहत एकीकृत फसल प्रबंधन और एकीकृत पोषक तत्व प्रबंधन (कीटनाशक मुक्त) की तुलना में उपज मे क्रमशः 52.3–57.3 प्रतिशत की कमी पाई गई। प्राकृतिक खेती के विभिन्न तरीकों के साथ धान और गेहूं के अर्थशास्त्र से पता चला है कि रुपये 1,56,131 का सकल प्रतिफल एकीकृत फसल प्रबंधन (50:50) के तहत अधिक पाया गया, इसके बाद एकीकृत पोषक तत्व प्रबंधन+ कीटनाशक मुक्त द्वारा रु 1,10,257/हेक्टेयर का सकल प्रतिफल खेती की कम लागत और धान एवं गेहूं की अधिक उपज के कारण प्राप्त हुआ।

मोदीपुरम (उत्तर प्रदेश): में एकीकृत फसल प्रबंधन (50% जैविक+50% अजैविक) के अंतर्गत बासमती धान की उपज जैसे कि बालियों का भार और लम्बाई, और 1000–दानों का वजन अधिक पाया गया था। बासमती चावल की उच्चतम उत्पादकता एकीकृत फसल प्रबंधन (50% जैविक+50% अजैविक) के तहत दर्ज की गई, इसके बाद जैविक खेती पैकेज के अंतर्गत पैदावर हुई। एकीकृत फसल प्रबंधन (50% जैविक+50% अजैविक) के मुकाबले जैविक खेती पैकेज, गुरुकुल पैकेज (गुरुकुल द्वारा आपूर्ति किए गए उत्पाद), स्थानीय रूप से तैयार गुरुकुल उत्पाद, स्थान विशिष्ट उन्नत उत्पादों और कंट्रोल ट्रीटमेंट के तहत बासमती धान की उपज में क्रमशः 18.6, 37.7, 31.8, 41.8 और 39.9 प्रतिशत की कमी पाई गयी। । गेहूं की फसल में, वर्षद्धि और उपज गुण जैसे लीफ एरिया इंडेक्स (6.27), पौधे की ऊंचाई (99.0 सेमी), टिलर की संख्या (94), बाली की लंबाई (13.3 सेमी) और दानों की प्रति बाली संख्या (62.9) आईसीएम के साथ सबसे अधिक पाई गई, इसके बाद जैविक खेती पैकेज रहा। गेहूं की अनाज उपज (4807 किग्रा/हे.) भी आईसीएम के तहत उच्चतम दर्ज की गई। जैविक खेती पैकेज, गुरुकुल पैकेज (गुरुकुल द्वारा आपूर्ति किए गए उत्पाद), स्थानीय रूप से तैयार गुरुकुल उत्पाद और स्थान विशिष्ट उन्नत उत्पादों का प्रयोग करने पर इंटीग्रेटेड क्रॉप मैनेजमेंट की तुलना में गेहूं की उपज में क्रमशः 44.2, 68. 8, 66.4 और 63 प्रतिशत की कमी आई थी।

पंतनगर (उत्तराखंड): में प्राकृतिक खेती इनपुट के विभिन्न मिश्रणों से प्रभावित बासमती धान के प्रदर्शन से पता चला है कि पौधे की ऊंचाई (134 सेमी), टिलर/वर्ग मी. (269) इंटीग्रेटेड क्रॉप मैनेजमेंट के साथ दर्ज की गई थी, जबकि 1000–दानो का वजन (25.0 ग्राम) कंट्रोल ट्रीटमेंट मे (24.4 ग्राम) पाया गया । प्राकृतिक खेती के विभिन्न प्रथाओ के बीच, धान की उच्च अनाज उपज भी (4191 किग्रा/हेक्टेयर) एकीकृत फसल प्रबंधन के साथ दर्ज की गई। इंटीग्रेटेड क्रॉप मैनेजमेंट की तुलना में गुरुकुल पैकेज के साथ उपज में कमी क्रमशः 22. 1, 20.8 और 17.8 प्रतिशत देखी गयी। प्राकृतिक खेती के विभिन्न प्रबंधन प्रथाओ के अर्थशास्त्र से पता चला है कि शुद्ध रिटर्न (रुपये 84,163) और बीःसी अनुपात (2.31) एनपीओएफ पैकेज के साथ दर्ज किया गया, इसके बाद उन्नत गुरुकुल पैकेज रहा। गेहूं में, पौधे की ऊंचाई, प्रति मीटर बालियों के संख्या और उपज (5068 किग्रा/हेक्टेयर) एकीकृत फसल प्रबंधन में अधिकतम पायी गई। गुरुकुल पैकेज के साथ एआई–एनपीओएफ पैकेज की तुलना में उपज में 29.6 प्रतिशत की कमी आई। विभिन्न उपचारों के आर्थिक विश्लेषण से पता चला है कि एआई–एनपीओएफ पैकेज के साथ अधिकतम शुद्ध रिटर्न (51625/हेक्टेयर) देखा गया था, हालांकि, उच्चतम बीरू सी अनुपात (1.74) कंट्रोल ट्रीटमेंट द्वारा दर्ज किया गया था।

कुरुक्षेत्र (हरियाणा): में प्राकृतिक कृषि पद्धतियों के विभिन्न संयोजनों में, अधिकतम अनाज उपज (3850 किग्रा/हेक्टेयर), खेती की लागत (8,2484/हेक्टेयर), सकल लाभ (1,12,491/हेक्टेयर), शुद्ध लाभ (30,007 / हेक्टेयर) और बीरू सी अनुपात 0.36 एकीकृत फसल प्रबंधन (50% जैविक+50% अकार्बनिक) के तहत दर्ज किया गया। एकीकृत फसल प्रबंधन के बाद एआई–एनपीओएफ पैकेज ने बेहतर प्रदर्शन किया। एकीकृत फसल प्रबंधन पैकेज के साथ गुरुकुल पैकेज की तुलना में 42.6% अधिक उपज हुई, जबकि एआई–एनपीओएफ गुरुकुल पैकेज से 17.2% से अधिक था।

ABSTRACT

The salient research findings made during 2018-19 under All India Network Programme on Organic Farming is given below.

1. Evaluation of organic, inorganic and integrated production systems

Bajaura: Among the crops evaluated under vegetable-based cropping systems, the performance of tomato, cauliflower, black gram, lady finger and summer squash were found to be better under integrated production systems. Higher yield of french bean was observed with organic package either under 100% organic or 75% organic + 25% organic supplemented through 10% vermiwash during *kharif* and summer. The yield of pea (7330 kg/ha) was maximum under organic production system with application of 75% organic + 25% organic supplemented through 10% vermiwash. Under integrated production system, yield increase over inorganic management was observed to the tune of 115.3, 66.6, 42.1, 56.8, and 92.9% in cauliflower, tomato, black gram, lady finger and summer squash respectively while in french bean and pea, it was increase 113.5 and 104.2% under organic with 100% nutrient supplied through organic sources and 75% organic + 25% innovative practice (organic supplemented through 10% vermiwash) over inorganic. In terms of system equivalent yield (cauliflower equivalent), blackgram-cauliflower-summer squash resulted in higher cauliflower equivalent yield (21350 kg/ha) among the cropping systems. Among different management practices, integrated management with 50% organic+50% inorganic dose of nutrients resulted in higher equivalent yield (20178 kg/ha) followed by application of 75% nutrients only through organic manures+ 25% nutrient supply through inorganic sources (18670 kg/ha). Cauliflower equivalent yield was increased to the tune of 47.1 and 74.6% with integrated nutrient (50% each organic and inorganic) over organic and inorganic nutrient management.

Bhopal: Higher mean yield of soybean (1467 kg/ha) was recorded under 100% organic management practice followed by management practices either with 75% nutrients application through organic manures+ innovative practices or under integrated. The yield of soybean was found to be higher with 100% organic by 18.3 and 36.7% compared to inorganic production system and state recommendation package respectively. *Rabi* crops such as, wheat, mustard, chickpea and linseed recorded higher yield under integrated management with (75% organic nutients suppiled through organic source + 25% inorganic nutients) of 4050, 1827, 1225 and 1620 kg/ha respectively. The yield difference between organic and inorganic management was 24, 20.7, 22.1, and 16.6% for *durum* wheat, mustard, chickpea and linseed respectively. In terms of system equivalent yield (soybean equivalent), towards organic, integrated management with 75% organic+ 25% inorganic nutrients through organic and inorganic sources registered higher equivalent yield (3695 kg/ha) followed by organic production package (3564 kg/ha) and difference between both the production system was only 3.7%. Among the cropping systems, soybean-wheat recorded higher soybean equivalent yield (3683 kg/ha) followed by soybean-mustard (3614 kg/ha).

Calicut: Among the different management packages, organic package consisting of 75% nutrient supply through organic manure +25% innovative practice recorded higher yield of turmeric (13900 kg/ha) followed by integrated (75% nutrient supply through organic manure +25% inorganic) of 13800 kg/ha. There is no significant difference was found in yield of turmeric among production system.

Coimbatore: Among the management practices, crops brinjal, chilli and tomato during *kharif* (25746, 12263 and 17562 kg/ha respectively) and pearl millet, finger millet during *rabi* (1896 and 2906 kg/ha) registered higher yield either with organic (75% organic nutrients+ innovative practice: Panchagavya @ 3% as foliar spray+*Azophos* @ 2kg/ha as basal) or towards organic under integrated with 75% nutrients through organic manures +25% through inorganic source, whereas barnyard millet recorded maximum under state recommendation of 1982 kg/ha. The yield was increased marginally by 3 and 4.9 % for brinjal and tomato respectively while chilli, pearl millet and finger millet were increased by 26.3, 7.3 and 23.3% respectively compared to inorganic package.

Dharwad: Crops such as green gram, safflower, sorghum and groundnut recorded higher yield under inorganic

production package either in 100% inorganic nutrients or state recommendation whereas, maize, sorghum and chickpea recorded higher under organic (75% organic + Innovative organic practices) and integrated (75 and 25% each organic and inorganic nutrients application). The reduction in yield with organic was found to be 13.1, 30.2, 24.6, and 40.1%, for safflower, pigeon pea sole, green gram and groundnut respectively. Maize, sorghum and chickpea performed better under organic and integrated management practice. Yield was found to be 20, 28.3 and 20.9% higher in sorghum, maize and chickpea respectively compared to inorganic practice. System equivalent yield as influenced by production management found to be higher with organic management package of 2520 kg/ha, whereas among the cropping systems, green gram - sorghum registered better in term of equivalent yield than other systems.

Jabalpur: Yield of basmati rice and other crops recorded higher with inorganic production system except chickpea. The yield reduction in basmati rice with organic was found to be 9.6% than inorganic. The reduction in the yield of wheat, maize (fodder), berseem seed & fodder, vegetable pea and sorghum (fodder) with 100% organic management package was 16.7 11.1, 11, 37.9, 12., and 18.6% respectively against inorganic nutrients management. Total productivity of cropping system in terms of basmati rice equivalent was recorded higher with 100% inorganic nutrient management (6238 kg/ha) followed by integrated (6085 kg/ha) among the production packages. Among crop-sequences, basmati rice- berseem seed and fodder led to record highest basmati rice equivalent yields (7745 kg/ha) followed by rice-wheat (5883 kg/ha).

Karjat: Higher mean yield of rice (4631 kg/ha) was recorded with application of 50% each organic and inorganic nutrients under integrated package but on par with organic and inorganic. Chickpea and onion also resulted good yield with integrated package and found to be higher by 16.7 & 18.6% over inorganic respectively. Field bean yield recorded higher with organic package having 100% nutrient application through organic sources but difference in yield was only 20kg/ha over inorganic nutrient management whereas brinjal resulted in higher yield with inorganic package (49705 kg/ha). System productivity in term of rice equivalent yield, rice-brinjal system produced maximum rice equivalent yield (52295 kg/ha) compared to other cropping systems. Among the management package, organic management with 100% nutrient supply through organic sources recorded 22.0% higher over inorganic management practice.

Ludhiana: Maximum yield of basmati rice (4030 kg/ha) was recorded in integrated nutrient management with application of 50% each organic and inorganic nutrient but on par with inorganic whereas other *kharif* crops, soybean and moong was record higher yield (1250 and 800 kg/ha) under organic package with application of 100% organic manure and 75% N equivalent by organic manure + innovative practice respectively. Chickpea also recorded maximum yield (1170 kg/ha) with 75% organic + Innovative organic practices under organic practice. Wheat and summer moong (5660 and 870 kg/ha) performed better towards organic under integrated (50% organic + 50 inorganic) practice. In term of system productivity among the management practices, wheat equivalent yield resulted in higher either in organic (100%) or with 75% organic + innovative practice. Among the cropping systems, it was higher in basmati rice-wheat but found to be on par with moong (*kharif*)-wheat-moong (summer) system.

Modipuram: Basmati rice and potato recorded higher yield (3876 and 24700 kg/ha) under organic production package. Coarse rice, wheat, barley and okra recorded maximum yield under inorganic management (4238, 4225 3804 and 5579 kg/ha respectively) with state recommendation package. Maize (sweet corn 1651 kg/ha & popcorn 6963 kg/ha), mustard (2303 kg/ha) and green gram (813 kg/ha) performed better under integrated package with 50% nutrient application through organic sources+50% through inorganic. In case of basmati rice and potato yield, it was 25 and 28% higher under organic compared to inorganic package, whereas the reduction in yield was noticed with organic by 11.8, 24.2, 9.6, 6% in coarse rice, wheat, barley, and okra, over state recommendation respectively. Productivity among the various systems, maize-potato-okra-*sesbania* recorded higher rice equivalent yield of 15475 kg/ha because of higher yield of potato and good premium price followed by maize (sweet corn)-mustard-*sesbania* (GM). Among the production practice, system equivalent yield was higher (13297 kg/ha) in organic.

Pantnagar: Higher yield of basmati rice during *kharif* was recorded with integrated package as it recorded mean grain yield of 4926 kg/ha but been on par with organic package 4915 kg/ha and it was higher by 15.2 and 15.5% over inorganic respectively. Among *rabi* crops, wheat recorded higher yield under integrated package (4946 kg/ha) and the yield difference between integrated and inorganic was only 114 kg/ha. Coriander was raised as intercrop with chickpea and vegetable pea in the manner of 4:2 ratio. Yield of main and intercrop converted into chickpea and vegetable pea equivalent. Chickpea and vegetable pea equivalent yield (2205 and 9173 kg/ha) recorded highest in organic (100% nutrient application through organic sources), tuber yield of potato also recorded maximum under organic management and increase by 16% over inorganic. System productivity in terms of basmati rice equivalent yield recorded higher in integrated package (9206 kg/ha) having 50% nutrients through organic manures and 50% nutrients through inorganic sources. SEY was increased by 13% over inorganic. Among

all the cropping systems, higher system productivity was recorded with basmati rice-chickpea +coriander-*sesbania* system (10615 kg/ha) followed by basmati rice-potato (8218 kg/ha).

Raipur: Organic production system either by 100% organic manure or 75% organic + innovative practice (foliar spray of vermin-wash (10%) followed by cow urine (10%) resulted in higher soybean yield (2006 and 2088 kg/ha respectively). Soybean yield under organic production system with100% organic source and 75% organic + innovative practice was enhanced by 11.9 and 16.4% compared to 100% inorganic. Other crops such as maize (sweet corn), pea, and chilli (14566, 7668 and 9013 kg/ha respectively) also resulted higher yield with 75% organic manures+ innovative practices (foliar spray of vermin-wash (10%) followed by cow urine (10%) under organic while, onion bulb yield recorded higher with state recommendation (16082 kg/ha). Yield reduction in onion with organic was found to be 17.1%. Likewise, yield variation from 100% organic to inorganic were found to be 17.8, 48.4 and 5.2% for maize, pea and chilli respectively. The productivity of cropping system in term of soybean equivalent yield recorded higher under organic management with 75% organic manure + innovative practices (7324 kg/ha) and it was increased by 13.4% over inorganic. Soybean-maize cropping system registered higher soybean equivalent yield (7417 kg/ha) followed by soybean-chilli (6402 kg/ha).

Ranchi: In rice (variety Birsamati), organic management practice (100% and 75% organic manure +innovative practice "*Azolla*") resulted in higher mean yield (3611 and 3407 kg/ha respectively). Under organic production system the yield was increased by 18.9 and 26% respectively than inorganic. Other crops like onion and potato during *rabi* recorded higher yield with organic package. The yield of onion and potato was increased with organic to the tune of 10.4 and 120% respectively over inorganic package. Wheat recorded highest yield (2875kg/ha) under inorganic package and found to be decrease by 12.1% with organic package (100% organic manure). Okra resulted in higher yield (9334 kg/ha) in integrated package with 75% nutrients through organic source+25% inorganic fertilizer. In case of systems equivalent, production package 100% organic found to be higher (10912 kg/ha) among the management practice. Among the cropping systems, rice-potato recorded highest system equivalent yield (11781 kg/ha) followed by rice-onion (11431 kg/ha).

Umiam: Among the management packages, 100% organic package recorded maximum broccoli yield 15220 kg/ha followed by integrated of 15140 kg/ha. The yield of broccoli was enhanced by 6.5% only over inorganic. Other vegetable crops viz. carrot and tomato recorded maximum yield under organic package with 15950 and 17500 kg/ha respectively. whereas potato and frenchbean recorded highest under integrated of 19950 and 7120 kg/ha respectively. Vegetable crops, carrot potato, frenchbean and tomato recorded their yield by 14.1, 20.9, 16.3 and 12.5% higher with either by following the organic management practice or with integrated over inorganic package. Rice varieties that grown in sunken beds were Megha Aromatic 2, Shahsarang-1, Ngoba and Lampnah. Among the rice varieties, Shahsharang-1 produced maximum grain yield (4670 kg/ha) followed by Lampnah (4480 kg/ha), Megha Aromatic 2 (4330 kg/ha) and Ngoba (4250 kgha). Among the management practices, maximum grain yield was recorded under integrated (4720 kg/ha) followed by 100% organic (4650 t/ha).

Ajmer: The performance of green gram, cluster bean, coriander and fennel were found to be better towards organic practice with integration of 75% organic +25% inorganic input under integrated package followed by state recommendation package. Among nutrient management practice, seed yield of green gram, clusterbean, coriander and fennel were higher by 20.5, 20.9, 18.7 and 32.8% respectively over inorganic whereas, it was higher by 28.7, 17.9, 22.2 and13.0% respectively over organic production package.

Almora: Different nutrient sources were evaluated for finger millet + black soybean (2:1 ratio – substitution of row)-wheat + *toria* (2:1 ratio) and grain amaranth-wheat + lentil (2:1 ratio) under rainfed system. Among crop management systems, application of 100% N requirement of crop through organic manure produced highest wheat equivalent grain yield of 4825 and 8059 kg/ha for finger millet + black soybean-wheat + *toria* and grain amaranth-wheat + lentil, respectively (Fig. 1). The highest yielding treatment recorded 68 and 107% higher wheat equivalent grain yield of finger millet + black soybean-wheat + *toria* and grain amaranth-wheat + lentil, respectively than 100% inorganic package, respectively.

Gangtok: Among all the cropping systems, maize, ginger, and turmeric were grown in *pre kharif*, soybean and black gram (*Pahenlo dal*) grown in *kharif* season and french bean, buckwheat rajmash and toria were grown in *rabi* season. Yield of maize with intercrops ginger, turmeric, soybean and black gram remarkably higher with organic package. Similarly, frenchbean, buckwheat and rajmash and toria also recorded highest yield with organic (100% N equivalent though organics (25% FYM+25% VC+25% NK+25% MC).

Narendrapur: Paddy (PB-1 and Shatabdi) recorded maximum yield under organic nutrient management by 100% organic manure followed by 75% organic manure + 25% innovative practice. The increase in yield of Paddy (PB-1 and Shatabdi) with organic to the tune of 14 and 4% respectively compared to inorganic nutrient package. Other crops in the systems such as broccoli, capsicum, green gram and sesame resulted in higher yield also with organic package while

mustard recorded with 75% organic manure + 25% innovative practice. The yield was increased by 16.3,14.1, 7.9 and 6.5% with organic compared to inorganic whereas French bean recorded maximum yield of 6278 kg/ha under integrated.

Sardarkrushinagar: The general performance of groundnut and green gram during *kharif*, wheat, coriander, and fennel during *rabi* and vegetable cowpea during summer was found to be better under inorganic with state recommendation. Organic practices in groundnut, green gram, wheat, coriander, fennel and vegetable cowpea recorded yield drop to the tune of 6.2, 3.7, 8.5, 28.3, 13.6 and 5.2% respectively over inorganic practice. System equivalent yield (ground nut equivalent) of 4946 kg/ha was recorded highest under organic with application of 100% organic input followed by 75% nutrient through organic source + 25 innovative practices ((Panchgavya and Jivamrut spray @ 2 %) of 4492 kg/ha among the production package which is 22.1% higher than inorganic. Among the cropping systems, ground nut-wheat-green gram resulted in higher GEY of 5267 kg/ha which gave 15 and 76.4% higher ground nut equivalent yield.

Thiruvananthapuram: Integrated production practice found to be better in cassava but being on par with organic. Tuber yield of cassava (25750 kg/ha) was higher in 50% each nutrient application through organic and inorganic sources while comel yield of taro was higher with 100% organic followed by 75% organic + innovative practices. Variation in yield for cassava was 7.5% from inorganic to organic however, in taro, it was 63.1% higher with organic over inorganic. Vegetable cowpea recorded maximum under organic with 75% organic + innovative practices whereas groundnut and blackgram recorded maximum yield under inorganic practice either by fully inorganic or state recommendation. Green gram was higher in integrated package (430 kg/ha)which was 216.2nd 38.7% higher over inorganic and organic respectively.

Udaipur: Effect of organic, inorganic and integrated practices on yield, all crops in cropping systems recorded higher yield with either by inorganic practices or state recommendation. Maize and sweet corn with inter crop of black gram (2786, 3057 and 200 kg/ha respectively), sole black gram (554 kg/ha) and soybean (616 kg/ha) during *kharif* and wheat *durum* and *aestivum* (3929 & 4214 kg/ha), chickpea and fenugreek (857 & 2071 kg/ha) recorded maximum yield either in inorganic or in state recommendation practice. Reduction in yield with organic in maize (15.4%), soybean (29.2%), black gram sole (18.8%) during *kharif* season and wheat *durum* and *aestivum* (20 & 21.7%), chickpea (33.4%) and fenugreek (17.2%) during *rabi* were observed over inorganic. Total productivity among the management practices in term of maize equivalent yield, inorganic production system being state recommendation package being the highest followed by inorganic. Out of four cropping systems, maize + blackgram (2:2)–wheat (*durum*)–*sesbania* (GM) cropping system gave maximum maize equivalent yield of 9055 kg/ha.

2. Evaluation of response of different varieties of major crops for Organic Farming

Bajaura: Best performing variety i.e., Parkinson Long Green recorded significantly higher fruit yield (8520 kg/ha), net returns (Rs. 1,44,608/ha) and B:C ratio (1.63) and being on par with Pusa makhmali. Among the frenchbean varieties, variety Contender recorded significantly higher pod length (13.7 cm), yield of 4100 kg/ha, net return (Rs. 74,633 /ha) and benefit cost ratio of 1.39 and found to be best performing variety followed by Pusa Parvati. Azad P-1 variety of pea recorded highest green pod yield (7700 kg/ha) with pods/plant (25.0), also gave maximum net return of Rs. 1,30,391/ha. Lincon produced the lowest yield (2890 kg/ha). Though higher curds size was obtained in US-178 (260.0 cm^2) but significantly higher curd weight (513.3 g), marketable curd (85.6%), curd yield (9930 kg/ha) that resulted in higher net return of Rs. 82,139 /ha with B:C ratio (0.79) in Chamdramukhi followed by US-178, which recorded curd yield (9430 kg/ha), curd weight (506.3 g), net return (Rs. 76,207 /ha) and B:C ratio (0.75).

Among the tomato varieties hybrid Red Gold recorded significantly higher fruit yield of 11210 kg/ha, net return (Rs. 1,75,104 /ha) and B:C ratio (1.66). RK 123 was being the next best performing variety (9900 kg/ha).

Bhopal: Twelve varieties of each soybean and maize in *kharif* and wheat and chickpea in *rabi* were evaluated in soybean-wheat and maize-chickpea cropping systems.Among the soybean varieties, variety, RVS-2002-4 resulted in significantly higher seed yield (1363 kg/ha). variety, RVS-2002-6 being the next best performing varirty whereas JS-97-52 recorded lower soybean yield (650 kg/ha). Though Kanchan recorded maximum cobs/plant (1.5) and grains row /cob (11.7), but Proagro-4212 recorded highest yield (3540 kg/ha) followed by kanchan and Pratap-5. During *rabi* wheat varieties, GW-366 significantly outperformed in number of spikes/meter row length (108.0), seeds/spike (77.0) resulted in higher grain and biomass yield (4240 and 8877 kg/ha) followed by GW-322 and Malwa shakti in term of yield. Among the chickpea varieties, variety JG-130 recorded significantly higher seed yield (2003 kg/ha), correspondingly higher seeds/pod (2.2) and pod/plant (100) followed by JG-63 (1907 kg/ha) and RVG-202 (1770 kg/ha).

Calicut: Among the 12 varieties of turmeric, maximum yield recorded by Pragati (18200 kg/ha) followed by Suguna (17000 kg/ha). In term of quality of turmeric, variety Pragati recorded

maximum curcumin content (6.3%) but being on par with Kedaram, Sugana and Prabha.

Coimbatore: Twelve varieties of rice were evaluated for their performance of suitability under organic production system. Mappillai samba recorded highest grain yield (4930 kg/ha), CO-43 was the next performer variety which recorded of 4720 kg/ha while CO -51 had lowest grain yield (2070 kg/ha).

Dharwad: Response of different varieties of chickpea and wheat for organic farming under rainfed farming situation were evaluated. Cultivar JAKI 9218(4119 kg/ha) produced 7.3%, 41.5%, 33.8% and 17.6% higher seed yield over cultivars BGD-103, MABC-37, MABC-27 and A-1, respectively. Among the wheat varieties, variety UAS 446 (3517kg/ha) produced 34.4%, 17.3%, 8.2% and 26.4% higher seed yield over cultivars Bijaga Yellow, DWR 2006, UAS-347, NIAW-1415 respectively.

Jabalpur: Twelve varieties of rice and wheat in system mode were evaluated. Maximum plant height (75.1 cm), effective tillers/hill (13.2 nos.), panicle length (26.1 cm), grains/panicle (68.7 nos.) and minimum sterility of filled grain (6.6%) resulted in highest grain yield 3299 kg/ha in Pusa Sugndha-3 followed by Pusa sugandha 5 in term of yield (3082 kg/ha). Lowest yield was recorded in Madhumati (2536 kg/ha). Among the wheat varieties, though effective tillers/m^2 (527 nos.) and spike length (12 cm) recorded higher in HI-1531 but grains/spike (48.9 nos.) and 1000-grains weight recorded higher in HD-2004. Significantly higher wheat yield was recorded with HI 1500 (4850 kg/ha). Variety HI 1418 (4575 kg/ha) was the next leading variety which was on par with and C 306 (4438 kg/ha) and HI-2967 (4392 kg/ha). JW3020 recorded minimum grain and straw yield of wheat (2745 and 4010 kg/ha).

Karjat: Among the rice varieties grouped in three categories, rice variety Karjat-3 (early maturing) which is popular among farmers, Karjat-5 (mid-late maturing) and Ratnagiri-3 (late maturing) recorded significantly higher grain yield of 5766, 6004, and 5562 kg/ha respectively. Karjat 4 recorded lowest yielded (3869 kg/ha) among the rice varieties. Among ground nut varieties, significantly higher pods yield of groundnut recorded in TG-26 (3110 kg/ha) which is on par with Konkan Gaurav, TAG 24, Phule-6021. Kopergaon-1 produced lower yield of 1977 kg/ha among the varieties.

Ludhiana: Twelve varieties of rice and nine varieties of wheat were evaluated in rice-wheat system for their suitability under organic management. Grain yield of basmati rice varied from 1830-3920 kg/ha with a maximum percent variation of 53.3 per cent. Basmati genotype RYT 3677 gave the highest grain yield (3920 kg/ha) which was significantly higher than Punjab basmati 5, CSR 30, Basmati 386 and Basmati 370 but was at par with all the other varieties. The lowest grain yield (1830 kg/ha) was recorded by Basmati 370. Among wheat varieties, significantly highest grain yield (3770 kg/ha) was observed in Unnat PBW 550, and it was statistically at par with BWL 3498, Unnat PBW 343 and BWL 3504 but was significantly higher than all the other varieties. The lowest grain yield was given by PBW 1 Zn (2210 kg/ha).

Modipuram: Twelve promising varieties of maize and mustard in maize-mustard system were evaluated. Grain yield of maize was significantly varied among the varieties of maize and higher grain yield was found to be in PMH-5 (9475 kg/ha) followed by Hy pioneer 3396 (9187 kg/ha) while lowest yield recorded in PMH-4 (5067 kg/ha). Cost of cultivation for all the varieties was similar however, Vivek PMH-5 gave maximum gross return, net returns and benefit cost ratio of Rs. 1,66,760, Rs.1,29,494 ha^{-1} and 3.47 respectively followed by H (Pioneer 3396) and Siri seed (Hybrid) 5455. Among the mustard varieties, significantly higher seed yield was recorded with Pusa bold (2748 kg/ha) followed by Pusa Tark (2282 kg/ha). Variety NPJ 112 gave minimum yield of 1190 kg/ha. The yield difference from highest yielded variety was found to be 131% than lowest yielded variety. Maximum gross return, net return and benefit cost ratio was recorded with Pusa bold (Rs. 1,15,430,000, 84,498 /ha and 2.73 respectively) followed by Pusa Tarak with Rs 64,898 as net return and 2.10 of BC ratio.

Pant Nagar: Total fourteen varieties of rice including seven fine grain basmati rice and seven coarse grain varieties during *kharif* and fourteen varieties of wheat in *rabi* were evaluated. Though 1000-grains weight among rice varieties was found higher in Pant Sugandha Dhan-21 (27.4 g) which was at par with Pant basmati-2, Pant Sugandha-4 and Pusa-1509 (27.1,27.0 & 26.0 g respectively) but significantly higher grain yield of rice was observed in Pant Sugandha Dhan-27 (4477 kg/ha) which was at *par* with Pant Sugandha-25 (4389 kg/ha), and 78% increase than Pant Basmati-1. Among the wheat varieties, HD 2967 recorded maximum spikes/m^2 followed by DPW62150 (309 cm), while lower was in UP 2425 (239). Highest grains weight of wheat recorded in UP–2425 (50.4 g) which was significantly higher than rest of varieties however lower test weight observed with DPW-62150 (39.3 g). Significantly higher grain yield was recorded in HD-2967 (4316 kg/ha) which was at par with UP-2565. Least performing variety of wheat was UP-2684 (3543 kg/ha).

Raipur: Fifteen traditional /improved scented rice varieties and 15 improved chickpea varieties in the region were evaluated. Among the different traditional short grain aromatic rice varieties, grain yield of traditional short grain aromatic rice varieties was recorded highest in Vishnubbhog sel-01 (4236 kg/ha) followed by Gopalbhog (4222 kg/ha) which were significantly superior over rest of the varieties. With respect

to Improved scented rice varieties, C.G. Sugandhit Bhog gave the maximum tillers/hill (10.53), filled grains/panicle (208.33), panicle length (29.02 cm) resulted in higher yield of 5515 kg/ha followed by Sugandhamati (4611 kg/ha). On the basis of yield stability index, Badshah Bhog Sel.01resulted in significantly higher (0.84 YSI) among the rice varieties followed by Vishanu Bhog Sel.01, Gopalbhog and Dubraj Sel.01 (0.75). Net monetary return was recorded higher with C.G. Sugandhit Bhog (Rs. 91,468/ha). Chickpea variety RG-2003-28 (48.55 cm) attained the tallest plant, higher no. of branches/plant, nos. of pods/plat, no.of seeds/plant (5.11, 65.2 and 81.1) resulted in maximum yield of 2000 kg/ha which was statistically on par with RG 2009-01, Vijay, JG-130, PKV Kabuli, JG-226 Vishal and Vaibhav.

Ranchi: Twelve varieties of rice and wheat were evaluated for their suitability. Rice variety B.V.D-110 attained the highest plant height (117.7 cm). Effective tiller/m^2, filled grains/panicle and 1000-grains weight was significantly higher in rice variety MTU 1010 of 278 nos., 110 nos. and 24.48g respectively resulted in higher grain yield of 4467 kg/ha. Birsa Vikas Dhan 110 produced lowest grain yield (3067kg/ha). Among w**heat** varieties, though number of tiller m^{-2} was higher in wheat variety Raj 4229 (346.7) but significantly higher grain yield of wheat (3276 kg/ha) recorded with K-0307 which was statistically at par with Raj 4229 (3144 kg/ha), DBW 39 (2962kg/ha) and GW 366 (2911 kg/ha).

Umiam: The experiment consisted of three major crops *viz*., maize, frenchbean and tomato. Consisting of 11 varieties in which eight were composites, one hybrid and two local varieties, 10 varieties of French bean consisted of 8 improved and 2 local varieties and for tomato crop, 20 varieties/lines were screened Among the maize varieties, longest cob length (14.8 cm), cob weight (231.1 g), green cob yield (6300 kg/ha), kernel yield (3700 kg/ha and stover yield (8900 kg/ha) was recorded with DA-61-A which is on par with RCM-75 for all the traits. Among the French bean varieties, Naga Local attained the highest plant height (244.3 cm), pod length (16.20), average pod weight (11.30 g), green pod yield (9100 kg/ha), seed yield (5100 kg/ha) and stover yield (7900 kg/ha) followed by RCM-FB-18 (240.3 cm, 16.2 cm, 10.60 g, 8400, 4000 and 6400 kg/ha respectively). The lowest green pod and seed yield was recorded in Maram (1500 and 1200kg/ha).

Ajmer: The total eight varieties each crop *i.e*., coriander, fennel, green gram and cluster was evaluated of their suitability for organic farming. Among the green gram varieties, Mum-2 performed significantly better for plant height (57.8 cm), number of primary branches (4.3), number of nods/plant (27.2), number of seeds/pod (10.9), also for seed yield (798 kg/ha) whereas SML 668 and Ganga-1 produced lower yield of 630 and 617 kg/ha respectively. Among the cluster bean varieties' RGC-1038 performed better with highest nos. of primary branch/plant (7.6), pods/plant (70.1), seeds/pod (8.4) resulted in higher seed yield of 1515 kg/ha and it was at par with RGC-1055. Variety RGC-986 recorded lowest performer in terms of number of pods/plant (29.9), numbers of seeds/pod (7.5), seed yield per hectare (647 kg). Among the coriander varieties, Azad Dhania-1 was found superior which recorded maximum plant height (115.9 cm), primary and secondary branches/plant (7.7 & 22.7), number of umbels/plant (41.9), number of umbellets/umbel (6.2) and seed yield (1671 kg/ha) followed by ACr-1 and Hissar Anand while RCr-446 been least performing variety which recorded seed yield of 1297 kg/ha. Among fennel varieties, GF-12 performed superior with all yield attributes and yield, It recorded highest plant height (162.1 cm), number of primary and secondary branches (12.7 & 22.4), umbels per plant (41.5), umbellets per umbel (27.5) resulted significantly higher seed yield per hectare (3235 kg) which was on par with AF-1, Rajendra Saurabha. GF-2. Variety RF-101 was the least performing variety in terms of seed yield (2817 kg/ha).

Gangtok: 12 varieties of each maize and buckwheat were evaluated. Among the maize varieties, Vivek Sankul -35 performed better in term of grain yield (2890 kg/ha), net return (Rs.72900/ha) and return per rupee invested (2.71) which were followed by RCM -75 and Vivek sankul -31 while lowest yield and net return recorded in KaloMakkai (1420 kg/ha and Rs.14,000/ha). Among the buckwheat varieties, IC 49671 was the highest yielded variety which produced of 1600 kg/ha yield and Sangla B1 was the lowest yielded variety.

Sardarkrushinagar: Eight verities of each crop in groundnut-wheat-green gram system were grown for their performance under organic farming**:** Though number of pods and pod weight per plant (25.3 and 10.8 respectively) and number of branches /plants (8.4) was highest in GG 20 SS but, pod yield (1549 kg/ha), net return (Rs 56,178/ha) and net return per rupee invested (1.42) along with higher number of nodules/plants (103.8 at 50 DAS) was maximum with GIG-17. Maximum yield was found in variety GW-451 (3964 kg/ha) which is higher than other varieties followed by GW 496, GW-273 and GDW-1255 among the wheat varieties. Highest net return and NRPRI was also obtained with GW 451 of Rs 37,976/ha and 0.55). Green gram variety GM-4 resulted higher seed and stover yield (487 and 904 kg/ha), net return (Rs 4,577/ha) and NRPRI (0.16) and found best performing variety but been at par to GAM-5.

Thiruvananthapuram: Among the cassava varieties grown under organic management, average tuber weight (428 g) was higher in Sree Jaya but maximum yield (23210 kg/ha) was recorded with CR-24-4 which was significantly higher

than others. Among the varieties evaluated, variety, CR-24-4 (Sree Reksha) generated higher net return (Rs. 1,79,839 ha^{-1}) and B:C ratio (2.07), followed by Sree Vijaya (Rs. 45,161 ha^{-1} net return and 1.27 B:C ratio) under organic mode of cultivation

Udaipur: Twelve varieties of maize and wheat grown in maize"wheat system were evaluated. Among the different category of maize varieties, variety, Pratap Hybrid Maize-3 among maize grain varieties, Sugar-75 among sweetcorn varieties, PM-3 among baby corn, VL Amber among popcorn varieties and Navjot among local varieties showed comparative better for yield attributes such as nos. of cobs, nos. of grains in row, grains/row total grains/cob, grains weight/ cob and test weight as a result of higher yield and economics. Among the different maize varieties, PHM-3 recorded significantly higher maize yield (6500 kg/ha) as compared to other followed by Sugar-75. Among different maize varieties, Sugar-75 recorded significantly higher gross return (Rs.2,31,614/ha) and net return (Rs. 1,52,794/ha) however, net return per rupee invested recorded higher with VL amber (2.18) Twelve wheat varieties were grown in three group *Triticum aestivum*, *Triticum durum* and local wheat**,** among them, variety HI- 8713 recorded significantly higher number of grains/ear (53.2), grain yield (5900 kg/ha), net return (Rs. 1,41,844 /ha) and NRPRI (3.10) and being best performing variety. Among *Triticum aestivum* varieties, significantly higher number of grains/ear, ear length, grains yield, net return and NRPRI was recorded in MP-3288 (50.0, 10.45 cm, 4460 kg/ ha, Rs. 99,634/ha and 2.18 respectively) as compared to other *aestivum* varieties. Among *Triticum durum* varieties, HI-8713 recorded significantly higher numbers of spikelet/ear, number of grains/ear, grains yield, net return and NRPRI (18.3, 53.2, 5900 kg/ha, Rs.1,41,844/ha and 3.10 respectively) as compared to other *durum* varieties. Among local wheat varieties, C-306 recorded significantly higher numbers of spikelet's /ear, ear length (cm), number of grains/ears, test weight (g), grain yield net return and net return per rupees invested (15.5, 9.5, 44.4, 48.4, 4000 kg/ha, Rs.83,763/ha and 1.83 cm, respectively) as compared to Lok-1.

3. Development of Integrated Organic Farming System models

Calicut: The model with spices, fodder and vegetables combination was established at Chelavoor farm. The crops pepper, turmeric, fodder grasses (Congo signal grass, CO-3, CO-4), tapioca, banana, cowpea, arrow root, coconut, elephant foot yam, yam, maize and pineapple were planted and established. Three cows and their calves were maintaining at IISR farm. Turmeric 480 kg, banana 100 kg, tapioca 75 kg, elephant foot yam and yam 20 kg each, pineapple 10 kg, arrowroot 17 kg, maize 19 kg and vegetable cowpea 10 kg, coconut 2200 nos. were harvested. A profit of Rs 1.23 lakhs was received from one acre. Employment generated man days/year is 415. The highest contribution towards the total net return by milk component of the model which is 86%.

Coimbatore: Fruit yield of bhendi 13025 kg/ha was recoded from the model. Cost of cultivation incurred per hectare was Rs.68730 and the net return Rs.61520/ha obtained with benefit cost ratio 2.12. Cotton variety Surabhi in IOFS model recorded 1358 kg/ha of seed cotton yield with the gross and net return of Rs. 73,604 and Rs. 24,344/ha respectively. Income from cow dung was obtained only Rs 3650 in a year which is 1825 kg in quantity. The Cumbu Napier CO (CN) 5 was raised in the IOFS model field under 0.10 ha. Fodder grass are harvested at regular intervals and fed to the Cattles. Total 95.4 t/ha was obtained for feed of cattle in three cutting. To supplement the protein requirement to cattle, Desmanthus (*Deamanthus varigatus*) was grown along the borders, harvested and fed to the cattle. Total 42.5 tonnes/ ha of green fodder was harvest in four cutting. A kitchen garden (200 m^2) has been maintained in the IOFS model to generate additional revenue and also to fulfil the nutrient requirement of the farm family. Total 248 kg of cauliflower was harvested with additional revenue of Rs. 2480 was obtained from kitchen garden. The tree name and species, such as Malaivembu (*Melia dubia)* 9 nos., Pungam (*Pongamia pinnata*) 1 no., Perumaram (*Ailanthus excelsia*) 2 nos., Neem (*Azadirachta indica*) 1 no. and Kumil (*Gmelina arborea*) 2 nos. were palnted. The tree species are fertilized with vermicompost, bio-fertilizers and bio-agents. The perennial crops *viz.,* banana, coconut, annual moringa and curry leaf were maintained along the borders of the field with the objective to fulfil the unforeseen expenses of the IOFS and Rs. 26493 realised.

Sardarkrushinagar: IOFS model is comprised of different components *viz*., crops (0.24 ha), green fodder crops (0.15 ha), dairy + vermicompost (0.01 ha) and boundary plantation. Net profit ₹ 21,721 was received by crop component and net profit ₹ 25,551 was obtained by green fodder unit. Ardusa, napier grass and lemon grass have been planted around the border and bunds. Total net profit from all the components of IOFS Model was ₹ 48,953 from 0.40 ha area.

Thiruvananthapuram: An Integrated Organic Farming System model was developed at research farm of ICAR-CTCRI, Thiruvananthapuram consisting of food crop components, cassava, vegetable cowpea, maize and fodder grass. The yield of cassava with veg. cowpea was recorded 850 and 22 kg/ha with net return of Rs. 23,005 respectively from the model.

Udaipur: An integrated farming system for 0.45 ha consisting of field crops in 0.25 ha (sweet corn + blackgram during Kharif

and wheat during Rabi), fodder crops in 0.05 ha. (Fodder maize + cowpea during kharif and berseem in Rabi and sesbania green manuring during zaid), Vegetables in 0.10 ha (tomato & brinjal in kharif, cabbage & cauliflower in rabi and okra in zaid), fruit crop in 0.04 ha (guvava) and compost unit in 0.01 ha were evaluated during 2018-19. The total maize equivalent yield of 5536 kg/ha and a net return of Rs. 49649/ ha was obtained from the farming system during 2018-19.

Umiam: The total cost of cultivation was recorded at Rs. 56,835/- per year under the IOFS model with an area of 0.43 ha. Maximum expenditure was incurred in crop component of the model with 46.68% of the total cost of cultivation. Dairy unit with one adult cow and one calf registered 37.29 % of the total cost of cultivation, while fishery component recorded 8.62% of the total cost of cultivation. A total net return of Rs. 78,950/- per year was achieved under the IOFS model which is about to Rs. 2,10,814/ha and much higher than the region's farmer common practices of rice mono-cropping or improved practice of rice-vegetables cropping system. The highest contribution towards the total net return was contributed by crop component of the model (67.21%) followed by dairy (23.24%) and fishery component (15.20%). The fish production was 132 kg.

4. Evaluation of concoctions of Natural Farming in Basmati rice-wheat system

Ludhiana: Among the different concoctions of natural farming practices, integrated nutrient management & pesticide free treatment followed by integrated crop management perform slightly better which recorded highest grain yield of basmati rice (3250 & 3240 kg/ha respectively). In case of wheat, maximum grain yield of wheat (4460 kg/ha) was obtained under integrated crop managements, which was statistically at par with integrated nutrient management+ pesticide free but significantly higher than all other concoctions of natural input management practices. The reduction under improved ZBNF treatments found to be 52.3-57.3 per cent compared to integrated crop managements and integrated nutrient management (pesticide free) respectively. Economics of rice and wheat under various concoctions of natural farming practices revealed that gross return of Rs. 1,156,131 found to be higher with under Integrated crop management (50:50) closely followed by Integrated nutrient management + pesticide free of Rs. 1,10,257/ha owing to lower cost of cultivation and high economic yield of rice and wheat with the same practice.

Modipuram: Yield attributing characters of basmati rice such as panicle weight, panicle length and 1000-grains weight were registered under integrated crop management (50% organic + 50% inorganic). Highest productivity of basmati rice was recorded under integrated crop management (50% organic + 50% inorganic) followed by organic farming package. Grain yield of basmati rice was reduced by 18.6%, 37.7%, 31.8%, 41.8% and 39.9% under organic farming package, Gurukul package (Product supplied by Gurukul), Locally prepared Gurukul products, Location specific improved products and control as compared to integrated crop management (50% organic + 50% inorganic), respectively. In wheat crop, growth and yield attributes such as leaf area index at 50 DAS (6.27), plant height (99.0 cm), number of tillers/m.r.l. at harvest (94), spike length (13.3 cm) and number of grains/spikes (62.9) was found highest under ICM followed by organic farming package. Grain yield of wheat was recorded highest also under with ICM (4807 kg/ha). Grain yield of wheat was reduced by 44.2%, 68.8%, 66.4%, and 63% under organic farming package, Gurukul package (Product supplied by Gurukul), Locally prepared Gurukul products and Location specific improved products as compared to ICM, respectively.

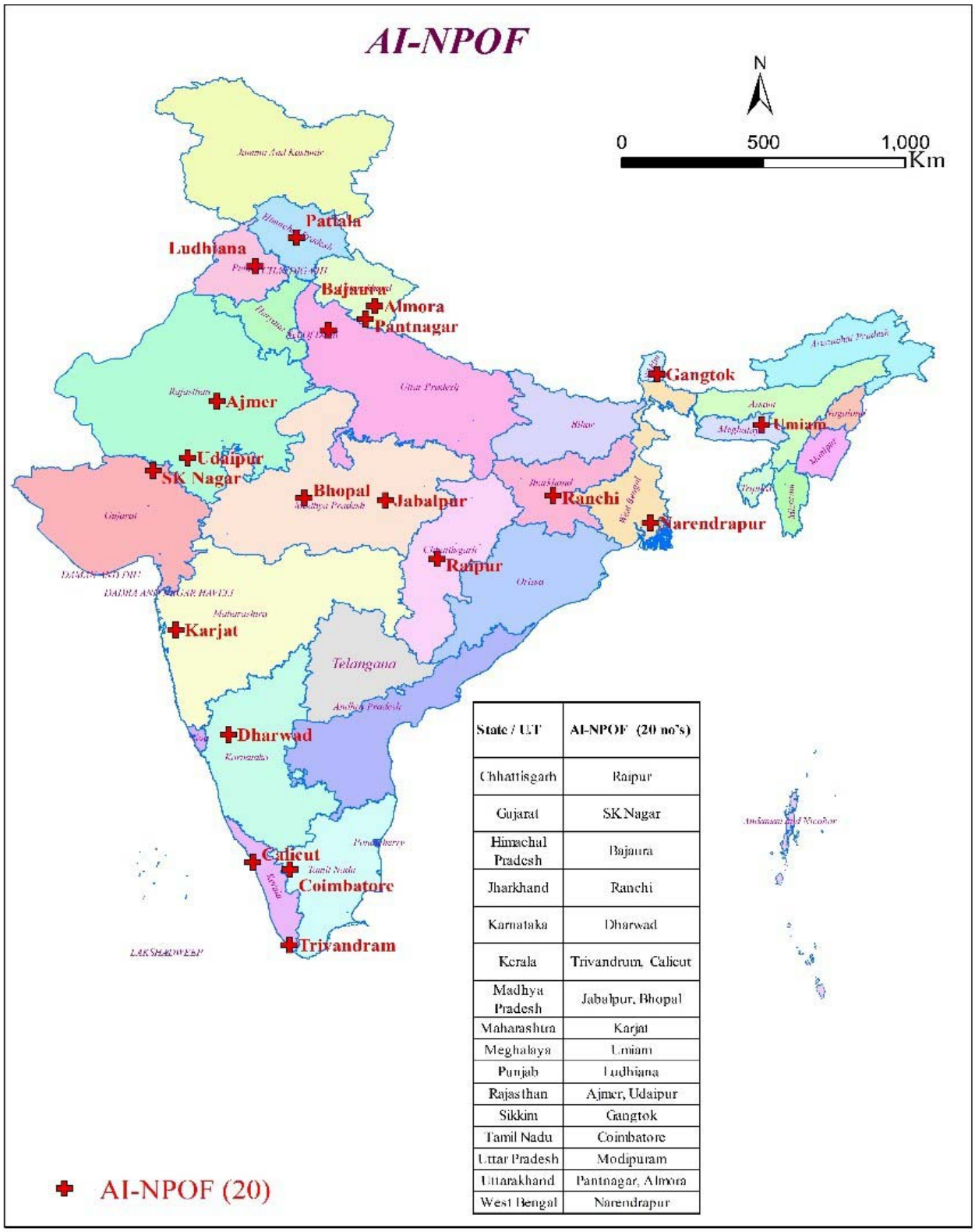
Pant Nagar: Performance of basmati rice as influenced by various concoctions of natural faming input showed that highest plant height (134 cm), tillers/m^2 (269) were recorded with ICM, while test weight i.e. 1000-grans-weight (25.0 g) recorded highest with control, gurukul package improved and integrated followed by gurukul package (24.4 g). Among the management practice of natural farming, significantly higher grain yield (4191 kg/ha) of rice recorded also with integrated crop management. Reduction in yield as compared to ICM recorded with Gurukul package i.e. from Kurukshetra, locally prepared and improved to the tune of 22.1, 20.8 and 17.8% respectively. Economics of different management practice of natural farming revealed that net return (Rs. 84,163) and B:C ratio (2.31) was observed with NPOF package followed by Gurukul package" Improved. In case of wheat, highest plant height (100 cm), spikes/m^2 and grain yield (5068 kg/ha) were recorded in integrated crop management. Gurukul package resulted in 29.6% decrease the yield compared to AI-NPOF package. Economic analysis of different treatment showed that maximum net return (Rs. 51625/ha) was observed with AI-NPOF package, however, highest B: C ratio (1.74) was recorded by Control.

Kurukshetra: Among various concoctions of natural farming practices, maximum grain yield (3850 kg/ha), Cost of cultivation (Rs 8,2484/ha), gross return (Rs 1,12,491/ha), net return (Rs 30,007/ha) and B: C ratio 0.36 was recorded under integrated crop management (50% organic+ 50% inorganic). AINP-OF package outperformed after integrated crop management. Integrated crop management package resulted in 42.6% higher yield than Gurukul package whereas AINPOF was higher to the tune of 17.2% by Gurukul package.

1 INTRODUCTION

During pre-green revolution period (up to 1960s) the rate of national agricultural growth was not able to keep pace with population growth and 'ship to mouth' situation prevailed. This was the major factor for introduction and large-scale popularization of the high yielding varieties (HYVs) of crops, which were highly responsive to the chemical fertilizers and water use. As a result, the total food grain production increased phenomenally – from mere 50.83 million tonnes in 1950-51 to 308.65 million tonnes in 2018-19 – indicating 6.07 times increase. This increase can be primarily attributed to large-scale adoption of HYVs, combined with other green revolution technologies (GRTs) in cereal crops, expansion of gross irrigated area (22.56 million ha in 1950-51 to 98.15 million ha in 2016-17) and increase in fertilizer nutrient consumption (0.07 million tonnes in 1950-51 to 29.37 million tonnes in 2019-20). All of them put together have led to substantial increase in the productivity of crops, especially food grains (from 522 kg/ha in 1950-51 to 2325 kg/ha in 2019-20) culminating into the change the status of India from a food importer to net food exporter in many commodities. However, the issues of dwindling natural resources, reduced factor productivity, monocropping, climate and market related risks and other associated factors forced the policy makers and strategists to rethink on production-oriented farming to sustainable farming practices. A long-term muti-location experiment on comparative evaluation of organic, integrated crop management (ICM; also referred as towards organic approach) and inorganic approaches initiated during 2004-05 at 13 locations and later on extended to 7 additional locations from 2015-16 under All India Network Programme on Organic Farming. clearly indicated advantages of towards organic (supply of 50 % N through organic and remaining 50 % through inorganic sources with integrated insect-disease-weed management practices) and organic (supply of 100 % N to each of the crop through organic fertilizers and management as per NPOP standards) compared to inorganic management. Yield ratio of organic production system was found to be higher during *kharif and rabi/summer* crops for coarse rice-based systems (1.24 and 1.13 during kharif and rabi /summer respectively) and soybean-based systems (1.30 and 1.17 during kharif and rabi /summer respectively) compared to towards organic and inorganic approaches indicating better suitability of these systems under long-term organic management approaches. Mean yield ratio obtained from multi-location trials of 28 crops belonging to various crop groups indicated that organic-to-towards organic approach was found to be 0.94 while organic-to-inorganic (purely synthetic input-based management) was 1.04 indicating clear advantage of organic over inorganic while lesser advantage over towards organic approaches in terms of productivity on individual crop basis. Therefore, cropping and farming systems approach is essential for realizing the productivity and profitability under organic production systems. Considering the consumer awareness and global demand for diversified commodities produced from organic production system in India, Government has set an ambitious target to bringing significant area under organic and natural farming by 2026. Technology upgradation and its scaling is essential to achieve the target.

To develop package of practices for organic farming in a system perspective, a Network Project on Organic Farming (NPOF) was initiated during 2004-05 by Indian Council of Agricultural Research (ICAR), New Delhi with ICAR-Indian Institute of Farming Systems Research (IIFSR) as lead centre. Initially, the project was operating with 13 centres covering 12 states. During XII plan, the numbers of centres of have been increased to 20 covering 16 states. Results of multi-location study and experiments conducted under the scheme including geo-tagged characterization of organic farmers, demonstration of organic farming packages, weed management, varietal evaluation, development of integrated organic farming systems and pilot evaluation of natural farming are presented in the report besides other aspects such as publications, human resource development *etc.* Outputs from the scheme during the year are significant in terms of development of package of practices and its demonstration and sharing with the stakeholders.



State / UT	AI-NPOF (20 no's)
Chhattisgarh	Raipur
Gujarat	SK Nagar
Himachal Pradesh	Bajaura
Jharkhand	Ranchi
Karnataka	Dharwad
Kerala	Trivandrum, Calicut
Madhya Pradesh	Jabalpur, Bhopal
Maharashtra	Karjat
Meghalaya	Umiam
Punjab	Ludhiana
Rajasthan	Ajmer, Udaipur
Sikkim	Gangtok
Tamil Nadu	Coimbatore
Uttar Pradesh	Modipuram
Uttarakhand	Pantnagar, Almora
West Bengal	Narendrapur

OBJECTIVES AND METHODOLOGY

2

Scheme Objectives

- To study productivity, profitability, sustainability, quality and input-use-efficiencies of different crops and cropping systems under organic farming in different agro-ecological regions
- To develop efficient crop and soil management options for organic farming
- To develop need-based cost-effective new techniques for farm-waste recycling

Methodology

The experiments in the project have been designed mainly to evaluate the relative performance of location-specific, important cropping systems under organic and conventional (chemical) farming, and assess agronomic efficiency of different production systems. Cropping systems, which are under evaluation, involve cereal crops (mainly basmati rice, coarse rice,*durum* and *aestivum* wheats, sorghum, barley and maize), pulsesand oilseeds (blackgram, cowpea, pigeonpea, chickpea, lentil, linseed, green gram, soybean, mustard, sunflower , safflower and groundnut), spices (black pepper, ginger, turmeric, chillies, onion, and garlic), vegetables (potato, okra, baby corn, cowpea, pea, tomato, frenchbean, summer squash, beetroot, carrot, dolichos bean, coriander and cauliflower), cotton and fodder crops (sorghum, maize, cow pea and berseem) in location-specific cropping systems. During 2015-16, following twelve experiments/study were undertaken at different centers:

1. Geo-referenced charecterization of organic farmers
2. Evaluation of organic, inorganic and integrated production systems for crops and cropping systems
3. Evaluation of response of different varieties of major crops for organic farming
4. Development of Integrated Organic Farming System models
5. Evaluation of Farm waste recycling techniques for organic farming
6. Documentation & validation of organic ITKs
7. Evaluation of organic management practices for insect pest in various crops
8. Evaluation of organic management practice for diseases in crops
9. Development of scientific organic package for large cardamom
10. Biochemical characterization & molecular identification of microbial population of different organic manures
11. Evaluation of weed management practices under organic production system
12. Evaluation of natural farming involving Beejamri, Jeevamrit and Ghanjeevamrit in basmati rice –wheat cropping system
13. Cluster based demonstration of Organic Farming Package under TSP

The objectives, locations and treatment details of each experiment at various locations are presented in chapter 7 and at respective tables. General guidelines and standards for the production of organic production, as suggested under National Standards for Organic Production (NSOP), forms

the basis for raising the experimental crops in the project. A compact block of land has been earmarked at each of the cooperating centres for experimental purposes, as far as possible. The plot identified was in general, free from hazards of erosion, sediments, chemical pollutants and contaminants. Shelterbelts have been developed by planting multi-purpose trees/shrubs etc. such as *Subabul*, *Sesbania* spp. etc. around the field. The individual centre has been advised to select organic sources of nutrients depending upon the local availability and also in suitable combination(s) to fulfill the entire requirement of nitrogen and 80-90% requirement of phosphorus and potassium for each cropping system. Cooperating centers have also been advised that each centre should select only those crops for organic farming research in which effective organic (non-chemical) measures are available for plant protection to avoid failure of crops at later stages. Bulky manures were prepared within the premises of cooperating centres under the project itself or under any other project going on at university/institute/ centre in order to ensure proper quality of inputs. Inputs related to plant protection, bio-fertilizers etc are procured from reliable sources only. Adequate care has also been taken by the centres that seeds purchased from outside are not treated with any chemical seed dresser.

3 LOCATION

Multi-location experiments were conducted during 2018-19 at 20 research centers of SAUs/ ICAR Institutes in 16 states. Statewise details of centres are given below in the order of results presented in the chapter 7.

Sl. No.	Location of centre	State	Address of SAU/ICAR institute
Centres functioning from 2004-05			
1.	Bajaura	Himachal Pradesh	CSK HPKVV Hill Agri. Res. & Extn. Centre, Bajaura-175 125
2.	Bhopal	Madhya Pradesh	ICAR-Indian Institute of Soil Science, Nabi Bagh, Berasia Road, Bhopal – 462 038
3.	Calicut	Kerala	ICAR-Indian Institute of Spices Research, P.B. No. 1701, Marikunnu PO, Calicut – 673 012
4.	Coimbatore	Tamil Nadu	Tamil Nadu Agricultural University, Coimbatore – 641 003
5.	Dharwad	Karnataka	University of Agricultural Sciences, Yettinagudda Campus, Krishinagar, Dharwad-580 005
6.	Jabalpur	Madhya Pradesh	Jawaharlal Nehru Krishi Viswa Vidyalaya, Jabalpur-482 004
7.	Karjat	Maharashtra	Dr. Balasaheb Sawant Konkan Krishi Vidypeeth, RARS, Karjat, Dist. Raigad – 410 201
8.	Ludhiana	Punjab	Punjab Agricultural University, Ludhiana-141 004
9.	Modipuram	Uttar Pradesh	ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut -250 110
10.	Pantnagar	Uttarakhand	G.B.Pant University of Agriculture Sciences and Technology, Pantnagar, Udham Singh Nagar – 263 145
11.	Raipur	Chhattisgarh	Indira Gandhi Krishi Vishwavidyalaya, Raipur-492 012
12.	Ranchi	Jharkand	Birsa Agricultural University, Kanke, Ranchi – 834 006
13.	Umiam	Meghalaya	ICAR Research Complex for NEH Region, Umiam – 737 102

Sl. No.	Location of centre	State	Address of SAU/ICAR institute
		Centres functioning from 2016-17	
14.	Ajmer	Rajasthan	ICAR-National Research Centre on Seed Spices, Tabiji, Ajmer-305 206,
15.	Almora	Uttarakhand	ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora-263 601
16.	Gangtok	Sikkim	ICAR Research Complex for NEH Region, Sikkim Centre, Tadong, Gangtok
17.	Narendrapur	West Bengal	School of Agriculture & Rural Development, Ramakrishna Mission Vivekananda University, PO Belur Math, Howrah-711 202,
18.	Sardar Krushinagar	Gujarat	Sardar Krushinagar-Dantiwada Agricultural University, Sardar Krushinagar, Banaskantha –385 506
19.	Thiruvananthapuram	Kerala	ICAR-Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram - 695 017
20.	Udaipur	Rajasthan	Agricultural Research Station, Maharana Prataprana University of Agriculture and Technology, Udaipur

4 MANPOWER

No regular posts, in any category, have been provided and the responsibility was assigned to a scientist, nominated as Principal Investigator of AI-NPOF, by the parent institute/ university (Names and contact addresses of PI's are given in Annexure10). The scientists of related disciplines were also involved in the research programme by the respective institution. In addition, two senior research fellows (as contractual staff) have been provided at each centre.

5 SOIL AND CLIMATE

Soil type, weather parameters and initial values of soil physico-chemical properties at various locations are presented below.

Soil type, weather, latitude and longitude of the various centres

Sl. No.	Name of centre	Soil Type	Weather				Latitude (N)	Longitude (E)
			Rainfall (mm)	Temperature (°C)		R.H (%)		
				Max.	Mini.			
Centres functioning from 2004-05								
1.	Bajura	Silty loam	1018.5	24.6	9.6	88.6	31.8^{0}N	77^{0}E
2.	Bhopal	Vertisols, Clay Montmorillonite/ smectite type	906.2	32.67	20.91	58.8	23°18’	77°24’
3.	Calicut	Clay loam, ustic Humitropept	4121	31.8	22.0	68	11°34’	75°48’
4.	Coimbatore	Sandy, Clay, Loam soil	967	29.8	21.3	86	11°	77°.0’
5.	Dharwad	Clay loam	582.8	31.2	18.8	76.9	15°26’	75°07’
6.	Jabalpur	Vertisoils, Chromusterts	1096.10	32.4	17.7	78.2	23°90’	79°90’
7.	Karjat	Red and medium black	3457	42.9	11.6	-	18°92’	77°33’
8.	Ludhiana	Ustochrepts-Ustic pramments association, alluvial, sandy & sandy loam	73.7	33.52	17.02	76.22	24°35’	74°42’
9.	Modipuram	Alluvium soils Typic ustochrept	747.0	43.5	2.5	72.7	29°4’	77°46’
10.	Pantnagar	Hapludolls, very deep alluvium coarse loomy soils	1191.5	30.1	17.7	84.2	29°N	79°30’
11.	Raipur	Ochraquals association, deep black soil	830	33.4	20.8	79.6	21°16’	81°36’
12.	Ranchi	Ultic Palesustalfs, very deep soils	1611.2	30.2	15.7	85.1	-	-
13.	Umiam	Clay loam	2631.9	26.2	15.3	63.6	24°44’	76°48’
Centres functioning from 2015-16								
14.	Ajmer	Sandy loam	450	-	-	-	36°01’	22°31’
15.	Almora	-	-	-	-	-	-	-
16.	Gangtok	-	2853.3	29.69	7.20	90.42	27^{0}32’	88^{0}60’
17.	Narendrapur	-	-	-	-	-	-	-
18.	Sardar Krushinagar	-	931.2	34.31	20.32	61.33	24°-19’	72°-19’

Initial nutrient status of soil (2018-19)

Centre	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)	S (ppm)	Fe (ppm)	Zn (ppm)	pH	EC (ds/m)
Bajaura	-	-	-	-	-	-	-	-	-
Bhopal	0.53	154.2	12.8	530	4.92	5.52	0.74	7.85	0.50
Calicut	1.8	196	6.6	146	-	32.0	0.10	4.96	.30
Coimbatore	0.66	247	17.5	495	-	30.40	4.10	8.3	0.06
Dharwad	5.87	273.9	28.40	359	13.06	9.50	1.46	7.5	0.13
Jabalpur	0.68	263	12.6	296	9.6	2.39	0.35	7.2	0.39
Karjat	1.14	230	20.0	327	-	-	1.72	7.02	0.28
Ludhiana	0.56	278	36.3	134	-	-	-	8.1	0.50
Modipuram	0.59	-	-	-	-	-	-	-	-
Pantnagar	1.04	350	35.8	235	30.8	30.24	0.84	6.8	0.29
Raipur	0.64	237	13.0	274	-	-	-	7.67	0.28
Ranchi	0.38	-	-	-	-	-	-	-	-
Umiam	1.32	-	-	-	-	-	-	-	-
Centres functioning from 2015-16									
Ajmer	0.28	124.60	11.91	336.22	-	-	-	7.13	0.13
Almora	-	-	-	-	-	-	-	-	-
Gangtok	0.88	237.6	14.07	273.6	23.78	-	2.18	5.57	-
Narendrapur	0.89	-	72.03	254.8	-	-	-	6.07	0.19
Sardar Krushinagar	0.33	141	13.5	180.0	8.20	8.40	0.68	7.22	0.15
Thiruvananthapuram	-	-	-	-	-	-	-	-	-
Udaipur	0.56	155.76	2.87	250.13	-	-	-	8.1	0.50

BUDGET 6

A total budget of Rs. 175.0 lakhs were released to 21 centers during 2018-19. The centre wise allocations of funds are given below.

Sl. No.	Name of University / Institutes	Grant-in-Aid, Other than NEH &TSP					Total Other than NEH & TSP	TSP Component	SCSP Compomnent			Grant-in-Aid, under NEH Component				Grand Total
		Sub-heads						Sub-head	Sub-heads			Sub-heads				
		Domestic T.A.	Research Expenses	Operational chareges	Minor Works	Livestock		Research Expenses	Research Expenses	Operational chareges	Total SCSP	Domestic T.A.	Research Expenses	Operational chareges	Total NEH	
1	IGKV, Raipur	0.10	1.05	0.75	0.00	0.00	1.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.90
2	SDAU, S.K. Nagar	0.10	0.75	1.75	2.00	1.60	6.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.20
3	HAREC, Bajaura	0.50	1.00	3.00	0.00	0.00	4.50	0.00	2.00	2.09	4.09	0.00	0.00	0.00	0.00	8.59
4	BAU, Ranchi	0.25	0.85	2.00	0.00	0.00	3.10	0.00	1.00	1.29	2.29	0.00	0.00	0.00	0.00	5.39
5	ICAR-IISR, Calicut	0.90	1.50	2.50	0.00	0.00	4.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.90
6	ICAR-CTCRI, Trivandram	0.62	2.37	3.91	2.00	1.60	10.50	0.00	4.49	0.00	4.49	0.00	0.00	0.00	0.00	14.99
7	UAS, Dharwad	0.40	1.00	2.00	0.00	0.00	3.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.40
8	JNKVV, Jabalpur	0.25	1.00	1.80	0.00	0.00	3.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.05
9	ICAR-IISS, Bhopal	0.75	2.00	4.50	0.00	0.00	7.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.25

Sl. No.	Name of University / Institutes	Grant-in-Aid, Other than NEH &TSP					Total Other than NEH & TSP	TSP Component	SCSP Compomnent			Grant-in-Aid, under NEH Component				Grand Total
		Sub-heads						Sub-head	Sub-heads			Sub-heads				
		Domestic T.A.	Research Expenses	Operational chareges	Minor Works	Livestock		Research Expenses	Research Expenses	Operational chareges	Total SCSP	Domestic T.A.	Research Expenses	Operational chareges	Total NEH	
10	KKV, Dapoli	0.30	0.50	1.40	0.00	0.00	2.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.20
11	ICAR Res. Comp., Umiam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	3.18	3.18	6.86	6.86
12	PAU, Ludhiana	0.80	1.00	3.00	2.00	0.80	7.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.60
13	MPUA&T, Udaipur	0.85	1.84	4.30	0.00	1.60	8.59	0.00	2.50	1.79	4.29	0.00	0.00	0.00	0.00	12.88
14	ICAR-NRC Seed Spices, Ajmer	0.50	1.50	5.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00
15	ICAR-RC-NEH, Gangtok	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	2.58	3.18	6.86	6.86
16	TNAU, Coimbatore	1.15	1.00	3.55	0.00	0.00	5.70	0.00	2.50	2.79	5.29	0.00	0.00	0.00	0.00	10.99
17	ICAR-IIFSR, Modipuram	1.25	1.00	4.48	0.00	0.00	6.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.73
18	National PI, ICAR-IIFSR, Modipuram	3.51	0.81	5.56	0.00	0.00	9.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.88
19	GBPUA&T, Pantnagar	0.80	1.60	3.00	2.00	1.60	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00
20	ICAR-VPKAS, Almora	0.35	1.60	3.00	2.00	0.80	7.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.75
21	RMVU, Narendrapur	0.50	3.03	3.50	0.00	0.00	7.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.03
Total		**13.88**	**25.40**	**59.00**	**10.00**	**8.00**	**116.28**	**0.00**	**12.49**	**7.96**	**20.45**	**1.60**	**5.76**	**6.36**	**13.72**	**150.45**

RESEARCH RESULTS 7

7.1 Geo-referenced characterization of organic farmers

In order to understand the successful practices and constraints of organic farmers, a study on geo-referenced characterization of organic farmers was initiated from 2014-15. A minimum of 30 farms household was fixed as target for collection of information. However, some centers have collected information from less or more number of farmers depending on the resources. The objective of the study was

- To understand and characterize the practice and constraints of organic farmers
- To access the technological gaps of organic farmers Centre wise results for each centre are presented below.

Bajaura

Geo-referenced characterization survey in organic clusters involving 30 farmers/farms in 9 different villages of Kullu district in Himachal Pradesh was carried out.

- Land size of surveyed farmers ranging from 1.2 ha. to 4.8 ha and had a total of 93.4-hectare area, out of which 7.98 hectare area (8.54%) under Subhash Palekar Natural Farming (SPNF) and remaining area was under conventional farming. Soil type in surveyed village found to be silty loam.
- Farmers grow vegetables and cereal using FYM and vermicompost as organic source of fertilizers
- In the surveyed villages, 36.7% of farmers had two farm implements sprayer and power weeder, while 50% had single implement of sprayer. Only 2 farmers had power tiller.
- Among the surveyed famers of the village, 100% of the farmers had cows and calves whereas, approximately 20% farmers also rear sheep/goats. No backyard poultry was present in the surveyed sites.
- The gross area under vegetable (cauliflower), cereal (maize), pulse (black gram and kulthi) and fruit crops (apple) was 2.36, 2.08, 0.9, 0.16 and 2.50 ha with average production of 9153, 6870, 818, 825 and 192 kg/hectare, respectively during *kharif*.
- During *rabi* season, the pea crop had maximum area (3.04 ha.) with productivity of 7757 kg/ha followed by wheat (area 1.80 ha & productivity 2558 kg/ha) and onion (area 0.32 ha) with productivity of 9125 kg/ha.
- During summer season farmers grow vegetables like french bean and tomato. Tomato had maximum area (4.06 ha.) than french bean (1.10 ha.) with average productivity of 8532 and 5986 kg/ha respectively. Only a small quantity of their produce is kept for self-consumption and rest is sold in the market.
- Weeds are normally managed manually. Farmers are using leaf extract of locally available plants for management of insect-pest
- Major constraints are selling of input in local market and availability of organic input. No separate market for SPNF products. Plant protection inputs are not effective against severe insect attack.
- The computation of yield gap for major crops between on-station experiment and at farmers field revealed that most of the crops had higher yield under on-station experiment than farmers field. Crops green pea, tomato and french bean was higher by 13.8, 27.3 and 10.2% respectively at on-station while black gram was higher on farmers field.

Mean yield of major crops

Name of the crop	Yield as per on-station experiment	Mean yield at farmers field (kg/ha)	Yield gap (%) (kg/ha)
Green pea	6400	5625	13.8
Tomato	10640	8360	27.3
French bean	6500	5900	10.2
Black gram	820	950	13.7

Bhopal

Geo-referenced organic cluster survey was carried out at Borkhedi, Phanda and Teelakhedi villages of Tehsil- Huzur, District- Bhopal, Madhya Pradesh during 2018-19. Total 30 farmers were surveyed.

- Among the respondents in the villages, the highest total land holding was found to be 21.0 acre while minimum was 2.0 acre. Out of which the maximum area under organic farming was 4 care and minimum was 1 acre.
- Among the on-farm resources, farmyard manure (FYM) is still the most predominant source of organic manures being used by the farmers followed by vermin-compost. Every respondent spare 1 to 19 tonnes of crop residue for organic recycling and composting annually.
- Madhya Pradesh is the soybean state, all the farmers grow soybean during *kharif* and depending on the water availability either wheat or chickpea is grown during *rabi*.
- Neem oil, buttermilk and kaddha (decoction) were used as organic pesticide for the control of insect pest and diseases in crops. kaddha was prepared by using leaves of different plants such as neem, oak, custard and karanj unlike SPNF specific input.
- Only 10-20% of organic produces is reserved for household consumption and the rest sold out in either krishi mandi or local market.
- The reasons behind adoption of organic farming were minimum purchase of external market inputs, healthy produce and improvement in soil health. However, slow responses to organic inputs, non-availability of premium price, market unavailability for organic produce were opined as the major constraints of adoption of organic farming in the region.
- Poor access to the certification agencies for adoption to organic farming.

Calicut

Geo-referenced characterization of organic cluster at Irulam, district wayanad, kerala was carried out. Total 30 farmers of Irulam, in wayanad district were characterized in which 100% of land was found under organic farming.

- The major crops were pepper, coffee, coconut, arecanut, ginger, turmeric and banana. These farmers were characterized under Large-0, Medium-6 and Small-24. Farmers having farm animals–18 and farm machineries–6.
- Crop residue availability within the farm for recycling – 2.03 t /ha/year. Framers not having vermi-compost/ bio-gas unit.

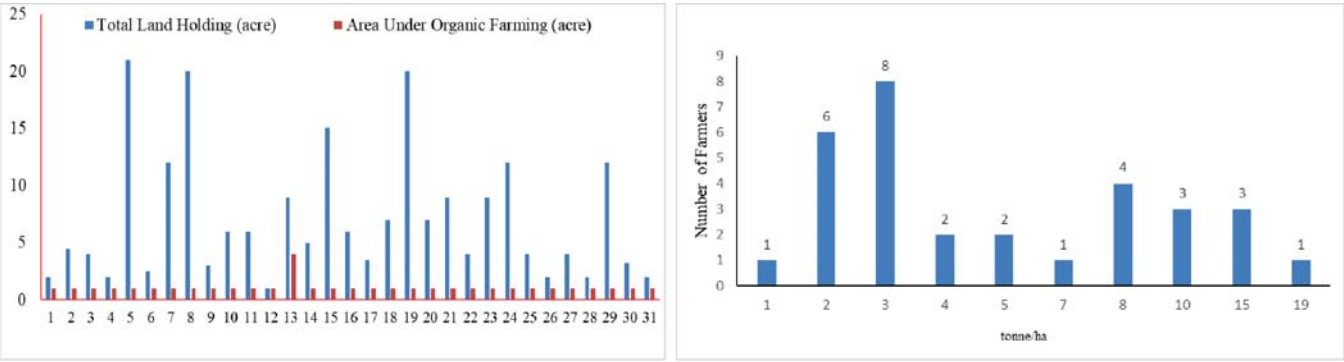


Fig. 1: Land profile of organic farmers and crop residue availability for diverting towards organic manuring in Bhopal

- Major mode of weed management is hand weeding for weed control in organic farming
- IMO is the certification Agency. Farmers selling their produce in local market and society.
- Major reason for adoption of organic farming-for healthy and safe food. Major constraints for adoption of organic farming are non-availability of marketing, diseases, lack of sufficient govt support and labour

Characterization of organic cluster at Irulam

Crops	Number of Farmersr	Land unde organic cultivation (ha)	Profit/ha (Rs)
Pepper	29	7.207	307797
Coffee	27	6.405	67263
Coconut	26	1.564	81841
Areca nut	25	5.241	429688
Cardamom	7	0.775	403870
Banana	10	0.215	113488
Turmeric	9	0.282	898936

Coimbatore

Geo-referenced characterization survey was carried out of 30 households in organic clusters where 175 farmers are practicing organic farming in different villages namely, Perumampatti, Ponnampattu and Salaiyur of Guziliamparai block, Dindigul district in Tamil Nadu. In the organic cluster, 6 farmers are under SPNF.

- The Mean holding size of organic farmer/farm is 0.40 ha consisting mean livestock population of 3 dairy cattle, 2 goat and 5 poultry.
- Major crops under organic farming are tomato, brinjal, bhindi. Farmers also growing Guava and Amla as horticulture crops. Under SPNF farming Onion is the major crops with Moringa. Yield gap between on-station and farmers field were 10,13 and 9% respectively which was higher with on-station experimentation. Under SPNF farming, onion and moringa was also higher by 13 and 10% on experiment field than SPNF.
- Majority of the organic farmers (80%) were adopting diversified crops besides vegetables (60%) flowers (60 %) and fruits trees (55%) cultivation as evinced from field survey. 80 per cent of the organic farmers were using FYM as basal application for nutrient management followed by three fourth (75%) of the organic farmers spray panchagavya @ 3 % as both nutrients source and for pest management. About half of the organic farmers (65%) were using neem extract as pest repellents followed by jeevamurth (60%). Majority of the organic farmers (80 %) were practicing organic cultivation without organic certification.
- Nearly three fourth of the farmers (80%) selling their products through local merchant followed by local market (30%) and few through online (10%).
- Reasons for adoption of organic farming as evinced through interaction with farmers were, use of locally available farm waste, less labour intensiveness, easy to manage, satisfaction in producing eco- safe food and service motto to save environment as expressed by majority (80%) of the organic farmers.
- Individual member of the groups involved in entrepreneurial activities value added product as moringa powder export to Middle East countries.
- Major constraints for organic farming were inadequate market facilities for the sale of organic products, no premium/guarantee price for organic products, lengthy procedure and long duration for organic certification and heavy infestation of pests and diseases

Dharwad

- The six villages namely Amminabhavi, Puddkalkatti, Garag, Tadkod, Kotabagi and Hangraki were surveyed Geo-referenced characterization in Dharwad district of Karnataka. Total 26 farmers were characterized but only 17 farmers really practicing organic farming are found that too in their 20% of the total cultivated area. Though the farmers are interested in organic farming because of the awareness regarding healthy food they are not happy with the returns what they obtained. The reasons for this is no subsidy for organic inputs if they want to purchase from outside Biopesticides, no organized market system for getting higher premium price , lesser availability of organic manures. Recently because of the introduction of NF programme in the state most of them are showing interest in this project again in their conventional organic farm only.

Mean yield of major crops

Name of the crop	Organic Farming			Natural Farming		
	Yield on-station experiment (kg/ha)	Yield at farmers field (kg/ha)	Yield gap (%)	Yield on-station experiment (kg/ha)	Yield at farmers field (kg/ha)	Yield gap (%)
Moringa-traditional variety	48100	45700	05	48100	43800	10
Tomato (Arka Rakshak)	14100	12800	10	-	-	-
Brinjal (Co2)	25700	22400	13	-	-	-
Bendhi (COBh H 1)	29700	27300	09	-	-	-
Onion	-	-	-	16000	12500	13

- Most of the farmers maintaining cows, buffalo and bullocks with average 2 numbers/household.
- Major crops grown under organic farming are greengram blackgram, groundnut, soybean, *rabi* sorghum, chickpea wheat and maize.
- Farmers using farmyard manure and vermicost as organic nutrient of source.
- Plant protection measures under organic farming are Neem seed kernel extract, Nimbecidine and Trichoderma
- Hoeing, hand weeding and intercropping are the main practices for control of weeds.

Yield gap of major crops in Dharwad

Name of the crop	Yield as per on-station experiment	Mean yield at farmers field (kg/ha)	Yield gap (%) (kg/ha)
Green gram	430	400	7%
Black gram	1200	1000	17%
Rabi Sorghum	2267	1750	23%
Groundnut	1507	1250	17%
Maize	3069	2500	19%
Chickpea	1345	1000	26 %
Soyabean	1500	1400	7%
Wheat	2029	1000	51%

Karjat

Geo-referenced characterization of organic cluster at Raigarh district in Maharashtra was carried out. Total 30 uncertified farmers of Tuksai, Ambhere and Durshet villages were characterized.

- Total land holding in surveyed villages were 28.48 ha in which 11.58 ha area are under organic farming. Soil type of land found to be red and medium black. Characterization of farmers, marginal 11 nos. (area 6.90 ha), small 13 nos. (area 4.62 ha), medium 4 nos. (area 6.10 ha) and large 2 nos. (area 10.86 ha).
- Farmers possessing farm animals of 87 numners, buffalo-03 nos., cow-22 nos. and bullock-57 nos. Crop residue availability within the farm for recycling shed waste-72.13%, straw-27.87%.
- Major crop in the cluster were rice followed by vegetable in rabi including fruits crops (perineal) such as mango adopting the farmers.
- Major organic inputs FYM, compost and vermin-compost being used by the farmers.
- Majority of farmers-controlled weeds through hand weeding in seasonal crops and animal grazing in rainfed fruit crops. Farmers using cow urine and Dashparni Aark for controlling the Insect & pest.
- Scarcity of laborers and high wage rates due to urbanization and industrialization, lack of information about organic inputs, non-availability of labours at the time of transplanting and harvesting, fluctuation

in market prices and lack of co-operative marketing are the major constraint.

Ludhiana

Geo-referenced characterization survey was conducted in Hoshiarpur district of Punjab. A total of 20 organic growers were surveyed. The surveyed area lies in 30°51.766' - 31° 26.674' N latitude, 75°34.825' - 75° 59.469' E longitude and at altitude of 216-331 m above mean sea level. Collected the information about total land holding of the farmers, area under organic management and ZBNF, crops being grown under organic farming and ZBNF, organic manures, ZBNF products and biopesticides being used, productivity level of the crops as compared to conventional crops, price premium on organic produce, perception of organic growers about organic farming and constraints in its adoption. The proportion of land under organic farming was calculated on the basis of total land holding of organic growers.

Salient findings

Area under organic farming

The proportion of area under organic farming out of total land holding of survey growers was 46.96 per cent. Out of total organic growers 40 per cent were semi medium farmers followed by small (25%), medium (15%), large (10%) and marginal (10%) farmers.

Adoption trend of organic farming

Most of the farmers adopted organic farming during 2015 and 2016 (20%) each followed by 15 per cent during 2010 and 10 per cent in 2008 and 2011 each. Five percent farmers adopted organic farming in 2001, 2007, 2014, 2013 and 2019 each (Fig 1).

Crops grown under organic farming

Vegetables (80 & 70%), basmati rice (65%) and wheat (80%) were the prominent crops being grown by farmers under organic farming. The *kharif* and *rabi* fodders were being grown by 45 percent of farmers. Thirty per cent farmers had grown sugarcane. The *kharif* maize and turmeric was being grown by 15 per cent of farmers and gobhisarson by 20 per cent of farmers. Other crops being grown were paddy (5%) in *kharif* and maize (5%) in *rabi* (Fig. 2 & 3). Although, the pulses are an integral component of organic farming and significantly known for soil health improvement but still these were being grown by lesser number of farmers.

Use of organic manures

Farmyard manure (FYM) was the major source of nutrition, being used by 95 and 100 percent of the organic growers in *kharif* and *rabi* season, respectively. Green manuring was the second major source of nutrition used by 50 per cent of farmers in *kharif* season. Vermicompost was used by 40 per cent of farmers during both seasons. Jeevamrit was used by 15 and 25 per cent of farmers in k*harif* and *rabi* season, respectively (Fig. 4 & 5). The different bacterial cultures were used by 5 per cent of farmers during both seasons. In *rabi* season, FYM and vermicompost were predominant source of nutrition being used by 100 and 40 per cent farmers, however, farmyard manure, green manure and vermicompost were predominant source of nutrition in *kharif* season being used by 95,50 and 40 per cent farmers.

Weed management

The hand weeding was the predominant method of weed control employed by 95 and 100 per cent of farmers in *kharif* and *rabi* crops, respectively (Fig. 6 and 7). Mulching to suppress weeds was used by 10 and 15 per cent farmers in *kharif* and *rabi* crops, respectively. Ten per cent of farmers used mechanical methods to control weeds during both seasons. Cutting was used by 5 per cent farmers in both seasons.

Disease and insect-pest management

The sour butter milk was used by 65 and 60 per cent of farmers in *kharif* and *rabi* crops, respectively. ZBNF products Agniasta and Brahmastra were also being used by farmers to control diseases and insect-pests. Fifty-five per cent farmers during *kharif* and 65 per cent during *rabi* used these products. Neem based pesticides were used

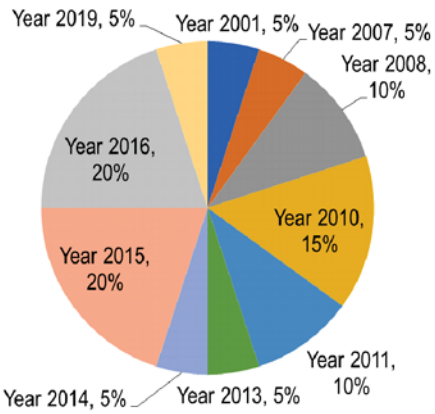


Fig. 2. Adoption trend of organic growers (year wise)

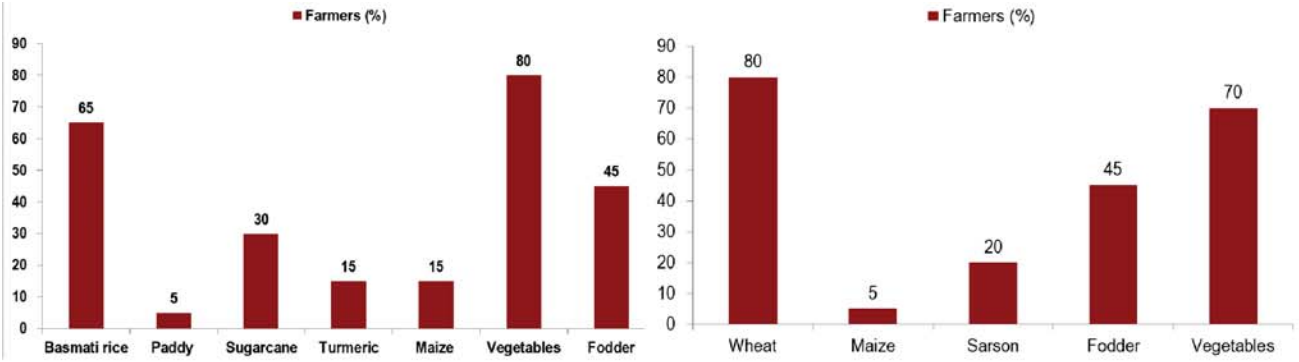


Fig. 3. Crops grown under organic farming in *kharif* and *rabi* season

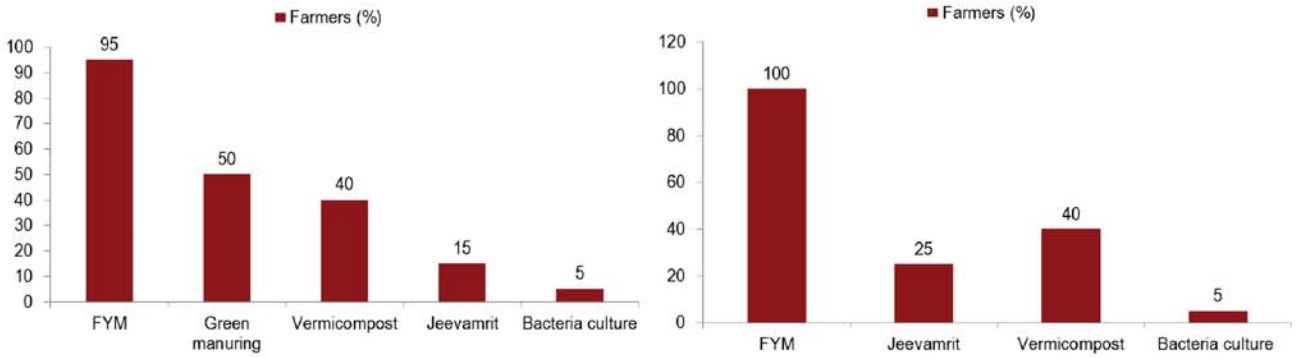


Fig. 4. Organic inputs used by farmers in *kharif* and *rabi* season

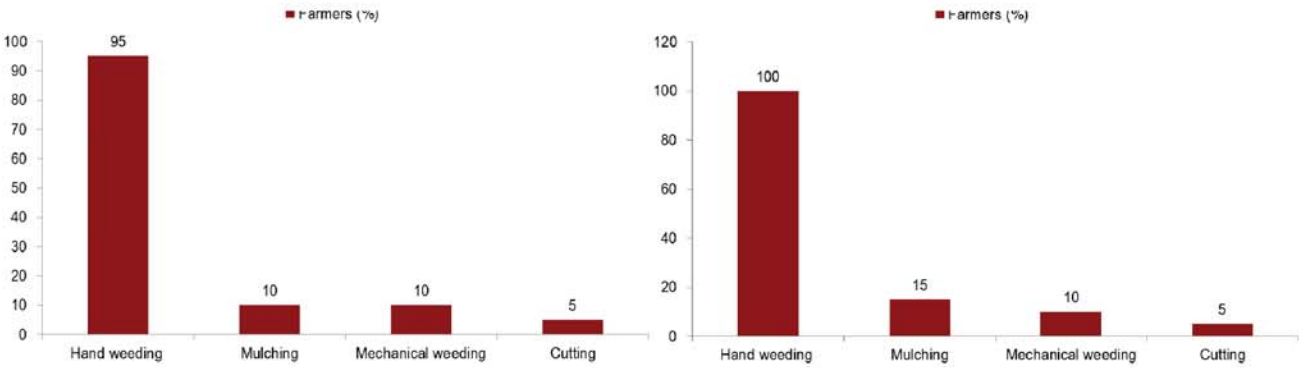


Fig. 5. Weed management in *kharif* and *rabi* season

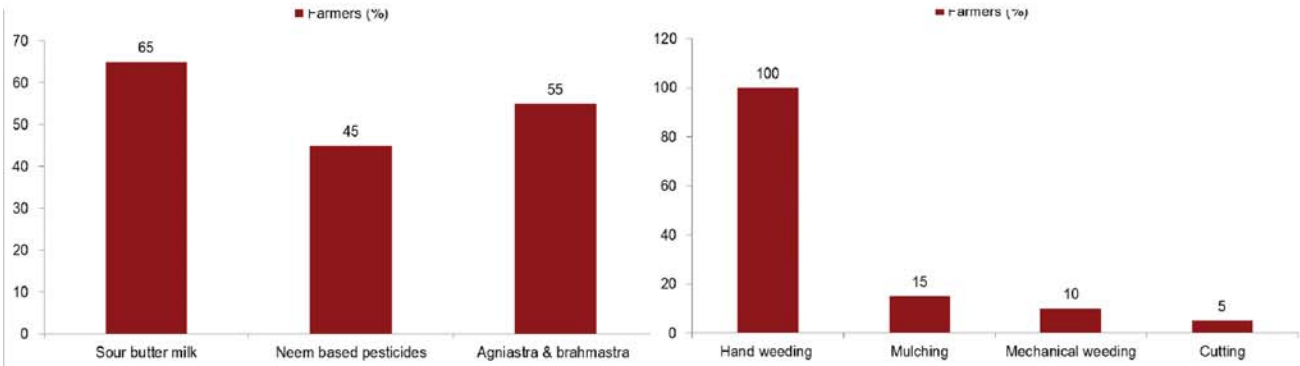


Fig. 6. Disease and insect-pest management in *kharif* and *rabi* season

by 45 and 30 per cent of farmers during *kharif* and *rabi* seasons, respectively.

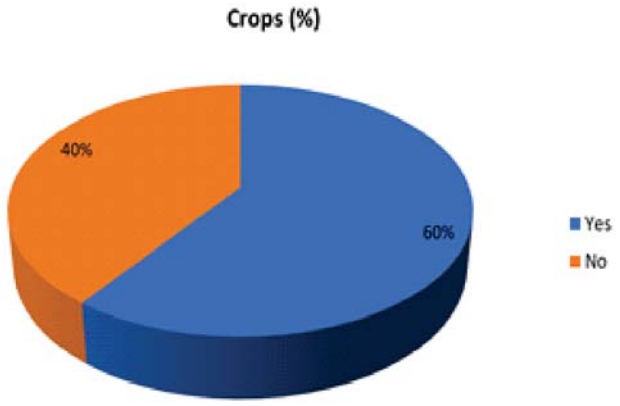


Fig. 7. Price premium available on organic crops

Productivity of crops

The economic yields of almost all the crops were lower under organic cultivation as compared to chemical cultivation of these crops. This might be due to use of less quantity of FYM and other composts resulting in inadequate nutrition. Other reasons could be infestation of diseases and insect-pests resulting in lower yields.

Marketing and price premium

The organic farmers got price premium on 60 per cent of crops which includes wheat sugarcane, pulses, oilseeds, maize flour and bajra. However, farmers get no premium on 40 per cent of crops which include basmati rice exclusively and maize grains (Fig. 10). The organic growers had been selling their produce in local market and big cities. Some of organic growers had sale point of their produce at their farms itself.

Reasons to adopt organic farming

The organic growers (40%) were practicing organic farming mainly due to perception that organic farming improves the human health (Table 4.1). Healthy food was the reason to adopt organic farming by 25 per cent of farmers. The healthy environment was the reason to adopt organic farming by 15 per cent of farmers. Other reasons for opting organic farming included passion (10%), (4%), business (5%) and peace of mind (5%).

Reasons to adopt organic farming

Reasons	Response (%) of farmers
Health benefits	40
Healthy food	25
Healthy Environment	15
Passion	10
Business	5
Peace of mind	5

Constraints in adoption

Labour intensive operations (27%), lack of marketing facilities (23%) difficulty in weed control (20%) and reduced yield (12%), were the major constraints expressed by the farmers in adoption of organic farming (Table 4.2). Non-availability of subsidized inputs, difficulty in pest and disease management, limited availability of organic manures and lack of technical knowledge for organic farming etc. were also the constraints in adoption of organic farming in Punjab.

Constraints in adoption of organic farming

Constraints	Response (%) of farmers
Labour intensive operations	27
Lack of marketing facility	23
Weed problem	20
Reduced yield	12
No subsidy on organic inputs	10
Lack of premium on organic products	8

Summary of Survey

Most of the surveyed farmers belonged to Natural Farming Association (NFA) but none of the surveyed farmers was practicing ZBNG in totality. However, one or more components of the ZBNF practices were being integrated with the organic farming practices. Vegetables (80 & 70%), basmati rice (65%) and wheat (80%) were the prominent crops grown by farmers under organic farming. Farmyard manure, green manure and vermicompost were the major

source of nutrition to crops followed by jeevamrit and bacterial cultures. The hand weeding was the predominant method of weed control. The pest and disease management was done with sour butter milk, Agniastra & Brahmastra and neem based pesticides. Human health concerns, healthy environment and improved soil health were the major reasons to adopt organic farming. Labour intensive operations, lack of marketing facilities, difficulty in weed control and reduced yield were the serious constraints in its adoption.

Modipuram

- Geo-referenced characterization of organic farmers for 16 farmers were conducted in Bijnore and Muzaffarnagar districts of western Uttar Pradesh.
- Mean holding size of surveyed farmers is 2.04 ha in which 82.2% area maintained under organic farming. Average dairy animal was 6-7 nos.
- FYM, Vermicompost, Green Manure, Waste decomposer, Jeevamrit and cow urine are the major source of nutrient.
- Farmers using Agniastra, Brahmastra, Neemastra, Cow urine, Beauveria bassiana, Metarrhizium and Trichocards as plant protection inputs. Weed management practice is hand weeding.
- Major Constraints identified such as; lack of marketing and no premium price, low productivity under organic farming, lack of bio-pesticides for pest and disease management, scattered cluster members of organic group, lack of low input responsive high yielding varieties, high cost for manual weeding and lack of specially designed. implements for organic farming

Yield and yield gap of major crops in Bijnore and Muzaffarnagar

Name of the crop	Yield on-station experiment (kg/ha)	Mean yield at farmers field (kg/ha)	Yield gap(%)
Sugarcane	72870	55000	-24.52%
Basmati rice	4398	4550	3.46%
Wheat	3214	2290	-28.75%
Mustard	1963	1367	-30.36%

Pant Nagar

Geo-referenced characterization of organic farmers was carried out at villages Maya Rampur, block Kotabagh in Nainital district of Uttarakhand. Total 30 nos. of organic farmers were surveyed.

- The land holding size of the organic farmers found to be in ranged from 0.133 ha to 1.33 ha.
- All most all the organic farmers are having 2-4 animals.
- Farmers are preparing compost at their own farm and composts are not being purchasing by the farmers.
- All the farmers are using cow urine fortified with neem leaves/neem oil/garlic paste for plant protection purposes.
- Generally weeding are being done manually.
- In surveyed area most of the farmers are growing traditional organic basmati rice (Organic Dehraduni Basmati) followed by wheat and other crops. *Rabi* crops mostly for their own consumptions.
- Productivity of the traditional basmati rice is 17% less than the station trial however that of wheat is 24% less.

Raipur

Geo-referenced characterization of 23 organic farmers was carried out and the salient features of the survey are as follows:

- Mean holding size of surveyed organic farmers of Durgukondal block of kanker district is 1.77 ha. The live stock maintained by the farmers are cow, buffalo, bullock, goat, poultry and pig with average livestock population of 2-3, 4-5, 10-11, 2-3 dairy goat, poultry and pig per farmer respectively.
- The main crop of these farmers is rice (short grain aromatic rice variety) and other crops like kodo millet, Urd and Horse gram is cultivated for self-consumption.
- FYM is main source of organic manure prepared from the livestock maintained and on an average 5-6 t/ha FYM is used in the field.

- For plant population neem oil and cow urine spray and weed management hand weeding has been adopted by the farmers with an average cost involvement of Rs 1000-1500 and 4000-4500/ha respectively.
- The yield of Rice (Javaphool- short grain aromatic rice) was 3300 kg/ha and gap of 30-50% was observed in aromatic rice over experimental yield.
- All the organic farmers have PGS certification.

Umiam

The ICAR Research Complex for NEH Region under the NPOF project has adopted three (3) villages in the Ri Bhoi District of Meghalaya viz., Mynsain, Pynthor and Umden Umbathiang and their GPS coordinates are 25°44'21,61"N - 92°1'1,73"E, 25°45'18,31"N - 92°1'48,14"Eand 25°44'58,99"N - 92°2'10,67"E, respectively.

- The altitudinal ranges of villages Mynsain, Pynthor and Umden Umbathiang are 853 – 901MSL, 853-894MSL and 853 – 892MSL, respectively.
- The major soil type found in the three villages is the red loamy soil along with few locations composing of the alluvial and laterite soils.
- The farmers of the villages are mostly dependent upon rainfall for raising their crops except for those who have constructed micro rain harvesting structures (Jalkund) which have greatly promoted the productivity of crops (especially vegetables) grown in the winter season.

Participation

- The number of farmers who are actively participating in the activities that are under the purview of the NPOF in Mynsain, Pynthor and Umden sums to about 303 individuals collectively.

Livelihood

- The main occupation of the villagers is agriculture. Paddy, maize, ginger, French bean and some vegetables are main crops cultivated by the villagers. Ginger is the cash crop and is the most profitable as ginger is non-perishable crop, and it has become a major source of income for the farmers. Paddy is mostly cultivated for self-consumption. There are other crops and vegetables that the villagers grow like sweet potatoes, potatoes, pumpkin, yam, corn, tomato, beans, chillies, cabbage, cauliflower, radish, broccoli, carrot etc.

Farming system

- Almost all farmers from the village maintain an average of 3-4 numbers of farm animals (goats, cows, pigs or poultry) for acquiring additional benefits and income for themselves and inputs for their farming practices.
- The climatic and edaphic condition of the 3 villages is more likely the same (receiving around 2400 mm annual rainfall in the months of April to November with a mild climate) with diminutive variations and therefore the food crops grown in the 3 villages at various cropping seasons are of the same type.
- Major Crops grown during the Kharif season at the aforementioned villages are rice, maize, French bean, ginger, colocasia, sweet potato, turmeric, some vegetables etc.
- During the Rabi season, the farmers usually cultivate French bean, mustard, radish, cole crops, tomato, potato, peas, etc., whilst the post Rabi season is highlighted by the cultivation of various cucurbits. But overall, the cropping intensity is very low (less than 130%).
- Crop enhancement inputs are purely organic based that are accessible and available within the village. Growth enhancement inputs such as manure comes in the form of farmyard manure which is either cow dung or pig manure, poultry manure, vermicompost and other composted materials.
- For most farmers, manure is collected from their livestock shed while for some is purchased.

Weed and pest management

- Weed management adopted by the farmers is basically a mechanical/manual approach which involves physical disturbance/uprooting of the weeds, through activities including hoeing with spades, pulling weeds, tilling the soil before or after weeds emerge, and mowing.
- Pest management is purely practiced by the villagers by manual and traditional means. As most of the farmers grow their local pest resistant varieties, incidence of large-scale attack is very less. However, with the introduction of high yielding cultivars, report

of some pest attack is noticed. After scientific intervention by ICAR, organic pest management options are being promoted.

Economy

- Crops produced are either utilized for household consumption or marketed if there is a surplus.
- Production profit analysis of crops cultivated and marketed from the three villages all year round reveals that production profit is maximum in the kharif season than when compared to production profit generated from the other 2 agro season.
- Production profit is highest in the kharif season since the major crops cultivated in this season such as rice, maize, ginger and turmeric are cultivated in larger land area as compared to other food crops belonging to other cropping seasons. Due to lack of irrigation facilities and absence of winter rain, cultivation of crops in this season is very limited.

Ajmer

Total 40 farmers from Ajmer district of Rajasthan were characterized during reporting period.

- Soil type in surveyed village found to be sandy loam in nature
- Land size of surveyed farmers ranging from 0.5 ha. to 2.0 ha out of which, 60% farmers having 1.0 ha, 37.5% having 0.5 and 2.5% farmers having 2.0 ha land under organic farming.
- Farmers (100%) are using only FYM as nutrient source for crop production.
- Major crops of *kharif* are bajra, sorghum, maize, green gram, chili and tomato whereas in *rabi* barley, wheat, cumin, coriander and cauliflower occupies the major area of land holding.
- All the farmers are following hand weeding for controlling weeds and most of them are using neem oil and neemax powder and homemade bio-pesticide for pests and disease management.
- Farmers (100%) are selling their produce in local market and not getting any premium price.
- Average yield of wheat is 3100 kg/ha, barley 2900 kg/ha, green gram 600 kg/ha, cumin 750 kg/ha, coriander 1350 kg/ha, chilli 9600 kg/ha and cauliflower 13500 kg/ha.
- All the surveyed farmers adopted organic farming due to harmful effect of chemicals in human health.

Almora

- The farmers (30 numbers) from village Chinauna, P.O. Goluchhina of District Almora, Uttarakhand are were surveyed under geo-referenced characterization of organic farmers. They are continuing those practices without any new or innovative organic technologies, except vermicomposting by very few farmers.
- USOCA, Dehradun has certified this cluster as organic in 2013.
- Due to erratic rainfall and damage due to wild animals, farmers stopped cultivating field crops during *rabi* seasons
- Farmers are mostly cultivating traditional local varieties and high yielding improved varieties but, most of them are traditional varieties.
- Most of the area is under rainfed condition, and farmers are having small and marginal land holding, so the production is less and mostly consumed in the family itself.

Name of the crop	Yield on-station experiment (kg/ha)	Mean yield at farmers field (kg/ha)	Yield gap(%)
Fingermillet	1677	1434	17
Barnyardmillet	1158	995	16
Soybean	1714	959	79
Black soybean	1608	1399	15
Garlic	6317	5500	15
Onion	1921	1687	14
Vegetable rai	6616	5818	14

- Farmers receive premium price on specific products, *i.e.* Cucumber, ridge gourd, horsegram, spinach
- Farmers, who are cultivating vegetables, sell their products in the local market. Usually they don't

receive premium price, except very few as mentioned above. Although the cluster is certified as organic in 2013, there is no change in cultivation practices than before certification, except very few farmers. The cultivation practices are similar to other non-certified farmers in the nearby villages.

Gangtok

Identified Tympem Village (East Sikkim) for geo-referenced characterization and conducted diagnostic survey for primary/ secondary data collection.

- Total geographical area is 6.9 ha out of which total cultivable area is 5.55 ha whereas 1.35 ha are barren land. cropping intensity of the surveyed village was 125%.
- Total nos. of household of this village are 35 wherein total population are 161 in which 87 male and 74 female. The village is having approximately 87% literacy rate.
- Various crops, vegetables and fruits are cultivated considering the local demand, agro-climatic condition, soil health etc. Farmers were encouraged to grow crops such as, maize, rice, vegetable pea and winter vegetables like squash (Sechium edule), yam etc. as food for consumption purpose and as feed for livestock.
- As pig farming is mostly followed by the farmers, improved piggery (Hampshire x local) was promoted. Some farmers practice dairying and backyard poultry farming system with Vanaraja variety. All the wastage, crop residues, weed biomass and cow dung is used for vermi composting, FYM preparation etc. for crop production.
- Water harvesting structures such as Jalkund, farm ponds etc. would be developed to provide necessary additional water during off season or lifesaving irrigation for Rabi and pre-kharif crops.
- Demonstration on organic ginger production technology was done under TSP has been initiated in Thanka village, East Sikkim during 2016.
- No–till vegetable pea technology was demonstrated in the village around 0.4 ha area and compared it with the conventional sowing and found that 24.4 percent increase in the yield in no-till planted over conventional planting.
- Conducting at least one trainers training and two farmers training on emerging issues for capacity building.
- Conducting multi-locational validation studies/trials on major crops/ survey/collection of management data.
- Low cropping intensity due to non-availability of irrigation water during winter season.
- Non availability of quality of seeds/ planting materials.

Some of the major problems in Tympem Village

- Irrigation during winter season is one of the major problems. There is lack of water resource in this village especially in winter season and farming becomes very difficult in this condition.
- Insect pests and diseases infestation are the common and serious problems.
- Unavailability of organic high yielding seeds.

Productivity at On-station and On-farm of crop in East Sikkim

Crops	Productivity at On-station (kg/ha)	Productivity at clusters demonstration (kg/ha)	Gap (%)
Rice	3490	3355	-3.87
Maize	3260	3160	-3.07
Soybean	1126	2360	109.59
Buckwheat	1020	980	-3.92
Mustard/ Toria	890	885	-0.57
Veg. pea	6250	5870	-6.08
Rajmash	1260	1660	31.75
Ginger	1029	8530	728.96
Turmeric	4960	-	-
Large cardamom	312	-	-

Thiruvananthapuram

Geo-referenced survey of 30 farmers practicing organic farming in Malappuram and Thiruvananthapuram districts of Kerala was conducted. The survey was carried out in and Mankada block, Malappuram and Kazhakkoottam and Kilimanoor blocks, Thiruvananthapuram (Figs. 19, 21 & 24).

- Eighty per cent of the farmers belonged to the small and marginal group with a land holding size <2 ha. 56.67% of farmers had a land holding size < 1 ha, 20% 1-2 ha and 23.33% >2 ha. Average land holding size was 0.86 ha.
- Most of the farming situation surveyed was rainfed (60%), some were irrigated.
- Being health conscious and aware of the quality of the organic produce, all the farmers used the organic produce for their house-hold consumption (100%), and the surplus was sold to the market by 86.67% of the farmers.
- The soil type was laterite (100%).
- Major Crops: Fruit crops (banana, mango, jack fruit, guava, rambuttan, Garcinia); Vegetables (okra, brinjal, bitter gourd, snake gourd, bottle gourd, ridge gourd, ash gourd, pumpkin, cucumber, chillies, amaranth, vegetable cowpea); Root and tuber crops (cassava, yams, elephant foot yam, taro, arrowroot, sweet potato); Spices (ginger, turmeric) and plantation crops (coconut, pepper) (Fig. 22).

Area occupied by crops

- About 50% of the surveyed farmers owned cow, 13.33% had goat, 46.66% had poultry (hen and duck) as an integral part of organic farming (Fig. 25). Out of the total livestock/bird population, 42% was cow, 39% was poultry, 11% was goat, 5% duck and 3 % fish.
- **Organic recycling units:** Animal wastes were converted to excellent manures using biogas (in 6.67% cases) and vermi compost units (10% farms) (with an average capacity to produce nearly 200 kg compost/annum).
- **Organic sources:** Nutrient sources for organic farming constituted cow dung slurry/FYM (100%), poultry manure (66.67%), vermicompost (43.33%), biogas slurry (6.7%), Neem cake (66.67%), ground nut cake (33.33%), bio-formulations like *Panchagavya* (33.33%), *Jeevamrutham* (16.67%), and green manuring (16.67%). Apart from these, ash (66.67%) and bone meal (50%) were also used. Majority of farmers conducted soil testing before raising the crop.
- **Insect pest management**: Through application of neem oil-garlic emulsion (46.67%), neem oil (16.67%), fish amino acid (46.67%), egg amino acid (26.67%), *Kanthari* emulsion (40%), neem soap (33.33%), *Beauveria* (60%), *Trichoderma* (66.67%), *Pseudomonas* (73.33%) and pheromone trap (40%). Also practicing cultural methods, intercropping, trap crops on field bunds and some indigenous practices.
- **Type of farm:** Type of farm is uncertified (100%)
- **Constraints faced:** High input cost, non-availability of quality organic manures, labour shortage, small and fragmented land holdings, low price of the produce, damage due to pig and other animal attack.

Location maps of georeferenced characterization of organic clusters

Glimpses of the survey

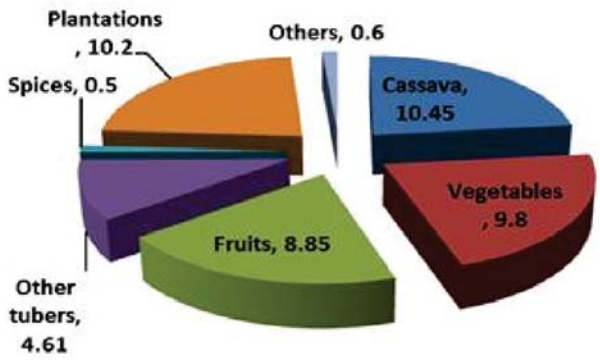


Fig. 8. Area occupied by crops

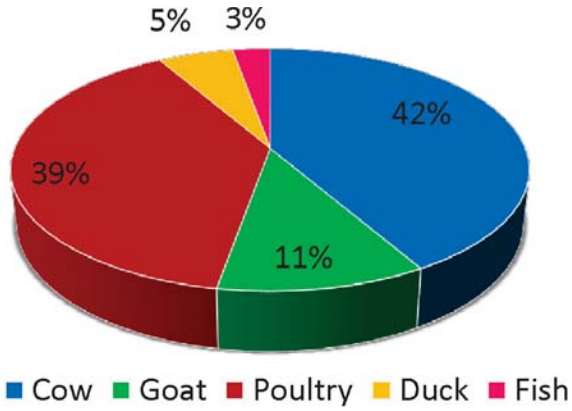


Fig. 9. Relative share of animals

Table 26. Yield gap analysis

Name of the crop	Yield as per on-station experiment (kg ha^{-1})	Mean yield at farmers field (kg ha^{-1})	Yield gap (%)
Cassava	25650	24690	-3.7%
Taro	9180	10100	No yield gap (higher by +10.02%)

Udaipur

Total 50 households selected from different villages, practicing organic farming in 4 villages *i.e.* Bhagwato ka Bhagal, Anuja, Kanoja, Devdo ka Bhagal of Rajsamand district. Farmers practicing SPNF in the villages of Daulatpura, Johida, Pemakhera, Badwahi in Chittorgarh district were also surveyed during 2018-19. The highlights of the Geo-referenced on–farm characterization of organic growers of Rajasthan are given below.

- Average land holding size in surveyed villages is 1.5 ha whereas, average land holding size under organic farming is 1.0 ha.
- Average number of animals per household is 6.5 whereas, average number of animals per ha is 6.5.
- Average vermicomposting production is 1.0 ton/year and crop residues available for recycling is 3.5 ton/ household.
- Majority of farmers grow maize in *kharif* and wheat in *rabi.* Average yield of maize is 1750 kg/ha and average yield of wheat is 2600 kg/ha. On average, 3.0 t/ha FYM & 2 t/ha vermicompost in maize during *Kharif* and 2.5 t/ha FYM & 1.5 t/ha vermicompost in wheat during *Rabi* was used. Fruit and vegetables were grown organically for home consumption.
- Use of neem leaves, Dashparni, NSKE and Go mutra were used for plant protection in crops, fruit and vegetables.
- For weed management hand weeding, weed hoe and weeder practice was using by the farmers. On average 25 man-days during *kharif* and 15 man-days during *rabi* were used in weeding.
- No assured market and lack of premium price for organic product, labor intensive and costly weed management, low productivity of crops, lack of availability of large quantity of organic inputs from small land holding are major constraints faced by organic farmers.
- Farmers are associated with NGOs and SHGs. Farmers get training from NGOs/SHGs & also sale the produce to these organizations as well as nearby market at Udaipur.

Gap in yield of different crops under organic farming and SPNF at farmers and experimental field

Name of the crop	Organic Farmers			SPNF Farmers		
	Yield as per on-station experiment (kg/ha)	Mean yield at farmers field (kg/ha)	Yield gap (%)	Yield as per on-station experiment (kg/ha)	Mean yield at farmers field (kg/ha)	Yield gap (%)
Maize	2357	2050	14.98	2205	1980	11.36
Blackgram	450	410	9.75	510	435	17.24
Soybean	436	350	24.57	470	378	24.34
Wheat (durum)	3150	2500	26.00	3240	2610	24.14
Wheat (bread)	3143	2640	19.05	3523	2735	28.81
Gram	571	500	14.2	640	545	17.43
Fenugreek	1714	1250	37.12	1818	1310	38.78

- Farmers use FYM and Vermicompost for nutrient management & cow based herbal concentration for pest management.
- The yield gap between organic management at farmer's field and experimental field varies from 11 to 38 percent.
- Problem of marketing of organic produce and lack of organic farming know how main constraints Lack of marketing opportunities of organic produce, Low quantity of organic produce to sale with a single farmer, Lack of right technical knowledge on organic production, Low productivity in crops.

Survey at village Ramavato ki Bhagal

Survey at village Bhagwato ki Bhagal

Survey at village Kanoj

Survey at village Nakli

Geo-referenced on – farm characterization of organic growers of Rajasthan

7.2 Evaluation of organic, inorganic and integrated production packages for crops and cropping systems

Title of the experiment: Evaluation of management packages for crops and cropping systems and its influence on crop productivity and soil health.

Objectives

The experiment was conducted at all the 20 locations with the following objectives.

- To study the impact of organic, conventional and integrated management practices on crop productivity and soil health
- To study the impact of various management practices on microbial population of soil and economics

Year of start: The experiment was originally planned during 2004-05. However, the year of start varied with the centres depending upon the establishment of infrastructure for conducting the experiments. All the centres started the experiment during 2004-05 except Modipuram and Umiam where it was started during 2005-06. From 2015-16, 7 new centres were included and start the experiment namely Ajmer, Almora, Narendrapur, Sardarkrushinagar, Gangtok, Thiruvananthapuram and Udaipur.

Treatments: The experiment was conducted in strip plot design as un-replicated trial. However, Karjat and Umiam centre have conducted the experiment with three replications in split plot design. The experiment stands modified by dividing the organic, inorganic and integrated plots divided into two for each cropping systems.

The treatments imposed in main plots are given below.

The cropping system was selected, as per suitability for the location and was assigned into the sub plots. The number of cropping systems ranged from 3 (Calicut, Coimbatore and SK Nagar) to as high as 5 (Dharwad) in various centres. The details of cropping systems are given in Tables along with experimental results. Nutrient package for the organic and integrated management packages were formulated based on recommended nitrogen dose of each system.

Locations: The experiment was conducted in five eco-systems as mentioned below. These locations represent the different ecological regions of Agro-ecological zone.

Main Plot	**Organic management**	**1. Supply of 100% nutrients through organic sources and complete organic management**
		2. Supply of only 75% nutrients through organic sources + innovative inputs (any two of cow urine @10%, Panchagavya, PGPR and vermiwash @10%) and complete organic management
	Inorganic management ***(Chemical)***	3. 100% inorganic nutrients and management
		4. Either state recommendation or farmers package (Choice to centres)
	Integrated management	5. 50% organic + 50% inorganic source of nutrients and management
		6. 75% organic +25% inorganic source of nutrients and management
Sub Plots	Cropping Systems	Location specific cropping system 1 Location specific cropping system 2 Location specific cropping system 3 Location specific cropping system 4

Eco-systemLocations (State)

Arid	Ajmer (Rajasthan) Dharwad (Karnataka) Sardar Krushinagar (Gujrat)
Semi-arid	Bhopal (Madhya Pradesh) Coimbatore (Tamil Nadu) Ludhiana (Punjab) Modipuram (Uttar Pradesh) Udaipur (Rajasthan)
Sub-humid	Almora (Uttarakhand) Gangtok (Sikkim) Jabalpur (Madhya Pradesh) Raipur (Chhattisgarh) Ranchi (Jharkhand)
Humid	Bajaura (Himachal Pradesh) Pantnagar (Uttarakhand) Narendrapur (west Bengal) Umiam (Meghalaya)
Coastal	Calicut (Kerala) Karjat (Maharashtra) Thiruvananthapuram (Kerala)

The details of inputs used for organic nutrient management and their nutrient content at various locations are given below.

Source of nutrient inputs and their NPK content at various locations

Centre	Nutrient Sources	NPK contents on dry weight basis (%)		
		N	P	K
Bajaura	Vermi-compost	0.90	0.20	0.75
	FYM	0.98	0.25	0.90
	Urea	46.0	-	-
	SSP	-	16.0	-
	MOP	-	-	58.0
	Rock phosphate	-	34.0	-
Bhopal	Vermi-compost	1.14	0.72	0.68
	Neem cake	1.50	0.92	1.04
	Sesbaniarostrata	2.90	0.7	1.54
Calicut	Farm Yard Manure	0.75	1.0	0.55
	Neem cake	1.50	0.36	1.51
	Ash	-	0.20	6.3
	Vermi-compost	0.76	0.88	0.65
	Green leaf manure	2.02	0.16	1.10
	Rajphos	-	18.5	-
	Urea	46	-	-
	MOP	-	-	58
Coimbatore	Vermi-compost	-	-	-
	Neem cake	-	-	-
	Sesbaniarostrata	-	-	-
Dharwad	Enriched compost	0.70	0.40	0.80
	Vermi-compost	1.00	0.86	0.98
	Farm yard manure	0.50	.025	0.49
	Glyricidia(Green leaf manure	0.50	0.32	1.15

Centre	Nutrient Sources	NPK contents on dry weight basis (%)		
		N	P	K
Jabalpur	Green manure (Sun hemp)	0.66	0.13	0.50
	FYM	0.54	0.20	0.26
	Vermi-compost	1.6	0.75	1.00
	Neem Oil Cake	5.2	1.10	1.50
	Urea	46	-	-
	SSP	-	16	-
	MOP	-	-	60
Karjat	F.Y.M.	0.50	0.25	0.50
	Neem cake	5.20	1.00	1.40
	Vermi-compost	1.50	1.00	1.50
	Glyricidia green leaves	2.74	0.50	1.15
	Paddy straw	0.61	0.16	1.14
Ludhiana	Urea	46.0	-	-
	DAP	18.0	46.0	-
	MOP	-	-	60.0
Modipuram	FYM	0.51	0.30	0.65
	VC	1.28	0.47	1.39
	Sesbania	2.25	0.41	3.01
	Urea	46.0	-	-
	DAP	18.0	46.0	-
	MOP	-	-	60.0
Raipur	Enriched compost	0.40	0.36	0.56
	Cow dung manure	0.57	0.39	0.72
	NEOC–Non edible oil cake	3.2	0.72	1.59
	Rock phosphate		22	
Ranchi	FYM	0.50	0.30	0.50
	Vermi compost	1.2	0.45	1.4
	Karanj cake	4.0	1.0	1.0
	Urea	46.0		
	SSP		16.0	
	MOP			60.0
Umiam	F.Y.M.	0.72	0.29	0.61
	Vermicompost	1.50	0.62	1.00
	Rock phosphate	-	18.00	-
	Tephrosia*spp*	3.31	0.44	1.46
Narendrapur	Vermicompost	1.5	1.0	0.5
	Sashyagavya	1.0	0.015	0.125
	Panchagavya	1.8	0.23	0.44
	Kunapajala	2.34	1.23	1.12

Centre	Nutrient Sources	NPK contents on dry weight basis (%)		
		N	P	K
SardarKrushinagar	-	-	-	-
Thiruvananthapuram	Green manure cowpea	2.80	0.52	2.02
	FYM	1.28	0.50	0.28
	Neem cake	0.95	0.29	0.59
	Vermi compost	0.97	0.42	0.45
	Ash	1.40	0.29	4.65
	Panchagavya	0.22	0.061	0.40
	Vermi wash	0.02	0.004	0.20
Udaipur	Vermicompost	1.114	0.278	0.317
	Neem Cake	5.091	1.135	1.397
	NADEP Compost	1.04	0.382	1.071
	Enriched Compost	1.361	0.472	0.973
	FYM	0.502	0.248	0.507

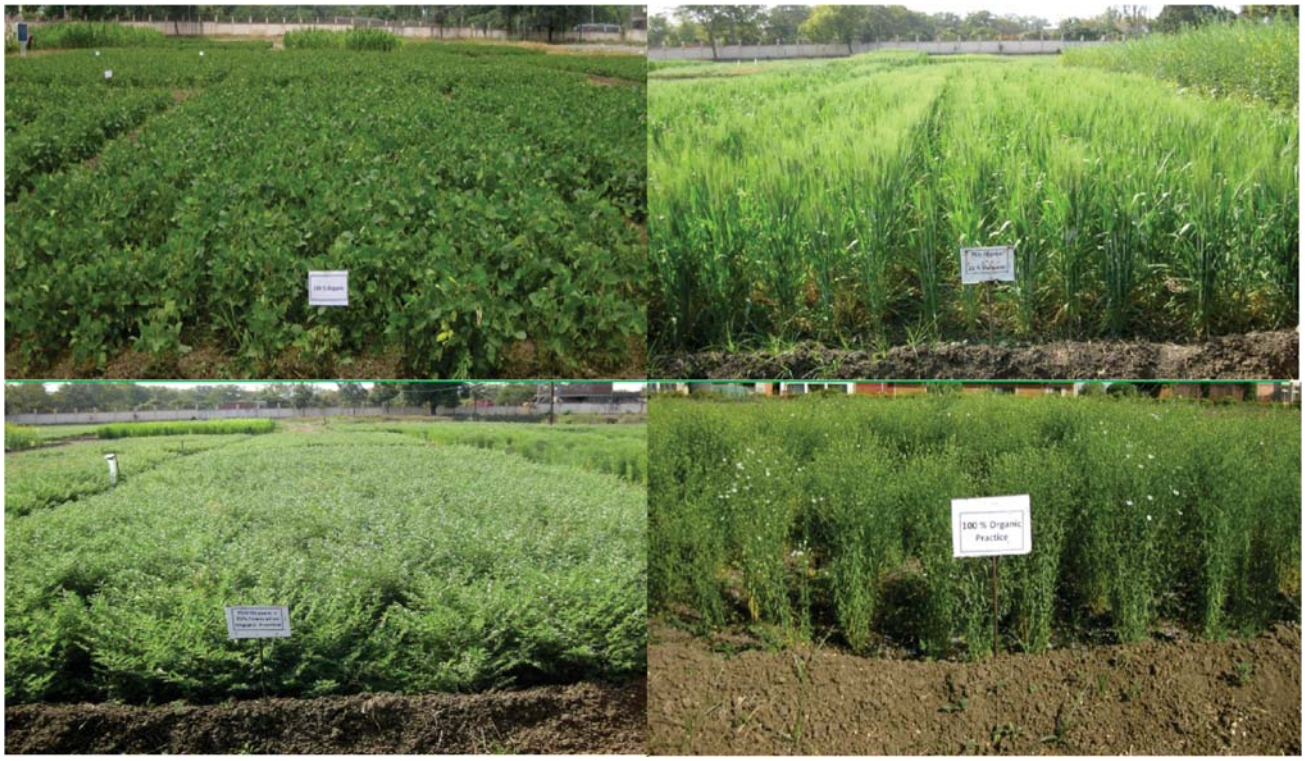
Results

The parameter wise result of 2018-19 for each centre are presented and discussed.

Studies on comparative efficiency of organic, inorganic and integrated management practices on crop productivity system equivalent yield of different cropping systems (Table 1-3)

Bajaura: Among the crops evaluated under vegetable-based cropping systems, the performance of tomato, cauliflower, black gram, lady finger and summer squash were found to be better under integrated production systems (towards organic). Higher yield of french bean was observed with organic package either under 100% organic or 75% organic + 25% organic supplemented through 10% vermiwash during *kharif* and summer. The yield of pea (7330 kg/ha) was maximum under organic production system with application of 75% organic + 25% organic supplemented through 10% vermiwash. Under integrated production system, yield increase over inorganic management was observed to the tune of 115.3, 66.6, 42.1, 56.8, and 92.9% in cauliflower, tomato, black gram, lady finger and summer squash respectively while in french bean and pea, it was increase 113.5 and 104.2% under organic with 100% nutrient supplied through organic sources and 75% organic + 25% innovative practice (organic supplemented through 10% vermiwash) over inorganic. In terms of system equivalent yield (cauliflower equivalent), blackgram-cauliflower-summer squash resulted in higher cauliflower equivalent yield (21350 kg/ha) among the cropping systems. Among different management practices, integrated management with 50% organic+50% inorganic dose of nutrients resulted in higher equivalent yield (20178 kg/ha) followed by application of 75% nutrients only through organic manures+ 25% nutrient

Best performing production system (black gram-cauliflower-summer squash) at Bajaura



Performance of soybean, wheat, chickpea and linseed under organic farming at Bhopal

supply through inorganic sources (18670 kg/ha). Cauliflower equivalent yield was increased to the tune of 47.1 and 74.6% with integrated nutrient (50% each organic and inorganic) over organic and inorganic nutrient management.

Bhopal: Higher mean yield of soybean (1467 kg/ha) was recorded under 100% organic management practice followed by management practices either with 75% nutrients application through organic manures+ innovative practices or under integrated. The yield of soybean was found to be higher with 100% organic by 18.3 and 36.7% compared to inorganic production system and state recommendation package respectively. *Rabi* crops in soybean-based systems such as, wheat, mustard, chickpea and linseed recorded higher yield under integrated management with (75% organic nutients suppiled through organic source + 25% inorganic nutients) of 4050, 1827, 1225 and 1620 kg/ha respectively. The yield difference between organic and inorganic management was 24, 20.7, 22.1, and 16.6% for *durum* wheat, mustard, chickpea and linseed respectively. In terms of system equivalent yield (soybean equivalent), towards organic, integrated management with 75% organic+ 25% inorganic nutrients through organic and inorganic sources registered higher equivalent yield (3695 kg/ha) followed by organic production package (3564 kg/ha) and difference between both the production system was only 3.7%. Among the cropping systems, soybean-wheat recorded higher soybean equivalent yield (3683 kg/ha) followed by soybean-mustard (3614 kg/ha).

Calicut: Spices crops such as ginger, turmeric and black pepper were evaluated under different management packages. Among the different management packages, organic package consisting of 75% nutrient supply through organic manure +25% innovative practice recorded higher yield of turmeric (13900 kg/ha) followed by integrated (75% nutrient supply through organic manure +25% inorganic) of 13800 kg/ha. There is no significant difference was found in yield of turmeric among production system.

Coimbatore: Among the management practices, crops brinjal, chilli and tomato during *kharif* (25746, 12263 and 17562 kg/ha respectively) and pearl millet, finger millet during *rabi* (1896 and 2906 kg/ha) registered higher yield either with organic (75% organic nutrients+ innovative practice:Panchagavya @ 3% as foliar spray+*Azophos* @ 2kg/ha as basal) or towards organic under integrated with 75% nutrients through organic manures +25% through inorganic source, whereas barnyard millet recorded maximum under state recommendation of 1982 kg/ha. The

yield was increased marginally by 3 and 4.9 % for brinjal and tomato respectively while chilli, pearl millet and finger millet were increased by 26.3, 7.3 and 23.3% respectively compared to inorganic package.

Dharwad: Crops such as green gram, safflower, sorghum and groundnut recorded higher yield under inorganic production package either in 100% inorganic nutrients or state recommendation whereas, maize, sorghum and chickpea recorded higher under organic (75% organic + Innovative organic practices) and integrated (75 and 25% each organic and inorganic nutrients application). The reduction in yield with organic was found to be 13.1, 30.2, 24.6, and 40.1%, for safflower, pigeon pea sole, green gram and groundnut respectively. Maize, sorghum and chickpea performed better under organic and integrated management practice. Yield was found to be 20, 28.3 and 20.9% higher in sorghum, maize and chickpea respectively compared to inorganic practice. System equivalent yield as influenced by production management found to be higher with organic management package of 2520 kg/ha, whereas among the cropping systems, green gram - sorghum registered better in term of equivalent yield than other systems.

Jabalpur: Basmati rice-based cropping systems with wheat (*duram*), chickpea, maize (fodder), berseem (seed and fodder), vegetable pea and *rabi* sorghum was grown in 4 cropping sequences. Mean grain yield of basmati rice and yield of other crops as influenced by different nutrient management was recorded higher with inorganic production system except chickpea. The yield reduction in basmati rice with organic was found to be 9.6% than inorganic. The reduction in the yield of wheat, maize (fodder), berseem seed & fodder, vegetable pea and sorghum (fodder) with 100% organic management package was 16.7 11.1, 11, 37.9, 12., and 18.6% respectively against inorganic nutrients management. Total productivity of cropping system in terms of basmati rice equivalent was recorded higher with 100% inorganic nutrient management (6238 kg/ha) followed by integrated (6085 kg/ha) among the production packages. Among crop-sequences, basmati rice- berseem seed and fodder led to record highest basmati rice equivalent yields (7745 kg/ha) followed by rice-wheat (5883 kg/ha).

Karjat: The rice-based cropping systems including vegetable crops were evaluated. Higher mean yield of rice (4631 kg/ha) was recorded with application of 50% each organic and inorganic nutrients under integrated package but on par with organic and inorganic. Chickpea and onion also resulted good yield with integrated package and found to be higher by 16.7 & 18.6% over inorganic respectively. Field bean yield recorded higher with organic package having 100% nutrient application through organic sources but difference in yield was only 20kg/ha over inorganic nutrient management whereas brinjal resulted in higher yield with inorganic package (49705 kg/ha). System productivity in term of rice equivalent yield, rice- brinjal system produced maximum rice equivalent yield (52295 kg/ha) compared to other cropping systems. Among the management package, organic management with 100% nutrient supply through organic sources recorded 22.0% higher over inorganic management practice.

Ludhiana: Maximum yield of basmati rice (4030 kg/ha) was recorded in integrated nutrient management with application of 50% each organic and inorganic nutrient but on par with inorganic whereas other *kharif* crops, soybean and moong was record higher yield (1250 and 800 kg/ha) under organic package with application of 100% organic manure and 75% N equivalent by organic manure + innovative practice respectively. Chickpea also recorded maximum yield (1170 kg/ha) with 75% organic + Innovative organic practices under organic practice. Wheat and summer moong (5660 and 870 kg/ha) performed better towards organic under integrated (50% organic + 50 inorganic) practice. In term of system productivity among the management practices, wheat equivalent yield resulted in higher either in organic (100%) or with 75% organic + innovative practice. Among the cropping systems, it was higher in basmati rice-wheat but found to be on par with moong (*kharif*)-wheat-moong (summer) system.

Modipuram: The response of different crops in the systems differed for the type of input packages applied. Among the various crops in the systems, basmati rice and potato recorded higher yield (3876 and 24700 kg/ha) under organic production package. Coarse rice, wheat, barley and okra recorded maximum yield under inorganic management (4238, 4225 3804 and 5579 kg/ha respectively) with state recommendation package. Maize (sweet corn 1651 kg/ha & popcorn 6963 kg/ha), mustard (2303 kg/ha) and green gram (813 kg/ha) performed better under integrated package with 50% nutrient application through organic sources+50% through inorganic. In case of basmati rice and potato yield, it was 25 and 28% higher under organic compared to inorganic package, whereas the reduction in yield was noticed with organic by 11.8, 24.2, 9.6, 6% in coarse rice, wheat, barley, and okra, over state recommendation respectively. Productivity among the various systems, maize-potato-okra-*sesbania* recorded

CHEMICAL WHEAT

CHEMICAL CHICKPEA

ORGANIC WHEAT AFTER SOYBEAN

ORGANIC SOYBEAN

ORGANIC WHEAT AFTER B RICE

ORGANIC BASMATI RICE

Basmati rice, Soybean, wheat and chickpea under organic production systems at Ludhiana

higher rice equivalent yield of 15475 kg/ha because of higher yield of potato and good premium price followed by maize (sweet corn)-mustard-*sesbania* (GM). Among the production practice, system equivalent yield was higher (13297 kg/ha) in organic.

Pantnagar: Among the crops evaluated under basmati rice-based cropping systems, the performance of basmati rice, wheat, and potato were found to be better under integrated production systems (towards organic) whereas chickpea + coriander and vegetable pea+ coriander performed higher in organic package either with 100% NPK through organic sources or 75% organic+ innovative practice. Higher yield of basmati rice during *kharif* was recorded with integrated package as it recorded mean grain yield of 4926 kg/ha but been on par with organic package 4915 kg/ha and it was higher by 15.2 and 15.5% over inorganic respectively. Among *rabi* crops, wheat recorded higher yield under integrated package (4946 kg/ha) and the yield difference between integrated and inorganic was only 114 kg/ha. Coriander was raised as intercrop with chickpea and vegetable pea in the manner of 4:2 ratio. Yield of main and intercrop converted into chickpea and vegetable pea equivalent. Chickpea and vegetable pea equivalent yield (2205 and 9173 kg/ha) recorded highest in organic (100% nutrient application through organic sources), tuber yield of potato also recorded maximum under organic management and increase by 16% over inorganic. System productivity in terms of basmati rice equivalent yield recorded higher in integrated package (9206 kg/ha) having 50% nutrients through organic manures and 50% nutrients through inorganic sources. SEY was increased by 13% over inorganic. Among all the cropping systems, higher system productivity was recorded with basmati rice-chickpea +coriander-*sesbania* system (10615 kg/ha) followed by basmati rice-potato (8218 kg/ha).

Raipur: Soybean based cropping systems were evaluated with maize, pea, chilli, and onion under different mode of management. Organic production system either by 100% organic manure or 75% organic + innovative practice (foliar spray of vermin-wash (10%) followed by cow urine (10%) resulted in higher soybean yield (2006 and 2088 kg/ha respectively). Soybean yield under organic production system with100% organic source and 75% organic + innovative practice was enhanced by 11.9 and 16.4% compared to 100% inorganic. Other crops such as maize (sweet corn), pea, and chilli (14566, 7668 and 9013 kg/ha respectively) also resulted higher yield with 75% organic manures+ innovative practices (foliar spray of vermin-wash (10%) followed by cow urine (10%) under organic while, onion bulb yield recorded higher with state recommendation (16082 kg/ha). Yield reduction in onion with organic was found to be 17.1%. Likewise, yield variation from 100% organic to inorganic were found to be 17.8, 48.4 and 5.2% for maize, pea and chilli respectively. The productivity of cropping system in term of soybean equivalent yield recorded higher under organic management with 75% organic manure + innovative practices (7324 kg/ha) and it was increased by 13.4% over inorganic. Soybean-maize cropping system registered higher soybean equivalent yield (7417 kg/ha) followed by soybean-chilli (6402 kg/ha).

Ranchi: Rice based cropping systems were evaluated wherein different crops such as wheat, onion, potato and okra were grown with basmati rice variety Birsamati. In rice, organic management practice (100% and 75% organic manure +innovative practice "*Azolla*") resulted in higher mean yield (3611 and 3407 kg/ha respectively). Under organic production system the yield was increased by 18.9 and 26% respectively than inorganic. Other crops like onion and potato during *rabi* recorded higher yield with organic package. The yield of onion and potato was increased with organic to the tune of 10.4 and 120% respectively over inorganic package. Wheat recorded highest yield (2875kg/ha) under inorganic package and found to be decrease by 12.1% with organic package (100% organic manure). Okra resulted in higher yield (9334 kg/ha) in integrated package with 75% nutrients through organic source+25% inorganic fertilizer. In case of systems equivalent, production package 100% organic found to be higher (10912 kg/ha) among the management practice. Among the cropping systems, rice-potato recorded highest system equivalent yield (11781 kg/ha) followed by rice-onion (11431 kg/ha).

Umiam: Four vegetable-based cropping system namely broccoli-carrot, broccoli -potato, broccoli -french bean, broccoli -tomato were grown on raised beds and four rice varieties Megha Aromatic 2, Shahsarang-1, Ngoba, Lampnah taken on sunken beds under four management practices viz. 100% organic, 75% organic + innovative practice i.e. (10 % vermiwash and 10% cow urine), integrated management with 50% inorganic+50% organic and 100 %inorganic undertaken to carry out the experiment. Among the management packages, 100% organic package recorded maximum broccoli yield 15220 kg/ha followed by integrated of 15140 kg/ha. The yield of broccoli was enhanced by 6.5% only over inorganic. Other vegetable crops viz. carrot and tomato recorded maximum

Performance of rice, wheat, onion potato and okra under organic management at Ranchi

yield under organic package with 15950 and 17500 kg/ha respectively. whereas potato and frenchbean recorded highest under integrated of 19950 and 7120 kg/ha respectively. Vegetable crops, carrot potato, frenchbean and tomato recorded their yield by 14.1, 20.9, 16.3 and 12.5% higher with either by following the organic management practice or with integrated over inorganic package. Rice varieties that grown in sunken beds were Megha Aromatic 2, Shahsarang-1, Ngoba and Lampnah. Among the rice varieties, Shahsharang-1 produced maximum grain yield (4670 kg/ha) followed by Lampnah (4480 kg/ha), Megha Aromatic 2 (4330 kg/ha) and Ngoba (4250 kgha). Among the management practices, maximum grain yield was recorded under integrated (4720 kg/ha) followed by 100% organic (4650 t/ha).

Broccoli crop on raised bed

Kharif rice on sunken beds

Table 7.2.1: Influence of organic, inorganic and integrated package on grain yield (kg/ha) of crops in cropping systems at various locations

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Bajaura																		
French bean (*kharif*)-cauliflower- french bean (*summer*)	4440	8310	4020	4050	7380	3650	2080	4440	2000	3200	9330	3820	3320	9560	3950	3650	9350	3460
Fallow-cauliflower-tomato		8400	9980		8050	10110		4670	8000		6220	10890		10220	13330		9400	11760
Black gram-cauliflower - summer squash	760	7960	12410	780	6300	11640	570	4440	11070	800	6030	13710	810	7110	21350	750	6560	16890
Lady finger-pea	5670	6440		5820	7330		4560	3590		6180	5110		7150	5210		6980	5560	
Bhopal																		
Soybean-durum wheat	1524	3977		1381	3577		1288	3267		1115	3247		1354	3907		1459	4050	
Soybean- mustard	1408	1697		1383	1650		1238	1513		1079	1577		1317	1787		1394	1827	
Soybean- chickpea	1515	1210		1329	1057		1288	1003		1269	965		1317	1173		1346	1225	
Soybean- linseed	1420	1530		1378	1490		1228	1390		1172	1283		1290	1470		1397	1620	
Mean (Soybean)	1467			1368			1260			1159			1319			1399		
Calicut																		
Turmeric	12800			13900			13500			-			13600			13800		
Coimbatore																		
Brinjal - pearl millet - green manure (daincha)	25746	1575		25228	1820		24991	1767		25729	1873		25214	1601		25331	1896	
Chillies - barnyard millet - green manure	10255	1706		11448	1786		9701	1353		10658	1982		8627	1499		12263	1757	
Tomato - Finger millet - green manure	14079	2606		17562	2906		16736	2357		15364	2545		15788	2623		16223	2831	
Dharwad																		
Greengram-safflower	365	1497		370	1394		379	1557		451	1723		318	1391		457	1491	
Pigeon pea (Sole)	1047			1319			1415			1501			1347			1262		
Green gram-sorghum	430	3267		540	2869		512	2723		570	2389		362	2942		451	2491	
Groundnut + hybrid cotton (2:1)	956+ 331			1507+ 438			1597+ 543			1381+ 444			1390+ 596			1492+ 543		

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Maize-chickpea	3069	1345		3148	1690		2454	1590		1657	1226		2345	1524		2002	1922	
Jabalpur																		
Basmati rice–wheat (durum) -green manure	2577	4022		2206	3619		2947	4831		1852	4543		2839	4544		2747	4122	
Basmati rice–chickpea - maize fodder	2608	507	51980	2222	466	36960	2777	501	58490	2006	383	47180	3117	481	53420	2762	342	45620
Basmati rice–berseem (Seed and fodder)	2747	126+70500		2299	129+69300		3132	203+79200		2237	190+758		2808	193+71000		2885	134+64500	
Basmati rice–vegetable pea- sorghum (fodder)	2716	2110	73740	2345	1832	47180	2916	2420	90620	2608	2020	82460	2747	2290	83660	2608	1850	82220
Mean (Rice)	2662		62860	2268	1972	42070	2943		74555	2176		64820	2878		68540	2751		63920
Karjat																		
Rice-brinjal		44777			40819			49705			35679			45990			44395	
Rice-chickpea		1637			1437			1488			1316			1737			1726	
Rice-field bean		1190			1027			1170			999			1184			1099	
Rice-onion (White)		16288			11231			14592			11100			17299			12961	
Mean (Rice)	4524			4116			4552			4254			4631			4312		
Ludhiana																		
Basmati rice-chickpea-green manure	3720	800		3890	1170		3920	510		4010	540		4030	670		3880	520	
Basmati rice-wheat-green manure	3650	3810		3710	3590		3900	4760		3950	4870		3950	4530		4000	4440	
Kharif moong-wheat-summer moong	800	5240	800	720	4990	800	500	5620	730	480	5650	630	620	5520	870	800	5660	780
Soybean -wheat	1190	4310		1250	4330		870	5230		840	5030		870	4710		1190	4850	
Modipuram																		
Basmati rice– wheat (durum) - sesbania green manure	3876	3214		3568	2980		3102	3723		3378	4238		3747	3964		3632	3491	
Coarse rice– barley (malt) – green gram	3725	3437	703	3569	3095	742	3942	3716	561	4225	3804	648	4020	3656	813	3858	3533	784

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Maize (popcorn) – potato– okra - sesbania green manure	1534	24700	5245	1408	23200	4859	1278	19300	5420	1359	21800	5579	1651	23700	5486	1598	23300	5159
Maize (sweet corn) – mustard - Sesbania green manure	6430	1963		5985	1804		6197	2163		6450	2213		6963	2303		6526	2166	
Pantnagar																		
Basmati rice-wheat	4676	4553		4163	4168		4216	4832		3972	4596		4579	4946		4453	4875	
Basmati rice-chickpea (4rows+2rows coriander)	5031	2205		4587	2181		4182	1933		4498	1982		5260	2096		4898	2186	
Basmati rice - vegetable pea (4 rows vegetable pea +2 rows coriander)	5194	9173		4854	8636		4402	7463		4409	7306		5071	8664		5009	8669	
Basmati rice -potato	4757	16099		4261	15480		4268	14551		4129	14180		4806	17337		4516	16409	
Mean (Basmati rice)	4915			4466			4267			4252			4929			4719		
Raipur																		
Soybean-maize	1853	13624		1997	14566		1691	12368		2122	13410		1742	9632		1635	1691	
Soybean- garden pea	2327	5989		2255	7668		1839	5168		1912	5433		1680	4705		1749	1839	
Soybean-chilli	1907	8235		2031	9013		1825	8570		1821	8961		1710	8583		1732	1825	
Soybean-onion	1937	13340		2067	13773		1815	15893		2076	16082		1650	11619		1743	1515	
Mean (Soybean)	2006			2088			1793			1983			1696			1715		
Ranchi																		
Rice -wheat	3463	2528		3749	2477		2856	2875		2642	2267		3231	2645		3302	2755	
Rice -onion	3327	15539		3570	14086		2820	14076		2499	11020		3113	15089		3192	15483	
Rice -potato	3534	21067		3624	17521		2945	9755		2517	8543		3213	16445		3277	20237	
Rice -okra	3302	8526		3499	7280		2838	8808		2392	5117		3070	8658		3177	9334	
Mean (Rice)	3407			3611			2865			2513			3157			3237		
Umiam																		
Vegetable-vegetable systems on raised bed																		

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Broccoli -carrot	14890	15950		13360	14580		14800	13980		-	-		13400	14940		-	-	
Broccoli - potato	13480	19650		12500	17450		13700	16500		-	-		14300	19950		-	-	
Broccoli -french bean	17600	6930		16840	5900		14490	6120		-	-		18500	7120		-	-	
Broccoli -tomato	14900	16450		14710	17500		13960	14550		-	-		14350	15200		-	-	
Mean (Broccoli)	15220			14350			14290			-	-		15140			-	-	
Rice- fallow system in sunken bed																		
Megha aromatic 2–fellow	4330			-			-			-			-			-		
Shasharang –fellow	4670			-			-			-			-			-		
Ngoba –fellow	4250			-			-			-			-			-		
Lampnah –fellow	4480			-			-			-			-			-		
Mean (Rice)	4650			4650			4250			-			4720			-		
New centres started from 2015-16																		
Ajmer																		
Green gram – fennel	593	1913		594	2042		633	1970		729	2278		601	2142		763	2338	
Green gram - coriander	593	623		594	635		633	530		729	679		601	588		763	704	
Cluster bean - fennel	1160	1913		1128	2042		1131	1970		1242	2278		1149	2142		1368	2338	
Cluster bean – coriander	1160	623		1128	635		1131	530		1242	679		1149	588		1368	704	
Gangtok																		
Maize + ginger (1:1) –french bean	2680+ 8780	4240		2480+ 8050	4120		-	-		1460+ 5870	2810		2190+ 7680	3620		-	-	
Maize + soybean (1:1) – buckwheat	3860+ 1430	2180		3500+ 1340	1880		-	-		2500+ 900	810		3220+ 1230	1340		-	-	
Maize + turmeric (1:1) – rajmash	2680+ 15200	2190		2310+ 14070	1590		-	-		1320+ 4520	1140		2190+ 10140	1360		-	-	
Maize + black gram (2:1)-toria	4050+ 990	860		3890+ 970	780		-	-		2460+ 590	630		3460+ 830	730		-	-	
Narendrapur																		
Basmati rice(PB-1) – broccoli – *sesbania* green manure	2759	1628	-	2735	1610	-	2421	1399	-	2450	1405	-	2693	1530	-	2567	1490	-

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Paddy (Satabdi)– mustard– green gram	5801	1644	1324	5798	1787	1322	5534	1628	1286	5632	1682	1289	5778	1679	1298	5734	1624	1295
Paddy (Satabdi)– capsicum– green gram	5901	2612	1332	5998	2556	1310	5734	2290	1234	5632	2292	1254	5798	2328	1298	5794	2318	1287
Paddy (Satabdi) – french bean – sesame	6021	6124	1382	6023	6143	1375	5899	6189	1298	5831	6093	1320	6072	6278	1365	5987	6190	1292
Mean	5908			5940			5722			5698			5883			5838		
Sardarkrushinagar																		
Groundnut- wheat- green gram	1888	4323	700	1683	3956	631	1825	4548	692	2013	4726	733	1938	4637	715	1523	4192	609
Greengram- coriander - vegetable cowpea	757	728	5076	667	649	4800	734	838	4912	785	1016	5355	767	925	5167	637	707	4367
Greengram-fennel -fennel	759	1646	-	669	1479	-	735	1740	-	788	1904	-	768	1827	-	637	1569	-
Thiruvananthapuram																		
Cassava-veg. cowpea	25650	366		23630	670		23960	74		24390	180		25750	273		18500	151	
Cassava-groundnut	25650	751		25650	957		23630	1801		23630	903		23960	1371		24390	1295	
Taro-black gram	9180	218		6350	119		5630	221		4330	284		8170	126		7420	207	
Taro-greengram	9180	310		9180	285		6350	136		6350	142		5630	202		5630	430	
Udaipur																		
Maize + blackgram (2:2)–wheat (*durum*) –*sesbania* (GM)	2357 +171	3143		2500+ 171	3357		2714+ 193	3714		2786+ 200	3929		2571+ 179	3214		2643+ 186	3286	
Blackgram–wheat (*Triticum aestivum*)	450	3143		486	3643		536	4071		554	4214		443	3500		471	3500	
Sweet corn + blackgram (2:2)– chickpea	2386+ 164	571		2529+ 168	679		3000+ 193	786		3057+ 200	857		2500+ 185	643		2386+ 171	536	
Soybean – fenugreek	436	1714		443	1857		597	1929		616	2071		557	1571		500	1786	

Table 7.2.2: Influence of organic, inorganic and integrated packages on straw yield (kg ha^{-1}) of crops in cropping systems at various locations

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Bajaura																		
French bean (*kharif*)-cauliflower- french bean (summer)	-	4820	1650	-	4180	1500	-	2660	1120	-	5600	1320	-	6000	1350	-	5850	1400
Fallow-Cauliflower -Tomato	-	5000	-	-	4660	-	-	2660	-	-	2940	-	-	6690	-	-	5900	-
Blackgram-cauliflower- Summer squash	1620	4760	-	1630	3640	-	1450	2330	-	1700	3660	-	1790	3910	-	1680	3680	-
Lady finger-pea	2000	-	-	2050	-	-	1720	-	-	2090	-	-	2170	-	-	2150	-	-
Bhopal																		
Soybean-durum wheat	3217	9257		3063	8300		2668	8037		2203	7907		2947	9180		3244	9600	
Soybean- mustard	3194	6723		3150	6620		2650	5873		2770	6167		2946	7167		3186	7767	
Soybean- chickpea	3125	4464		3075	3707		2898	4103		2850	3627		2908	4120		2995	4550	
Soybean- linseed	3147	4983		2949	4837		2623	4000		2541	3907		2917	4543		3057	5023	
Mean	3171			3059			2710			2591			2930			3120		
Coimbatore																		
Brinjal - pearl millet - green manure (daincha)	5450	19000		6050	19280		6150	17000		6450	17680		6650	17200		6100	18200	
Chillies - barnyard millet - green manure		2896	15200		2658	16600		3011	17800		3188	18600		2897	17600		3133	17280
Tomato - Finger millet - green manure		7212	23800		7630	24200		9168	16400		8472	17400		7308	18800		7428	19400
Jabalpur																		
Basmati rice–durum wheat-green manure	3989	4486		3216	4200		4403	6015		2698	5641		4237	7412		4078	6950	
Basmati rice–chickpea - maize fodder	3869	2231		3240	2066		4147	2759		2907	2374		4688	2231		4136	2066	

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Basmati rice–berseem (fodder and seed)	4096			3317			4734			3295			4145			4352		
Basmati rice–vegetable pea-sorghum (fodder)	4054			3437			4357			3887			4087			3868		
Basmati rice Mean	4002			3303			4410			3197			4289			4109		
Karjat																		
Rice-brinjal		4319			3564			4499			3377			4405			4125	
Rice-chickpea		3123			3053			3121			2931			3594			3212	
Rice-field bean		3941			3467			4209			3267			4028			4028	
Rice-onion (White)		957			600			924			595			1055			677	
Mean (Rice)	5565	3085		5065	2671		5668	3188		5390	2543		5713	3271		5427	3011	
Ludhiana																		
Basmati rice-chickpea-green manure	6520	1970		6450	1710		6520	433		6620	950		6720	931		6560	880	
Basmati rice-wheat-green manure	6400	6180		6380	6210		6650	5930		6600	6890		6520	6420		6620	6720	
Kharif moong-wheat-summer moong	1390	7080		1190	6950		620	7570		560	7250		1010	7200		1400	7300	
Soybean -wheat	3830	6300		4520	6800		3410	7050		2900	7010		3960	6510		4400	6850	
Pantnagar																		
Basmati rice-wheat	5375	5094		4732	4681		5172	5626		5066	5418		5410	5783		5601	5586	
Basmati rice - chickpea (4rows+ 2rows coriander)	5523	3118		5575	2782		4747	2598		4728	2779		6076	2791		5988	2534	
Basmati rice - vegetable pea (4 rows vegetable pea + 2 rows coriander)	5938			6052			5116			4827			5382			5947		
Basmati rice -potato	5274			5009			5193			4870			5207			5555		
Basmati rice mean	5528			5342			5057			4872			5519			5773		

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Umiam																		
Rice- fallow system on sunken bed																		
Megha aromatic 2 –fellow	6940									-						-		
Shasharang –fellow	6840									-						-		
Ngoba –fellow	6880									-						-		
Lampnah –fellow	6890									-						-		
Mean	7000			6550			6950			-			7050			-		
New centre started from 2015-16																		
Sardarkrushinagar																		
Groundnut- Wheat - Green gram	2398	6183	1428	1904	5662	1299	2256	6620	1422	2575	6912	1534	2542	6662	1436	1860	5745	1187
Greengram-Coriander-Vegetable cowpea	1450	913	2266	1348	840	2091	1421	985	2189	1567	1121	2485	1521	1086	2474	1323	869	1858
Greengram-Fennel	1467	4118	-	1371	3680	-	1440	4512	-	1585	4694	-	1544	4608	-	1344	3943	-
Udaipur																		
Maize+blackgram (2:2)–durum wheat–*sesbania* (GM)	3850+ 451			3942+ 457			4485+ 500			4575 507			4220+ 464			4125+ 479		
Blackgram – wheat	1036			1079			1200			1257			1029			1071		
Sweet corn + blackgram (2:2) – chickpea	4500+ 493			4571+ 507			5571+ 571			5643+ 587			4587+ 543			4714+ 514		
Soybean - fenugreek	1207			1314			1607			1600			1464			1371		
Fallow-Cauliflower-Tomato	-	5000	-	-	4660	-	-	2660	-	-	2940	-	-	6690	-	-	5900	-

Table 7.2.3: Influence of organic, inorganic and integrated package on systems productivity (kg/ ha) at various locations

Locations/Treatments	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommen-dation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Bajaura (CEY)							
French bean (Kharif)-cauliflower-french bean (summer)	18890	17010	9540	18110	18650	18240	16740
Fallow-cauliflower-tomato	1830	18160	12670	17110	23550	21160	18510
Black gram-cauliflower- summer squash	22020	20170	15860	21170	26150	22740	21350
Lady finger-pea	12110	13150	8150	11290	12360	12540	11600
Mean	13713	17123	11555	16920	20178	18670	
Bhopal (SEY)							
Soybean-durum wheat	4047	3651	3361	3175	3833	4029	3683
Soybean-mustard	3749	3659	3325	3254	3782	3914	3614
Soybean- chickpea	3351	2933	2810	2733	3097	3205	3021
Soybean- linseed	3108	3433	3145	2942	3318	3631	3263
Mean	3564	3419	3160	3026	3507	3695	
Dharwad (Cot.EY)							
Greengram-safflower	1562	1485	1625	1829	1431	1650	1597
Pigeon pea (Sole)	1047	1319	1415	1501	1347	1262	1315
Green gram-sorghum	3955	3627	3551	3300	3520	3276	3538
Groundnut + hybrid cotton (2:1)	1234	1860	2051	1749	1909	1952	1793
Maize-chickpea	2726	3107	2694	1971	2574	2822	2649
Mean	2369	2520	2480	2212	2359	2425	
Jabalpur (REY)							
Basmati rice – wheat (durum) – green manure	5564	4833	7549	4516	7617	5219	5883
Basmati rice – chickpea – maize fodder	3588	4227	3687	4155	4014	4762	4072
Basmati rice-berseem (fodder and seed)	7831	6580	9444	7087	8602	6925	7745
Basmati rice – vegetable pea–sorghum (fodder)	3906	5219	4271	6013	4028	5753	4865
Mean	5222	5215	6238	5443	6065	5665	
Karjat (REY)							
Rice-brinjal	62240	56470	54630	40230	51030	49170	52295
Rice-chickpea	12610	11460	9750	9020	10570	10200	10602
Rice-field bean	13380	11910	11970	9550	10820	9980	11268
Rice-onion (White)	44380	32090	32370	25580	37590	29190	33533
Mean	33153	27983	27180	21095	27503	24635	
Ludhiana (WEY)							
Basmati rice-chickpea-green manure	9600	11100	7300	7500	7800	7200	8417
Basmati rice-wheat-green manure	11700	11600	10700	10900	10500	10500	10983
Kharif moong-wheat-summer moong	12800	12100	9500	9200	10100	10600	10717
Soybean -wheat	8000	8200	6700	6500	6600	7000	7167
Mean	10525	10750	8550	8525	8750	8825	
Modipuram (BREY)							
Basmati rice– wheat (durum) - sesbania green manure	12081	11148	8902	9880	10212	9542	10294

Locations/Treatments	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommen-dation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Coarse rice– barley (malt) – green gram	11481	11136	9069	9760	10079	9706	10205
Maize (popcorn) – potato– okra - sesbania green manure	19520	18181	12621	13620	14693	14212	15475
Maize (sweet corn) – mustard - Sesbania green manure	10106	9340	8420	8675	9166	8608	9053
Mean	13297	12451	9753	10484	11038	10517	11257
Pantnagar (BREY)							
Basmati rice-wheat	7999	7205	7743	7327	8190	8012	7746
Basmati rice -chickpea (4rows+2rows coriander)	11205	10694	9595	10047	11128	11019	10615
Basmati rice -vegetable pea (4 rows vegetable pea+2 rows coriander)	8864	8308	7387	7331	8537	8477	8151
Basmati rice -potato	8621	7976	7760	7532	8967	8455	8219
Mean	9172	8546	8121	8059	9206	8991	
Raipur (SEY)							
Soybean-maize	7971	8321	7222	8966	6050	5970	7417
Soybean-pea	7147	7871	5258	5607	4545	4760	5865
Soybean-chilli	6381	6726	6426	6653	6011	6216	6402
Soybean-onion	6249	6378	6938	7716	5035	5705	6337
Mean	6937	7324	6461	7236	5410	5663	
Ranchi (REY)							
Rice -wheat	6122	6354	5880	5026	6013	6200	5933
Rice -Onion	11900	11342	10586	8579	14442	11734	11431
Rice -potato	15157	13242	8327	7230	12286	14442	11781
Rice -Onion	10467	9524	9894	6627	10359	10902	9629
Mean	10912	10116	8672	6866	10775	10820	
Sardarkrushinagar (GNEY)							
Groundnut- wheat- green gram	6107	5502	5053	5270	5248	4421	5267
Green gram- cumin- vegetable cowpea	5323	4927	4257	4706	4512	3741	4578
Green gram-fennel- fennel conti.	3407	3048	2844	3090	2982	2537	2985
Mean	4946	4492	4051	4355	4247	3566	
Thiruvananthapuram							
Cassava-veg. cowpea	25392	5744	127339	181848	160905	-21731	79916
Cassava-groundnut	274554	261904	403027	251726	254352	109968	259255
Taro-black gram	53996	-108992	34511	-3477	83864	36297	16033
Taro-greengram	5772	-115216	37536	-50276	47147	-115258	-31716
Mean	89929	10860	150603	94955	136567	2319	80872
Udaipur (MEY)							
Maize + black gram (2:2)–wheat (*durum*)–sesbania (GM)	7993	8872	9842	10167	8775	8681	9055
Black gram –wheat (*Triticum aestivum*)	7309	7840	8663	9087	7477	7540	7986
Sweet corn + black gram (2:2)–chickpea	5880	6478	7620	7952	6310	5764	6667
Soybean – fenugreek	6246	6693	7300	7773	6769	5980	6794
Mean	6857	7471	8356	8745	7333	6991	

Performance of green gram, cluster bean, coriander and fennel crops integrated with 75% organic +25% inorganic input at Ajmer

Ajmer: Seed spices coriander and fennel in *rabi* was evaluated with green gram and cluster bean (*kharif*) in system mode. The performance of green gram, cluster bean, coriander and fennel were found to be better towards organic practice with integration of 75% organic +25% inorganic input under integrated package followed by state recommendation package. Among nutrient management practice, seed yield of green gram, clusterbean, coriander and fennel were higher by 20.5, 20.9, 18.7 and 32.8% respectively over inorganic whereas, it was higher by 28.7, 17.9, 22.2 and13.0% respectively over organic production package.

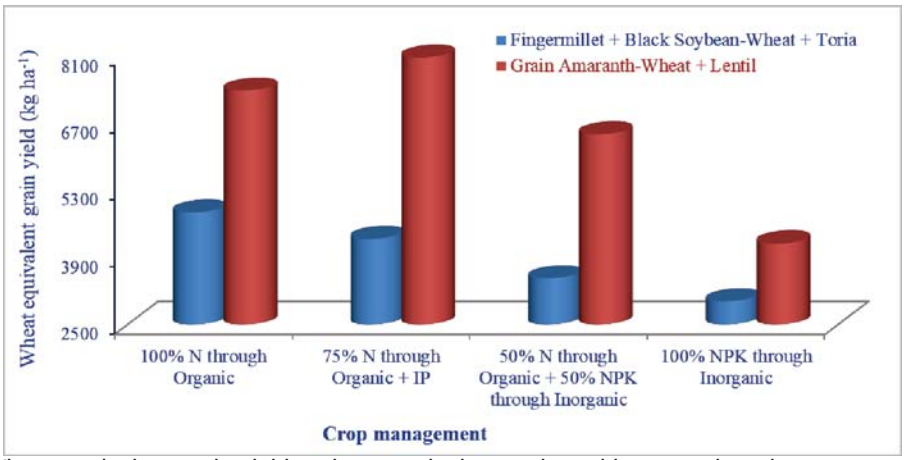


Fig. 10. Wheat equivalent grain yield under organic, inorganic and integrated nutrient management at Almora

Almora: Different nutrient sources were evaluated for fingermillet + black soybean (2:1 ratio – substitution of row)-wheat + *toria* (2:1 ratio) and grain amaranth-wheat + lentil (2:1 ratio) under rainfed system. Among crop management systems, application of 100% N requirement of crop through organic manure produced highest wheat equivalent grain yield of 4825 and 8059 kg/ha for finger millet + black soybean-wheat + *toria* and grain amaranth-wheat + lentil, respectively (Fig. 1). The highest yielding treatment recorded 68 and 107% higher wheat equivalent grain yield of finger millet + black soybean-wheat + *toria* and grain amaranth-wheat + lentil, respectively than 100% inorganic package, respectively.

Gangtok: Among all the cropping systems, maize, ginger, and turmeric were grown in *pre kharif*, soybean and black gram (*Pahenlo dal*) grown in *kharif* season and french bean, buckwheat rajmash and toria were grown in *rabi* season. Yield of maize with intercrops ginger, turmeric, soybean and black gram remarkably higher with organic package. Similarly, frenchbean, buckwheat and rajmash and toria also recorded highest yield with organic (100% N equivalent though organics (25% FYM+25% VC+25% NK+25% MC).

Narendrapur: Paddy (PB-1 and Shatabdi) recorded maximum yield under organic nutrient management by 100% organic manure followed by 75% organic manure + 25% innovative practice. The increase in yield of Paddy (PB-1 and Shatabdi) with organic to the tune of 14 and 4% respectively compared to inorganic nutrient package. Other crops in the systems such as broccoli, capsicum, green gram and sesame resulted in higher yield also with organic package while mustard recorded with 75% organic manure + 25% innovative practice. The yield was increased by 16.3,14.1, 7.9 and 6.5% with organic compared to inorganic whereas French bean recorded maximum yield of 6278 kg/ha under integrated.

Sardarkrushinagar: The general performance of groundnut and green gram during *kharif*, wheat, coriander, and fennel during *rabi* and vegetable cowpea during summer was found to be better under inorganic with state recommendation. Organic practices in groundnut, green gram, wheat, coriander, fennel and vegetable cowpea recorded yield drop to the tune of 6.2, 3.7, 8.5, 28.3, 13.6 and 5.2% respectively over inorganic practice. System equivalent yield (ground nut equivalent) of 4946 kg/ha was recorded highest under organic with application of 100% organic input followed by 75% nutrient through organic source + 25 innovative practices ((Panchgavya and Jivamrut spray @ 2 %) of 4492 kg/ha among the production package which is 22.1% higher than inorganic. Among the cropping systems, ground nut-wheat-green gram resulted in higher GEY of 5267 kg/ha which gave 15 and 76.4% higher ground nut equivalent yield.

Wheat and coriander under organic with 75% organic input+25% innovative practice at SK Nagar

Thiruvananthapuram: Integrated production practice found to be better in cassava but being on par with organic. Tuber yield of cassava (25750 kg/ha) was higher in 50% each nutrient application through organic and inorganic sources while comel yield of taro was higher with 100% organic followed by 75% organic + innovative practices. Variation in yield for cassava was 7.5% from inorganic to organic however, in taro, it was 63.1% higher with organic over inorganic. Vegetable cowpea recorded maximum under organic with 75% organic + innovative practices whereas groundnut and blackgram recorded maximum yield under inorganic practice either by fully inorganic or state recommendation. Green gram was higher in integrated package (430 kg/ha)which was 216.2nd 38.7% higher over inorganic and organic respectively.


Cassava


Vegetable cowpea


Taro


Ground nut


Black gram


Green gram

Udaipur: Effect of organic, inorganic and integrated practices on yield, all crops in cropping systems recorded higher yield with either by inorganic practices or state recommendation. Maize and sweet corn with inter crop of black gram (2786, 3057 and 200 kg/ha respectively), sole black gram (554 kg/ha) and soybean (616 kg/ha) during *kharif* and wheat *durum* and *aestivum* (3929 & 4214 kg/ha), chickpea and fenugreek (857 & 2071 kg/ha) recorded maximum yield either in inorganic or in state recommendation practice. Reduction in yield with organic in maize (15.4%), soybean (29.2%), black gram sole (18.8%) during *kharif* season and wheat *durum* and

75% organic +innovative practice in maize + blackgram

100% organic in sweet corn + blackgram

75% organic+ 25% inorganic in *wheat (Aestivum)*

100% organic in *wheat (Durum)*

75% organic + innovative practice in sole blackgram

75% organic+ 25% inorganic in fenugreek

75% organic + innovative practice in soybean

50% organic + 50% in organic in gram

Effect of organic, inorganic and integrated systems on different k*harif* and *rabi* crops in maize-based cropping systems at Udaipur

aestivum (20 & 21.7%), chickpea (33.4%) and fenugreek (17.2%) during *rabi* were observed over inorganic. Total productivity among the management practices in term of maize equivalent yield, inorganic production system being state recommendation package being the highest followed by inorganic. Out of four cropping systems, maize + blackgram (2:2)–wheat (*durum*)–*sesbania* (GM) cropping system gave maximum maize equivalent yield of 9055 kg/ha.

Effect of organic, inorganic and integrated systems on different k*harif* and *rabi* crops in maize-based cropping systems at Udaipur

Influence of organic management with reduced dose of organic manures, integrated and inorganic nutrient management packages on soil physical and available nutrient status (Table 7.2.4 -7.2.10)

Six centres have reported bulk density, water holding capacity and electric conductivity while pH, organic carbon available N, P & K parameters have reported by 14 centres and results are given below.

Bajaura: pH, organic carbon, available N, P, K, Mn, Zn, Cu and Fe were estimated. The soil pH in different cropping systems as influenced by nutrient management was higher with integrated and being on par with organic package whereas lower value of soil pH was recorded in inorganic management. Cropping systems and nutrient management package recorded soil organic carbon ranging from 0.66 as minimum under inorganic to 1.51% as maximum in organic management with 100% nutrients application through organic manures in frenchbean-cauliflower-frenchbean system. An increase in 73.4% in organic carbon was observed with organic over inorganic practice. Variation of only 2.7% was observed among cropping systems. Availability of residual N (255.5 kg/ha) was higher with organic followed by integrated (252.7 kg/ha) while phosphorus and potassium were highest in integrated of 76.3 and 250 kg/ha respectively. Among the cropping systems, french bean-cauliflower- frenchbean recorded maximum N availability in the soil whereas P and K was not differed due to the cropping systems. Available iron and zinc (15.9 and 3.68 ppm) were recorded higher under organic package with 100% organic management and being on par with integrated while manganese and copper recorded higher under integrated package (50% each organic and inorganic) of 12.0 and 2.95 ppm. Available iron and zinc was found to be higher (14.2 & 2.91 ppm) at the end of black gram-cauliflower- summer squash whereas, manganese (10.1 ppm) was higher in cauliflower-tomato, ladyfinger-pea recorded higher copper (2.45 ppm) among the cropping systems.

Bhopal: Physical and chemical properties of soil in term of EC, pH, OC, available N, P, & K were estimated. Not much variation in electric conductivity and pH was observed among various input practice and cropping systems. Soil organic carbon was higher under organic (1.01%) followed by 75% input through organic +innovative practice (0.96%) and integrated (75% organic input+25% inorganic) of 0.94%. An increase in organic carbon was found to be 44.3% with organic over inorganic. Among the copping systems soybean-wheat recorded marginal higher SOC (0.90%) followed by soybean-mustard, soybean-chickpea and soybean-linseed. . Available N, P and K were higher under organic management and found to be increase by N (7.4%), P (47.1%) and K (10.9%) compared to inorganic package.

Calicut: pH, OC, available N, P, & K were estimated. In ginger and black pepper, soil pH, organic carbon, nitrogen, phosphorus and potassium were higher under organic management practice. An increase in SOC, found to higher to the tune of 55 170% with organic over inorganic in ginger and black pepper respectively. crop. The soil pH, organic carbon, nitrogen content was significantly higher under organic management system in turmeric whereas phosphorous was higher under integrated management. In case of potassium, it was higher in inorganic management system. Micronutrients such as iron, manganese, zinc and copper recorded higher under organic with either 100% input supply through organic (100% organic) or 75% organic +innovative practice in ginger, turmeric and black pepper.

Dharwad: Numerically similar value recorded for bulk density among various input practices and cropping system. Lower EC was recorded with inorganic management practice while, in case of pH it was higher (7.40) under inorganic management with state recommendation. pH was lower under organic. (6.68). Not significant variation in these parameters was observed among cropping system. The organic carbon increased significantly from 4.86 g/kg with 100% inorganic to 6.62 g/kg with 100% organic and it was increased by 36.2%. Among the cropping systems, maize-chickpea recorded maximum SOC (6.05 g/kg). An increase of 8.7% was observed in available N under organic practice over inorganic while remarkable improvement in residual P (23.2%) and K (23.7%) was noticed. No significant variation in soil available N, P & K was observed among

different cropping systems. Higher residual availability of Fe, Mn, Zn and Cu were observed under organic practice compared to inorganic and integrated. The cropping systems showed mixed influence on micronutrient status and did not influence Zn and Fe status. The cropping systems greengram-sorghum and cowpea-safflower registered higher availability of Cu and Mn compared to other systems.

Jabalpur: Among the nutrient managements, bulk density, EC and pH was lower under organic (1.22 g/cm^3, 0.60 ds/m & 7.16) either with 100% organic input or by 75% organic +innovative practice compared to inorganic (1.44 g/cm^3, 0.72 ds/m & 7.27) whereas different cropping system did not differ for these parameters and recorded more or less similar value. The pH was neutral in reaction ranging from 7.16 with organic to 7.31 under state recommendation. In case of organic carbon, organic management practice was considerably higher as compared to inorganic as well as integrated package. Organic and integrated mmanagement practice recorded 20.3 and 12.3% higher organic carbon respectively compared to inorganic input. Among the cropping systems, basmati rice-wheat-green gram system recorded (7.95 g/kg) slightly higher than other cropping systems and being at par to each other. Available nitrogen, phosphorus and potassium were not influenced due to the cropping system however, organic management practices either 100% or reduce dose of manure up to 25% + innovative practice recorded higher N.P and K.

Karjat: There was not any significant effect on pH and EC in soil due to input package as well as different cropping systems. Adoption of 100% organic package remained at par with 75% organic+ innovative organic practices recorded and significantly higher SOC content in soil and improved to the tune of 20.7% over inorganic. Both rice-filed bean and rice-chickpea owing to their higher drop of dry matter to the soil recorded higher organic carbon (1.38 and 1.35% respectively) compared to other systems. Variation in soil available N, P and K was observed among different input packages but these were not influenced due to different cropping systems. Organic packages registered significantly higher residual N, P and K (259.8, 26 and 356.1 kg/ha respectively).

Ludhiana: Electrical conductivity, pH, soil organic carbon, soil available nitrogen, phosphorus and potassium were higher under organic management either with adoption of 100% organic input or 75% input through organic manure+25% innovative practice. Soil organic carbon found to be higher by 17.3% over inorganic. Available N, P and K were also higher under organic management package and found to be higher by N (8.3%), P (8.2%) and K (6.3%) than inorganic package. Among the cropping systems, all the systems did not found to be significant to each other for retention of N, P and K as residue in the soil.

Pant Nagar: Lower EC (0.34 dsm^{-1}) was recorded under organic package with 75% nutrient application through organic manure+25% innovative practice as compared with other packages. Basmati rice-wheat and basmati rice-wheat-potato system recorded lowest EC (0.41 dsm^{-1}). Soil pH varied from 6.75 to 7.91 across the various management options and cropping systems. At the end of cropping cycle, maximum soil organic carbon (1.40%) was recorded under 100% organic package followed by 75% organic +innovative input (1.27%). The significant improvement in soil organic carbon found to be 68.7% with organic package over inorganic. Cropping systems did not influenced for organic carbon. Likewise, maximum available N, and P (384.3 and 68.5 kg/ha) in soil was recorded under organic management followed by integrated whereas, availability of K was higher with state recommendation package. Availability of iron (81.8 ppm) and copper (5.22 ppm) was higher under organic with 75% Organic+ Innovative Technology. However, the availability of Zn (1.54 ppm) and Mn (15.5 ppm) was maximum under organic (100% input through organic source). Among the cropping systems, the availability of iron and zinc were maximum in basmati rice- vegetable pea system (61.4 ppm and 1.27 ppm, respectively) whereas higher availability of copper (4.50 ppm) and Mn (13.3 ppm) were found under basmati rice –potato system.

Raipur: Soil organic carbon content varied from 0.72 to 0.76% after end of cropping cycle. Organic carbon content was similar among the nutrients input package and not remarkable difference was noticed; it was highest under 100% organic followed by integrated. As regards to cropping system no significant variation in soil carbon was noticed among different soybean-based cropping system. The available N, P and K content of soil was affected due to nutrient management practices. Farmers recommendation (100% inorganic + 5 t FYM) recorded higher N, P and K content in soil followed by 100% organic nutrient management practices.

Ranchi: Higher pH, organic carbon, available N and K were obtained with 100% organic followed by 75% organic + innovative practices however available P was maximum with inorganic nutrient management. Among cropping

system, pH and organic carbon were maximum in rice-onion, available N and P were in rice-potato and available K was highest with rice-wheat system. About 69% remarkable improvement in soil organic carbon with organic package was observed however under integrated an increase of about 33% was noticed compared to inorganic

Umiam: Results showed that bulk density in both raised and sunken bed was slightly decreased to their initial year (1.18 g/cm3 and 1.27 g/cm3 respectively). In raised (1.12 g/cm3) and sunken beds (1.18 g/cm3), the bulk density was recorded higher under inorganic management however it was less than the initial values. Improvement in soil organic carbon was recorded over the initial status in all the management practices. Initial organic carbon in raised beds soil was higher as compared to sunken beds. Under raised bed condition, 100% organic treatment recorded maximum SOC with 3.37% and 2.72% at both depths 0-15 cm and 15-30 cm respectively. In sunken beds, 100% organic treatment recorded higher SOC (2.75%) followed by integrated (2.74 %) as compared to inorganic and 75% organic. Available nitrogen (N), phosphorus (P) and potassium (K) in raised beds were increased in all management practices from initial status. Maximum available N was found under 100% organic (262.60 kg/ha) whereas, maximum P and K were found under integrated management (22.91 kg/ha and 275.60 respectively). In case of sunken beds, available N and K were found maximum under 100% organic (240.07 and 288.96 kg/ha respectively) while available P was maximum under integrated (23.63 kg/ha). Broccoli -French bean cropping system among the different sequences found to be higher in term SOC, available N, P and K in the soil

Table 7.2.4: Influence of organic, inorganic and integrated package on soil physical properties (bulk density and electrical conductivity) at the end of cropping cycle at various locations

Locations/Treatments	Bulk density (g/cc)							Soil EC (ds/m)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bhopal														
Soybean-durum wheat	-	-	-	-	-	-	-	0.30	0.32	0.28	0.29	0.30	0.28	0.30
Soybean- mustard	-	-	-	-	-	-	-	0.32	0.31	0.26	0.30	0.32	0.29	0.30
Soybean- chickpea	-	-	-	-	-	-	-	0.29	0.28	0.31	0.30	0.31	0.28	0.30
Soybean- linseed	-	-	-	-	-	-	-	0.28	0.26	0.28	0.29	0.29	0.30	0.28
Mean	-	-	-	-	-	-	-	0.30	0.29	0.28	0.30	0.31	0.29	
Dharwad														
Cowpea/green gram-safflower	1.25	1.27	1.26	1.23	1.25	1.24	1.25	0.08	0.09	0.10	0.08	0.09	0.09	0.09
Pigeon pea (Sole)	1.26	1.26	1.27	1.24	1.28	1.23	1.26	0.10	0.14	0.08	0.07	0.07	0.08	0.09
Green gram-sorghum	1.27	1.25	1.25	1.26	1.27	1.26	1.26	0.10	0.09	0.09	0.07	0.06	0.10	0.09
Groundnut + hybrid cotton (2:1)	1.26	1.23	1.22	1.26	1.25	1.23	1.24	0.11	0.10	0.06	0.06	0.08	0.11	0.09
Maize-chickpea	1.21	1.26	1.24	1.26	1.26	1.26	1.25	0.06	0.10	0.05	0.05	0.09	0.09	0.07
Mean	1.25	1.25	1.25	1.25	1.26	1.24		0.09	0.10	0.08	0.07	0.08	0.10	
Jabalpur														
Basmati rice –wheat (duram) -green manure	1.22	1.22	1.39	1.45	1.41	1.32	1.34	-	-	-	-	-	-	-
Basmati rice – chickpea - maize fodder	1.21	1.21	1.48	1.44	1.34	1.31	1.33	-	-	-	-	-	-	-
Basmati rice – berseem (fodder and seed)	1.23	1.26	1.45	1.42	1.32	1.31	1.33	-	-	-	-	-	-	-
Basmati rice – vegetable pea-sorghum (fodder)	1.22	1.28	1.42	1.44	1.35	1.31	1.34	-	-	-	-	-	-	-
Mean	1.22	1.24	1.44	1.44	1.36	1.31	1.33	-	-	-	-	-	-	-
Karjat														
Rice-brinjal	-	-	-	-	-	-	-	-	-	-	-	-	-	0.34

Locations/Treatments	Bulk density (g/cc)							Soil EC (ds/m)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Rice-chickpea	-	-	-	-	-	-	-	-	-	-	-	-	-	0.35
Rice-field bean	-	-	-	-	-	-	-	-	-	-	-	-	-	0.34
Rice-onion (White)	-	-	-	-	-	-	-	-	-	-	-	-	-	0.34
Mean	-	-	-	-	-	-	-	0.34	0.34	0.34	0.34	0.34	0.34	
Ludhiana														
Basmati rice-chickpea-GM	-	-	-	-	-	-	-	0.27	0.25	0.48	0.44	0.53	0.51	0.41
Basmati rice-wheat-GM	-	-	-	-	-	-	-	0.28	0.26	0.24	0.22	0.21	0.26	0.25
Clusterbean-wheat-summer moong	-	-	-	-	-	-	-	0.34	0.34	0.22	0.22	0.27	0.28	0.28
Soybean -wheat	-	-	-	-	-	-	-	0.27	0.26	0.21	0.20	0.24	0.26	0.24
Mean	-	-	-	-	-	-	-	0.29	0.28	0.29	0.27	0.31	0.33	0.29
Pantnagar														
Basmati rice-wheat	-	-	-	-	-	-	-	0.39	0.30	0.52	0.43	0.47	0.35	0.41
Basmati rice -chickpea														
(4rows+2rows coriander)	-	-	-	-	-	-	-	0.38	0.32	0.62	0.53	0.40	0.46	0.45
Basmati rice -vegetable pea (4 rows vegetable pea + 2 rows coriander)	-	-	-	-	-	-	-	0.50	0.36	0.51	0.49	0.43	0.44	0.46
Basmati rice -potato	-	-	-	-	-	-	-	0.32	0.36	0.49	0.57	0.37	0.36	0.41
Mean	-	-	-	-	-	-	-	0.40	0.34	0.54	0.51	0.42	0.40	
Umiam														
Vegetable-vegetable systems on raised bed														
Broccoli -carrot	-	-	-	-	-	-	1.09	-	-	-	-	-	-	60.32
Broccoli - potato	-	-	-	-	-	-	1.10	-	-	-	-	-	-	59.49
Broccoli -french bean	-	-	-	-	-	-	1.07	-	-	-	-	-	-	61.1
Broccoli -tomato	-	-	-	-	-	-	1.11	-	-	-	-	-	-	58.09
Mean	1.06	1.08	1.14	-	1.10	-		64.19	55.05	56.96	-	62.79	-	

Locations/Treatments	Bulk density (g/cc)							Soil EC (ds/m)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Rice- fallow system in sunken bed														
Megha aromatic 2–fellow	-	-	-	-	-	-	1.13	-	-	-	-	-	-	-
Shasharang–fellow	-	-	-	-	-	-	1.11	-	-	-	-	-	-	-
Ngoba–fellow	-	-	-	-	-	-	1.14	-	-	-	-	-	-	-
Lampnah–fellow	-	-	-	-	-	-	1.10	-	-	-	-	-	-	-
Mean	1.08	1.09	1.18	-	1.13	-		-	-	-	-	-	-	
New centres started from 2015-16														
Gangtok														
Maize + ginger (1:1)–french bean	-	-	-	-	-	-	1.18	-	-	-	-	-	-	-
Maize + soybean (1:1) – buckwheat	-	-	-	-	-	-	1.17	-	-	-	-	-	-	-
Maize + turmeric (1:1) – rajmash	-	-	-	-	-	-	1.18	-	-	-	-	-	-	-
Maize + black gram (2:1)-toria	-	-	-	-	-	-	1.18	-	-	-	-	-	-	-
Mean	1.20	1.20	-	1.13	1.18	-		-	-	-	-	-	-	
Narendrapur														
Basmati rice–broccoli – *sesbania* green manure	1.50	1.51	1.50	1.50	1.50	1.50	1.50	0.38	0.40	0.42	0.40	0.43	0.45	0.41
Paddy– mustard– green gram	1.90	1.90	1.91	1.90	1.91	1.90	1.90	0.35	0.33	0.29	0.29	0.35	0.33	0.32
Paddy– capsicum– green gram	1.86	1.88	1.88	1.87	1.88	1.87	1.87	0.39	0.34	0.38	0.36	0.31	0.43	0.37
Paddy –french bean – sesame	1.88	1.88	1.89	1.88	1.89	1.88	1.88	0.46	0.38	0.55	0.53	0.59	0.44	0.49
Mean	1.79	1.79	1.79	1.79	1.79	1.79		0.39	0.36	0.41	0.39	0.42	0.41	
Thiruvananthapuram														
Cassava-veg. cowpea	1.22	1.33	1.23	1.18	1.16	1.20	1.22	-	-	-	-	-	-	-
Cassava-groundnut	1.17	1.11	1.17	1.15	1.29	1.12	1.17	-	-	-	-	-	-	-
Taro-black gram	1.16	1.17	1.25	1.18	1.29	1.24	1.22	-	-	-	-	-	-	-
Taro-greengram	1.27	1.29	1.28	1.25	1.20	1.22	1.25	-	-	-	-	-	-	-
Mean	1.21	1.23	1.23	1.19	1.24	1.20		-	-	-	-	-	-	

Table 7.2.5: Influence of organic, inorganic and integrated package on soil chemical properties (pH and organic carbon) at the end of cropping cycle at various locations

Locations/Treatments	pH							Organic carbon						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura (%)														
French bean (Kharif)-cauliflower-french bean (summer)	7.20	7.10	6.60	6.90	7.10	7.20	7.02	1.51	1.20	0.69	1.02	1.12	1.15	1.12
Fallow-cauliflower-tomato	7.10	7.10	6.80	7.00	7.20	7.20	7.07	1.30	1.21	0.82	1.00	1.18	1.11	1.10
Black gram-cauliflower-Summer squash	7.10	7.20	6.70	6.80	7.20	7.10	7.02	1.35	1.24	0.81	1.09	1.12	1.18	1.13
Lady finger-pea	7.20	7.20	6.70	7.00	7.20	7.20	7.08	1.31	1.24	0.83	0.96	1.19	1.16	1.12
Mean	7.15	7.15	6.70	6.93	7.18	7.18		1.37	1.22	0.79	1.02	1.15	1.15	
Bhopal														
Soybean-durum wheat	7.66	7.71	7.70	7.63	7.59	7.64	7.66	1.08	1.02	0.76	0.74	0.90	0.89	0.90
Soybean- mustard	7.61	7.61	7.55	7.61	7.58	7.60	7.59	1.01	1.00	0.69	0.69	0.90	0.92	0.87
Soybean- chickpea	7.55	7.59	7.56	7.58	7.59	7.65	7.59	1.00	0.94	0.67	0.63	0.92	1.02	0.86
Soybean- linseed	7.55	7.60	7.55	7.59	7.57	7.66	7.59	0.93	0.88	0.69	0.67	0.89	0.91	0.83
Mean	7.59	7.63	7.59	7.60	7.58	7.64		1.01	0.96	0.70	0.68	0.90	0.94	
Calicut														
Ginger -fallow	5.10	4.90	4.40	-	4.70	4.80	4.78	3.10	2.90	2.00	-	2.10	2.40	2.50
Turmeric-fallow	5.30	5.20	4.60	-	4.60	4.90	4.92	2.30	2.50	1.30	-	1.60	2.60	2.06
Black pepper	6.40	-	4.40	-	5.50	-	5.43	2.70	-	1.00	-	1.70	-	1.80
Dharwad														
Cowpea-safflower	6.88	6.71	7.14	7.32	6.87	7.07	7.00	6.67	5.25	4.28	5.26	6.58	6.03	5.68
Pigeon pea (sole)	6.89	7.03	7.25	7.36	6.95	6.83	7.05	6.83	5.42	5.03	5.04	6.25	6.33	5.82
Green gram- sorghum	6.71	6.98	7.16	7.46	6.78	7.03	7.02	6.53	5.46	4.71	5.44	5.27	6.40	5.64
Groundnut + hybrid cotton (2:1)	6.87	7.13	7.20	7.41	7.01	7.20	7.14	6.53	5.25	4.54	4.93	6.19	6.46	5.65
Maize-chickpea	6.96	7.10	7.51	7.44	6.91	7.13	7.18	6.53	5.75	5.76	5.71	6.38	6.19	6.05
Mean	6.86	6.99	7.25	7.40	6.91	7.05		6.62	5.43	4.86	5.28	6.13	6.28	
Jabalpur (g/kg)														
Basmati rice –wheat-green manure	7.18	7.22	7.25	7.28	7.21	7.25	7.23	8.56	8.49	7.22	7.15	8.16	8.12	7.95
Basmati rice – chickpea - maize (fodder)	7.12	7.20	7.26	7.31	7.34	7.24	7.25	8.35	8.21	6.75	6.68	7.63	7.59	7.54

Locations/Treatments	pH							Organic carbon						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Basmati rice – berseem (fodder and seed)	7.15	7.14	7.23	7.25	7.20	7.21	7.20	8.26	8.19	6.81	6.62	7.71	7.58	7.53
Basmati rice – vegetable pea-sorghum (fodder)	7.20	7.21	7.35	7.38	7.35	7.21	7.28	8.44	8.27	7.12	7.03	7.86	7.79	7.75
Mean	7.16	7.19	7.27	7.31	7.28	7.23		8.40	8.29	6.98	6.87	7.84	7.77	
Karjat														
Rice-brinjal	-	-	-	-	-	-	6.59	-	-	-	-	-	-	1.23
Rice-Cchickpea	-	-	-	-	-	-	6.53	-	-	-	-	-	-	1.35
Rice-field bean	-	-	-	-	-	-	6.58	-	-	-	-	-	-	1.38
Rice-onion (White)	-	-	-	-	-	-	6.59	-	-	-	-	-	-	1.15
Mean	6.56	6.56	6.6	6.58	6.5	6.63		1.46	1.42	1.21	1.15	1.23	1.2	
Ludhiana														
Basmati rice-chickpea-GM	7.40	7.20	7.30	7.30	7.30	7.30	7.30	0.56	0.52	0.48	0.44	0.53	0.51	0.51
Basmati rice-wheat-GM	7.70	7.40	7.40	7.10	7.40	7.30	7.38	0.67	0.66	0.49	0.47	0.58	0.56	0.57
Clusterbean-wheat-summer moong	7.20	7.20	7.50	7.40	7.20	7.40	7.32	0.61	0.61	0.59	0.57	0.43	0.42	0.54
Soybean -wheat	7.80	7.40	7.20	7.20	7.40	7.60	7.43	0.6	0.58	0.53	0.54	0.44	0.43	0.52
Mean	7.53	7.30	7.35	7.25	7.33	7.40		0.61	0.59	0.52	0.51	0.50	0.48	
Pantnagar														
Basmati rice-wheat	7.48	7.25	7.50	7.91	6.70	7.31	7.36	1.35	1.25	0.86	0.89	1.12	1.25	1.12
Basmati rice -chickpea (4rows+2rows coriander)	6.81	6.81	7.69	7.82	7.10	7.20	7.24	1.39	1.19	0.82	0.95	1.18	1.2	1.12
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	7.32	6.75	7.81	7.54	6.77	7.24	7.24	1.52	1.35	0.87	0.9	1.15	1.28	1.18
Basmati rice -potato	7.39	6.87	7.90	7.38	7.25	6.89	7.28	1.33	1.29	0.75	0.92	1.11	1.19	1.10
Mean	7.25	6.92	7.73	7.66	6.96	7.16		1.40	1.27	0.83	0.92	1.14	1.23	
Raipur														
Soybean-maize	-	-	-	-	-	-	-	-	-	-	-	-	-	0.73
Soybean-pea	-	-	-	-	-	-	-	-	-	-	-	-	-	0.76
Soybean-chilli	-	-	-	-	-	-	-	-	-	-	-	-	-	0.76
Soybean-onion	-	-	-	-	-	-	-	-	-	-	-	-	-	0.76
Mean	-	-	-	-	-	-	-	0.76	0.75	0.73	0.75	0.72	0.75	

Locations/Treatments	pH							Organic carbon						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Ranchi														
Rice -wheat	-	-	-	-	-	-	6.00	-	-	-	-	-	-	0.60
Rice -Onion	-	-	-	-	-	-	6.06	-	-	-	-	-	-	0.62
Rice -potato	-	-	-	-	-	-	5.95	-	-	-	-	-	-	0.61
Rice -Onion	-	-	-	-	-	-	5.91	-	-	-	-	-	-	0.58
Mean	6.39	6.32	5.46	5.42	6.07	6.15		0.76	0.73	0.45	0.40	0.60	0.64	
Umiam														
Rice- fallow system on sunken bed														
Megha aromatic 2–fellow	-	-	-	-	-	-	5.51	-	-	-	-	-	-	2.7
Shasharang–fellow	-	-	-	-	-	-	5.64	-	-	-	-	-	-	2.77
Ngoba –fellow	-	-	-	-	-	-	5.42	-	-	-	-	-	-	2.65
Lampnah –fellow	-	-	-	-	-	-	5.48	-	-	-	-	-	-	2.64
Mean (management practices)	5.51	5.40	5.56	-	5.57	-		2.75	2.57	2.70	-	2.74	-	
New centres started from 2015-16														
Gangtok														
Maize + ginger (1:1)–french bean	-	-	-	-	-	-	-	-	-	-	-	-	-	0.97
Maize + soybean (1:1) – buckwheat	-	-	-	-	-	-	-	-	-	-	-	-	-	0.98
Maize + turmeric (1:1) – rajmash	-	-	-	-	-	-	-	-	-	-	-	-	-	0.97
Maize + black gram (2:1)-toria	-	-	-	-	-	-	-	-	-	-	-	-	-	0.96
Mran	-	-	-	-	-	-		1.01	0.98	-	0.95	0.98	-	
Narendrapur														
Basmati rice–broccoli – sesbania green manure	6.64	6.70	6.67	6.68	6.68	6.68	6.67	0.89	0.91	0.69	0.70	0.83	0.83	0.81
Paddy– mustard– green gram	6.72	6.62	6.67	6.64	6.66	6.65	6.66	0.92	0.85	0.71	0.74	0.82	0.83	0.81
Paddy– capsicum– green gram	6.98	6.93	6.95	6.94	6.95	6.95	6.95	0.92	0.89	0.74	0.73	0.87	0.84	0.83
Paddy –french bean – sesame	7.21	7.25	7.23	7.24	7.24	7.24	7.24	1.04	0.91	0.75	0.75	0.89	0.94	0.88
Mean	6.88	6.88	6.88	6.88	6.88	6.88		0.94	0.89	0.72	0.73	0.85	0.86	
Thiruvananthapuram														
Cassava-veg. cowpea	5.12	5.26	4.87	4.80	4.34	4.68	4.85	1.05	1.02	1.05	0.95	0.85	0.93	0.98
Cassava-groundnut	5.26	5.18	5.00	4.92	4.16	5.12	4.94	1.08	0.99	0.93	0.84	0.80	0.90	0.92
Taro-black gram	5.34	5.16	4.88	5.16	4.46	4.82	4.97	1.02	0.87	0.93	0.78	1.02	0.90	0.92
Taro-greengram	5.58	5.06	4.68	4.37	4.48	4.89	4.84	1.20	1.20	1.08	1.14	0.90	0.84	1.06
Mean	5.33	5.17	4.86	4.81	4.36	4.88		1.09	1.02	1.00	0.93	0.89	0.89	

Table 7.2.6: Influence of organic, inorganic and integrated package on soil available nitrogen at the end of cropping cycle at various locations

Locations/Treatments	Available Nitrogen (kg ha^{-1})						Mean
	Organic		Inorganic		Integrated		
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommen-dation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Bajaura							
French bean (Kharif)-cauliflower-french bean (summer)	258.1	256.2	233.0	248.7	257.8	256.8	251.8
Fallow-cauliflower-tomato	252.8	254.0	247.5	150.2	253.2	257.2	235.8
Black gram-cauliflower- summer squash	258.1	256.2	233.0	248.7	257.4	256.8	251.7
Lady finger-pea	252.8	254.0	247.5	251.0	237.8	240.0	247.2
Mean	255.5	255.1	240.3	224.7	251.6	252.7	
Bhopal							
Soybean-durum wheat	260.0	245.0	229.0	232.0	244.0	235.0	241.0
Soybean- mustard	263.0	245.0	256.0	248.0	226.0	222.0	243.0
Soybean- chickpea	244.0	230.0	213.0	221.0	236.0	245.0	231.0
Soybean- linseed	216.0	222.0	217.0	229.0	225.0	236.0	224.0
Mean	246.0	235.0	229.0	232.0	233.0	234.0	
Calicut							
Ginger-fallow	320.0	314.0	207.0	-	223.0	250.0	262.8
Turmeric-fallow	283.0	268.0	142.0	-	182.0	288.0	232.6
Black pepper-fallow	233.7	-	89.5	-	145.3	-	156.2
Dharwad							
Greengram-safflower	241	224	202	286	204	230	231
Pigeon pea (sole)	249	254	218	274	192	221	235
Green gram - sorghum	264	207	233	221	214	228	228
Groundnut + hybrid cotton (2:1)	269	213	202	246	186	267	230
Maize-chickpea	232	230	212	258	225	232	231
Mean		251	226	213	257	204	236
Jabalpur							
Basmati rice –wheat (duram)-green manure	299	295	260	256	286	282	280
Basmati rice – chickpea - maize fodder	288	286	241	235	275	275	267
Basmati rice – berseem (fodder and seed)	289	281	237	241	278	279	268
Basmati rice – vegetable pea-sorghum (fodder)	292	286	264	255	279	278	276
Mean	292	287	251	247	280	279	
Karjat							
Rice-Brinjal	-	-	-	-	-	-	245.3
Rice-Chickpea	-	-	-	-	-	-	259.1
Rice-Field bean	-	-	-	-	-	-	262.0
Rice-Onion (White)	-	-	-	-	-	-	235.8
Mean	259.8	257.3	242.3	233.3	254.8	256.2	
Ludhiana							
Basmati rice-chickpea-GM	365.5	363.1	312.9	318.9	350.9	347.9	343.2
Basmati rice-wheat-GM	357.8	352.9	345.8	338.9	351.9	351.8	349.9
Clusterbean-wheat-summer moong	318.5	310.8	319.0	312.5	310.5	319.0	315.1
Soybean -wheat	361.4	358.5	317.3	318.9	352.2	358.7	344.5
Mean	350.8	346.3	323.8	322.3	341.4	344.4	

Locations/Treatments	Available Nitrogen (kg ha^{-1})						Mean
	Organic		Inorganic		Integrated		
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommen-dation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Pantnagar							
Basmati rice-wheat	382	322	370	362	390	380	368
Basmati rice -chickpea (4rows+2rows coriander)	375	368	352	348	405	391	373
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	389	370	358	372	345	365	367
Basmati rice -potato	391	376	312	380	392	370	370
Mean	384	359	348	366	383	377	
Raipur							
Soybean-maize	-	-	-	-	-	-	246
Soybean-pea	-	-	-	-	-	-	253
Soybean-chilli	-	-	-	-	-	-	250
Soybean-onion	-	-	-	-	-	-	247
Mean	254	236	257	252	246	248	
Ranchi							
Rice -wheat	323.6	309.7	263.5	258.0	285.4	298.3	289.7
Rice -Onion	136.7	133.0	155.5	115.4	135.5	141.7	136.3
Rice -potato	318.5	312.5	292.3	264.0	305.4	309.2	300.3
Rice -Onion	125.4	136.7	136.7	105.4	120.4	130.5	125.9
Mean	226.0	223.0	212.0	185.7	211.7	219.9	
Umiam							
Vegetable-vegetable systems on raised bed							
Broccoli -carrot	-	-	-	-	-	-	242.5
Broccoli - potato	-	-	-	-	-	-	238.2
Broccoli -french bean	-	-	-	-	-	-	254.6
Broccoli -tomato	-	-	-	-	-	-	251.4
Mean	262.6	241.1	236.0	-	246.9	-	
Rice- fallow system on sunken bed							
Megha aromatic 2–fellow	-	-	-	-	-	-	228.8
Shasharang–fellow	-	-	-	-	-	-	239.5
Ngoba–fellow	-	-	-	-	-	-	238.7
Lampnah–fellow	-	-	-	-	-	-	227.2
Mean	240.1	240.1	234.1	-	230.6	-	
New centres started from 2015-16							
Ajmer							
Green gram – fennel	160.9	155.9	150.5	153.8	154.0	152.5	154.6
Green gram - coriander	153.7	149.9	139.2	142.1	143.3	141.4	144.9
Cluster bean - fennel	160.9	155.9	150.5	153.8	154.0	152.5	154.6
Cluster bean – coriander	153.7	149.9	139.2	142.1	143.3	141.4	144.9
Mean	157.3	152.9	144.9	147.9	148.7	147.0	
Gangtok							
Maize + ginger (1:1)–french bean	-	-	-	-	-	-	368.8
Maize + soybean (1:1) – buckwheat	-	-	-	-	-	-	380.8
Maize + turmeric (1:1) – rajmash	-	-	-	-	-	-	362.5
Maize + black gram (2:1)-toria	-	-	-	-	-	-	377.7
Mean	384.1	362.2	-	298.0	346.3	-	

Table 7.2.7: Influence of organic, inorganic and integrated package on soil available phosphorus at the end of cropping cycle at various locations

Locations/Treatments	Available Phosphorus (kg ha^{-1})						Mean
	Organic		Inorganic		Integrated		
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommen-dation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Bajaura							
French bean (Kharif)-cauliflower-french bean (summer)	71.0	69.4	42.0	49.9	72.5	70.2	62.5
Fallow-cauliflower-tomato	72.5	69.0	43.0	48.5	77.5	72.2	63.8
Black gram-cauliflower- summer squash	71.9	70.5	42.2	46.7	78.5	73.6	63.9
Lady finger-pea	75.8	75.0	40.5	47.5	76.5	72.8	64.7
Mean	72.8	71.0	41.9	48.2	76.3	72.2	
Bhopal							
Soybean-durum wheat	106.0	104.0	70.0	50.0	86.0	95.0	85.0
Soybean- mustard	108.0	100.0	78.0	62.0	83.0	113.0	91.0
Soybean- chickpea	105.0	96.0	49.0	55.0	86.0	107.0	83.0
Soybean- linseed	94.0	93.0	82.0	49.0	84.0	93.0	82.0
Mean	103.0	98.0	70.0	54.0	85.0	102.0	
Calicut							
Ginger-fallow	49.0	57.0	13.0	-	32.0	31.0	36.4
Turmeric-fallow	37.4	19.0	3.4	-	22.3	24.8	21.4
Black pepper-fallow	35.4	-	3.6	-	14.1	-	17.7
Dharwad							
Greengram-safflower	43	33	37	43	37	44	39
Pigeon pea (sole)	53	33	34	52	38	46	43
Green gram - sorghum	40	37	34	55	37	32	39
Groundnut + hybrid cotton (2:1)	47	49	40	48	34	34	42
Maize-chickpea	38	46	35	44	39	43	41
Mean	44	39	36	49	37	40	
Jabalpur							
Basmati rice –wheat (duram)-green manure	18.1	18.0	16.4	16.0	17.2	18.2	17.3
Basmati rice – chickpea - maize fodder	17.7	17.0	16.1	14.4	16.7	17.0	16.5
Basmati rice – berseem (fodder and seed)	16.5	16.2	16.5	15.8	17.1	16.2	16.4
Basmati rice – vegetable pea-sorghum (fodder)	16.6	16.3	15.9	16.0	17.3	18.1	16.7
Mean	17.2	16.8	16.2	15.5	17.1	17.4	
Karjat							
Rice-Brinjal	-	-	-	-	-	-	24.7
Rice-Chickpea	-	-	-	-	-	-	26.1
Rice-Field bean	-	-	-	-	-	-	26.5
Rice-Onion (White)	-	-	-	-	-	-	23.3
Mean	26.0	25.8	23.9	23.6	25.7	25.8	
Ludhiana							
Basmati rice-chickpea-GM	46.9	48.0	41.8	40.1	43.2	48.5	44.8
Basmati rice-wheat-GM	50.4	50.3	47.1	46.5	45.1	46.0	47.6
Clusterbean-wheat-summer moong	50.0	48.9	46.8	45.0	49.8	47.0	47.9
Soybean -wheat	48.3	45.7	45.0	42.8	46.5	47.1	45.9
Mean	48.9	48.2	45.2	43.6	46.2	47.2	
Pantnagar							
Basmati rice-wheat	69.1	52.8	40.3	47.4	64.4	58.4	55.4

Locations/Treatments	Available Phosphorus (kg ha^{-1})						Mean
	Organic		Inorganic		Integrated		
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommen-dation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Basmati rice -chickpea (4rows+ 2rows coriander)	64.8	59.6	38.3	45.8	69.3	60.7	56.4
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	66.3	60.5	43.4	48.3	65.1	53.7	56.2
Basmati rice -potato	73.8	63.9	53.9	55.7	71.6	50.2	61.5
Mean	68.5	59.2	44.0	49.3	67.6	55.8	
Raipur							
Soybean-maize	-	-	-	-	-	-	21.7
Soybean-pea	-	-	-	-	-	-	22.2
Soybean-chilli	-	-	-	-	-	-	21.9
Soybean-onion	-	-	-	-	-	-	22.2
Mean	22.7	21.7	20.5	22.9	22.0	22.3	
Ranchi							
Rice -wheat	60.6	58.2	64.3	59.7	55.5	56.6	58.2
Rice -Onion	54.9	33.8	32.0	26.4	77.1	47.7	45.3
Rice -potato	55.6	42.1	25.1	28.2	62.6	46.4	43.3
Rice -Onion	53.1	48.4	27.8	31.6	72.6	48.6	47.0
Mean	56.0	45.6	37.3	36.5	66.9	49.8	
Umiam							
Vegetable-vegetable systems *on raised bed*							
Broccoli -carrot	-	-	-	-	-	-	19.5
Broccoli - potato	-	-	-	-	-	-	19.7
Broccoli -french bean	-	-	-	-	-	-	20.2
Broccoli -tomato	-	-	-	-	-	-	20.1
Mean	20.1	19.5	17.0	-	22.9	-	
Rice- fallow system on sunken bed							
Megha aromatic 2–fellow	-	-	-	-	-	-	19.6
Shasharang–fellow	-	-	-	-	-	-	20.8
Ngoba–fellow	-	-	-	-	-	-	19.7
Lampnah–fellow	-	-	-	-	-	-	19.9
Mean	22.5	18.7	15.1	-	23.6	-	
New centres started from 2015-16							
Ajmer							
Green gram – fennel	23.8	21.5	18.7	19.4	19.4	19.0	20.3
Green gram - coriander	22.4	20.5	16.5	18.0	17.9	17.9	18.8
Cluster bean - fennel	23.8	21.5	18.7	19.4	19.4	19.0	20.3
Cluster bean – coriander	22.4	20.5	16.5	18.0	17.9	17.9	18.8
Mean	23.1	21.0	17.6	18.7	18.6	18.5	
Gangtok							
Maize + ginger (1:1)–french bean	-	-	-	-	-	-	18.7
Maize + soybean (1:1) – buckwheat	-	-	-	-	-	-	22.4
Maize + turmeric (1:1) – rajmash	-	-	-	-	-	-	19.2
Maize + black gram (2:1)-toria	-	-	-	-	-	-	21.0
Mean	21.8	20.4	-	12.4	18.8	-	
Narendrapur							
Basmati rice –broccoli – *sesbania* green manure	70.1	66.5	67.5	68.2	69.5	61.7	67.2
Paddy– mustard– green gram	66.2	69.9	71.6	74.1	67.0	69.0	69.6
Paddy – capsicum– green gram	63.3	54.9	73.4	76.8	42.8	54.9	61.0
Paddy –french bean – sesame	63.6	74.7	55.0	54.7	62.5	67.1	62.9
Mean	65.8	66.5	66.8	68.4	60.5	63.2	

Table 7.2.8: Influence of organic, inorganic and integrated package on soil available potassium at the end of cropping cycle at various locations

Locations/Treatments	Available Potassium (kg ha^{-1})						Mean
	Organic		Inorganic		Integrated		
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommen-dation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Bajaura							
French bean (Kharif)-cauliflower-french bean (summer)	242.7	251.2	128.3	135.2	245.1	243.3	207.6
Fallow-cauliflower-tomato	247.0	250.5	145.8	150.2	253.2	257.0	217.3
Black gram-cauliflower- summer squash	249.0	232.5	140.0	151.8	259.2	251.1	213.9
Lady finger-pea	235.3	227.2	132.1	138.4	242.3	240.5	202.6
Mean	243.5	240.4	136.6	143.9	250.0	248.0	
Bhopal							
Soybean-durum wheat	674.0	681.0	666.0	692.0	664.0	668.0	674.0
Soybean- mustard	691.0	652.0	614.0	625.0	639.0	606.0	638.0
Soybean- chickpea	694.0	628.0	601.0	570.0	621.0	620.0	622.0
Soybean- linseed	674.0	641.0	584.0	595.0	616.0	589.0	617.0
Mean	683.0	650.0	616.0	620.0	635.0	621.0	
Calicut							
Ginger-fallow	243.0	224.0	226.0	-	821.0	1123.0	527.4
Turmeric-fallow	222.0	232.0	406.0	-	406.0	222.0	297.6
Black pepper-fallow	311.7	-	86.7	-	201.5	-	200.0
Dharwad							
Greengram-safflower	543	583	440	586	493	478	520
Pigeon pea (sole)	561	574	440	596	483	452	518
Green gram - sorghum	580	595	485	606	468	434	528
Groundnut + hybrid cotton (2:1)	515	589	468	619	452	555	533
Maize-chickpea	598	557	426	621	440	574	536
Mean	559	580	452	606	467	499	
Jabalpur							
Basmati rice –wheat (duram)-green manure	301	292	290	285	292	295	293
Basmati rice – chickpea - maize fodder	299	307	284	275	291	285	290
Basmati rice – berseem (fodder and seed)	308	295	280	275	292	295	291
Basmati rice – vegetable pea-sorghum (fodder)	297	299	266	260	298	287	285
Mean	301	298	280	274	293	291	
Karjat							
Rice-Brinjal	-	-	-	-	-	-	334.6
Rice-Chickpea	-	-	-	-	-	-	345.0
Rice-Field bean	-	-	-	-	-	-	348.6
Rice-Onion (White)	-	-	-	-	-	-	340.7
Mean	356.1	353.9	331.2	315.0	346.4	350.7	
Ludhiana							
Basmati rice-chickpea-GM	155.0	151.8	140.6	146.1	146.1	139.9	146.6
Basmati rice-wheat-GM	158.5	155.9	148.3	150.7	145.6	146.4	150.9
Clusterbean-wheat-summer moong	150.8	145.0	141.6	145.9	142.1	146.2	145.3
Soybean -wheat	148.0	150.9	145.5	143.5	140.3	139.8	144.7
Mean	153.1	150.9	144.0	146.6	143.5	143.1	

Locations/Treatments	Available Potassium (kg ha^{-1})						Mean
	Organic		Inorganic		Integrated		
	100% organic	75% organic + innovative organic practices	100% inorganic	State recommen-dation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Pantnagar							
Basmati rice-wheat	238	252	242	240	260	268	250
Basmati rice -chickpea (4rows+2rows coriander)	260	258	259	298	245	270	265
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	269	249	240	290	287	295	272
Basmati rice -potato	258	260	245	278	265	264	262
Mean	256	255	247	277	264	274	
Raipur							
Soybean-maize	-	-	-	-	-	-	380
Soybean-pea	-	-	-	-	-	-	382
Soybean-chilli	-	-	-	-	-	-	381
Soybean-onion	-	-	-	-	-	-	379
Mean	385	370	374	389	380	383	
Ranchi							
Rice -wheat	229.5	220.7	154.5	151.3	192.6	194.7	190.6
Rice -Onion	233.1	229.3	157.2	147.2	168.8	174.5	184.0
Rice -potato	205.3	197.6	154.4	142.6	174.2	175.3	184.0
Rice -Onion	217.8	215.4	169.5	160.7	189.5	196.3	191.5
Mean	221.4	215.7	158.9	150.5	181.3	185.2	
Umiam							
Rice- fallow system on sunken bed							
Megha aromatic 2–fellow	-	-	-	-	-	-	277.6
Shasharang–fellow	-	-	-	-	-	-	285.0
Ngoba–fellow	-	-	-	-	-	-	275.7
Lampnah–fellow	-	-	-	-	-	-	280.5
Mean	289.0	276.7	272.2	-	281.0	-	
New centres started from 2015-16							
Ajmer							
Green gram – fennel	337.5	350.4	315.6	312.5	313.2	355.0	330.7
Green gram - coriander	363.3	368.8	367.8	371.3	374.2	371.3	369.4
Cluster bean - fennel	337.5	350.4	315.6	312.5	313.2	355.0	330.7
Cluster bean – coriander	363.3	368.8	367.8	371.3	374.2	371.3	369.4
Mean	350.4	359.6	341.7	341.9	343.7	363.2	
Gangtok							
Maize + ginger (1:1)–french bean	-	-	-	-	-	-	420.4
Maize + soybean (1:1) – buckwheat	-	-	-	-	-	-	426.2
Maize + turmeric (1:1) – rajmash	-	-	-	-	-	-	422.5
Maize + black gram (2:1)-toria	-	-	-	-	-	-	431.1
Mean	432.0	415.8	-	395.6	405.3	-	
Narendrapur							
Basmati rice –broccoli – *sesbania* green manure	273.1	260.7	265.7	268.5	257.2	251.2	262.7
Paddy– mustard– green gram	214.8	214.9	248.2	251.7	223.4	243.0	232.7
Paddy – capsicum– green gram	233.3	219.4	205.4	210.9	204.5	206.3	213.3
Paddy –french bean – sesame	206.1	204.6	204.6	222.2	207.4	270.3	219.2
Mean	231.8	224.9	231.0	238.3	223.1	242.7	

Ajmer: Soil nutrient status after completion of crop Coriander was greatly influenced by different input management and the maximum value of organic carbon (0.322 %), N (153.66 kg/ha) and P (22.38 kg/ha) was recorded under 100 % Organic package followed by 75 % Organic + innovative practices however maximum K value is found (374.22 kg/ha) under integrated with 50 % Organic + 50% inorganic practices. Likewise, Soil nutrient status after completion of fennel crop, OC, N, P and K was also influenced by different input management and the maximum value organic carbon (0.32 %), N (160.88 kg/ha) and P (23.81 kg/ha) was recorded under 100 % Organic followed by 75 % Organic + innovative practices whereas maximum K value (355.04 kg/ha) is observed under integrated with 75% Organic + 25% Inorganic. Improvement in term of organic carbon after end of cropping cycle having coriander and fennel in crop sequence is increased by 13 and 8.11% respectively.

Gangtok: Bulk density, organic carbon and available NPK were estimated. Bulk density did not influence by various input management package or as well as cropping systems. Lower bulk density was recorded under state recommendation (1.13 g/cc) while maximum being with organic 1.20 g/cc). Adoption of 100% organic input in all the cropping systems recorded marginal but positive increase in soil organic carbon of 1.01% to 0.95% under inorganic. Among the cropping systems, maize-soybean-buckwheat cropping sequence had greater soil organic carbon and nitrogen contents as compared to the other systems In general, soil available N (384.1 kg/ha), P (21.8 kg/ha) and K (432 kg/ha) were observed under organic management package with 100% nutrients equivalent through organics sources *i.e.*, (25% FYM+25%vermicompost+25% neem cake +25% mixed compost).

Narendrapur: Bulk density and pH did not differ by the management practices and recorded ranging from 1.50 to 1.91 (g/cc) and 6.64 to 7.24 respectively across the management practice and cropping system. However, soil electrical conductivity and organic carbon did change due to different nutrient management. Lower EC was observed under organic input practice either by 100 oragnic or 75%

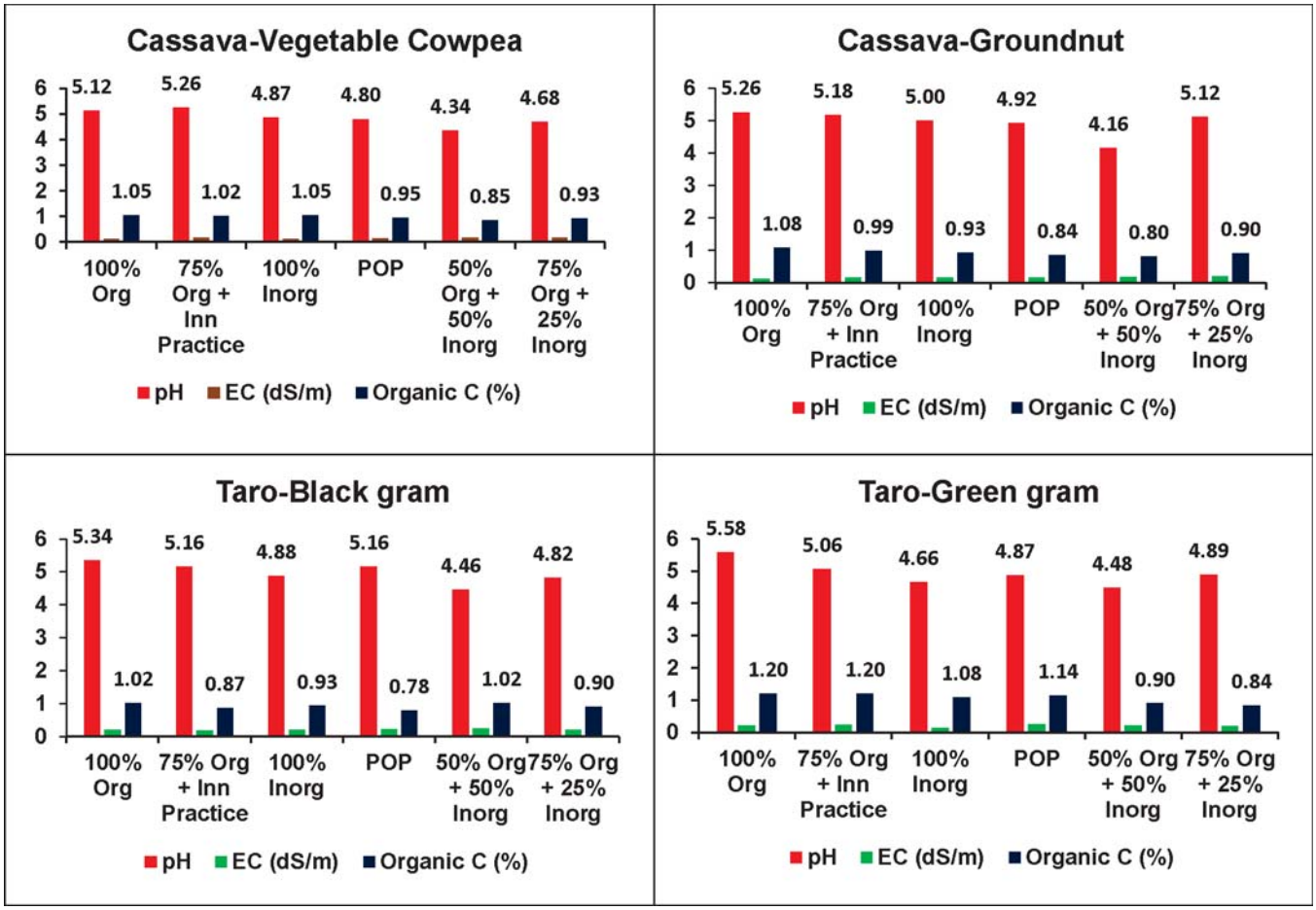


Fig. 11. The pH, EC and organic C status of the soil under various management options in the different systems

organic + innovative practice. Among the management practices, soil organic carbon was recorded higher with 100% organic management (0.94%) followed by integrated (50% organic + 50% inorganic) of 0.86%. Among the cropping systems more or less similar value was recorded in all sequences. Improvement of soil organic carbon content was noticed with organic to the tune of 30.6% over inorganic. Available phosphorus in soil was higher in state recommendation of 68.4 kg/ha however, available potassium was maximum in integrated with application 75% nutrient through organic sources +25 inorganic input of 242.7 kg/ha. Among the copping systems, rice–mustard– green gram recorded higher available phosphorus (69.6 kg/ha) whereas, K was higher in basmati rice–broccoli –*sesbania* system of 262.7 kg/ha.

Thiruvananthapuram: In general, the pH and organic carbon status were improved due to the adoption of 100% organic input or towards organic practices. The pH and organic carbon content were higher in organic practices (100% organic and 75% organic + innovative) in all the four cropping systems (Fig. 11). The electrical conductivity was within the safe limits due to the management practice and cropping systems. In general, available N, P and K status of the soil at the end of the various cropping systems was higher under inorganic or state POP.

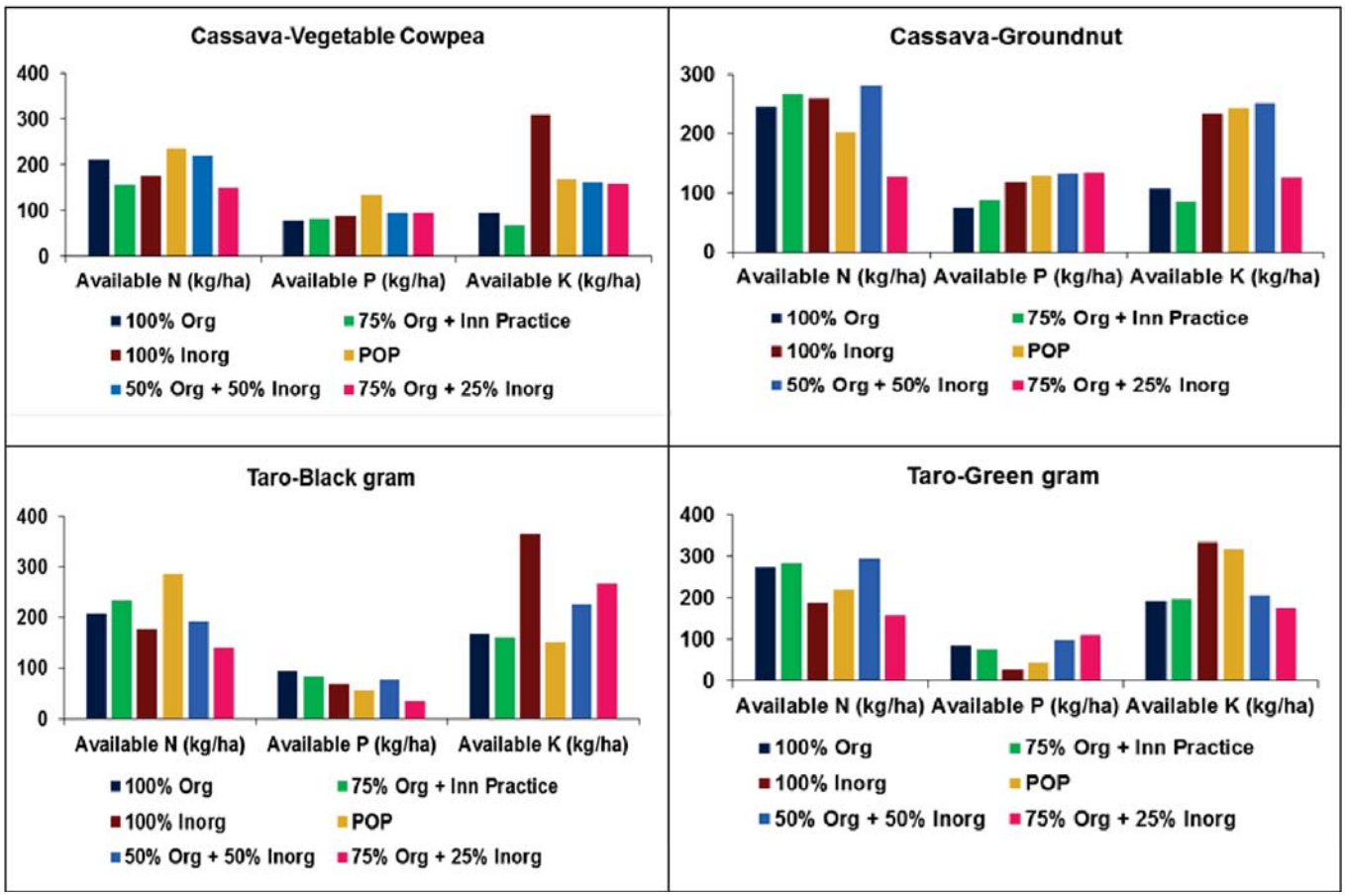


Fig. 12. Available N, P and K status of the soil under various management options in the different systems

Table 7.2.9: Influence of methods of organic, inorganic and integrated package on soil available micronutrients (Iron and Manganese) at the end of cropping cycle at different locations

Management practice/ Locations	Soil Available Iron (ppm)							Soil Available Manganese (ppm)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura (%)														
French bean (Kharif)-cauliflower-french bean (summer)	15.2	12.5	8.1	10.4	14.9	12.8	12.3	11.3	9.9	6.8	7.9	12.9	10.2	9.8
Fallow-cauliflower-tomato	15.8	12.9	9.8	11.2	14.2	13.3	12.9	12.1	10.2	6.5	8.9	12.8	10.3	10.1
Black gram-cauliflower - summer squash	18.0	14.3	8.9	11.6	17.2	15.1	14.2	11.4	8.2	6.1	7.2	11.2	10.0	9.0
Lady finger-pea	14.6	13.8	9.1	10.5	17.0	14.6	13.3	11.6	10.3	6.5	8.9	11.2	10.3	9.8
Mean	15.9	13.4	9.0	10.9	15.8	14.0		11.6	9.7	6.5	8.2	12.0	10.2	
Calicut														
Ginger - fallow	52.4	50.9	52.3	-	51.0	52.4	51.8	18.9	21.1	20.0	-	16.4	18.4	19.0
Turmeric-fallow	52.2	53.7	41.8	-	48.8	50.8	49.5	19.3	18.4	16.5	-	17.2	16.3	17.5
Black pepper-fallow	53.2	-	44.2	-	51.4	-	156.2	33.3	-	18.4	-	28.3	-	156.2
Dharwad														
Cowpea-safflower	16.3	15.9	12.5	14.9	15.1	13.8	14.7	22.6	19.8	17.0	15.4	21.3	18.6	19.1
Pigeon pea (sole)	16.5	15.5	12.7	13.2	14.8	12.8	14.2	22.4	19.2	14.6	16.2	18.2	16.5	17.8
green gram - sorghum	16.6	15.2	12.7	14.5	14.8	13.7	14.6	23.8	20.3	14.8	17.2	20.6	19.4	19.4
Groundnut + hybrid cotton (2:1)	15.4	14.8	12.9	13.4	14.0	13.4	14.0	17.1	18.3	14.7	14.4	19.3	19.8	17.3
Maize-chickpea	16.0	14.6	12.1	12.6	14.5	14.0	14.0	17.1	17.5	13.9	14.9	19.9	19.4	17.1
Mean	16.1	15.2	12.6	13.7	14.6	13.5		20.6	19.0	15.0	15.6	19.8	18.7	
Pantnagar														
Basmati rice-wheat	76.1	81.2	51.8	40.8	57.5	56.9	60.7	13.9	12.7	10.2	11.1	12.0	12.4	12.1
Basmati rice -chickpea (4rows+2rows coriander)	78.2	80.9	51.9	40.2	62.8	54.1	61.4	15.2	13.2	10.5	10.4	13.6	14.2	12.9
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	71.9	82.1	50.2	39.9	61.1	58.2	60.6	17.8	13.9	11.3	9.2	13.1	12.5	13.0
Basmati rice -potato	71.1	82.8	49.8	39.8	48.9	60.8	58.9	15.0	16.3	10.8	10.3	14.2	13.4	13.3
Mean	74.3	81.8	50.9	40.2	57.6	57.5		15.5	14.0	10.7	10.3	13.2	13.1	

Table 7.2.10: Influence of methods of organic, inorganic and integrated package on soil available micronutrients (Zinc and Copper) at the end of cropping cycle at different locations

Management practice/ Locations	Zinc (ppm)							Copper (ppm)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-cauliflower- french bean	3.98	2.88	1.95	1.98	3.12	2.94	2.81	2.20	1.75	1.02	1.50	2.38	2.19	1.84
Fallow-cauliflower-tomato	3.39	2.90	1.74	2.17	3.30	2.95	2.74	3.20	1.92	1.10	1.71	3.78	2.49	2.37
Black gram-cauliflower-summer squash	3.76	3.16	1.87	2.90	2.95	2.80	2.91	1.37	1.19	1.02	1.07	1.70	1.51	1.31
Lady finger-pea	3.57	2.62	1.96	2.42	3.14	2.79	2.75	3.55	2.18	1.04	1.50	3.93	2.52	2.45
Mean	3.68	2.89	1.88	2.37	3.13	2.87		2.58	1.76	1.05	1.45	2.95	2.18	
Calicut														
Ginger -fallow	3.60	3.20	3.70	-	2.30	2.10	3.0	12.80	3.20	2.30	-	2.10	2.40	4.6
Turmeric-fallow	2.60	5.00	1.50	-	2.30	1.90	2.7	2.70	2.60	1.50	-	2.30	1.90	2.2
Black pepper-fallow	6.90	-	3.60	-	6.00	-	5.5	13.80	-	8.40	-	12.70	-	11.6
Dharwad														
Cowpea-safflower	0.66	0.68	0.51	0.41	0.65	0.68	0.60	2.81	2.91	2.50	2.46	2.65	2.48	2.64
Pigeon pea (sole)	0.72	0.64	0.46	0.63	0.68	0.65	0.63	2.88	2.65	2.49	2.72	2.55	2.36	2.61
Green gram - sorghum	0.64	0.61	0.53	0.57	0.57	0.60	0.59	3.06	2.76	2.66	2.67	2.58	2.61	2.73
Groundnut + hybrid cotton (2:1)	0.67	0.59	0.47	0.48	0.60	0.50	0.55	2.61	2.82	2.51	2.58	2.45	2.60	2.59
Maize-chickpea	0.64	0.67	0.44	0.52	0.59	0.58	0.57	2.90	2.86	2.30	2.49	2.48	2.59	2.60
Mean	0.67	0.64	0.48	0.52	0.62	0.60		2.85	2.80	2.49	2.58	2.54	2.53	
Pantnagar														
Basmati rice-wheat	1.44	1.57	0.88	0.92	1.33	0.95	1.18	5.04	5.21	3.40	4.01	3.61	3.52	4.10
Basmati rice -chickpea (4rows+2rows coriander)	1.47	1.66	0.87	0.91	1.39	1.11	1.24	5.13	5.32	3.52	4.22	4.03	3.85	4.30
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	1.69	1.59	0.90	0.95	1.27	1.23	1.27	4.91	5.18	3.48	3.95	3.75	4.29	4.30
Basmati rice -potato	1.55	1.35	0.89	0.88	1.18	1.16	1.17	4.98	5.15	4.08	4.25	3.91	4.72	4.50
Mean	1.54	1.54	0.89	0.92	1.29	1.11		5.02	5.22	3.62	4.11	3.83	4.10	

Thiruvananthapuram: Organic practices or towards organic practices enhanced the secondary and micronutrient status of the soil after almost all cropping systems tested. Available Fe, Mn, and Zn contents were higher under 100% inorganic practice and available Cu in 50% organic + 50% inorganic practice in cassava-vegetable cowpea. Integrated practices resulted in higher micronutrient contents in cassava-groundnut system. In taro-black gram, organic and towards organic (75% organic + 25% inorganic) practices favoured available Fe, Mn, Zn and Cu status in the soil. In taro-green gram system, 75% organic + 25% inorganic practice resulted in higher Fe and Mn status in soil, whereas state recommendation practice resulted in higher Zn content and 100% inorganic practice resulted in higher Cu content in the soil.

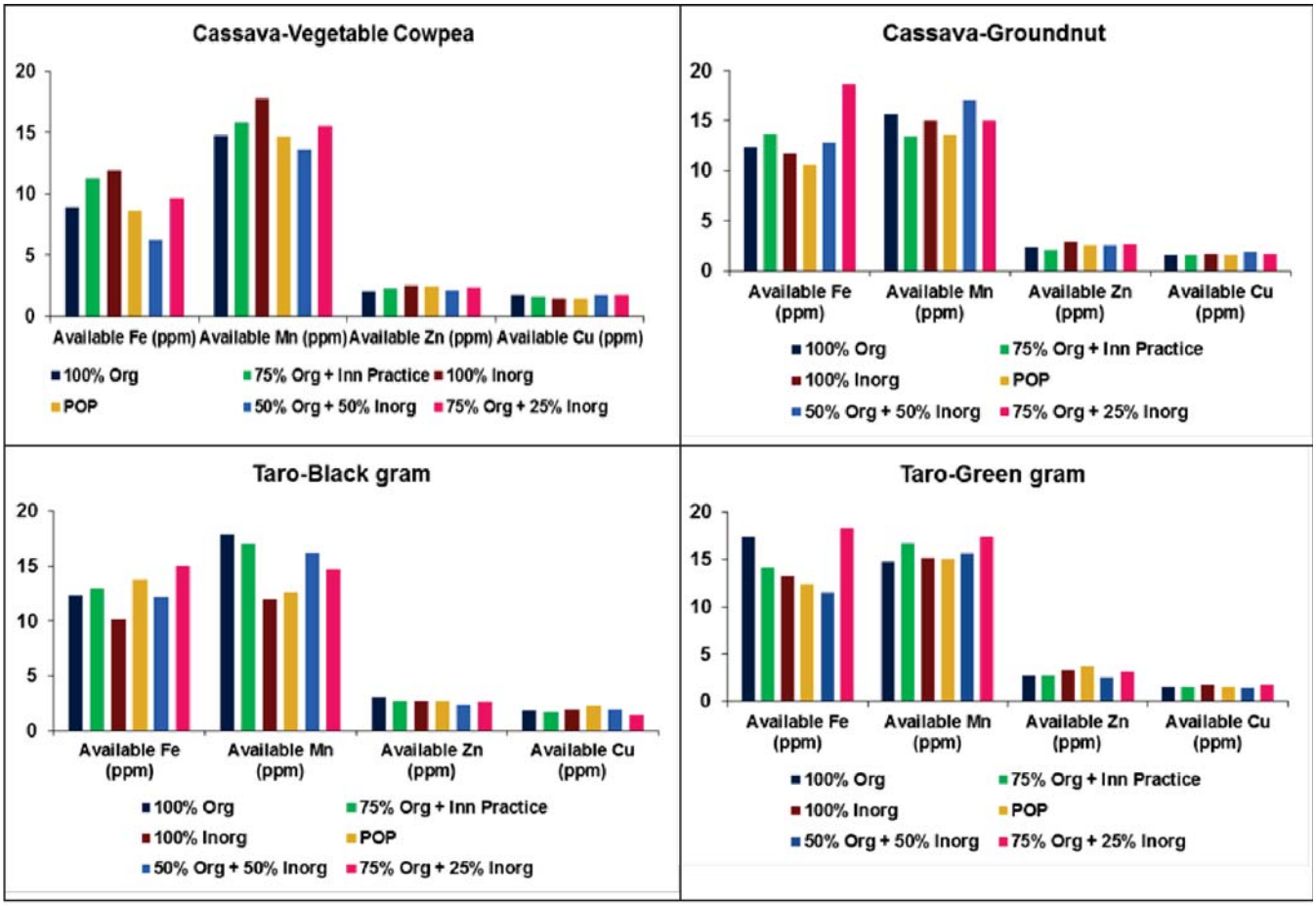


Fig. 13. Available S and micronutrient (Fe, Mn, Zn and Cu) status of the soil under various management options in the different systems

Influence of organic management package with reduced dose of organic manures, integrated and inorganic management packages on N, P and K and micronutrients uptake (Table 7.2.11&7.2.14)

Eight centres namely Bajaura, Calicut, Karjat, Pant Nagar, Raipur, Ranchi, Ajmer and Udaipur estimated the uptake of nutrients for all the crops evaluated influenced by management practice.

Bajaura: Effect of organic, inorganic and integrated nutrient management on uptake of major nutrients revealed that black gram-cauliflower-summer squash and cauliflower-tomato system uptake the maximum N, P and K under integrated management package and being on par to each other. The total N, P and K uptake among input management, these were also higher with integrated (50% organic+ 50% inorganic). Micronutrients, iron, manganese, zinc and copper uptake among cropping systems was recorded higher in integrated nutrient management consisting of 50% organic+ 50% inorganic or in 75% organic+25% inorganic nutrients inputs while, minimum being with 100% inorganic. Among different cropping systems and management practices, the uptake of Fe, Mn and Zn found to be higher in black gram-cauliflower-summer squash cropping system of 1738, 753,

692 and 276 g/ha respectively under integrated consisting of 50% organic + 50% inorganic nutrient inputs.

Calicut: In case of turmeric, nutrient uptake of N, P and K in turmeric rhizome was found to be higher under integrated either with 50:50 each organic and inorganic input or with 75 % organic manure +25% inorganic input.

Karjat: Uptake of nitrogen and phosphorus by *kharif* and *rabi* crops were found to be higher under organic with application of organic manure (100%) followed by integrated while potassium uptake in all the crops were higher under integrated consisting of 50:50 each organic and inorganic input.

Pant Nagar: During *kharif* in basmati rice, highest uptake of nutrient N was observed under integrated with 50% organic+50% inorganic practice followed by 75% organic input+25% inorganic (89.3 and 89.2 kg/ha) which was closely on par with each other. Uptake of P and K in basmati rice was also highest in integrated with 75 organic + 25 % inorganic (28.3 & 79.3 kg/ha respectively) followed by 50% organic + 50% inorganic (27.4 and 77.7 kg/ha respectively). During *rabi*, uptake of nitrogen (130.3 &127.7 kg/ha), phosphorus (48.8 & 53.4 kg/ha) and potassium (99.4 &101.9) by wheat recorded highest under integrated either with 75% organic input+25% inorganic or 50% each organic and inorganic input practice while nutrients N, P & K uptake in chickpea crop was maximum under organic either with 100% organic input practice or 75% organic input+ innovative organic practice (89.2 kg/ha).

Raipur: Uptake of macro nutrients by soybean crop, the highest uptake of N, P and K was recorded under organic consisting 75% organic input+ innovative practice (foliar spray of vermiwash 10%, cow urine (10%) at 20 days interval at 30 DAS and 50 DAS) which was significantly superior over rest of the nutrient management practices.

Ranchi: Total nitrogen uptake by rice crop was maximum (90.5 kg/ha) in the 75% organic + innovative practices followed by with 100% organic input practice (84.5 kg/ha) under organic. Similar trend was observed with P & K uptake. During *rabi*, the uptake of N, P and K in wheat was higher in inorganic package (75.3, 15 and 43 kg/ha respectively) and being on par with integrated with 75% input through organic source+25% through inorganic 71.4, 14 and 40.2 kg/ha respectively). In case of onion and potato both the crop removed maximum nutrients N, P & K from soil under organic input practice followed by integrated with 75% nutrient supply through organic sources +25% though inorganic. Okra recorded highest uptake of N, P and K in integrated with 75% organic + inorganic practices followed by inorganic.

Ajmer: Highest uptake of macronutrients i.e., N (18.51& 68.87 kg/ha), P (4.39 & 15.11 kg/ha) and K (15.12& 54.43 kg/ha) were recorded in coriander and fennel respectively under integrated with application of 75% Organic + 25% inorganic input followed by State recommendation. Spice crops coriander (45.6 & 24.2%) and fennel (32.1 & 29.6%) received higher N compared to organic and inorganic, respectively

Udaipur: In general, total N, P & K uptake by maize based intercropping system found to be higher under inorganic input practice followed by integrated input management. Other crop such as soybean, total uptake of N, P and K (64.55, 7.18 and 32.85 kg/ha, respectively) was found to be higher in 100% inorganic practices and the minimum (46.30, 5.27 and 24.18 kg/ha, respectively) in 100% organic management practices.During *rabi,* wheat *aestivam,* uptake of N and P (101.03 and 30.56 kg/ha) was found to be higher in 100% inorganic management practices whereas K (131.05 kh/ha) uptake was highest in state recommendation. However, wheat *aestivam* uptake of N and K (103.72 and 141.57 kg/ha, respectively) was recorded in state recommendation management practices whereasthe maximum total uptake (grain and straw) of P (33.36 kg/ha) was found in100% Inorganic practicesand the minimum total uptake of N, P and K (79.06, 24.89 and 110.29 kg/ha, respectively) in 100% organic management practices. In case of chick N was higher in state recommendation practice whereas, P & K found to be higher under inorganic practice. In case of fenugreek these nutrients i.e., N, P & K recorded higher also with state recommendation.

Table 7.2.11: Influence of organic, inorganic and integrated package on N uptake of crops and cropping systems

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Bajaura (%)																		
French bean (Kharif)-cauliflower- french bean (summer)	433.0	-	-	390.0	-	-	230.0	-	-	434.0	-	-	454.0	-	-	446.00	-	-
Fallow-cauliflower-tomato	440.0	-	-	428.0	-	-	301.0	-	-	435.0	-	-	615.0	-	-	551.00	-	-
Black gram-cauliflower - summer squash	477.0	-	-	405.0	-	-	346.0	-	-	411.0	-	-	632.0	-	-	527.00	-	-
Lady finger-pea	331.0	-	-	359.0	-	-	209.0	-	-	301.0	-	-	323.0	-	-	330.00	-	-
Calicut																		
Turmeric-fallow (kg/ha)	48.3			51.8			50.5			-			53.2			51.4		
Karjat																		
Rice-Brinjal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-Chickpea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-Field bean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-Onion (White)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	76.2	90.4		65.2	68.8		71.3	73.3		63.0	42.8		72.2	80.5		65.6	66.8	
Pantnagar																		
Basmati rice - wheat	78.7	110.8		73.3	101.4		79.6	127.3		67.4	118.8		82.0	130.3		85.5	127.7	
Basmati rice–chickpea (4 rows chickpea + 2 rows coriander)	88.9	82.8		88.5	78.4		75.7	70.1		80.9	75.4		95.4	76.9		94.7	75.8	
Basmati rice–vegetable pea (4 rows vegetable pea + 2 rows coriander)	95.2			92.9			65.6			78.0			89.3			91.3		
Basmati rice–potato	85.8			77.7			78.9			77.3			90.4			85.2		
Mean	87.2			83.1			75.0			75.9								

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Raipur																		
Soybean-maize	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-pea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-chilli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-onion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	144.6	-	-	150.4	-	-	128.5	-	-	140.9	-	-	120.8	-	-	123.2	-	-
Ranchi																		
Rice- wheat	86.8	64.9	-	94.4	62.6	-	70.4	75.3	-	66.2	55.4	-	79.8	68.5	-	81.3	71.4	
Rice - onion	81.0	81.8	-	88.1	67.7	-	66.8	56.1	-	59.9	36.7	-	74.7	71.1	-	75.4	78.7	
Rice- potato	91.0	50.3	-	95.1	41.9	-	75.6	27.7	-	64.7	21.8	-	83.2	40.9	-	83.1	49.5	
Rice - okra	79.2	72.2	-	84.4	58.7	-	67.2	77.8	-	57.8	36.4	-	73.3	76.6	-	74.2	87.7	
Mean	84.5			90.5			70.0			62.1			77.8			78.5	-	
New centres included from 2015-16																		
Ajmer																		
Green gram – fennel	53	-	-	58	-	-	52	-	-	66	-	-	59	-	-	69	-	-
Green gram-coriander	15	-	-	15	-	-	13	-	-	18	-	-	14	-	-	19	-	-
Cluster bean-fennel	53	-	-	58	-	-	52	-	-	66	-	-	59	-	-	69	-	-
Cluster bean–coriander	15	-	-	15	-	-	13	-	-	18	-	-	14	-	-	19	-	-
Udaipur																		
Maize + blackgram (2:2) – *sesbania* (GM)	62.4	79.1		62.2	93.0 –		79.6	102.1		62.6	103.7 durum		77.0	91.2		62.9	89.0	8 9 . 0 wheat
Blackgram – wheat	30.8	85.0		31.9	91.4		38.3	101.0		30.5	95.9		34.7	60.6		38.3	89.0	
Sweet corn + blackgram chickpea	83.4	34.4		83.7	39.9		111.9	45.3		89.5	46.6		98.6	39.1		83.1	34.9	3 4 . 9 (2:2)–
Soybean - fenugreek	46.3	101.0		47.8	109.5		64.6	114.0		60.1	119.0		61.7	105.6		57.3	93.9	

Table 7.2.12: Influence of inorganic, inorganic and integrated on P uptake of crops at different locations

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Bajaura (%)																		
French bean-cauliflower-french bean	-	59	-	-	52	-	-	26	-	-	60	-	-	63	-	-	59	-
Fallow-cauliflower-tomato	-	72	-	-	65	-	-	43	-	-	64	-	-	86	-	-	78	-
Black gram-cauliflower - summer squash	-	71	-	-	60	-	-	50	-	-	63	-	-	101	-	-	81	-
Lady finger-pea	-	37	-	-	40	-	-	25	-	-	38	-	-	43	-	-	42	-
Calicut																		
Ginger-fallow (%)																		
Turmeric-fallow (kg/ha)	26.6			26.2			206			-			26.1			26.6		
Karjat																		
Rice-Brinjal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-Chickpea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-Field bean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-Onion (White)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	14.1	16.0	-	12.4	13.4	-	13.3	15.7	-	6.8	10.0	-	14.6	15.8	-	12.2	14.4	-
Pantnagar																		
Basmati rice - wheat	19.7	36.7		20.6	36.7		24.7	46.4		25.6	44.7		25.3	48.8		23.3	53.4	
Basmati rice-chickpea (4 rows chickpea + 2 rows coriander)	22.4	35.8		29.1	32.7		24.4	28.2		23.8	28.1		29.6	32.5		28.5	31.8	
Basmati rice-vegetable pea (4 rows vegetable pea + 2 rows coriander)	27.5	-		29.0	-		25.4	-		20.0	-		27.0	-		34.4	-	
Basmati rice – potato	22.2	-		21.0	-		24.9	-		19.8	-		27.6	-		27.1	-	
Mean (BR)	23.0	-		24.9	-		24.9	-		22.3	-		27.4	-		28.3	-	

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Raipur																		
Soybean-maize	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-pea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-chilli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-onion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	18.3	-	-	18.3	-	-	15.7	-	-	17.6	-	-	14.7	-	-	15.3	-	-
Ranchi																		
Rice -wheat	16.1	12.5	-	16.8	11.7	-	12.5	15.0	-	10.2	10.6	-	13.7	13.2	-	14.4	14.0	-
Rice -onion	15.3	45.4	-	16.5	34.8	-	12.6	29.5	-	10.9	20.5	-	13.4	34.6	-	13.8	42.0	-
Rice -potato	17.1	40.5	-	18.3	37.2	-	13.7	23.3	-	11.0	19.4	-	15.4	36.8	-	15.0	38.3	-
Rice -okra	14.8	33.7	-	15.8	27.2	-	11.7	37.8	-	9.2	15.5	-	13.9	36.4	-	13.7	43.6	-
Mean	15.8			16.9			12.6			10.3			14.1			14.2	-	-
New centres included from 2015-16																		
Ajmer																		
Green gram – fennel	12			13			11			15			12			15		
Green gram - coriander	3			4			3			4			4			4		
Cluster bean - fennel	12			13			11			15			12			15		
Cluster bean – coriander	3			4			3			4			4			4		
Udaipur																		
Maize + blackgram (2:2) – durum wheat – *sesbania* (GM)	12.0	24.9		11.9	30.3		13.9	33.4		11.8	31.2		13.5	29.0		14.8	29.2	
Blackgram – wheat	4.4	25.4		4.5	27.4		5.4	30.6		4.6	29.2		5.0	27.1		5.4	27.4	
Sweet corn + blackgram (2:2) – chickpea	13.6	6.4		13.6	7.4		18.3	8.4		13.9	7.3		16.6	7.5		17.3	7.1	
Soybean - fenugreek	5.2	16.1		5.4	17.8		7.2	18.8		6.4	19.0		6.8	17.2		6.5	15.9	

Table 7.2.13: Influence of inorganic, inorganic and integrated on K uptake of crops at different locations

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Bajaura (%)																		
French bean-cauliflower-french bean	-	59.00	-	-	52.00	-	-	26.00	-	-	60.00	-	-	63.00	-	-	59.00	-
Fallow-cauliflower-tomato	-	72.00	-	-	65.00	-	-	43.00	-	-	64.00	-	-	86.00	-	-	78.00	-
Black gram-cauliflower - summer squash	-	71.00	-	-	60.00	-	-	50.00	-	-	63.00	-	-	101.00	-	-	81.00	-
Lady finger-pea	-	37.00	-	-	40.00	-	-	25.00	-	-	38.00	-	-	43.00	-	-	42.00	-
Calicut																		
Ginger-fallow (%)																		
Turmeric-fallow (kg/ha)	56.2			58.7			58.5			-			69.8			61.6		
Karjat																		
Rice-Brinjal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-Chickpea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-Field bean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rice-Onion (White)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	83.5	57.0	-	74.2	47.6	-	83.1	58.5	-	75.0	42.1	-	84.8	59.7	-	78.6	53.3	-
Pantnagar																		
Basmati rice - wheat	73.0	88.3		58.0	83.3		72.6	99.1		64.7	97.4		71.5	99.4		76.0	101.9	
Basmati rice–chickpea (4 rows chickpea + 2 rows coriander)	74.0	58.5		72.9	52.3		64.2	50.0		66.3	51.1		84.6	52.9		79.6	50.0	
Basmati rice–vegetable pea (4 rows vegetable pea + 2 rows coriander)	77.7	-		80.0			71.7			65.6			78.0			83.8		
Basmati rice – potato	69.5	-		70.3			67.8			61.5			76.6			77.9		

Locations/ Treatments	Organic						Inorganic						Integrated					
	100% organic			75% organic + innovtive organic practices			100% inorganic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Mean (BR)	73.6			70.3			69.1			64.5			77.7			79.3		
Raipur																		
Soybean-maize	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-pea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-chilli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soybean-onion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	60.0	-	-	60.8	-	-	54.9	-	-	54.3	-	-	51.4	-	-	51.4	-	-
Ranchi																		
Rice -wheat	75.8	36.5	-	80.9	34.9	-	61.8	43.0	-	56.5	29.7	-	70.1	38.6	-	67.8	40.2	
Rice -Onion	66.9	119.5	-	71.7	100.2	-	65.1	93.6	-	59.6	70.6	-	64.5	98.6	-	63.3	115.6	
Rice -potato	78.1	90.0	-	81.3	82.1	-	66.0	57.1	-	53.4	52.1	-	69.2	77.9	-	67.5	83.5	
Rice -okra	67.8	79.2	-	74.1	64.1	-	57.8	86.0	-	51.7	40.9	-	63.1	84.1	-	63.3	97.5	
Mean	72.2			77.0			62.7			55.3			66.7			65.5	-	
New centres included from 2015-16																		
Ajmer																		
Green gram – fennel	42			45			43			52			47			54		
Green gram - coriander	12			13			10			14			11			15		
Cluster bean - fennel	42			45			43			52			47			54		
Cluster bean – coriander	12			13			10			14			11			15		
Maize + blackgram (2:2) – durum wheat – *sesbania* (GM)	61.4	110.3		61.7	129.6		76.9	138.0		66.1	141.6		76.9	129.3		89.9	125.5	
Udaipur																		
Blackgram – wheat	14.0	108.5		14.4	115.6		17.3	126.0		15.9	131.1		15.3	115.1		17.1	112.4	
Sweet corn + blackgram (2:2) –chickpea	72.5	31.3		70.0	35.0		90.2	38.3		75.5	35.6		78.3	35.8		84.3	34.3	
Soybean - fenugreek	24.2	54.1		25.7	58.6		32.9	61.1		29.8	63.9		30.2	56.6		28.4	50.7	

Table 7.2.14: Influence of organic, inorganic and integrated nutrient management on micronutrients uptake (Fe, Mn, Zn and Cu) uptake (kg/ha) by different crops at Bajaura

	Organic		Inorganic		Integrated			Organic		Inorganic		Integrated		
	100% Organic	75% Organic+Innovative Organic practice	100% Inorganic	State recommendation	50% Organic + 50% inorganic	75% Organic + 25% Inorganic	Mean	100% Organic	75% Organic+Innovative Organic practice	100% Inorganic	State recommendation	50% Organic + 50% inorganic	75% Organic + 25% Inorganic	Mean
	Fe							(Mn)						
French bean (Kharif)-cauliflower- french bean (summer)	984	873	422	805	855	822	794	215	214	90	178	184	178	177
Fallow-cauliflower-tomato	1056	1007	579	907	1366	1197	1019	471	460	269	439	615	531	464
Black gram-cauliflower-summer squash	1235	1045	717	1083	1738	1410	1205	549	449	278	473	753	583	514
Lady finger-pea	545	571	303	483	558	568	505	284	289	140	255	302	287	260
Mean	955	874	505	820	1129	999		380	353	194	336	464	395	
				(Zn)							(Cu)			
French bean-cauliflower-french bean	249.0	223.0	76.0	184.0	202.0	181.0	185.8	117.0	95.0	35.0	68.0	88.0	76.0	79.8
Fallow-cauliflower-tomato	450.0	387.0	199.0	344.0	565.0	466.0	401.8	202.0	172.0	92.0	153.0	239.0	208.0	177.7
Black gram-cauliflower-summer squash	495.0	452.0	275.0	415.0	692.0	503.0	472.0	221.0	186.0	98.0	156.0	276.0	240.0	196.2
Lady finger-pea	199.0	201.0	91.0	166.0	202.0	184.0	173.8	179.0	188.0	57.0	118.0	141.0	152.0	139.2
Mean	348.3	315.8	160.3	277.3	415.3	333.5		179.8	160.3	70.5	123.8	186.0	169.0	

Soil Microbial population as influenced by the different management practices (Table 7.2.15 and 7.2.16)

Bajaura: In general, the organic management practice improved soil microbial properties irrespective of cropping systems compare to inorganic and integrated practice. At the end of cropping cycle, microbial bacteria (21.6 log cfu/g) recorded maximum in lady finger-pea system in organic management practice. Fungi (18.1 log cfu/g) was maximum in french bean (Kharif)-cauliflower- french bean (summer) system also with organic management practice. Actinomycetes (18.7 log cfu/g) and phosphatase activity (20 µg/g/hr) were in black gram-cauliflower- summer squash and ladyfinger-pea system. Microbes with organic found to be higher by 61.4, 35.9, and 56% for bacteria, fungi, and actinomycetes respectively compared to inorganic package.

Dharwad: Higher bacteria and fungi population was maximum under organic consisting of 100% organic inputs (93.6 and 9.7 log cfu/g). Actinomycetes recorded higher (40.1 and 38.5 log cfu/g) with inorganic. Among the cropping systems, cowpea-safflower and pigeon pea sole recorded higher bacteria and fungi population while actinomycetes in soil was maximum in maize-chickpea.

Jabalpur: Adoption of organic input practice either fully (100% organic) or reduced dose (75% organic +innovative organic practice) exhibited improvement in microbial population in the soil *viz*. fungi, bacteria, actinomycetes and PSB. Microbial count of fungi, bacteria, and actinomycetes were with organic, practice and these were increased by 85.1, 53.7 and 123% over inorganic respectively. Among the cropping systems, basmati-rice-wheat-green manure system recorded 60.2,49.2 and 18.6 log cfu/g respectively higher compared to other systems.

Narendrapur: Application of organic nutrient consisting of 75% organic+25% innovative organic practice resulted in higher microbial population in the soil *viz*. fungi, bacteria and actinomycetes. Population of bacteria (25 log cfu/g), fungi (16.8 log cfu/g) and actinomycetes (30.9 log cfu/g) with 75% organic +innovative practices under organic management was increased to the tune 107, 84.6 and 92.0% for bacteria, fungi and actinomycetes of compared to inorganic management, respectively. Among the cropping systems, basmati rice-broccoli-*sesbania* green manure recorded higher bacteria and actinomycetes while paddy-capsicum-green gram recorded maximum fungi count in the soil at the end of crop cycle.

Thiruvanthapuram: Bacterial count was higher in either by 100% organic or 75% organic + 25% inorganic in all the cropping systems, except cassava-groundnut, in which integrated (50% organic + 50% inorganic practice) recorded higher bacterial count. The fungal and actinomycete counts were mostly higher under state recommendation or inorganic practices. However, in cassava-groundnut system, the actinomycete count was higher in 75% organic + 25% inorganic practice.

Table 7.2.15: Rhizosphre microbial population (Bacteria and Fungi micro-organisms) in soil as influenced by the different nutrient practices and cropping systems

Locations/Treatments	Bacteria (x10^6 cfu/g)							Fungi (x10^6 cfu/g)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
French bean -Cauliflower-French bean	21.5	18.3	12.7	16.4	17.0	19.5	17.6	18.1	16.8	13.0	17.0	16.4	17.3	16.4
Fallow-Cauliflower-Tomato	20.0	17.9	12.8	16.2	18.5	17.9	17.2	17.9	16.7	13.0	16.8	16.4	17.1	16.3
Black gram-Cauliflower-Summer squash	18.9	16.2	12.5	16.4	16.6	18.8	16.6	17.5	16.0	13.3	17.1	17.4	17.8	16.5
Lady finger-Pea	21.6	18.4	12.8	16.5	16.8	18.9	17.5	17.7	16.0	13.2	15.9	17.1	17.7	16.3
Mean	20.5	17.7	12.7	16.4	17.2	18.8		17.8	16.4	13.1	16.7	16.8	17.5	
Dharwad														
Green gram/Cowpea-safflower	119.7	59.3	66.7	84.7	67.7	25.0	70.5	14.7	4.0	10.0	11.7	10.0	9.3	9.9
Pigeon pea (sole)	143.7	41.0	61.3	49.3	68.0	52.0	69.2	8.0	8.3	17.0	13.7	9.3	2.0	9.7
Green gram - sorghum	75.3	71.3	81.0	57.0	43.7	78.0	67.7	9.3	15.3	5.7	5.3	6.3	6.3	8.1
Groundnut +hybrid cotton (2:1)	70.0	51.3	85.0	96.3	47.3	35.3	64.2	8.3	11.7	8.3	3.7	9.7	9.3	8.5
Maize-chickpea	59.3	53.0	44.7	56.3	45.3	54.7	52.2	8.3	9.0	6.3	5.7	7.3	6.0	7.1
Mean	93.6	55.2	67.7	68.7	54.4	49.0		9.7	9.7	9.5	8.0	8.5	6.6	
Jabalpur														
Basmati rice – wheat (durum) – green manure	73.1	70.5	50.2	47.9	58.9	60.5	60.2	58.6	57.2	37.6	36.1	51.9	54.0	49.2
Basmati rice – chickpea – maize fodder	68.7	65.6	45.6	47.9	54.5	55.6	56.3	57.3	56.0	36.7	34.8	44.6	46.6	46.0
Basmati rice – berseem (fodder and seed)	68.3	68.4	44.6	45.7	59.0	60.4	57.8	59.3	56.9	37.9	36.1	47.7	50.8	48.1
Basmati rice – vegetable pea–sorghum (fodder)	71.1	69.6	49.8	49.0	57.7	60.7	59.7	57.4	55.6	38.9	36.9	45.2	47.4	46.9
Mean	70.3	68.5	47.6	47.6	57.5	59.3		58.1	56.4	37.8	36.0	47.4	49.7	
Narendrapur														
Basmati rice–broccoli – *sesbania* green manure	25.7	31.8	10.6	11.8	23.0	19.9	20.5	12.1	14.9	7.1	7.2	10.7	11.1	10.5

Locations/Treatments	Bacteria (x10^6 cfu/g)							Fungi (x10^6 cfu/g)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Paddy– mustard– green gram	19.6	21.9	11.2	12.6	19.4	16.8	16.9	14.2	18.3	8.2	8.9	13.8	11.6	12.5
Paddy– capsicum– green gram	24.1	25.4	14.8	13.2	23.5	21.0	20.3	17.4	19.6	12.6	11.6	15.5	16.7	15.6
Paddy –french bean – sesame	20.0	20.7	11.9	10.5	16.3	16.2	15.9	13.0	14.3	8.6	9.5	11.5	12.6	11.6
Mean	22.4	25.0	12.1	12.0	20.6	18.5		14.2	16.8	9.1	9.3	12.9	13.0	
Thiruvananthapuram														
Cassava-veg. cowpea	19.3	10.3	12.7	3.7	9.0	15.0	11.7	8.0	5.3	6.0	11.7	10.3	20.7	10.3
Cassava-groundnut	13.7	18.0	15.7	1.7	24.3	12.7	14.4	10.3	10.3	13.0	11.3	7.7	11.0	10.6
Taro-black gram	14.7	7.7	15.0	28.0	39.3	123.3	38.0	3.3	4.3	7.0	21.3	1.3	2.3	6.6
Taro-greengram	310.0	140.7	26.7	16.3	84.0	317.7	149.2	45.3	11.7	54.3	61.3	17.7	27.7	36.3
Mean	89.4	44.2	17.5	12.4	39.2	117.2		16.7	7.9	20.1	26.4	9.3	15.4	

Table 7.2.16: Rhizosphre microbial population (Actinomycetes and phosphate solubilizing micro-organisms) in soil as influenced by the different nutrient practices and cropping systems

	Soil actinomycetes (x10^3 cfu/g)							Phosphate solubilizing bacteria (x10^4 cfu/g)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
French bean (Kharif)-cauliflower - french bean (summer)	17.6	15.2	11.3	15.2	15.6	16.3	15.2	18.9	16.1	13.3	16.0	16.2	17.1	16.3
Fallow-Cauliflower-Tomato	17.4	15.7	11.0	14.6	15.4	16.5	15.1	18.1	15.7	13.8	17.0	16.8	17.0	16.4
Black gram-Cauliflower-Summer squash	18.7	17.2	11.2	15.9	16.2	17.2	16.1	19.9	16.0	13.9	16.0	16.7	17.2	16.6
Lady finger-Pea	16.4	15.3	11.3	15.8	16.3	17.0	15.4	20.0	16.3	14.0	16.1	16.3	17.1	16.6
Mean	17.5	15.9	11.2	15.4	15.9	16.8		19.2	16.0	13.8	16.3	16.5	17.1	

	Soil actinomycetes (x10³ cfu/g)							Phosphate solubilizing bacteria (x10⁴ cfu/g)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Dharwad														
Cowpea-safflower	21.7	32.7	27.0	43.3	25.3	40.3	31.7	2.3	16.0	8.0	4.7	12.7	15.0	9.8
Pigeon pea (sole)	47.7	40.3	41.3	34.0	26.7	38.3	38.1	9.0	6.3	7.3	13.7	16.7	9.3	10.4
Green gram - sorghum	37.7	18.0	41.0	31.3	11.7	28.3	28.0	4.7	27.0	17.7	6.0	7.3	9.7	12.1
Groundnut +hybrid cotton (2:1)	18.7	32.3	40.3	47.7	23.3	31.7	32.3	8.7	25.7	16.3	6.3	11.7	13.7	13.9
Maize-chickpea	47.3	50.3	51.0	36.0	30.0	32.0	41.1	10.7	5.3	11.7	4.3	1.3	10.7	9.0
Mean	34.6	34.7	40.1	38.5	23.4	34.1		7.1	16.3	12.2	7.0	11.9	11.7	
Jabalpur														
Basmati rice – wheat (durum) – green manure	25.5	24.6	15.7	8.4	17.7	19.4	18.6	24.6	24.5	18.4	16.7	21.4	21.2	21.1
Basmati rice – chickpea – maize fodder	24.4	20.9	7.8	6.7	17.0	18.2	15.8	25.7	22.7	15.8	15.6	16.4	18.5	19.1
Basmati rice – berseem (fodder and seed)	19.4	21.6	7.8	6.6	17.4	18.4	15.2	23.3	19.9	13.3	11.9	16.5	17.4	17.1
Basmati rice – vegetable pea –sorghum (fodder)	20.0	16.9	8.6	7.4	18.2	19.7	15.1	22.7	21.1	14.0	12.3	21.5	24.6	19.4
Mean	22.3	21.0	10.0	7.3	17.6	18.9		24.0	22.1	15.4	14.1	19.0	20.4	
Narendrapur														
Basmati rice–broccoli – *sesbania* green manure	34.6	37.9	22.7	22.0	31.5	34.8	30.6	-	-	-	-	-	-	-
Paddy– mustard– green gram	26.6	26.1	12.9	15.5	19.4	21.1	20.3	-	-	-	-	-	-	-
Paddy– capsicum– green gram	28.1	29.8	12.8	14.1	22.2	22.6	21.6	-	-	-	-	-	-	-
Paddy –french bean – sesame	28.9	29.7	16.1	15.3	24.0	25.2	23.2	-	-	-	-	-	-	-
Mean	29.5	30.9	16.1	16.7	24.3	25.9		-	-	-	-	-	-	
Thiruvananthapuram														
Cassava-veg. cowpea	1.00	1.30	2.00	1.70	1.30	1.30	1.43	-	-	-	-	-	-	-
Cassava-groundnut	1.00	2.00	0.70	1.30	7.30	10.30	3.77	-	-	-	-	-	-	-
Taro-black gram	1.00	2.00	2.70	0.30	2.70	1.00	1.62	-	-	-	-	-	-	-
Taro-greengram	0.30	0.70	1.00	3.00	0.70	1.00	1.12	-	-	-	-	-	-	-
Mean	0.83	1.50	1.60	1.58	3.00	3.40		-	-	-	-	-	-	

Effect of different management systems (Organic, inorganic and integrated) on quality aspects of organic produce (Table 2.7.17)

Bajaura: Quality parameters protein, TSS (^{0}brix) and vitamin C in different vegetable crops namely frenchbean, black gram, tomato, pea and cauliflower were estimated. In general, protein content among the various input practice observed slightly numerically higher under organic nutrient management, although in pea, protein was better in integrated. Tomato and pea recorded maximum TSS content with integrated consisting of 50% each input through organic and inorganic practice. The highest vitamin C content of tomato fruits (35.5 mg/100g) was recorded in integrated consisting of 75% Organic + 25% Inorganic nutrients however, the vitamin C content in cauliflower curds across the cropping systems was highest under 100% Organic management package of 47.3 mg/100g.

Bhopal: Although, nutritional quality constituents in soybean, wheat and mustard did not influence significantly due to different nutrient management practices but all the quality parameters *viz*. protein, oil, methionine and tryptophan content percent in soybean, protein, globulin, ash and gluten percent in wheat and phenol and glucosinolate in mustard crop were maximum in organic either with 100% organic or in 75% organic and 25% innovative organic practice as compared to other nutrient management practices.

Calicut: In turmeric, curcumin, oleoresin and oil content was higher in organic management followed by with 75% nutrient through organic manure+25% innovative practice. Under organic input practice, the curcumin content was 8.5% high than inorganic. Oil and oleoresin content in black pepper recorded higher under inorganic while, peperine% content being maximum with integrated (50% organic+50%inorganic input practice).

Coimbatore: All the quality parameter in chilli and tomato did not differ significantly due to various input management package. Ascorbic acid (225.3 mg/100g) and TSS (5.4 Brix) in chilli was higher under organic input practice. Lycopene content (4.1 mg/g) in tomato found to be higher under integrated with application of 50% each input through organic and inorganic source. however, ascorbic acid (43.2 mg/100g) and TSS (4.7 Brix) was higher under organic practice, but these were on par to other management practices.

Ranchi: Nutritional quality constituents such as protein and moisture did not significantly differ due to production practice. Protein and moisture in rice was higher in organic production management either with 100% organic manure or with 75% organic + 25% innovative practice compared to inorganic. In case of wheat, reverse was recorded wherein protein and moisture was found to be higher in inorganic 100% followed by state recommendation.

Ajmer: Quality parameters such as protein and essential oil in coriander and fennel crops were not influenced by various nutrient management practices and, both are observed higher in integrated with 75% organic + 25% inorganic followed by inorganic with state recommendation that was on par with organic management package.

Influence of organic, inorganic and integrated management packages on economics of different crops and cropping systems Table (7.2.18 and 19)

Bajaura: Gross return was significantly higher (81.7%) with organic input practice followed by integrated (83.5%) over inorganic package. Although, cost of cultivation was higher under organic and integrated, the increase in net return was 306 and 245% higher with organic and integrated over inorganic. Among the cropping system, blackgram-cauliflower-summer squash gave the highest gross return and net return under organic package with 75% nutrient through manure + innovative organic practice followed by 100% organic practice. All the systems registered higher B:C ratio with organic practice and among the systems, cauliflower-tomato system recorded higher B:C ratio 1.06

Bhopal: Organic production package by application of 100% organic input followed by integrated (75% nutrient through manure + 25% inorganic) recorded maximum gross returns (Rs. 127557 and 127028/ha), net returns (Rs 53362 and 52812/ha) and benefit cost ratio (2.1 and 2.08) respectively as compared to inorganic management. Among the cropping systems, soybean-mustard recorded maximum net return (Rs 53281/ha) and B:C ratio of 2.11.

Calicut: Gross return and net return of turmeric (Rs. 4,14,003 and 2,45,657) was highest with organic consisting of 75% organic nutrient +innovative organic practice while B:C ratio found to be higher under integrated followed by organic management over inorganic. Organic input practice gave 18.9 and 42.5% higher return over inorganic.

Table 7.2.17: Influence of organic, inorganic and integrated package on quality of crops at different locations

Locations	Crops	Quality parameter	Organic		Inorganic		Integrated	
			100% organic	75% organic + innovative organic practices	100% inorganic	State recommen-dation	50% organic + 50% inorganic	75% organic+ 25% inorganic
Bajura	French bean (*kharif*)	Protein %	14.2	14.0	13.5	13.8	14.0	13.8
	Black gram		14.0	13.8	13.4	14.0	14.2	14.0
	French bean (*summer*)		14.2	14.0	13.6	14.0	14.2	14.0
	Pea		20.6	20.4	20.0	20.8	20.2	20.8
	Tomato (*summer*)	TSS (^{0} Brix)	5.4	5.2	4.4	5.5	5.6	5.4
	Pea		16.2	15.8	13.5	17.2	17.0	15.8
	Tomato	Vitamin C (mg/100g)	35.0	34.5	30.2	32.0	34.6	35.5
Bhopal	Cauliflower		47.3	45.2	42.2	44.8	46.4	45.2
	Soybean	Protein %	36.3	36.1	35.3	35.1	35.9	36.2
		Oil (%)	18.0	18.0	17.9	17.9	18.0	17.9
		Methionine (g/16gN)	1.7	1.7	1.7	1.7	1.7	1.7
		Tryptophan (g/16gN)	1.9	1.8	1.8	1.8	1.8	1.9
	Wheat	Protein %	11.9	11.6	11.6	11.7	11.6	11.8
		Globulin %	24.5	24.0	23.7	23.7	23.8	24.2
		Ash%	1.8	1.7	1.6	1.7	1.7	1.7
		Gluten%	17.2	17.2	16.9	17.0	16.9	17.0
Calicut	Turmeric	Curcumin (%)	5.1	5.0	4.7	-	4.9	4.8
		Oleoresin (%)	12.7	13.6	12.3	-	12.4	13.5
		Oil content (%)	5.3	5.3	5.2	-	5.2	5.2
	Black pepper	Oil (%)	3.0	-	3.3	-	3.1	-
		Oleoresin (%)	8.2	-	8.8	-	8.6	-
		Piperine (%)	5.0	-	5.4	-	5.6	-
		Fresh yield (g/pl)	2.1	-	1.4	-	1.8	-
Coimbatore	Chilli	Ascorbic acid (mg/100g)	225.3	211.1	224.1	213.7	205.9	215.9
		TSS (Brix)	5.4	4.6	4.8	5.1	5.0	5.1
	Tomato	Lycopene content (mg/g)	3.6	3.1	3.6	3.8	4.1	3.4
		Ascorbic acid (mg/100g)	32.3	43.2	40.6	36.0	41.9	46.3
		TSS (Brix)	4.5	4.7	4.7	4.5	4.7	4.4
Ranchi	Rice	Protein (%)	9.2	9.4	9.1	8.9	9.1	9.2
		Moisture (%)	14.3	14.1	14.0	14.0	14.0	14.0
	Wheat	Protein (%)	11.3	11.2	11.5	11.2	11.4	11.3
		Moisture (%)	10.1	10.2	10.3	10.2	10.2	10.2
Ajmer	Coriander	Protein (%)	15.5	14.9	15.0	16.3	14.9	16.4
		Essential oil (%)	0.3	0.3	0.3	0.3	0.3	0.3
	Fennel	Protein (%)	17.4	17.6	16.5	18.0	17.1	18.4
		Essential oil (%)	1.4	1.3	1.4	1.4	1.4	1.4

Coimbatore: Among the production systems, not much variation was observed in respect of gross return however, maximum gross return, net return and benefit cost ratio was recorded in organic or towards organic approach i.e. integrated management consisting of 50% each organic + inorganic or by 75% organic+25% inorganic. Higher net return in organic with 75% organic +innovative organic practice due to the lower cost of cultivation over inorganic. Cropping system brinjal-pearl millet-green manure found more profitable in term of net return for Rs.199,979/ha and it is higher by 94.2 and 243% than tomato-finger millet-green manure and chili-barnyard green manure system. Though lower cost of cultivation of Rs.18,588 /ha was under inorganic management resulted higher B:C ratio of 2.77 among the production systems but being on par with integrated.

Dharwad: Among the production package, gross return although recorded high under organic input package however, production practices involving recommended dose of inorganic fertilizers recorded higher net return and B:C ratio (Rs.70,996/ha and 2.93, respectively) in maize-chickpea system followed by sorghum-green gram which obtained of Rs 56,995/ha as net return and 2.79 0f B:C ratio.

Jabalpur: Organic nutrient input practice recorded only 3.5% higher gross return along with 50% high cost of cultivation over inorganic. Among the input nutrient packages, inorganic resulted in high net return and befit cost ratio of Rs. 1,22,666 and 2.86 respectively. Reduction in net return with organic was 8.6% over inorganic. Among the cropping systems, basmati rice – berseem (fodder and seed) recorded higher net return (Rs.1,85,126/ha) and benefit cost ratio (4.15) under inorganic management.

Karjat: Application of 100% organic input resulted in significantly higher gross and net returns as compared to other production systems followed by adoption of 75% organic + innovative organic practices. Though the net returns were higher under 100% organic package, but the B:C ratio were significantly higher with inorganic package followed by 100% organic and adoption of 75% organic + Innovative organic practices. Among the cropping systems, higher net returns of Rs 5,72,749 and 3,53,738/ ha and B:C ratio (3.10 and 2.88) were observed in rice-brinjal and rice-onion system respectively under organic package as compared to other cropping systems. Both the system found highest profitable among the systems.

Ludhiana: Though the cost of cultivation was higher under organic input practice (23.7%) due to the higher gross return (24.5%). Significantly higher increase in net return was obtained with organic (20.5 and 26.4%) over inorganic practice. Benefit cost ratio did not much differ due to the input practice however, integrated package consisting of 50% each input through organic and inorganic recorded marginally higher B:C ratio of 2.11 followed by organic of 2.09. In case of cropping systems, basmati rice-wheat-green manure system recorded maximum gross return and net return of Rs 2,24,495/ha and Rs 1,22,498/ha respectively with 75% organic +innovative organic practice although benefit cost ratio of 2.53 in this system being under integrated due to the lower cost of cultivation. Cluster bean-wheat-summer moong system being the next performing system which recorded net returns of Rs.1,19,145/ha with benefit cost ratio of 2.13 across the input packages.

Modipuram: Among the management practices, organic management package with 100% organic input application through manure recorded 46.7% higher net return. Among the cropping system, maize (popcorn) - potato- okra recorded maximum return (1,25,384/ha) with organic package and found more profitable. It is higher by 37, 44.6 and 54% than maize (sweet corn)-mustard-green manure *sesbania,* basmati rice-wheat-*sesbania* and rice-barley-green gram respectively.

Pantnagar: Increase in net return by adoption of organic practice through application of 75% organic +innovative practice and integrated nutrient management found to be 34.5 and 14%over inorganic. Benefit cost ratio also followed the same trend with organic practice recording 3.63. Among the cropping systems, basmati rice-chickpea +coriander (4:2) recorded significantly higher net return of Rs. 2,56,880/ha and B:C ratio 3.91. It was higher by 66, 35.1, and 47.6% than basmati rice -vegetable pea coriander (4:2), basmati rice-potato and basmati rice-wheat system respectively in term of net return.

Raipur: The of cost of cultivation with organic and integrated package was found to increase by 22.1 and 9.5% over inorganic. Although net return increased significantly 45.8 and 69.8% under organic consisting of 75% organic input application +innovative organic practice followed by 100% organic owing to higher gross return which was also increase to the tune of 38 and 52.5% respectively in same treatment. B:C ratio followed the same trend. Among different cropping system, the maximum net return and benefit cost ratio (Rs 2,09,052/

ha and of 3.38) was obtained in soybean-maize followed by soybean-chili (Rs 1,63,863/ha and 3.05).

Ranchi: Adoption of organic package with 100% organic input and 75% organic manure +innovative practices produced higher net return and benefit cost ratio followed by integrated either by with 50:50% organic and inorganic or towards organic by 75% organic manure +25% inorganic. Organic and integrated package recorded increase in gross return by 55.7 and 14.3% respectively over inorganic. Owing to higher gross return, an increase in net return by 58 and 9.4% recorded with organic and integrated however marginal difference was observed in B:C ratio of 2.5% between organic and inorganic. Rice-Onion system recorded higher net return (1,12,924/ha) and B:C ratio (1.58) Among cropping systems, rice-potato being the second-best performing system in term of net return (Rs1,12,521/ha) with benefit cost ratio of 1.25.

Umiam: Maximum net returns were recorded in broccoli-tomato cropping system (Rs. 3,23,143/ha) followed by broccoli-carrot (Rs. 3,14,008/ha) and broccoli-French bean (Rs. 2,60,675/ha). Application of 100% organic management practice recorded the highest average net return (Rs. 2,98,420/ha) followed by integrated management (50% organic + 50% inorganic) (Rs. 2,90,256/ha) and 75 % organic management + 2 vermiwash sprays (Rs. 278668/ha).

Ajmer: State recommendation followed by Integrated input package recorded maximum gross return of 1,54,392 and 1,34,664 respectively. Net returns and B:C ratio of recorded higher under integrated with 75% input through organic sources+25% through inorganic of Rs 98,623/ha and 3.74 respectively. A decrease in net return with organic 29.4% and 41.3% over inorganic and integrated respectively was observed. Among cropping systems, fennel with cluster bean and green gram performed better in term of net monetary return.

Gangtok: Highest net return was recorded under maize + ginger-french bean (2,36,600 '/ha without premium prices followed by maize + turmeric – rajmash (1:1) cropping system (2,07,.200 '/ha) resulting both the system gave 173.2 and 139.3% more net returns than the lowest maize-black gram- Toria system (86,600 '/ha). Among the nutrient sources, highest gross return was recorded under 100% N equivalent though organics (25% FYM+25% VC+25% NK+25% MC) of 3,34,700 '/ha. Similar trend was followed in the net return and NRPRI with or without premium prices of both nutrient sources and cropping systems. On the other hand, the lowest return and NRPRI ratio was recorded in farmer's practice in nutrient sources and maize-soybean-buckwheat cropping system.

Narendrapur: Gross return was significantly higher (51.6%) with organic input practice followed by integrated (27.8%) over inorganic package. Although, cost of cultivation was higher under organic and integrated, the increase in net return was 45.6 and 13.7% higher with organic and integrated over inorganic. Among the cropping system, rice-capsicum-green gram gave the highest gross return and net return of (3,39,234 and2,01969 '/ha). All the systems registered higher B:C ratio with organic practice and among the systems, paddy– mustard– green gram system recorded higher B:C ratio 1.51 and closely with rice-capsicum-green gram of 1.50

Sardarkrushinagar: All the cropping systems recorded higher gross and net return under organic followed by 75% input through organic sources + innovative practice. Net return was higher with organic (17.8%) whereas reduction under integrated with 500% each input of organic and inorganic was found by 3.3%, significant reduction with 75% N equivalent through organic+ 25% inorganic recorded to the tune of 41.2%. compared to inorganic package. Benefit cost ratio was higher under inorganic due the lower cost of cultivation than organic. Among the cropping systems, Groundnut- Wheat- Green gram system recorded higher net return of Rs. 1,20,896/h and while in term of net return per rupee invested (1.24), green gram-Cumin- vegetable cowpea gave maximum being the best performer

Thiruvananthapuram: Among the various cropping systems, cassava followed by groundnut recorded highest net return of Rs 3.13.418/ha and found to more remunerative. In case of taro-based systems, taro followed by black gram system recorded higher net return of Rs. 1,58,410/ha under organic with premium price.

Udaipur: Al the four cropping systems performed better under inorganic for gross return, net return and benefit cost ratio due to the lower cost of cultivation compared to organic input practice. Organic and integrated practice recorded 17.2 and 50% lower gross and net return respectively. Among four cropping systems evaluated under different management practices Maize + black gram (2:2) – durum Wheat – sesbania (GM) recorded maximum net return (Rs1,14254/ha) with B:C ratio of 1.60, however, soybean – fenugreek recorded highest net rupees per rupees invested of 1.81.

Table 7.2.18. Influence organic, inorganic and integrated production systems on economics (gross return and cost of cultivation) of different crops and cropping system at different locations

Locations/Treatments	Gross returns (Rs/ha)							Cost of cultivation (Rs/ha)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
French bean (Kharif)-cauliflower-french bean (summer)	4,72,292	4,25,069	1,90,833	3,62,167	3,72,917	3,64,750	3,64,671	2,59,556	2,51,806	2,28,781	2,63,792	2,46,924	2,57,171	2,51,338
Fallow-Cauliflower-Tomato	4,59,500	4,54,028	3,11,133	2,84,444	4,71,044	4,23,200	4,00,558	2,06,090	1,96,840	1,69,565	2,09,565	1,88,594	1,86,539	1,92,866
Black gram-Cauliflower-Summer squash	5,50,478	5,04,306	3,17,408	4,23,311	5,22,996	4,54,649	4,62,191	2,56,385	2,49,035	2,15,913	2,67,413	2,50,328	2,58,872	2,49,658
Lady finger-Pea	3,02,861	3,28,722	1,63,000	2,25,822	2,47,222	2,50,611	2,53,040	1,60,515	1,56,265	1,45,805	1,73,405	1,61,882	1,66,857	1,60,788
Mean	4,46,283	4,28,031	2,45,593	3,23,936	4,03,545	3,73,303		2,20,637	2,13,487	1,90,016	2,28,544	2,11,932	2,17,360	
Bhopal														
Soybean- wheat							1,28,166							52,102
Soybean- Mustard							1,06,972							47,864
Soybean- Chickpea							97,589							46,926
Soybean- Linseed							1,04,178							47,618
Mean Nutrient Sources	1,27,557	1,17,991	1,09,311	1,03,777	1,20,410	1,27,028		48,624	47,643	48,501	49,909	48,337	48,751	
Calicut														
Ginger														
Turmeric	38,400	4,14,003	3,24,000	-	3,26,400	3,31,200	2,86,801	1,78,996	1,68,346	1,51,635	-	1,46,701	1,69,045	1,62,945
Coimbatore														
Brinjal - pearl millet - green manure (daincha)	39,242	43,051	37,951	40,156	34,864	44,272	39,923	27,684	24,660	17,616	26,716	20,183	24,294	23,526
Chillies - barnyard millet - green manure	39,918	41,031	30,369	42,057	32,775	37,893	37,341	20,920	19,769	14,669	27,269	17,798	19,356	19,964
Tomato - Finger millet - green manure	66,538	72,688	60,765	62,768	61,830	72,962	66,259	35,107	32,705	23,478	36,078	29,296	32,198	31,477
Mean	48,566	52,257	43,028	48,327	43,156	51,709		27,904	25,711	18,588	30,021	22,426	25,283	
Dharwad														
Green gram-safflower	62,480	59,400	65,000	73,160	57,240	66,000	63,880	49,348	43,539	32,169	43,340	38,199	45,213	41,968
Pigeon pea (sole)	41,880	52,760	56,600	60,040	53,880	50,480	52,607	31,714	28,915	21,587	28,330	25,280	29,460	27,548

Locations/Treatments	Gross returns (Rs/ha)							Cost of cultivation (Rs/ha)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Green gram - Sorghum	98,875	90,675	88,775	82,500	88,000	81,900	88,454	51,554	45,654	31,810	42,982	38,630	46,577	42,868
Groundnut +hybrid cotton (2:1)	44,424	66,960	73,836	62,964	68,724	70,836	64,624	59,300	52,316	35,194	50,620	39,755	47,802	47,498
Maize-Chickpea	1,09,040	1,24,280	1,07,760	78,840	1,02,960	1,12,880	1,05,960	58,026	54,499	36,764	47,566	44,393	47,700	48,158
Mean	71,340	78,815	78,394	71,501	74,161	76,419		49,988	44,985	31,505	42,568	37,251	43,350	
Jabalpur														
Basmati rice – wheat (durum) – green manure	2,00,745	1,67,685	1,70,537	1,32,791	1,62,418	1,52,824	1,64,500	86,390	79,190	66,630	61,430	76,510	81,000	75,192
Basmati rice – chickpea – maize fodder	1,60,685	1,33,450	1,50,324	1,13,260	1,55,797	1,49,625	1,43,857	90,150	82,350	70,590	63,526	80,370	85,260	78,708
Basmati rice – berseem (fodder and seed)	2,20,795	2,02,765	2,43,210	2,09,310	2,19,690	2,03,400	2,16,528	72,516	67,128	58,644	54,544	67,082	69,048	64,827
Basmati rice – vegetable pea–sorghum (fodder)	1,92,565	1,70,215	1,84,485	1,70,385	1,79,505	1,67,655	1,77,468	90,150	82,350	70,590	63,526	80,370	85,260	78,708
Mean	1,93,698	1,68,529	1,87,139	1,56,437	1,79,353	1,68,376		84,802	77,755	66,614	60,757	76,083	80,142	
Karjat														
Rice-brinjal	-	-	-	-	-	-	8,47,190	-	-	-	-	-	-	-
Rice-chickpea	-	-	-	-	-	-	1,71,741	-	-	-	-	-	-	-
Rice-field bean	-	-	-	-	-	-	1,82,557	-	-	-	-	-	-	-
Rice-onion (White)	-	-	-	-	-	-	5,43,250	-	-	-	-	-	-	-
Mean	5,37,073	4,53,314	4,40,337	3,41,768	4,45,546	3,99,069		-	-	-	-	-	-	-
Ludhiana														
Basmati rice-chickpea-GM	1,76,400	2,03,718	1,33,322	1,37,228	1,43,794	1,32,664	1,54,521	93,000	92,875	82,600	82,850	83,562	83,245	86,355
Basmati rice-wheat-GM	2,15,380	2,12,420	1,96,784	2,00,208	1,93,696	1,93,952	2,02,073	91,125	89,922	78,954	79,208	74,257	76,474	81,657
Cluster bean-wheat-summer moong	2,36,020	2,24,495	1,74,441	1,68,063	1,87,616	1,95,389	1,97,671	1,16,875	1,14,955	81,908	81,615	81,235	82,398	93,164
Soybean -wheat	1,37,805	1,40,215	1,22,767	1,18,172	1,20,214	1,25,535	1,27,451	76,500	75,863	61,757	61,524	60,278	62,426	66,391
Mean	1,91,401	1,95,212	1,56,829	1,55,918	1,61,330	1,61,885		94,375	93,404	76,305	76,299	74,833	76,136	
Modipuram														
Basmati rice– wheat (durum) - sesbania green manure	-	-	-	-	-	-	-	1,12,930	1,06,555	79,050	89,650	1,03,840	1,08,686	1,00,119

Locations/Treatments	Gross returns (Rs/ha)							Cost of cultivation (Rs/ha)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Coarse rice– barley (malt) – green gram	-	-	-	-	-	-	-	1,09,780	1,06,093	92,985	1,03,585	1,03,483	1,06,932	1,03,810
Maize (pop corn) – potato– okra - sesbania green manure	-	-	-	-	-	-	-	1,61,766	1,54,100	1,38,805	1,66,705	1,53,437	1,58,052	1,55,478
Maize (sweet corn) – mustard - Sesbania green manure	-	-	-	-	-	-	-	80,698	76,950	56,186	67,786	76,293	78,797	72,785
Mean	-	-	-	-	-	-	-	1,16,294	1,10,925	91,757	1,06,932	1,09,263	1,13,117	
Pantnagar														
Basmati rice-wheat	-	-	-	-	-	-	-	70,102	67,727	60,696	62,526	68,873	70,822	66,791
Basmati rice -chickpea (4rows+2rows coriander)	-	-	-	-	-	-	-	66,447	67,197	60,926	62,451	67,918	68,755	65,616
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	-	-	-	-	-	-	-	69,172	72,422	62,516	64,346	69,508	70,345	68,052
Basmati rice -potato	-	-	-	-	-	-	-	74,856	73,106	74,500	75,415	81,469	84,284	77,272
Mean	-	-	-	-	-	-	-	70,144	70,113	64,660	66,185	71,942	73,552	
Raipur														
Soybean-Maize	3,76,624	4,03,873	1,81,734	2,05,446	1,36,859	1,37,531	2,40,345	95,290	92,466	75,884	82,049	87,621	92,761	87,679
Soybean-Pea	2,54,822	3,16,173	98,689	1,06,092	86,561	81,309	1,57,274	76,724	74,202	61,713	68,352	68,859	75,242	70,849
Soybean-Chilli	2,79,695	3,05,210	1,39,403	1,46,701	1,40,513	1,40,172	1,91,949	86,087	82,429	71,175	79,667	76,187	83,263	79,801
Soybean-Onion	2,75,307	2,85,087	1,58,274	1,64,348	1,07,437	1,14,320	1,84,129	85,333	79,454	72,465	77,543	75,240	82,949	78,831
Mean	2,96,612	3,27,586	1,44,525	1,55,647	1,17,843	1,18,333		85,859	82,138	70,309	76,903	76,977	83,554	
New centres started from 2015-16														
Ajmer														
Green gram – fennel	19010	17445	14962	17462	17081	18053	17336	-	-	-	-	-	-	-
Green gram - coriander	45515	39590	25976	35976	35815	40638	37252	-	-	-	-	-	-	-
Cluster bean - fennel	19010	17445	14962	17462	17081	18053	17336	-	-	-	-	-	-	-
Cluster bean – coriander	53300	30174	62675	40174	46451	54578	47892	-	-	-	-	-	-	-
Mean	34209	26164	29644	27769	29107	32831		-	-	-	-	-	-	

Locations/Treatments	Gross returns (Rs/ha)							Cost of cultivation (Rs/ha)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Gangtok														
Maize + ginger (1:1)–french bean	-	-	-	-	-	-	37920.0	-	-	-	-	-	-	-
Maize + soybean (1:1) – buckwheat	-	-	-	-	-	-	14340.0	-	-	-	-	-	-	-
Maize + turmeric (1:1) – rajmash	-	-	-	-	-	-	24640.0	-	-	-	-	-	-	-
Maize + black gram (2:1)-toria	-	-	-	-	-	-	11850.0	-	-	-	-	-	-	-
Mean	33470	30190	-	16970	25060	-		-	-	-	-	-	-	-
Narendrapur														
Basmati rice-broccoli-Sesbania green manure	2,53,573	2,50,945	1,95,638	1,96,850	2,14,939	2,08,041	2,19,998	1,18,501	1,06,253	91,211	91,211	1,03,805	1,11,894	1,03,813
Paddy– mustard– greengram	3,15,385	3,23,038	1,94,358	1,98,991	2,62,806	2,62,626	2,59,534	1,24,800	1,13,300	75,660	75,660	1,15,037	1,21,855	1,04,385
Paddy– capsicum– greengram	4,12,222	4,09,561	2,69,264	2,67,240	3,40,581	3,36,533	3,39,234	1,68,925	1,49,325	1,00,945	1,00,945	1,44,484	1,58,966	1,37,265
Paddy – french bean – sesame	4,02,925	3,96,803	2,53,597	2,50,941	3,08,997	3,59,038	3,28,717	1,90,953	1,67,722	1,08,549	1,08,550	1,58,017	1,77,852	1,51,941
Mean	3,46,026	3,45,087	2,28,214	2,28,506	2,81,831	2,91,560		1,50,795	1,34,150	94,091	94,092	1,30,336	1,42,642	
Sardarkrushinagar														
Groundnut- Wheat- Green gram	2,80,926	2,53,071	2,32,431	2,48,543	2,41,399	2,03,360	2,43,288	1,37,841	1,27,520	1,03,486	1,14,265	1,21,038	1,30,204	1,22,392
Greengram- Cumin- Vegetable cowpea	2,44,866	2,26,664	1,95,841	2,16,477	2,07,556	1,72,096	2,10,583	97,401	92,480	87,255	98,034	93,602	96,777	94,258
Greengram-Fennel- Fennel cont.	1,56,734	1,40,201	1,30,841	1,42,161	1,37,173	1,16,698	1,37,301	81,628	73,506	58,066	65,252	71,757	82,858	72,178
Mean	2,27,509	2,06,645	1,86,371	2,02,394	1,95,376	1,64,051		1,05,623	97,835	82,936	92,517	95,466	1,03,280	
Udaipur														
Maize + blackgram (2:2)–durum wheat–*sesbania* (GM)	1,71,817	1,90,256	2,09,631	2,17,181	1,90,636	1,87,347	1,94,478	1,03,045	93,694	52,412	64,072	77,736	90,387	80,224
Blackgram – wheat (*Triticum aestivum*)	1,44,744	1,54,531	1,69,940	1,79,148	1,48,681	1,48,752	1,57,633	72,693	69,955	1,12,768	1,17,593	91,130	84,118	91,376
Sweet corn + blackgram (2:2)–chickpea	1,36,427	1,46,986	1,72,469	1,79,215	1,07,103	1,03,496	1,40,949	1,01,835	97,316	70,041	81,745	85,462	93,647	88,341
Soybean – fenugreek	1,20,262	1,29,090	1,40,547	1,49,149	1,18,290	1,27,604	1,30,824	53,259	53,076	37,979	45,569	46,105	49,145	47,522
Mean	1,43,313	1,55,216	1,73,147	1,81,173	1,41,178	1,41,800		82,708	78,510	68,300	77,245	75,108	79,324	

Table7.2.19: Influence organic, inorganic and integrated production systems on net return and return per rupee invested of different crops and cropping system at different locations

Locations/Treatments	Net returns (Rs/ha)							Net return per rupee invested (NRPRI)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
French bean (Kharif)-cauliflower-french bean (summer)	2,12,736	1,73,263	-37,948	98,375	1,25,993	1,07,579	1,13,333	0.82	0.69	-0.17	0.37	0.51	0.42	0.44
Fallow-Cauliflower-Tomato	2,53,410	2,57,188	1,41,568	74,879	2,82,450	2,36,661	2,07,693	1.23	1.31	0.83	0.36	1.50	1.27	1.08
Black gram-Cauliflower-Summer squash	2,94,093	2,55,271	1,01,495	1,55,898	2,72,668	1,95,777	2,12,533	1.15	1.03	0.47	0.58	1.09	0.76	0.85
Lady finger-Pea	1,42,346	1,72,457	17,195	52,417	85,340	83,754	92,252	0.89	1.10	0.12	0.30	0.53	0.50	0.57
Mean	2,25,646	2,14,545	55,577	95,392	1,91,613	1,55,943		1.02	1.03	0.31	0.40	0.91	0.74	
Bhopal														
Soybean- wheat	-	-	-	-	-	-	44,301	-	-	-	-	-	-	1.85
Soybean- Mustard	-	-	-	-	-	-	53,261	-	-	-	-	-	-	2.11
Soybean- Chickpea	-	-	-	-	-	-	40,645	-	-	-	-	-	-	1.87
Soybean- Linseed	-	-	-	-	-	-	48,168	-	-	-	-	-	-	2.01
Nutrient Sources	53,362	46,694	38,896	33,064	47,935	52,812		2.10	1.98	1.80	1.66	1.99	2.08	
Calicut														
Ginger														
Turmeric	2,05,004	2,45,657	1,72,365	-	1,79,699	1,62,155	192976	1.71	1.96	2.13	-	2.22	1.95	1.99
Black papper (Kg/vine)														
Coimbatore														
Brinjal - pearl millet - green manure (daincha)	2,42,973	2,43,626	1,88,165	1,67,904	1,77,827	1,79,378	1,99,979	1.42	1.75	2.15	1.50	1.73	1.82	1.73
Chillies - barnyard millet - green manure	59,371	85,789	61,174	49,585	31,126	62,061	58,184	1.91	2.08	2.07	1.54	1.84	1.96	1.90
Tomato - Finger millet - green manure	93,219	1,56,242	1,22,929	79,672	78,875	87,051	1,02,998	1.90	2.22	2.59	1.74	2.11	2.27	2.14
Mean	1,31,854	1,61,886	1,24,089	99,054	95,943	1,09,497		1.74	2.02	2.27	1.59	1.89	2.02	
Dharwad														
Cowpea-safflower	13,144	15,853	32,833	29,818	19,041	20,781	21,912	1.27	1.36	2.02	1.69	1.50	1.46	1.55

Locations/Treatments	Net returns (Rs/ha)							Net return per rupee invested (NRPRI)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Pigeon pea (sole)	10,166	23,845	35,013	31,710	28,600	21,020	25,059	1.32	1.83	2.62	2.12	2.13	1.71	1.96
Sorghum-green gram	47,321	45,021	56,965	39,518	49,370	35,323	45,586	1.92	1.99	2.79	1.92	2.28	1.76	2.11
Groundnut +hybrid cotton (2:1)	-14,876	14,644	38,642	12,344	28,969	22,470	17,032	0.75	1.28	2.10	1.24	1.73	1.47	1.43
Maize-Chickpea	51,014	69,781	70,996	31,274	58,567	65,180	57,802	1.88	2.28	2.93	1.66	2.32	2.37	2.24
Mean	21,354	33,829	46,890	28,933	36,909	32,955		1.43	1.75	2.49	1.73	1.99	1.75	
Jabalpur														
Basmati rice – wheat (durum) – green manure	1,22,355	96,495	1,11,907	79,361	93,908	79,824	97,308	2.32	2.12	2.56	2.16	2.12	1.89	2.2
Basmati rice – chickpea – maize fodder	70,535	51,100	79,734	49,734	75,427	64,365	65,149	1.78	1.62	2.13	1.78	1.94	1.75	1.83
Basmati rice – berseem (fodder and seed)	1,53,031	1,39,201	1,85,126	1,55,326	1,56,766	1,38,056	1,54,584	3.04	3.02	4.15	3.84	3.27	2.95	3.38
Basmati rice – vegetable pea–sorghum (fodder)	1,02,415	87,865	1,13,895	1,06,859	99,135	82,395	98,761	2.14	2.07	2.61	2.68	2.23	1.97	2.28
Mean	1,12,084	93,665	1,22,666	97,820	1,06,309	91,160		2.32	2.21	2.86	2.62	2.39	2.14	
Karjat														
Rice-Brinjal	6,86,422	6,21,431	6,52,316	4,26,061	5,49,468	5,00,797	5,72,749	3.13	3.12	3.80	2.89	2.98	2.69	3.10
Rice-Chickpea	77,208	68,668	60,287	53,379	57,856	47,839	60,873	1.61	1.59	1.62	1.58	1.51	1.41	1.55
Rice-Field bean	84,063	70,213	81,764	55,804	55,923	38,527	64,382	1.63	1.57	1.73	1.56	1.47	1.31	1.55
Rice-Onion (White)	4,91,317	3,14,961	3,68,540	2,63,749	4,17,390	2,66,468	3,53,738	3.16	2.54	3.36	2.75	3.18	2.29	2.88
Mean	3,34,753	2,68,818	2,90,727	1,99,748	2,70,159	2,13,408		2.38	2.21	2.63	2.20	2.29	1.93	
Ludhiana														
Basmati rice-chickpea-GM	83,400	1,10,843	50,722	54,378	49,102	60,549	68,166	1.89	2.19	1.61	1.65	1.58	1.72	1.77
Basmati rice-wheat-GM	1,24,255	1,22,498	1,17,830	1,21,000	1,19,439	1,17,478	1,20,417	2.36	2.36	2.49	2.52	2.31	2.53	2.43
Cluster bean-wheat-summer moong	1,19,145	1,09,540	92,533	86,448	1,14,154	1,05,218	1,04,506	2.01	1.95	2.12	2.05	2.40	2.27	2.13
Soybean -wheat	61,305	64,352	61,010	56,648	65,257	57,788	61,060	1.80	1.84	1.98	1.92	2.08	1.92	1.92
Mean	97,026	1,01,808	80,524	79,619	86,988	85,258		2.02	2.09	2.05	2.04	2.09	2.11	

Locations/Treatments	Net returns (Rs/ha)							Net return per rupee invested (NRPRI)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Modipuram														
Basmati rice– wheat (durum) - sesbania green manure	1,06,342	95,785	82,513	89,669	81,508	64,508	86,721	-	-	-	-	-	-	-
Coarse rice– barley (malt) – green gram	98,595	96,022	71,623	73,560	79,443	69,238	81,414	-	-	-	-	-	-	-
Maize (pop corn) – potato– okra - sesbania green manure	1,92,524	1,75,880	90,265	80,490	1,13,243	99,903	1,25,384	-	-	-	-	-	-	-
Maize (sweet corn) – mustard - Sesbania green manure	1,02,735	92,573	96,630	89,660	90,063	77,435	91,516	-	-	-	-	-	-	-
Mean	1,25,049	1,15,065	85,258	83,345	91,064	77,771		-	-	-	-	-	-	-
Pantnagar														
Basmati rice-wheat	2,14,527	1,89,456	1,60,988	1,49,669	1,67,078	1,62,281	1,74,000	3.06	2.80	2.65	2.39	2.43	2.29	2.60
Basmati rice -chickpea (4rows+ 2rows coriander)	3,15,518	3,02,150	2,11,764	2,22,171	2,47,012	2,42,663	2,56,880	4.75	4.50	3.48	3.56	3.64	3.53	3.91
Basmati rice -vegetable pea (4 rows vegetable pea +2 rows coriander)	24,593	2,28,128	1,56,338	1,54,343	1,83,182	1,81,179	1,54,627	3.56	3.15	2.50	2.40	2.64	2.58	2.81
Basmati rice -potato	2,35,686	2,12,528	1,64,089	1,57,465	1,92,342	1,79,034	1,90,191	3.15	2.91	2.20	2.09	2.36	2.12	2.47
Mean	1,97,581	2,33,066	1,73,295	1,70,912	1,97,404	1,91,289		3.63	3.34	2.71	2.61	2.77	2.63	
Raipur														
Soybean-Maize	2,81,334	3,11,407	1,81,734	2,05,446	1,36,859	1,37,531	2,09,052	3.95	4.37	3.39	3.50	2.56	2.48	3.38
Soybean- Garden pea	1,78,098	2,41,971	98,689	1,06,092	86,561	81,309	1,32,120	3.32	4.26	2.60	2.55	2.26	2.08	2.85
Soybean-Chilli	1,93,608	2,22,781	1,39,403	1,46,701	1,40,513	1,40,170	1,63,863	3.25	3.70	2.96	2.84	2.84	2.68	3.05
Soybean-Onion	1,89,974	2,05,633	1,58,274	1,64,348	1,07,437	1,14,320	1,56,664	3.23	3.59	3.18	3.12	2.43	2.38	2.99
Mean	2,10,754	2,45,448	1,44,525	1,55,647	1,17,843	1,18,333		3.44	3.98	3.03	3.00	2.52	2.41	
Ranchi														
Rice -wheat	-	-	-	-	-	-	42,288	-	-	-	-	-	-	0.65
Rice -Onion	-	-	-	-	-	-	1,12,924	-	-	-	-	-	-	1.60
Rice -potato	-	-	-	-	-	-	1,12,520	-	-	-	-	-	-	1.29
Rice -Onion	-	-	-	-	-	-	82,246	-	-	-	-	-	-	1.02
Mean	1,17,867	81,590	74,597	53,188	1,13,376	84,350		1.25	1.02	1.21	0.94	1.34	1.09	

Locations/Treatments	Net returns (Rs/ha)							Net return per rupee invested (NRPRI)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Umiam														
Vegetable-vegetable systems *on raised bed*														
Broccoli -carrot	3,39,260	3,01,900	3,17,920	-	2,96,950	-	3,14,008	-	-	-	-	-	-	-
Broccoli - potato	2,48,370	2,25,250	2,18,850	-	2,59,650	-	2,38,030	-	-	-	-	-	-	-
Broccoli -french bean	2,74,850	2,55,000	2,32,775	-	2,80,075	-	2,60,675	-	-	-	-	-	-	-
Broccoli -tomato	3,31,200	3,32,520	3,04,500	-	3,24,350	-	3,23,143	-	-	-	-	-	-	-
Mean	2,98,420	2,78,668	2,68,511	-	2,90,256	-		-	-	-	-	-	-	
New centres started from 2016-17														
Ajmer														
Green gram – fennel	78578	94776	112584	123216	121021	134263	110740	1.96	2.34	2.83	2.71	3.56	3.49	2.82
Green gram - coriander	15952	25739	27976	31379	31268	38849	28527	1.25	1.45	1.55	1.54	1.73	3.15	1.78
Cluster bean - fennel	99098	125055	142820	147927	132045	160873	134636	2.21	2.77	3.33	3.05	3.79	3.98	3.19
Cluster bean – coriander	37942	39862	44659	54767	52146	60507	48314	1.59	1.70	1.88	1.94	2.21	4.35	2.28
Mean	57893	71358	82010	89322	84120	98623		1.75	2.06	2.40	2.31	2.82	3.74	
Gangtok														
Maize + ginger (1:1)–french bean	-	-	-	-	-	-	23660.0	-	-	-	-	-	-	2.65
Maize + soybean (1:1) – buckwheat	-	-	-	-	-	-	11060.0	-	-	-	-	-	-	2.54
Maize + turmeric (1:1) – rajmash	-	-	-	-	-	-	20720.0	-	-	-	-	-	-	2.66
Maize + black gram (2:1)-toria	-	-	-	-	-	-	8660.0	-	-	-	-	-	-	3.22
Mean	22750	19190	-	7740	14410	-		3.47	2.99	-	2.04	2.57	-	
Narendrapur														
Basmati rice–broccoli – *sesbania* GM	1,35,072	1,44,692	1,04,427	1,05,639	1,11,134	96,147	1,16,185	1.14	1.36	1.14	1.16	1.07	0.86	1.12
Paddy– mustard– green gram	1,90,585	2,09,738	1,18,698	1,23,331	1,51,769	1,40,811	1,55,822	1.53	1.85	1.57	1.63	1.32	1.16	1.51
Paddy– capsicum– green gram	2,43,297	2,60,236	1,68,319	1,66,294	1,96,097	1,77,568	2,01,969	1.44	1.74	1.67	1.65	1.36	1.12	1.50
Paddy –french bean – sesame	2,11,971	2,29,080	1,45,047	1,42,390	1,50,981	1,81,187	1,76,776	1.11	1.37	1.34	1.31	0.96	1.02	1.18
Mean	1,95,231	2,10,937	1,34,123	1,34,414	1,52,495	1,48,928		1.30	1.58	1.43	1.44	1.18	1.04	

Locations/Treatments	Net returns (Rs/ha)							Net return per rupee invested (NRPRI)						
	Organic		Inorganic		Integrated		Mean	Organic		Inorganic		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% Inorganic	State recom-menda-tion	50% organic + 50% inorganic	75% organic + 25% inorganic	
Sardarkrushinagar														
Groundnut- Wheat- Green gram	1,43,085	1,25,551	1,28,945	1,34,278	1,20,361	73,156	1,20,896	1.04	0.98	1.25	1.18	0.99	0.56	1.00
Greengram- Cumin- Vegetable cowpea	1,47,465	1,34,184	1,08,586	1,18,443	1,13,954	75,319	1,16,325	1.51	1.45	1.24	1.21	1.22	0.78	1.24
Greengram-Fennel- Fennel cont.	75,106	66,695	72,775	76,909	65,416	33,840	65,124	0.92	0.91	1.25	1.18	0.91	0.41	0.93
Mean	1,21,885	1,08,810	1,03,435	1,09,877	99,910	60,772		1.16	1.11	1.25	1.19	1.04	0.58	
Thiruvananthapuram														
Cassava-veg. cowpea	1,45,718	1,16,665	1,27,339	1,81,848	1,60,905	-21,731	1,18,457							
Cassava-groundnut	4,36,862	4,24,572	4,03,027	2,51,726	2,54,352	1,09,968	3,13,418							
Taro-black gram	1,58,410	-38,678	34,511	-3,477	83,864	36,297	45,155							
Taro-greengram	1,00,857	-46,375	37,536	-50,276	47,147	-1,15,258	-4,395							
Mean	2,10,462	1,14,046	1,50,603	94,955	1,36,567	2,319								
Udaipur														
Maize + blackgram (2:2) – durum Wheat – *sesbania* (GM)	68,772	96,562	1,57,219	1,53,109	1,12,900	96,960	1,14,254	0.67	1.03	3.00	2.39	1.45	1.07	1.60
Blackgram – wheat (*Triticum aestivum*)	72,051	84,576	1,22,800	1,24,463	88,755	81,957	95,767	0.99	1.21	1.09	1.06	0.97	0.97	1.05
Sweet corn + blackgram (2:2) – chickpea	34,592	49,670	1,02,428	97,470	61,051	43,689	64,817	0.34	0.51	1.46	1.19	0.71	0.47	0.78
Soybean – fenugreek	67,003	76,014	1,02,568	1,03,580	84,171	66,473	83,302	1.26	1.43	2.70	2.27	1.83	1.35	1.81
Mean	60,605	76,706	1,21,254	1,19,656	86,719	72,270		0.81	1.05	2.06	1.73	1.24	0.97	

7.3 Evaluation of response of different varieties of major crops for Organic Farming

Objectives

- To evaluate the response of varied duration and nutrient requiring varieties of major crops to organic production system
- To identify the suitable varieties of crops for organic management practices

Three to four groups of varieties based on crop duration, nutrient and water requirement and insect/disease tolerance was selected for evaluation. Two major varieties grown by the farmers in the region was also included. About 10-12 different varieties/ hybrids, which are popular in farmers or recommended by institutions were evaluated for potential cropping system of organic farming in 3 replications in RBD having the minimum Plot size 20 m^2. All the centers have taken up this experiment as it is especially important to identify the varieties which form the core of organic farming package.

Year of start: 2013-14

Locations: All the 20 centers in different ecosystem as mentioned in section 7.1 have conducted the experiments including 7 new centers started experimentation from 2015-16. Almora and Narendrapur not conducted the experiments.

Results

Bajaura (Table 7.3.1.1 – 7.3.1.4)

Four varieties and two hybrids of okra and french bean in *kharif*, seven varieties of cauliflower including four hybrids, eight varieties of pea including three hybrids in *rabi* and twelve varieties of tomato including seven hybrids in summer season were evaluated for their performance and suitability under organic conditions.

Performance of *kharif* crops

Okra (Table 7.3.1.1): Significant differences among the varieties for the entire traits for okra except plant height were observed. Best performing variety i.e., Parkinson Long Green recorded significantly higher number of fruits/ plant (32.6), fruit length (8.9 cm), days to flowering (40 days) plant population (97.4 1000/ha), owing to higher fruit yield (8520 kg/ha), net returns (Rs. 1,44,608/ha) and B:C ratio (1.63) and being on par with Pusa makhmali. Variety Chameli-015 recorded lowest yield (5610 kg/ha), number of fruits/ plant (25.6), fruit length (7.9 cm) and net return of Rs. 67,480/ha.

Table 7.3.1.1: Yields attributes and yield of okra in under organic management at Bajaura

Varieties/Hybrids	Plant height (cm)	No. of fruits /plant	Fruit length (cm)	Days taken to harvest	Fruit yield (kg/ha)	Net Returns (Rs./ha)	B:C ratio
Perkins Long Green	215.2	32.6	8.9	40.0	8520	144608	1.63
Pusa Makhmali	217.3	31.6	8.8	37.0	8040	132745	1.50
Palam Komal	202.4	29.6	8.2	35.3	7020	107386	1.21
P-8 (check)	209.3	28.6	8.4	38.0	6550	89085	0.94
Indranil*	210.8	27.0	8.0	36.3	5980	73740	0.77
Chameli-015*	204.2	25.6	7.9	39.3	5610	67480	0.72
CD (P=0.05)	NS	2.38	0.62	1.52	493	13411	0.16

*Hybrid

French bean (7.3.1.2): Significant among the frenchbean varieties for yield and economics were observed except plant height and no. of pods/plant. Palam Mridula recorded tallest plant (50.8 cm) while Falguni found to be smallest in plant height. Variety Contender recorded significantly higher pod length (13.7 cm), yield of 4100 kg/ha, net return (Rs. 74,633 /ha) and benefit cost ratio of 1.39 and found to be best performing variety followed by Pusa Parvati.

Table 7.3.1.2: Yields attributes and yield of frenchbean in under organic management at Bajaura

Varieties/Hybrids	Plant height (cm)	No. of pods /plant	Fruit length (cm)	Days taken to harvest	Fruit yield (kg/ha)	Net Returns (Rs./ha)	B:C ratio
Vaishnavi 264*	49.7	25	13.2	60	3360	21649	0.26
Palam Mridula	50.8	24	13.2	57	3400	52881	0.99
Falguni*	48.3	25	13.2	59	3290	15847	0.18
Contender	51.4	25	13.7	60	4100	74633	1.39
Shivani*	50.3	25	13.2	57	3290	23347	0.29
Pusa Parvati	49.1	24	12.7	59	3860	59745	0.98
CD (P=0.05)	NS	NS	0.41	2.47	190	41350	0.09

*Hybrid

Performance of *rabi crops*

Pea (Table 7.3.1.3): Azad P-1 recorded highest green pod yield (7700 kg/ha) with pods/plant (25.0), also gave maximum net return of Rs. 1,30,391/ha but being at par with NP-20, Ten plus and Pb-89. Lincon produced the lowest yield (2890 kg/ha) however, Nirali and Ten plus took maximum days to flowering (110 days). Quality of pea in term of TSS found non-significant among pea varieties.

Table 7.3.1.3: Yields attributes and yield of vegetable pea (*rabi*) in under organic management at Bajaura

Variety/ Hybrid	Plant height (cm)	Days to flowering	No. of pods / plant	No. of seeds/ pod	Pod length (cm)	Shelling %	Pod yield/ ha (q)	TSS	Net Returns (Rs/ha)	B:C
GC 477	53.3	107.0	20.6	4.6	5.4	61.4 (7.8)	42.2	15.0	43393	0.69
Pb-89	53.4	92.0	23.3	6.6	6.5	64.0 (8.0)	70.8	15.0	114767	1.84
Azad P-1	54.5	92.0	25.0	6.0	6.6	65.0 (8.1)	77.0	16.0	130391	2.09
Lincon	51.7	102.0	16.6	5.0	6.7	65.1 (8.1)	28.9	15.0	10206	0.16
Palam Triloki	50.4	94.0	18.6	4.6	5.7	63.6 (8.0)	47.5	15.0	56510	0.90
Nirali*	55.0	110.0	16.0	5.6	6.4	63.4 (8.0)	59.6	15.0	75996	1.04
NP-20*	55.3	109.0	21.6	6.6	6.6	63.4 (8.0)	73.3	15.0	110236	1.51
Ten Plus*	55.1	110.0	23.2	6.6	6.9	65.3 (8.1)	71.1	16.0	104835	1.43
CD at 5%	NS	4.08	4.02	NS	0.64	NS	7.12	NS	17839	0.26

*Hybrid

Cauliflower (Table 7.3.1.4): Significant differences were observed among the varieties/hybrids for all traits. Though higher curds size was obtained in US-178 (260.0 cm^2) but significantly higher curd weight (513.3 g), marketable curd (85.6%), curd yield (9930 kg/ha) resulted in higher net return of Rs. 82,139 /ha and B:C ratio (0.79) was obtained in Chamdramukhi among the varieties followed by US-178, curd yield (9430 kg/ha), curd weight (506.3 g), net return (Rs. 76,207 /ha) and B:C ratio (0.75). Variety Madhuri recorded lowest yield (5930 kg/ha) with curd size (213.0 g).

Table 7.3.1.4: Yields attributes and yield of cauliflower (*rabi*) under organic farming at Bajaura

Varieties/Hybrids	% Marketable curd**	Curd size (cm^2)	Curd weight(g)	Curd yield (kg/ha)	Biomass yield(kg /ha)	Net Returns (Rs/ha)	B:C ratio
PSBK-1	76.6 (8.8)	231.0	448.6	7060	14060	33486	0.34
PSB-1	80.0 (8.9)	251.0	460.6	7730	1480	45998	0.46
Madhuri*	78.0 (8.8)	213.0	466.3	5930	11960	12153	0.12
KT 25	63.3 (8.0)	253.0	410.3	7700	14700	54185	0.60
US-178*	83.3 (9.2)	260.0	506.3	9430	16530	76207	0.75
Chamdramukhi*	85.6 (9.3)	252.0	513.3	9930	13960	82139	0.79
71No.*	79.0 (8.9)	237.0	442.0	7100	14100	31576	0.31
CD at 5%	0.31	9.81	13.50	522	490	9490	0.09

*Hybrid ** Figures within the parentheses are the square root transformed

Tomato (Table 7.3.1.5): Significant differences were observed among the tomato varieties/hybrids for all variables. Though tallest plant of tomato was recorded with Hybrid 7730 and Yash 100.1 and 97.1 cm respectively, but fruit size (29.1 cm^2) and number of fruits/plant (43.3) were higher significantly with RK-123. Fruit yield was recorded among the tomato varieties ranged from 2901 to 11210 kg/ha. Tomato hybrid Red Gold recorded significantly higher fruit yield of 11210 kg/ha, net return (Rs. 1,75,104 /ha) and B:C ratio (1.66). RK 123 was being the next best performing variety (9900 kg/ha) but found to be at par with Manisha, Heem Sona and Hybrid 7730 which gave 9460, 9350 and 9320 kg/ha yield respectively. TSS (^{0}Brix) in term of quality varied ranging from 4.8 to 5.7. Variety Roma recorded lowest while Heem Sona recorded highest TSS content (^{0}Brix).

Table 7.3.1.5: Yields attributes and yield of tomato in tomato-pea-tomato system under organic management at Bajaura

Variety	Plant height(cm)	Days taken to flowering	No. of fruits /plant	Fruit size (cm^2)	Fruit yield kg/ha	TSS (^{0}Brix)	Net Returns (Rs/ha)	B:C
Yash*	97.1	40.0	35.6	23.4	6130	5.6	48885	0.46
Naveen 2000*	88.9	38.6	32.3	20.6	5440	5.2	30704	0.29
Manisha*	90.2	48.0	37.6	22.6	9460	5.6	131380	1.24
Red Gold*	96.7	43.6	42.3	25.6	11210	5.5	175104	1.66
Hybrid 7730*	101.1	40.3	40.6	19.8	9320	5.1	127706	1.21
Roma	69.4	50.0	23.6	18.0	4580	4.8	16138	0.16
Sioux	85.5	41.6	21.6	17.6	3230	5.0	-17665	-0.17
Best of All	85.7	43.3	23.6	16.5	3350	5.4	-14726	-0.14
Palam Pink	84.9	42.0	23.6	23.8	2910	5.2	-25748	-0.26
Mar Globe	93.2	40.6	31.3	24.3	5260	4.9	33040	0.33
RK 123*	94.5	43.0	43.3	29.1	9900	5.5	142403	1.35
Heem Sohna*	95.5	45.0	40.7	26.6	9350	5.7	128441	1.22
CD at 5%	4.29	3.25	2.81	2.73	636	0.37	15914	0.15

*Hybrids

Best performing varieties of okra, french bean, pea, tomato and cauliflower under organic farming at Bajaura

Bhopal (Table 7.3.2.1-7.3.2.4)

Twelve varieties of each soybean and maize in *kharif* and wheat and chickpea in *rabi* including two major varieties grown by the farmers in the region were evaluated in soybean-wheat and maize-chickpea cropping systems.

Performance of *kharif* crops

Soybean (Table 7.3.2.1): Among the soybean varieties, JS-20-29 was significantly tall (57.0 cm) but higher numbers of seeds/pod (3.3) were recorded in JS-20-41. Variety, RVS-2002-4 resulted in significantly higher seed

Table 7.3.2.1: Yield attributes yields and quality of soybean varieties under organic farming at Bhopal

Varieties	Plant height (cm)	Pods/ plant	Seeds/ pod	Seed yield (kg/ha)	Total Biomass yield (kg/ha)	Protein (%)	Oil(%)	Methionine (g/16 g N)
JS-335	48	45	2.87	1052	3625	37.66	19.01	1.79
JS-93-05	42	42	2.4	868	2925	37.52	18.50	1.68
JS-95-60	39	42	2.87	933	2733	37.03	18.08	1.75
JS-20-41	49	48	3.33	1033	3225	36.70	18.89	1.75
NRC-7	43	46	2.67	942	2800	36.81	18.27	1.50
NRC-37	53	43	2.53	873	3108	36.99	18.08	1.70
JS-20-29	57	44	3.07	1108	3500	37.75	18.82	1.71
RVS-2002-4	43	49	3.3	1363	3875	37.59	18.85	1.76
RVS-2002-6	50	49	2.47	1133	3458	37.11	18.83	1.78
RVS-2002-7	52	44	2.6	1021	2992	37.27	19.14	1.77
JS-97-52	45	40	3.13	650	2285	36.93	18.15	1.71
JS-20-34	43	45	2.8	908	3092	37.16	18.04	1.72
LSD (P= 0.05)	7.0	6.0	0.40	175	285	0.60	0.40	NS

yield (1363 kg/ha) among varieties whereas JS-97-52 recorded lower soybean yield (650 kg/ha). Nutritional quality constituents such as protein, oil and methionine, content was determined in seeds of different varieties of soybean and significant variation was also observed for oil and protein content. The percentage of protein among different varieties of soybean seeds was being in the range from 3670 to 37.75% however, oil was recorded in maximum in RVS-2002-7, JS 20-34 recorded the lowest oil content (18.04%). Higher methionine (1.79 g/16 g N) was observed with JS-335.

Maize (Table 7.3.2.2): Variety JM 216 recorded tallest plant (164 cm) while sweet con being the smallest in plant height (115cm). Though Kanchan recorded maximum cobs/plant (1.5) and grains row /cob (11.7), but Proagro-4212 recorded highest yield (3540 kg/ha) followed by kanchan and Pratap-5 which were on par among the maize varieties grown under similar nutrient source and doses. Nutritional quality such as protein, ash and tryptophan content were determined in grains of different varieties of maize and differ significantly among varieties of maize. The higher values of protein concentration (9.96%) and Tryptophan (0.97 g/16 g N) recorded in JM-8 whereas higher ash percentage recorded in Arawali (1.78%).

Table 7.3.2.2: Yield attributes, yield and quality of different maize varieties under organic farming at Bhopal

Varieties	Plant height (cm)	Cobs/ Plant	Row/ Cob	Seeds/ Row	Seed yield (kg/ha)	Biomass yield(kg/ha)	Protein (%)	Tryptophan (g/16 g N)	Ash (%)
Kanchan	159	1.5	11.7	57	3513	7730	9.79	0.93	1.71
Pratap 5	161	1.4	11.2	58	2830	5813	9.77	0.96	1.55
Arawali	147	1.2	11.6	53	2450	4993	9.85	0.89	1.78
Sona 222	154	1.4	11.1	56	2173	5047	9.89	0.97	1.54
Pratap 6	161	1.3	11.2	58	2447	5513	9.56	0.90	1.62
JM 216	164	1.3	10.8	59	2567	5510	9.88	0.88	1.58
Popcorn 1	111	1	10.9	41	1360	2933	9.84	0.87	1.53
JM 8	156	1.3	10.7	56	2643	5310	9.96	0.97	1.55
JM 12	161	1.2	11.4	58	2147	5230	9.62	0.93	1.57
Proagro 4212	164	1.4	11.4	59	3540	7310	9.78	0.97	1.70
Sweet Corn	115	1.1	10.6	42	1610	3363	9.38	0.88	1.59
CPBG 4202	145	1.3	11	52	2197	4920	9.73	0.95	1.50
CD (P= 0.05)	15	0.24	0.98	2.0	466	592	0.34	0.05	0.22

Performance of soybean and maize crops under organic conditions at Bhopal

Performance of *rabi* crops

Wheat (Table 7.3.2.3): Among the wheat varieties, GW-366 significantly outperformed in number of spikes/meter row length (108.0), seeds/spike (77.0) resulted in higher grain and biomass yield (4240 and 8877 kg/ha) followed by GW-322 and Malwa shakti in term of yield. Lok-1 produced lower yield (3057 kg/ha) with total biomass (6390 kg/ha).

Table 7.3.2.3: Response of wheat varieties for yield attributes and yields under organic farming at Bhopal

Varieties	Spikes/ length (cm)	Seeds/spike	Grain yield (kg ha^{-1})	Biomass yield (kg ha^{-1})	Harvest Index (%)
C-306	95	65	3330	7053	47
HI-8663	104	71	3773	8610	44
HI-1544	100	70	3417	7287	47
Malwashakti	104	72	3813	7690	50
GW-322	106	73	3822	8737	44
GW-366	108	77	4240	8877	48
HI-1531	93	62	3175	6867	46
HI-8498	103	71	3793	8193	46
HI-1500	102	69	3401	7390	46
JW-1202	98	72	3301	7321	45
HD-932	96	65	3323	7527	44
LOK-1	92	63	3057	6390	48
CD (P= 0.05)	4.70	3.20	228	766	

Chickpea (Table 7.3.2.4): Among the chickpea varieties, though JG-63 produced highest total biomass of 5413 kg/ha but variety JG-130 recorded significantly higher seed yield (2003 kg/ha), correspondingly higher seeds/pod (2.2) and pod/plant (100) followed by JG-63 (1907 kg/ha) and RVG-202 (1770 kg/ha) in term of yield. Rest of varieties were ranged from 1233 to 1750 kg/ha on yield basis.

Table 7.3.2.4: Yield indices and yield of different chickpea varieties under organic farming at Bhopal

Varieties	Pods/plant	Seed/pod	Grain yield (kg ha^{-1})	Biomass yield (kg ha^{-1})	Harvest Index (%)
RVG-202	93	2.1	1770	4990	35
JG-16	91	1.9	1713	4493	38
JGK-3	84	1.9	1233	3310	37
RVG-203	90	2.1	1633	4433	37
JG-11	86	2.1	1603	4363	37
JG-6	93	2.1	1750	5390	32
JG-130	100	2.2	2003	5123	39
JG-315	94	2.0	1740	4507	39
JG-63	95	2.1	1907	5413	35
JG-74	91	1.9	1447	4297	34
VIRAT	87	1.9	1457	3780	39
UJJWALA	85	2.0	1423	3737	38
CD (P=0.05)	6.7	NS	175	457	

Calicut (Table 7.3.3.1)

Twelve varieties of turmeric were evaluated under organic management. Among the 12 varieties of turmeric, maximum yield was recorded by Pragati (18200 kg/ha) followed by Suguna (17000 kg/ha). Variation in other turmeric varieties was recorded in range from 16500 kg/ha (Kanthi) to 5600 kg/ha (Prabha). In term of quality of turmeric, variety Pragati recorded maximum curcumin and oleoresin content (6.3 and 15.0% respectively) but being on par with Kedaram, Sugana and Prabha. However, oil content was found to be higher in Pratibha (6.0%) and recorded on par with Alleppey Supreme.

Table 7.3.3.1. Response of different management systems on yield and quality of turmeric under organic conditions at Calicut

Turmeric Varieties	Yield (kg/ha)	Oil content (%)	Oleoresin content (%)	Curcumin (%)
Prathibha	8900	6.0	12.3	5.84
Alleppey Supreme	9200	5.9	13.0	5.99
Varna	13400	5.0	11.2	3.69
Sobha	13900	4.9	10.3	3.01
Sona	13900	5.1	10.4	3.62
Kanthi	16500	5.6	11.0	3.92
Suvarna	13900	4.9	11.8	3.66
Suguna	17000	5.4	13.9	6.14
Sudarsana	15800	5.1	14.0	6.08
Kedaram	7500	5.3	14.6	6.27
Prabha	5600	5.4	15.2	6.14
Pragati	18200	5.3	15.0	6.30
(CD=0.05)	1210	0.09	0.24	0.12

Coimbatore (Table 7.3.4.1 – 7.3.4.2)

Twelve varieties of rice were evaluated for their performance of suitability under organic production system. All the traits showed significant difference in rice varieties and variation in productive tillers (numbers/hill) recorded between 12.4 to 19.2. IW Ponni had the maximum productive tillers (19.2 numbers/hill) while Red Kavuni had least numbers of productive tillers / hill (12.4). Red kavuni (107.0 cm) recorded tallest variety while rice variety IR 20 (72.2 cm) being the smallest in plant height. Significant difference for grain yield was observed among the rice varieties. Difference in grain yield ranged from 2073 to 4930 kg/ha. Mappillai samba recorded highest grain yield (4930 kg/ha) while CO -51 had lowest grain yield (2070 kg/ha). CO-43 was the next performer variety which recorded of 4720 kg/ha.

Table 7.3.4.1: Performance of rice verities under organic condition at Coimbatore

Rice varieties	Plant height at 60 DAT (cm)	Productive tillers / hillat 60 DAT (No)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
Bhavani	94.3	14.7	4180	11620	0.26
IW Ponni	81.2	19.2	4050	8830	0.31
Mappillai samba	103.4	14.1	4930	14620	0.23
Kitchidi samba	95.1	18.1	3210	6540	0.33
IR 20	72.2	17.2	3480	6940	0.33
CO 43	80.8	18.2	4740	8220	0.37
CO (R) 48	77.6	17.2	4680	9950	0.32

Rice varieties	Plant height at 60 DAT (cm)	Productive tillers / hillat 60 DAT (No)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
CO 51	82.9	14.3	2070	5740	0.26
CB 05022	89.2	18.4	4450	10740	0.29
KDML 105	92.1	13.7	3360	10160	0.25
Red kavuni	107.0	12.4	3280	11410	0.22
Jeeraga samba	91.3	18.8	3360	12710	0.21
CD (P=0.05)	6.14	12.35	1000	3980	-

Cooking characters of rice (Table 7.3.4.2): The quality characters *viz.*, brown rice weight, grain length before and after cooking, LB ratio, Gel consistency, linear elongation ration, volume expansion ratio and breadth wise expansion ration are analyzed. The length of the kernel before cooking was highest in IW ponni (6.4 mm) followed by Mappillai samba (6.1mm), and KDML 105 (5.9 mm). Whereas the lowest kernel length of 4.5mm was observed in Jeeraga samba. In case of kernel length after cooking, it was highest in KDML 105 (11.0mm) followed by CO 51 (10.0mm) and Mappillai samba (9.9mm). The lowest kernel length after cooking was observed in Red kavuni (6.3 mm). The kernel breadth after cooking was highest in Mappillai samba (3.5 mm) followed by CB05022 (3.4mm) and Red kavuni (3.1 mm). The lowest kernel breadth after cooking was in IR 20 (2.4 mm). linear elongation ratio (LER) ranged from 1.11 to 1.86. The highest linear elongation ratio of 1.86 was recorded in KDML 105 followed by CO 51 (1.72) and IW ponni (1.66). The lowest LER of 1.11 was recorded in organic culture Red kavuni. The highest volume expansion ratio of 4.9 was recorded in CO 43 followed by Improved white ponni (4.7) and Kitchidi samba (4.6). The lowest VER of 3.3 was recorded in CO05022 organic culture. The breadthwise expansion ratio was highest in Cb05022 (1.62) followed by Kitchidi samba (1.48) and IW ponni (1.47). The lowest breadth wise expansion ratio of 1.04 was recorded in IR 20 rice variety.

Table 7.3.4.2: Quality parameters of rice varieties under organic system at Coimbatore

Treatments	Head Rice Recovery (HRR) %	Before cooking		L/B ratio	After cooking		Gel Consistency (mm)	Linear Elongation Ratio (LER)	Volume Expansion Ratio	Breadth wise Expansion Ratio
		Length of kernel (mm)	Breadth of kernel (mm)		Length of kernel (mm)	Breadth of kernel (mm)				
Bhavani	80	6.4	2.2	2.9	9.2	2.9	110	1.44	4.0	1.32
IW Ponni	75	5.9	1.9	3.1	9.8	2.8	101	1.66	4.7	1.47
Mappillai samba	85	6.1	2.5	2.4	9.9	3.5	93	1.62	4.0	1.40
Kitchili samba	80	5.7	2.1	2.7	8.6	3.1	110	1.51	4.6	1.48
IR 20	80	5.9	2.3	2.6	9.1	2.4	135	1.54	3.7	1.04
CO 43	75	5.9	2.2	2.7	8.3	3.0	132	1.41	4.9	1.36
CO (R) 48	75	6.4	2.1	3.1	8.9	2.9	105	1.39	4.5	1.38
CO 51	70	5.8	2.1	2.8	10.0	2.7	120	1.72	3.5	1.29
CB 05022	75	5.6	2.1	2.7	9.1	3.4	79	1.63	3.3	1.62
KDML 105	75	5.9	2.1	2.8	11.0	2.6	139	1.86	4.0	1.24
Red kavuni	70	5.7	2.3	2.5	6.3	3.1	40	1.11	3.5	1.35
Jeeraga samba	75	4.5	2.0	2.3	7.2	2.1	130	1.60	4.5	1.05

Dharwad (Table 7.3.5.1)

Response of different varieties of chickpea and wheat for organic farming under rainfed farming situation were evaluated. Significant differences of chickpea and wheat varieties for yield were observed. Cultivar JAKI 9218(4119 kg/ha) produced 7.3%, 41.5%, 33.8% and 17.6% higher seed yield over cultivars BGD-103, MABC-37, MABC-27 and A-1, respectively. Among the wheat varieties, variety UAS 446 (3517kg/ha) produced 34.4%, 17.3%, 8.2% and 26.4% higher seed yield over cultivars Bijaga Yellow, DWR 2006, UAS-347, NIAW-1415 respectively.

Table 7.3.5.1: Yield of chickpea and wheat under rainfed farming in organic condition at Dharwad

Chickpea yield (kg/ha)		Wheat yield (kg/ha)	
Varieties	Yield	Varieties	Yield
A 1	3621	Bijaga Yellow	2696
MABC 27	3182	UAS 446	3517
MABC 37	3008	DWR 2006	2997
BGD 103	3969	UAS 347	3251
JAKI 9218	4258	NIAW 1415	2777
CD (P=0.05)	347		521

Jabalpur (Table 7.3.6.1-7.3.6.5)

Twelve varieties of rice and wheat in system mode were evaluated for their performance and suitability under organic condition.

Rice (Table 7.3.6.1): Significant difference among the varieties for yield and yield attributing characters were observed. Pusa sugandha 3 was the leading varieties in all the traits but statistically on par to Pusa sugandha 5, Pusa sugandha 4 and BVD 109. Maximum plant height (75.1 cm), effective tillers/hill (13.2 nos.), panicle length (26.1 cm), grains/panicle (68.7 nos.) and minimum sterility of filled grain (6.6%) resulted in highest grain yield 3299 kg/ha in Pusa Sugndha-3 rice variety followed by Pusa sugandha 5 in term of yield (3082 kg/ha). Lowest yield was recorded in Madhumati (2536 kg/ha).

Wheat (Table 7.3.6.2): Among the wheat varieties, all the parameters showed significant differences. Plant height

Table 7.3.6.1: Yield attributes and yield of rice varieties under organic farming at Jabalpur

Rice varieties	Plant height (cm)	Effective tillers / m^2	Panicle length (cm)	Grains/ panicle	1000-grains weight (g)	sterility (%)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)
PS 5	73.9	13.0	24.8	67.1	22.1	8.3	3082	5129	37.5
Sahyadri	63.1	11.9	21.1	54.0	25.0	20.7	2691	4687	36.5
PS 4	72.5	12.5	24.5	60.1	22.0	12.6	2987	5022	37.3
BVD 109	66.0	12.3	21.7	54.8	24.0	19.3	2916	5339	35.3
JR-201	73.9	13.1	25.1	68.1	23.0	6.9	2750	5334	34.0
Danteshwari	67.6	12.3	21.7	57.3	23.3	18.4	2797	5435	34.0
Madhumati	63.0	11.5	20.9	53.3	24.0	23.5	2536	5220	32.7
IR 36	70.4	12.4	24.0	58.6	23.9	13.2	2775	4670	37.3
MTU 1010	61.3	11.4	19.7	53.1	24.7	26.6	2845	4825	37.1
IR 64	73.0	12.7	24.7	65.0	24.0	9.7	2786	4695	37.2
Pusa basmati 1	64.5	11.9	21.3	54.2	22.1	20.5	2824	5136	35.5
PS 3	75.1	13.2	26.1	68.7	23.0	6.6	3299	5464	37.7
CD (P=0.05)	5.64	2.99	3.45	2.36	1.11	-	4.38	8.11	-

Table 7.3.6.2: Yield attributes and yield of wheat varieties under organic farming at Jabalpur

Wheat varieties	Plant height (cm)	Effective tillers /m²	Spike length (cm)	Grains/ spike	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index
JW 17	80.0	520.0	11.1	44.9	49.6	3935	5230	43.0
JW 3020	82.4	508.0	9.6	43.3	49.5	2745	4010	40.8
JW 3173	81.6	506.0	11.0	38.7	46.6	3797	5420	41.3
JW 3269	81.3	499.0	9.3	38.4	48.1	4163	5520	43.0
JW 3288	80.8	502.0	10.7	40.7	49.3	4209	5560	43.4
HI 1531	81.5	527.0	12.0	41.4	46.7	3843	5280	41.9
HI 1500	82.1	509.0	10.6	47.6	49.2	4850	6240	44.4
C 306	80.6	509.0	12.2	44.8	47.4	4438	5830	43.6
HD 2004	82.0	518.0	11.6	48.9	50.6	3569	4818	42.6
HI 2987	81.5	502.0	9.8	41.4	46.5	4392	5760	43.6
HD 4672	80.7	495.0	10.0	42.2	49.3	3660	5070	41.7
HI 1418	83.1	500.0	11.0	41.3	48.4	4575	5920	44.2
CD (P=0.05)	1.09	7.34	0.81	3.67	0.54	2.87	2.41	-

recorded in range from 80.0 cm to 83.1 cm whereas tallest plant was recorded for HI 1418 and smallest was for JW 17. Though effective tillers/m² (527 nos.) and spike length (12 cm) recorded higher in HI-1531 but grains/spike (48.9 nos.) and 1000-grains weight recorded higher in HD-2004 among the wheat varieties. Significantly higher wheat yield was recorded with HI 1500 (4850 kg/ha). Variety HI 1418 (4575 kg/ha) was the next leading variety which was on par with and C 306 (4438 kg/ha) and HI-2967 (4392 kg/ha). JW3020 recorded minimum grain and straw yield of wheat (2745 and 4010 kg/ha).

System yield and economics of different varieties of rice and wheat (Table 7.3.6.3)**:** The system productivity in term of rice equivalent yield (REY), net return (Rs/ha/year) and B;C rato recorded maximum with the combination of Pusa sungandha (rice)– HI-1418 (wheat) 7230 kg/ha (REY), Rs. 1,66,674/ha (NR), and 1.93 (B:C ratio) followed by Madhumati (rice)–HI-1500 (wheat) of 6684 kg/ha (REY), Rs. 1,47,560/ha/year (NR) and 2.71 (B:C ratio). Sahyadri (rice)-JW-3020 (wheat) system recorded minimum rice equivalent yield of 5129 kg/ha with lowest ret return of Rs. 93,137/ha/year.

Table 7.3.6.3: Rice equivalent yield and economics of rice - wheat systems under organic farming at Jabalpur

Kharif (Rice)	*Rabi* (Wheat)	Rice equivalent yield (kg/ha/year)	Gross return (Rs/ha/annum)	Cost of cultivation (Rs/ha)	Net return (Rs/ha/annum)	B:Cratio
PS 5	JW 17	6488	227064	86390	140674	2.63
Sahyadri	JW 3020	5129	179527	86390	93137	2.08
PS 4	JW 3173	6307	220752	86390	134362	2.56
BVD 109	JW 3269	6515	228034	86390	141644	2.64
JR-201	JW 3288	6385	223489	86390	137099	2.59
Danteshwari	HI 1531	6150	215245	86390	128855	2.49
Madhumati	HI 1500	6684	233950	86390	147560	2.71
IR 36	C 306	6578	230235	86390	143845	2.67
MTU 1010	HD 2004	5945	208079	86390	121689	2.41
IR 64	HI 2987	6551	229285	86390	142895	2.65
Pusa basmati 1	HD 4672	6020	210686	86390	124296	2.44
PS 3	HI 1418	7230	253064	86390	166674	2.93
CD (P=0.05)		733				

Effect of rice and wheat varieties on soil chemical and microbial properties (Table 7.3.6.4 & 7.3.6.5): Response on soil properties was observed among the rice and wheat varieties after completion of cropping cycle. Maximum organic carbon content (7.74 g/kg) in the soil was found to be with rice (PS-3) - wheat (HI-1418) and PS 4 – JW 3173 in the system and lowest was with PS-5 – JW-17 of 7.32 g/kg in the system. Variation in pH was from 7.26 to 7.38 and neutral in reaction and in case of EC it was in range from 0.35 to 0.37 (dm/m). Maximum available N and P in soil was higher with combination of MTU 1010 (rice) –D 2004 (wheat) of 285.6 and 13.82 kg/ha respectively. Biological properties of soil *viz*. fungi, bacteria, azotobacter and actinomycetes were also differ among different combinations of rice and wheat varieties. Higher fungi (43.22 x10^4/g cfu) and azotobacter (31.75 x10^6/g cfu) was recorded in rice (IR 64) - wheat (HI 2987). Bacteria and phosphate solubilizing bacteria was found to be higher in rice (PS-5)–wheat (JW 17) of 55.04 and 20.24 x10^6/g cfu whereas combination rice (MTU 1010)–wheat (HD 2004) retained higher actinomycetes (27.27 10^6/g cfu).

Table 7.3.6.4: Effect of different varieties of rice and wheat on soil properties at the end of cropping cycle in Jabalpur

Rice (*Kharif*)	Wheat (*Rabi*)	pH	EC (dS/m)	OC(%)	Available nutrients (kg/ha)		
					N	P	K
PS 5	JW 17	7.26	0.35	7.32	281.6	12.98	326
Sahyadri	JW 3020	7.26	0.35	7.44	279.5	13.48	318
PS 4	JW 3173	7.31	0.35	7.74	280.9	14.90	327
BVD 109	JW 3269	7.30	0.36	7.63	278.5	13.73	326
JR-201	JW 3288	7.28	0.35	7.73	282.2	13.85	310
Danteshwari	HI 1531	7.32	0.35	7.63	279.6	13.41	331
Madhumati	HI 1500	7.26	0.37	7.44	269.7	12.92	319
IR 36	C 306	7.38	0.37	7.54	284.2	13.85	308
MTU 1010	HD 2004	7.29	0.36	7.53	285.6	13.82	330
IR 64	HI 2987	7.28	0.37	7.54	278.6	13.58	322
Pusa basmati 1	HD 4672	7.29	0.36	7.63	276.6	13.74	319
PS 3	HI 1418	7.26	0.35	7.74	280.1	13.13	320
CD (P=0.5)		0.034	0.04	0.11	2.01	0.75	2.81

Table 7.3.6.5: Effect of microbial changes in soil under different varieties of rice and wheat at Jabalpur

Rice (*Kharif*)	Wheat (*Rabi*)	Fungi (10^4/g)	Bacteria (10^6/g)	AZB (10^6/g)	PSB (10^6/g)	ACT (10^6/g)
PS 5	JW 17	42.35	55.04	28.68	20.24	20.52
Sahyadri	JW 3020	39.95	51.94	30.34	19.42	19.31
PS 4	JW 3173	37.48	53.91	30.57	19.78	20.16
BVD 109	JW 3269	41.05	54.90	28.16	19.42	21.46
JR-201	JW 3288	41.21	53.03	31.31	20.28	20.78
Danteshwari	HI 1531	40.18	52.02	29.31	19.86	20.45
Madhumati	HI 1500	38.65	53.60	30.17	19.02	19.45
IR 36	C 306	40.95	53.14	29.96	19.69	20.40
MTU 1010	HD 2004	41.59	53.05	30.29	18.54	27.27
IR 64	HI 2987	43.22	53.79	31.75	19.73	20.55
Pusa basmati 1	HD 4672	37.66	51.06	29.83	19.65	20.21
PS 3	HI 1418	39.18	53.29	29.49	19.04	19.89
CD (P=0.5)		0.99	1.03	4.23	5.50	2.86

Karjat (Table 7.3.7.1 – 7.3.7.4).

Fifteen varieties of rice including early, mid-late and late maturity category (4 varieties in each) and 3 popular varieties grown by the farmers in the region during *kharif* and 15 varieties of groundnut during *rabi* hot weather were evaluated in the system mode under organic management.

Rice (Table 3.7.7.1): Among the rice varieties grouped in three categories, rice variety Karjat-3 (early maturing) which is popular among farmers, Karjat-5 (mid-late maturing) and Ratnagiri-3 (late maturing) recorded significantly higher grain yield of 5766, 6004, and 5562 kg/ha respectively. All rice hybrids produced statistically identical grain and straw yield. Karjat 4 recorded lowest yielded (3869 kg/ha) among the rice varieties.

Ground nut (Table 7.3.7.2)**:** Significantly higher pods yield of groundnut recorded in TG-26 (3110 kg/ha) which is on par with Konkan Gaurav, TAG 24, Phule-6021 but these are statistically on par to each other. The variation in other varieties of groundnut ranging from 1977 to 2665 kg/ha. Kopergaon-1 produced lower yield of 1977 kg/ha among the varieties. Haulm weight (4095 kg/ha) was also recorded higher in TG-26 over rest of the varieties.

Table 3.7.7.1: performance of different rice and ground nut varieties under organic management at Karjat

Duration	Rice *(kharif)*			Groundnut *(rabi*-hot weather)		
	Rice varieties	Grain Yield (kg ha^{-1})	Straw Yield (kg ha^{-1})	Groundnut varieties	Yield dry pods (kg/ ha)	Haulm weight (kg/ ha)
Early	Karjat – 4	3869	4328	Phule-6021	2819	3976
	Karjat-7	4894	5432	SB XI	2022	3138
	Ratnagiri-1	4635	4995	Western-44	2190	3270
	Hybrid Sahyadri-4	6453	7048	Western-66	2516	3388
Mid-late	Karjat-5	6004	6645	TAG-24	2842	3755
	Karjat-6	4458	4937	TKG-Bold	2247	3402
	Palghar-1	4622	5419	Kopergaon-1	1977	3050
	Hybrid Sahyadri-3	6642	7106	Phule Pragati	2065	3314
Late	Ratnagiri-2	5403	6166	JL-220	2039	3255
	Ratnagiri-3	5562	6380	JL-776	2665	3652
	Karjat-8	4826	5386	JL-501	2488	3520
	Hybrid Sahyadri-5	6697	7378	TG-37 A	2307	3608
Grown by farmers	Karjat-3	5766	6316	TG-26	3110	4049
	Jaya	5970	6657	Konkan Gaurav	2959	3917
	Karjat-2	5197	5794	RHRG-6083	2400	3255
	CD(P=0.05)	490	586	CD(P=0.05)	170	473

System equivalent yield and economics (Table 7.3.7.2)**:** Significantly higher rice equivalent yield (REY 27693 kg/ ha), net return (Rs. 2,84,894/ha) and benefit cost ratio (2.74) were recorded with combination of Karjat-3 (rice) in *kharif* and TG-26 (groundnut) in *rabi* compared to other varieties evaluated in the system and were statistically on par with Jaya (rice) - Konkan Gaurav (groundnut). Lowest system equivalent yield and net return was recorded in rice (palghar-1) - groundnut (kopergaon-1) of 19180 kg/ ha and Rs. 1,46,9773/ha respectively.

Table 7.3.7.2. System equivalent yield and economics of different rice and groundnut varieties under organic management at Karjat

Rice	Groundnut	System's equivalent yield (kg/ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Karjat – 4	Phule-6021	23429	379546	215811	2.32
Karjat-7	SB XI	19811	320934	157199	1.96
Ratnagiri-1	Western-44	20336	329449	165714	2.01
Sahyadri-4	Western-66	25059	405949	242214	2.48
Karjat-5	TAG-24	26332	426573	262838	2.61
Karjat-6	TKG-Bold	20627	334164	170429	2.04
Palghar-1	Kopergaon-1	19180	310713	146978	1.90
Sahyadri-3	Phule Pragati (JL-24)	22503	364553	200818	2.23
Ratnagiri-2	JL-220	20499	332078	168343	2.03
Ratnagiri-3	JL-776	24649	399313	235578	2.44
Karjat-8	JL-501	22655	367005	203270	2.24
Sahyadri-5	TG-37 A	24155	391313	227578	2.39
Karjat-3	TG-26	27693	448630	284895	2.74
Jaya	Konkan Gaurav	27034	437958	274223	2.67
Karjat-2	RHRG-6083	22588	365925	202190	2.23
CD (*P=0.05*)		1370	22200	22200	0.14

Table 7.3.7.3. Response of rice and groundnut varieties in system on physical and chemical properties of soil after end of cropping cycle at Karjat

Rice	Groundnut	pH	EC (dSm^{-1})	Organic carbon (%)	Available N (Kg/ha)	Available P_2O_5 (Kg/ha)	Available K_2O (Kg/ha)
Karjat - 4	Phule-6021	6.86	0.36	1.21	260.83	19.1	377.7
Karjat-7	SB XI	6.92	0.38	1.22	255.11	18.8	374.5
Ratnagiri-1	Western-44	6.83	0.36	1.20	243.28	18.6	368.3
Sahyadri-4	Western-66	6.85	0.38	1.20	248.29	18.8	370.5
Karjat-5	TAG-24	6.76	0.37	1.18	249.13	18.1	360.2
Karjat-6	TKG-Bold	6.94	0.38	1.14	242.44	18.8	353.9
Palghar-1	Kopergaon-1	6.89	0.39	1.11	229.90	18.8	339.1
Sahyadri-3	Phule Pragati (JL-24)	6.70	0.38	1.25	266.68	19.9	396.9
Ratnagiri-2	JL-220	6.63	0.38	1.22	260.83	19.62	390.2
Ratnagiri-3	JL-776	7.03	0.37	1.30	275.04	21.4	406.8
Karjat-8	JL-501	7.08	0.38	1.14	243.28	18.1	357.5
Sahyadri-5	TG-37 A	6.85	0.38	1.24	270.03	20.1	392.0
Karjat-3	TG-26	6.84	0.39	1.27	280.06	21.9	411.3
Jaya	Konkan Gaurav	6.83	0.39	1.30	285.08	22.2	414.8
Karjat-2	RHRG-6083	6.78	0.35	1.27	275.88	21.6	408.6
CD (*P=0.05*)		NS	NS	0.07	11.87	1.36	9.76

Soil chemical properties (Table 7.3.7.3)**:** The soil chemical properties estimated after completion of rice - groundnut system. Soil pH and EC were not influenced significantly due to varietal combination of rice and groundnut. Maximum organic carbon content (1.30 %), available N (285.1 Kg ha^{-1}), available P_2O_5 (22.2 Kg ha^{-1}) and available K_2O (414.8 Kg ha^{-1}) were observed with 'Jaya (rice)– Konkan Gaurav' (groundnut) varietal sequence as compared to other sequences followed by 'Karjat-3 –TG 26' , both are statistically at par to each other. Cropping system 'Palghar-1- Kopergaon-1' was observed as lowest in organic carbon (%), available N, P and K.

Ludhiana (Table 7.3.8.1-7.3.8.2)

Twelve varieties of rice and nine varieties of wheat were evaluated in rice-wheat system for their suitability under organic management. All the varieties of rice and wheat were grown under similar nutrient source and doses.

Basmati rice (Table 7.3.8.1): Basmati rice variety basmati 386 attained the highest plant height (156.8 cm) which was statistically at par with Basmati 370 and significantly higher than the other varieties. The lowest plant height was observed in Punjab basmati 4 (92.3 cm). Highest number of effective tillers/m^2 (404) were recorded in Punjab Basmati 4 which was at par with the Basmati 370 and significantly higher than all other varieties. The CSR 30 recorded the lowest number of effective tillers/m2 (313). The highest panicle length (29.4 cm) was observed in Pusa Basmati 1121, however the differences among all the varieties were non-significant. Maximum number of grains per panicle (74.9) was observed in Basmati 370, which was significantly higher than all other varieties. The thousand-grain weight (29.4 g) was the highest in Pusa basmati 1121 which was at par with Pusa Basmati 1509, RYT 3677, RYT 3649, Punjab Basmati 4 and significantly higher than all the other varieties

Grain yield of basmati rice varied from 1830-3920 kg/ha with a maximum percent variation of 53.3 per cent. Basmati genotype RYT 3677 gave the highest grain yield (3920 kg/ha) which was significantly higher than Punjab basmati 5, CSR 30, Basmati 386 and Basmati 370 but was at par with all the other varieties. The lowest grain yield (1830 kg/ha) was recorded by Basmati 370, and it was statistically at par with CSR 30 and Basmati 386.

Table 7.3.8.1: Performance of basmati rice varieties under organic management in rice-wheat system at Ludhiana

Rice varieties	Plant height (cm)	Effective tillers/m^2	Panicle length (cm)	Grains /panicle	1000 grain weight (g)	Economic yield (kg/ha)	Straw yield (kg/ha)
Punjab Basmati 5	114.8	320	25.4	53.7	25.4	3080	61.00
Punjab Basmati 4	92.3	404	27.6	56.1	27.6	3600	61.6
Punjab Basmati 3	109.3	343	27.1	59.2	27.1	3380	61.5
Punjab Basmati 2	123.8	364	23.8	61.1	23.8	3370	62.5
Pusa Basmati 1121	114.8	358	29.4	49.3	29.4	3320	66.8
Pusa Basmati 1509	100.9	349	29.3	61.6	29.3	3770	58.7
CSR 30	140.4	313	24.3	64.9	24.3	2350	66.8
Basmati 386	156.8	333	23.4	65.6	23.4	2020	70.6
Basmati 370	156.6	389	24.3	74.9	24.3	1830	57.8
RYT 3649	115.4	356	28.5	65.9	28.5	3620	68.5
RYT3677	105.2	346	28.9	61.2	28.9	3920	46.6
RYT3517	120.2	336	26.1	63.2	26.4	3440	62.5
CD (P=0.05)	5.1	38.1	NS	6.7	2.5	630	4.1

Wheat (Table 7.3.8.2): Significant differences were found among the varieties for plant height, effective tillers/m^2 and grain yield. The variation for plant height was observed from 88.6 to 151.6 cm, variety C306 attained tallest plant while Unnat PBW-550 been smallest. The variation for number of effective tillers $meter^{-2}$ was noted from 264.2 as lowest and 292.4 as highest that was statistically at par with BWL 3498, Unnat PBW 343 and BWL 3504 and was significantly higher than all the other varieties. Spike length was the maximum in BWL 3504 (9.9 cm), however the differences among all the varieties were non-significant. The number of grains per spike were highest

in Unnat PBW 550 (46.1), however the differences among all the varieties were non-significant. The highest thousand-grain weight (41.3g) was observed in Unnat PBW 550, however the differences among all the varieties were non-significant. The wheat grain yields varied from 2210-3770 kg/ha among different varieties and the maximum percent variation was of 64.4 per cent. The highest grain yield (3770 kg/ha) was observed in Unnat PBW 550, and it was statistically at par with BWL 3498, Unnat PBW 343 and BWL 3504 but was significantly higher than all the other varieties. The lowest grain yield was given by PBW 1 Zn (2210 kg/ha).

Table 7.3.8.2: Performance of wheat varieties under organic management in rice-wheat system at Ludhiana

Wheat varieties	Plant height (cm)	Effective tillers/m²	Spike length (cm)	Grains/ spike	1000-grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
PBW 1 Zn	111.5	264.2	9.0	38.0	39.5	22.1	38.5
C-306	151.6	272.4	9.2	39.1	39.8	28.2	52.3
BWL 3500*	103.2	279.1	9.4	40.5	40.2	31.0	47.3
PBW 175	102.5	268.4	9.1	38.6	40.0	25.4	39.8
PBW 660	105.7	278.0	9.5	40.0	40.4	30.6	45.3
BWL 3498*	116.6	285.2	9.7	43.0	40.8	33.7	54.0
Unnat PBW 343	99.8	281.4	9.7	41.6	40.5	32.9	50.2
Unnat PBW 550	88.6	292.4	9.8	46.1	41.3	37.7	58.3
BWL 3504*	115.6	288.2	9.9	44.9	41.0	36.2	56.2
CD (P=0.05)	5.1	13.0	NS	NS	NS	6.4	8.1

Modipuram (Table 7.3.9.1 and 7.3.9.2)

Twelve promising varieties of maize and mustard in maize-mustard system were evaluated with similar nutrient source and doses under organic condition.

Yield and net return Maize (Fig.1): Grain yield of maize was significantly varied among the varieties of maize and higher grain yield was found to be in PMH-5 (9475 kg/ha) followed by Hy pioneer 3396 (9187 kg/ha) while lowest yield recorded in PMH-4 (5067 kg/ha). Cost of cultivation for all the varieties was similar however, Vivek PMH-5 gave maximum gross return, net returns and benefit cost ratio of Rs. 1,66,760, Rs.1,29,494 ha^{-1} and 3.47 respectively followed by H (Pioneer 3396) and Siri seed (Hybrid) 5455 .

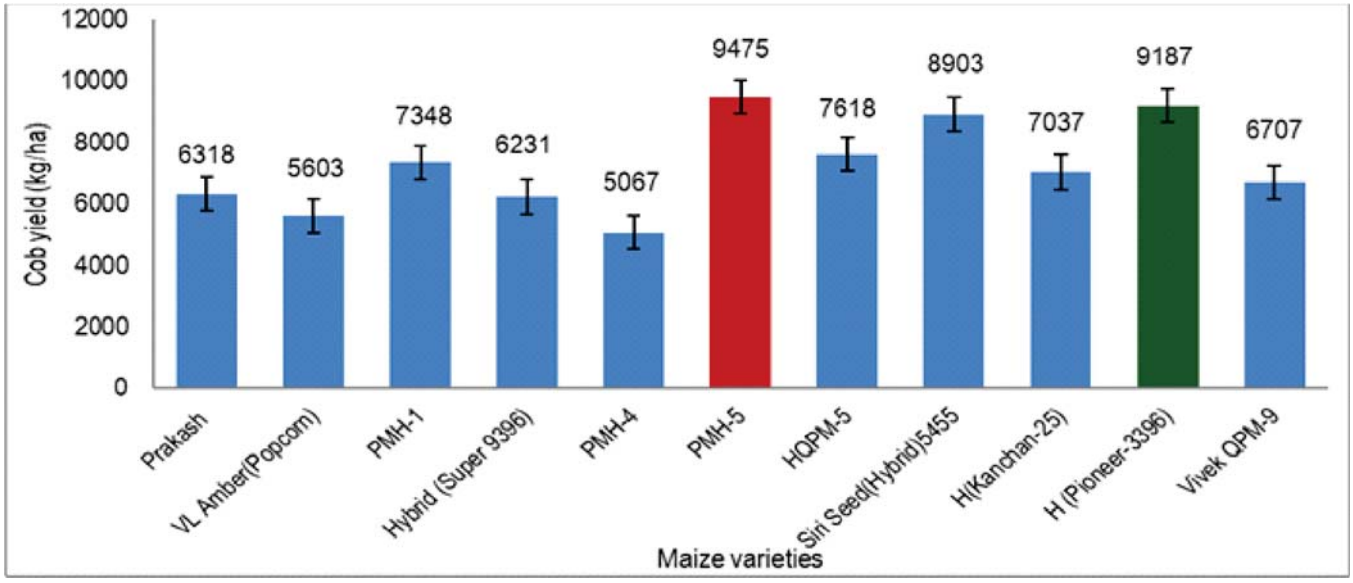


Fig. 14. Performance of different varieties of maize under organic farming at Modipuram

Table 7.3.9.1: Economic of different varieties of maize under organic farming at Modipuram.

Name of variety	Cost of Cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs/ha)	Benefit cost ratio
PMH-5	37266	166760	129494	3.47
H (Pioneer-3396)	37266	161697	124431	3.34
Siri Seed(Hybrid)5455	37266	156699	119433	3.20
HQPM-5	37266	134083	96817	2.60
PMH-1	37266	129319	92053	2.47
H(Kanchan-25)	37266	123857	86591	2.32
Vivek QPM-9	37266	118049	80783	2.17
Prakash	37266	111191	73925	1.98
Prakash	37266	111191	73925	1.98
Hybrid (Super 9396)	37266	109666	72400	1.94
VL Amber(Popcorn)	37266	98619	61353	1.65
PMH-4	37266	89185	51919	1.39

Mustard (Fig....): Among the mustard varieties, significantly higher seed yield was recorded with Pusa bold (2748 kg/ha) followed by Pusa Tark (2282 kg/ha). Variety NPJ 112 gave minimum yield of 1190 kg/ha. The yield difference from highest yielded variety was found to be 131% than lowest yielded variety. Cost of cultivation was found equal for all the varieties of mustard. Maximum gross return, net return and benefit cost ratio was recorded with Pusa bold (Rs. 1,15,430,000, 84,498 /ha and 2.73 respectively) followed by Pusa Tarak with Rs 64,898 as net return and 2.10 of BC ratio.

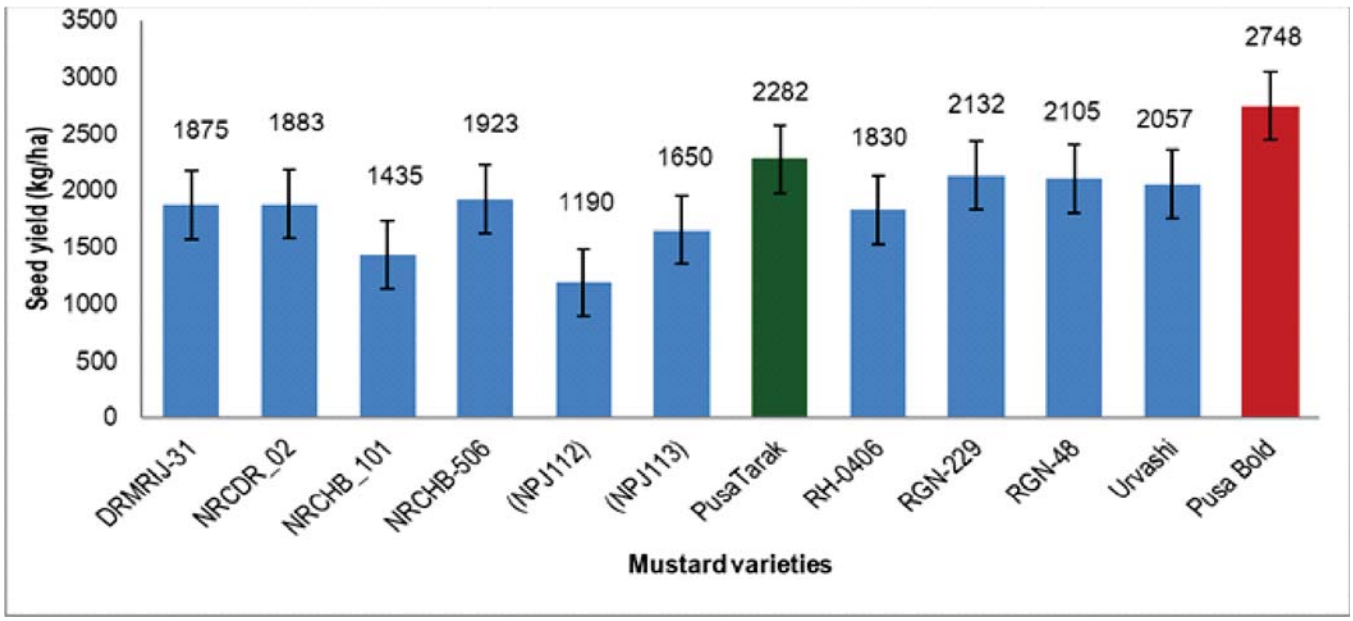


Fig. 15. Seed yield of different varieties of mustard under organic farming at Modipuram

Table 7.3.9.2: Economic of different varieties of mustard under organic farming at Modipuram

Variety	Cost of Cultivation (Rs./ha)	Gross return (Rs./ha)	Net returned (Rs./ha)	Benefit: cost ratio
DRMRIJ-31	30932	78750	47818	1.55
NRCDR_02	30932	79100	48168	1.56
NRCHB_101	30932	60270	29338	0.95
NRCHB-506	30932	80780	49848	1.61
(NPJ112)	30932	49980	19048	0.62
(NPJ113)	30932	69300	38368	1.24
PusaTarak	30932	95830	64898	2.10
RH-0406	30932	76860	45928	1.48
RGN-229	30932	89530	58598	1.89
RGN-48	30932	88410	57478	1.86
Urvashi	30932	86380	55448	1.79
Pusa Bold	30932	115430	84498	2.73

Overview of Maize and Mustard varietal trial at Modipuram

Pant Nagar (Tables 7.3.10.1 – 7.3.10.3)

Total fourteen varieties of rice including seven fine grain basmati rice and seven coarse grain varieties during *kharif* and fourteen varieties of wheat in *rabi* were evaluated under organic mode of cultivation.

Rice (Table7.3.10.1)**:** Significant variation was observed among the rice varieties for all the traits. Pant Sugandha dhan 21 was recorded as tallest variety (152 cm) while Pusa-1509 been smallest (101 cm). Highest number of effective tillers/m^2 was in Pusa Sugandha Dhan 15 (317) whereas, type-3 produced lowest effective tiller/m^2 (235). Among different varieties, significantly higher grain weight/ panicle was observed in Pant Sugandha dhan-25 (2.10 g) being at par with Pant basmati-1, Pant basmati-2 and Pant Sugandha dhan-21 and 17. Though 1000-grains weight among rice varieties was found higher in Pant Sugandha Dhan-21 (27.4 g) which was at par with Pant basmati-2, Pant Sugandha-4 and Pusa-1509 (27.1,27.0 & 26.0 g respectively) but significantly higher grain yield of rice was observed in Pant Sugandha Dhan-27 (4477 kg/ha) which was at *par* with Pant Sugandha-25 (4389 kg/ha), and 78% increase than Pant Basmati-1. Harvest index was also significantly higher in Pant Sugandha Dhan-27 (0.59) as compared to others. Economics of different rice varieties under organic cultivation showed that maximum net return (Rs. 1,03,368 /ha/year) and B:C ratio (2.84) was recorded with Pant Sugandha dhan-27 followed by Pant Sugandha dhan -25 of Rs. 1,00,692/ha/year and 2.76 respectively.

Table 7.3.10.1: Response for yield attributes and yield of rice varieties in rice-wheat system under organic management at Pantnagar

Rice varieties	Plant height (cm)	Effective tillers/m²	Grain weight/ panicle (g)	1000-grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index	CoC (Rs/ha)	NR (Rs/ha)	B:C ratio
Pant Basmati-2	134	241	2.03	27.1	3940	4972	0.44	36452	86659	2.38
Pusa Sugandha-4	135	258	1.71	27.0	3866	4000	0.49	36452	84345	2.31
Pant Sugandha Dhan-21	152	263	2.01	27.4	4222	3810	0.53	36452	95484	2.62
Pusa Basmati-1612	129	289	1.78	24.4	3893	3896	0.50	36452	85208	2.34
Pusa Basmati-1	118	265	1.76	21.0	3782	3613	0.51	36452	81741	2.24
Pusa Sugandha-5	115	279	1.68	24.3	4014	5222	0.45	36452	88974	2.44
Taraori	146	305	1.42	19.0	2509	3639	0.41	36452	41957	1.15
Pant Basmati-1	127	281	2.09	24.0	4194	4190	0.50	36452	94616	2.60
Type-3	139	235	1.79	19.0	2611	3282	0.44	36452	45140	1.24
Pusa-1509	101	289	1.63	26.0	3129	3050	0.50	36452	61343	1.68
Pant Sugandha Dhan-17	123	313	2.01	24.2	3764	3018	0.56	36452	81162	2.23
Pant Sugandha Dhan-15	131	317	1.62	22.2	3592	3954	0.48	36452	75809	2.08
Pant Sugandha Dhan-25	131	274	2.10	23.0	4389	3724	0.54	36452	100692	2.76
Pant Sugandha Dhan-27	111	301	1.87	23.0	4474	3077	0.59	36452	103368	2.84
CD (P=0.05)	12.6	39.4	0.31	2.28	358	NS	0.09			

Table 7.3.10.2: Response for yield attributes and yields of wheat_varieties in rice-wheat system under organic management at Pantnagar

Wheat varieties	Plant height (cm)	spikes/ m²	1000-grain wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index	CoC (Rs/ha)	NR (Rs/ha)	B:C ratio
WH-1105	78	303	42.0	3705	3740	0.49	34650	49853	1.44
PBW-550	80	271	41.0	3619	4078	0.47	34650	47899	1.38
UP-2628	87	277	43.1	3683	4317	0.46	34650	49352	1.42
UP-1109	104	247	42.2	3632	3670	0.51	34650	48188	1.39
UP-2425	92	239	50.4	3552	3666	0.49	34650	46379	1.34
UP-2843	91	254	41.3	3679	3553	0.51	34650	49276	1.42
UP-2841	96	259	39.6	3587	3757	0.49	34650	47177	1.36
UP-2572	91	257	45.0	3689	3960	0.48	34650	49496	1.43
DPW-62150	83	309	39.3	3568	3882	0.49	34650	46744	1.35
UP-2565	88	249	46.0	4073	4009	0.50	34650	58255	1.68
HD-2967	95	351	42.2	4316	4363	0.45	34650	63790	1.84
UP-2684	97	291	40.3	3543	4656	0.48	34650	46158	1.3
DBW-17	92	292	40.0	3606	4158	0.47	34650	47610	1.37
UP-2784	92	271	43.1	3584	3821	0.48	34650	47109	1.36
CD (P=0.05)	9.7	39.9	1.75	269	NS	NS			

Wheat (Table 7.3.10.2)**:** Significant variation among the wheat varieties were observed for plant height, spike/m^2 and 1000-grains weight and grain yield whereas, straw yield and harvest index found to be non-significant. Plant height at harvest of different wheat varieties ranged from 78 to 104 cm, and UP-1109 recorded as tallest variety while smallest was recorded with WH-1105. Significant differences in spikes/m^2 of wheat varieties were observed and it ranged from 239 to 351. HD 2967 recorded maximum spikes/m^2 which was followed by DPW62150 (309 cm), while lower was in UP 2425 (239). Grains weight (1000-grains) of different wheat varieties recorded in range from 39.3 to 50.4 g. Highest grains weight of wheat recorded in UP–2425 (50.4 g) which was significantly higher than rest of varieties however lower test weight observed with DPW-62150 (39.3 g). Significantly higher grain yield was recorded in HD-2967 (4316 kg/ha) which was at par with UP-2565. Least performing variety of wheat was UP-2684 (3543 kg/ha).

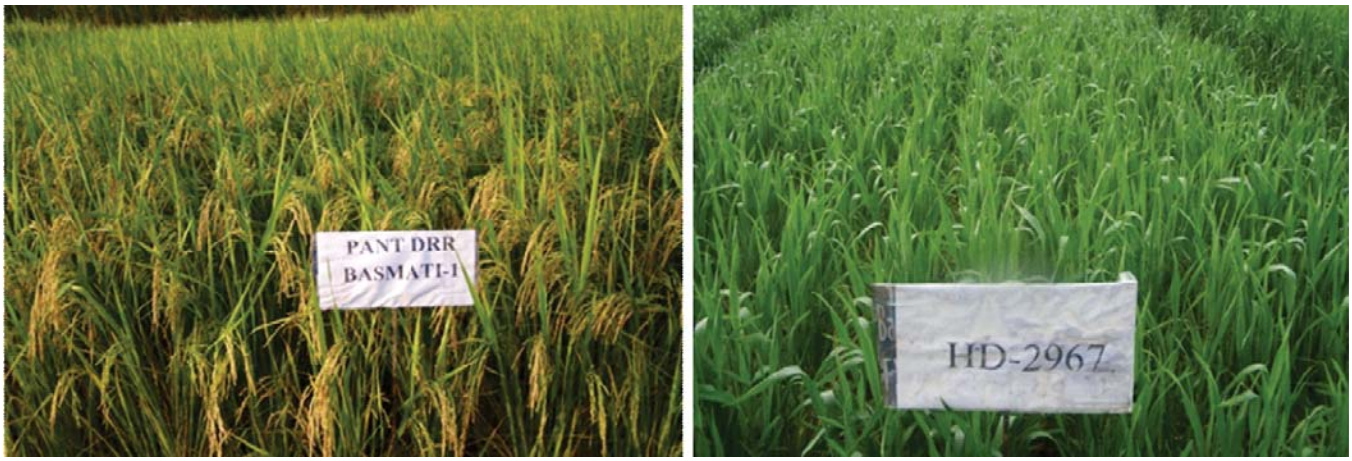
Nutrient Uptake by paddy (Table 7.3.10.3)**:** Significant variation in N, P, K and S uptake were observed among different rice varieties under organic cultivation. Nitrogen uptake among rice varieties was found to be significantly higher in Pant Basmati-2 Dhan-27 (81.0 kg/ha) followed by Pant Sugandha dhan-21 (76.1 kg/ha). P uptake was significantly higher in Pant Sugandha -5 (27.0 kg/ha) which was followed by Pant Basmati-12 (23.1 kg/ha). K uptake was significantly higher in Pant Sugandhai-5 (81.0 kg/ha) followed by Pant basmati-2 (77.1 kg/ha), and minimum fount in Type-3(51 kg/ha). Similarly, and significantly sulphur uptake among rice varieties was higher in Pant Basmati-1 (17.4 kg/ha) which was at par with Pant Sugandha Dhan-21 (16.0 kg/ha), Pusa basmati 1612 (16.0 kg/ha), Pusa Sugandha -5 (16.0 kg/ha), Pant Sugandha Dhan-25 & 27 (15.4 & 15.2 kg/ha).

Nutrients uptake by wheat (Table 7.3.10.3)**:** Significant difference were found in nitrogen and sulphur uptake,

Table 7.3.10.3: Total N, P, K and S uptake in different varieties of rice and wheat in rice-wheat system under organic cultivation.

Varieties		N uptake			P uptake			K uptake			S uptake		
Rice (kharif)	Wheat *(rabi)*	*Kharif*	*Rabi*	Total	*Kharif*	*Rabi*	Total	*Kharif*	*Rabi*	Total	*Kharif*	*Rabi*	Total
Pant Basmati-2	WH-1105	81.0	72.0	153.0	22.5	17.0	39.5	77.1	84.4	161.5	14.4	23.4	37.8
Pusa Sugandha-4	PBW-550	73.0	69.0	142.0	21.0	17.0	38.0	67.0	85.0	152.0	15.0	22.2	37.2
Pant Sugandha Dhan-21	UP-2628	76.1	68.0	144.1	22.0	15.2	37.2	65.0	86.0	151.0	16.0	20.0	36.0
Pusa Basmati-1612	UP-1109	67.0	65.0	132.0	23.1	16.2	39.3	63.0	78.3	141.3	16.0	22.0	38.0
Pusa Basmati-1	UP-2425	63.1	65.3	128.4	19.0	15.0	34.0	60.0	82.0	142.0	14.3	20.1	34.4
Pusa Sugandha-5	UP-2843	74.2	67.0	141.2	27.0	18.3	45.3	81.0	81.2	162.2	16.0	22.0	38.0
Taraori	UP-2841	49.0	66.3	115.3	16.1	18.0	34.1	55.1	82.0	137.1	11.0	23.4	34.4
Pant Basmati-1	UP-2572	73.0	69.0	142.0	22.3	19.3	41.6	70.1	80.0	150.1	17.4	25.0	42.4
Type-3	DPW-62150	54.0	64.0	118.0	15.2	16.0	31.2	51.0	81.0	132.0	11.2	24.0	35.2
Pusa-1509	UP-2565	57.4	75.0	132.4	17.0	17.2	34.2	51.0	86.4	137.4	13.0	24.0	37.0
Pant Sugandha Dhan-17	HD-2967	67.0	80.2	147.2	21.0	18.2	39.2	55.0	94.0	149.0	13.4	29.0	42.4
Pant Sugandha Dhan-15	UP-2684	70.2	70.0	140.2	22.0	17.0	39.0	64.0	91.0	155.0	15.0	26.3	41.3
Pant Sugandha Dhan-25	DBW-17	75.0	67.0	142.0	23.0	18.0	41.0	67.0	86.0	153.0	15.2	26.0	41.2
Pant Sugandha Dhan-27	UP-2784	76.0	67.0	143.0	22.0	17.0	39.0	59.0	84.0	143.0	15.4	24.0	39.4
CD(P=0.05)		7.18	7.74		3.40	NS		16.3	NS		2.19	4.39	

however, phosphorus and potassium varied non-significant. Among wheat varieties, maximum uptake of nitrogen, potassium and sulphur were recorded in HD-2967 (80.2, 94.0 and 29.0 kg/ha, respectively). However, phosphorus uptake recorded maximum in UP-2572 (19.3 kg/ha) followed by UP-2843 (18.3 kg/ha).



Best Performing varieties of rice and wheat under Organic farming at Pant nagar

Raipur (Table 7.3.11.1 – 7.3.11.4)

Fifteen traditional /improved scented rice varieties and 15 improved chickpea varieties in the region were evaluated for their performance under organic management in rice-chickpea cropping system.

Rice (Table 7.3.11.1): Among the different traditional short grain aromatic rice varieties, variety Gangabaru was taller (167.0 cm) followed by Vishnubhog (166.0 cm). The number of tiller hill^{-1} were similar and higher in Vishnubhog, Gopalbhog, Tarunbhog, Sel-1 and Badshahbhog varieties

Table 7.3.11.1: Response of different traditional and improved scented varieties of rice under organic production system

Rice varieties	Plant height at harvest (cm)	Tiller's hill^{-1} at harvest	No. of filled grains/ panicle	Panicle length (cm)	Test weight	Grain yield (kg/ha)	Straw yield kg/ha	Harvest Index	Yield stability index	Net return (Rs/ha)	B:C ratio
Traditional short grain aromatic varieties											
Badshah Bhog Sel.01	164	9.6	143.7	30.0	14.98	3244	9778	24.9	0.84	41779	2.22
Gopapl Bhog	159	9.7	185.7	33.2	19.96	4222	10500	28.7	0.75	63177	2.85
Vishanu Bhog Sel.01	166	9.7	175.3	24.7	15.50	4236	10931	27.8	0.76	63484	2.86
Shyamajeera	158	9.3	166.7	24.1	15.30	3653	10236	26.3	0.65	50720	2.48
Kubri mohar	155	8.9	147.7	27.8	16.93	3194	10528	23.3	0.69	40692	2.19
Dubraj Sel.01	126	8.7	154.0	24.0	20.96	3736	11097	25.0	0.75	52544	2.54
Lohandi	161	8.7	156.0	26.6	17.76	3019	11722	20.5	-	36863	2.08
Gangabaru	167	8.7	174.7	24.7	15.56	3569	10903	24.8	0.73	48897	2.43
Karigilas	163	9.2	164.0	27.9	37.84	3821	9694	28.3	-	54403	2.59
Lalu 14	112	5.2	92.7	20.9	15.50	1042	4861	17.7	0.51	-6401	0.81
Tarun bhog Sel.01	156	9.7	187.7	23.0	15.77	4000	12972	23.6	-	58327	2.71
Improved scented rice varieties											
C.G. Sugandhit Bhog	121	10.5	208.3	29.0	21.60	5515	10570	34.46	-	91468	3.67
IndiraSugandhit dhan	128	8.1	193.0	24.7	22.82	4208	7153	37.07	-	62878	2.84
Sugandhmati	127	10.1	192.7	25.5	24.72	4611	9583	32.62	0.57	71689	3.10
CR Sugandha dhan 907	166	8.8	158.7	23.8	18.66	4178	10986	27.57	0.72	62207	2.82
CD (P = 0.05)	5.0	1.05	37.5	5.4	1.69	594	1408	4.24	-	-	-

whereas the maximum filled grains panicle^{-1} was obtained in Vishnubhog, Tarunbhog, Sel-1 and Gopalbhog. Panicle length was higher in Gopalbhog (33.2 cm) which was significantly higher with Badshah Bhog Sel-1, Karigilas and Kubri Mohar. As regards to test weight of the scented rice varieties, the highest test weight was achieved by Karigilas (33.2 g) while the lowest test weight in Lalu-14 (20.9 g). Grain yield of traditional short grain aromatic rice varieties was recorded highest in Vishnubbhog sel-01 (4236 kg/ha) followed by Gopalbhog (4222 kg/ha) which were significantly superior over rest of the varieties. With respect to Improved scented rice varieties, C.G. Sugandhit Bhog gave the maximum tillers/hill (10.53), filled grains/panicle (208.33), panicle length (29.02 cm) resulted in higher yield of 5515 kg/ha followed by Sugandhamati (4611 kg/ha). On the basis of yield stability index, Badshah Bhog Sel.01resulted in significantly higher (0.84 YSI) among the rice varieties followed by Vishanu Bhog Sel.01, Gopalbhog and Dubraj Sel.01 (0.75). Net monetary return was recorded higher with C.G. Sugandhit Bhog (Rs. 91,468/ ha).

Chickpea (Table 7.3.11.2)**:** All the growth and yield parameters of different desi and kabuli chickpea varieties were influenced significantly. Variety RG-2003-28 (48.55 cm) was taller while, smaller plant was recorded of Vishal (37.85 cm). Significantly higher no. of branches/plant, nos. of pods/plat, no.of seeds/plant (5.11, 65.2 and 81.1) recorded with variety RG 2003-28 resulted in maximum yield of 2000 kg/ha which was statistically on par with RG 2009-01, Vijay, JG-130, PKV Kabuli, JG-226 Vishal and Vaibhav. The harvest index was also higher RG 2003-28 (51.06). Net return and B:C ratio showed the similar trend as RG 2003-28 followed by RG 2009-01 recorded maximum net return and B:C ratio

Table: 7.3.11.2 Response of different improved varieties of chickpea under organic production system at Raipur

Chickpea Varieties	Plant height at harvest (cm)	No. of branches at harvest	No. of pods/ plant at harvest	No. of seeds/ plant	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest Index	Yield stability index	Net return (Rs/ha)	B:C ratio
Vaibhav	46.6	5.2	43.8	51.4	1800	1750	50.74	0.84	77550	3.94
JG-226	43.2	4.0	49.8	60.6	1806	2069	46.67	0.79	77877	3.95
Jaki	45.2	4.7	43.8	44.9	1252	1222	50.82	0.70	45922	2.74
RG2009-01	46.4	3.6	40.2	54.9	1903	1889	50.22	0.69	83498	4.16
RG2009-16	44.8	3.3	33.1	39.0	1397	1889	42.50	0.88	54277	3.06
RG2003-28	48.5	5.1	65.2	81.1	2000	1917	51.06	0.58	89100	4.38
Vishal	37.8	3.4	23.2	24.9	1805	1931	48.28	0.79	77858	3.95
JG-16	42.6	4.7	62.7	78.8	1736	1861	48.26	0.81	73873	3.80
Vijay	44.9	3.8	64.2	70.9	1833	2083	46.72	0.61	79475	4.01
JG-11	42.2	4.1	41.9	45.8	1695	1805	48.42	0.84	71467	3.71
JG-14	43.6	3.0	37.9	42.3	1431	1819	44.04	0.91	56221	3.13
Daftari-21	41.5	3.8	37.7	54.3	1136	1222	48.13	0.75	39204	2.49
JG-130	46.0	4.4	49.1	60.9	1833	2139	46.10	0.68	79475	4.01
PKV Kabuli	40.5	3.9	44.0	52.3	1819	1736	50.99	0.74	78667	3.98
BGD-128 (Kabuli)	41.6	3.6	51.0	57.4	1628	1931	45.76	0.83	67598	3.56
CD (P=0.05)	5.3	1.3	7.3	11.2	207.24	185.05	3.86	-	-	-

Soil nutrient status: Soil organic carbon, available nitrogen, phosphorus in soil did not influence significantly on availability of these nutrients in soil except potassium. The ranged for organic carbon was found to be between 0.76 to 0.82%, whereas the range for available N (244.5 – 251.5 kg/ha), available P (20.1-21.8 kg/ha) and K were from 345.5 – 358.3 kg/ha. Among the different chickpea varieties, highest organic carbon (%) in the soil was recorded in RG 2009-16 and JG 14 (0.82%).

Table: 7.3.11.3: Nutrients status after harvest of different varieties of chickpea under organic production system.

Variety	Organic Carbon (%)	Available N (Kg ha^{-1})	Available P (Kg ha^{-1})	Available K (Kg ha^{-1})
Vaibhav	0.80	247.15	21.63	346.42
JG-226	0.81	248.04	21.52	349.77
Jaki	0.78	245.74	20.63	355.86
RG2009-01	0.79	247.02	21.21	356.51
RG2009-16	0.82	249.71	20.17	350.32
RG2003-28	0.80	249.39	20.57	358.28
Vishal	0.80	244.71	20.37	354.89
JG-16	0.80	249.71	21.44	348.61
Vijay	0.76	251.52	20.89	354.46
JG-11	0.76	245.74	21.79	350.29
JG-14	0.82	250.89	20.33	347.55
BGD-128	0.77	249.62	21.55	347.88
Daftari-21	0.79	244.52	20.07	345.46
PKV Kabuli	0.77	244.57	21.72	346.46
JG-130	0.77	244.91	21.32	347.15
CD (P=0.05)	NS	NS	NS	11.29

Best Performance varieties of rice and chickpea under organic farming at Raipur

Ranchi (Table 7.3.12.1 – 7.3.12.4)

Twelve varieties of rice and wheat were evaluated for their suitability under organic farming in the system mode with same level and sources of nutrients

Rice (Table 7.3.12.1): Rice variety B.V.D-110 attained the highest plant height (117.7 cm) which was statistically at par with all other varieties except, Birsamati, Naveen and Lalat. Effective tiller/m^2, filled grains/panicle and 1000-grains weight was significantly higher in rice variety MTU 1010 of 278 nos., 110 nos. and 24.48g respectively resulted in higher grain yield of 4467 kg/ha. Birsa Vikas Dhan 110 produced lowest grain yield (3067kg/ha).

Wheat (Table 7.3.12.2)**:** Variation for yield attributes and yield were found to be significant among the wheat verities. Plant height and spike length recorded maximum in wheat variety K-307 of 91.6 cm and 9.9 respectively however, nos. of grain/spike and 1000-grains weight recorded highest in wheat variety WR-544 of 40.07 and 48.20 respectively. Though number of tiller m^{-2} was higher in wheat variety Raj 4229 (346.7) but significantly higher grain yield of wheat (3276 kg/ha) recorded with K-0307 which was statistically at par with Raj 4229 (3144 kg/ha), DBW 39 (2962kg/ha) and GW 366 (2911 kg/ha).

Systems productivity and economics of rice and wheat varieties (Table 7.3.12.3): System equivalent yield in term

Table 7.3.12.1: Yield and yield attributing characters of rice varieties under organic management practices at Ranchi

Rice varieties	Plant height (cm)	Panicle length (cm)	Filled grain/ panicle	1000 grain weight (g)	Effective tillers/m²	Grain yield (kg/ha)	Straw yield (kg/ha)
Short duration varieties							
B.V.D 110	117.7	22.8	92	22.29	220	3067	5218
Anjali	115.9	23.2	98	21.56	233	3145	5769
Sahbhagidhan	112.7	22.4	93	22.70	226	3389	5640
Birsa Vikas Dhan 203	104.7	24.9	100	22.07	260	3806	6176
Medium duration varieties							
Naveen	101.4	23.3	105	21.52	252	3900	6129
Akhchhay	110.3	25.7	95	23.27	232	3300	5569
Birsa Dhan 201	106.6	22.7	99	23.00	248	3745	6107
Lalat	103.6	26.6	108	23.14	262	4233	6540
Late duration varieties							
Birsamati	96.0	24.7	103	19.94	267	4022	6300
Birsa Vikas Sugandha 1	113.6	23.1	103	21.31	248	3711	6142
Pusa Sugandha	110.7	25.4	110	20.88	258	3756	6000
M.T.U 1010	107.3	25.8	110	24.48	278	4467	6816
CD (P=0.05)	13.1	2.9	12.1	NS	29.9	627	797

Table 7.3.12.2: Yields and yield attributing characters of wheat varieties under organic management practices at Ranchi

Wheat varieties	Plant height (cm)	Spike length (cm)	No. of grains/ Spike	1000 grain weight (g)	Effective tillers/m²	Grain yield (kg/ha)	Straw Yield (kg/ha)
Timely sown varieties							
Raj 4229	86.3	7.8	37.5	44.46	346.7	3144	4619
HD-2733	84.5	9.4	35.9	42.47	274.4	2207	4561
K-0307	91.6	9.9	34.3	42.90	311.0	3276	4296
DBW 39	88.9	8.4	35.6	46.03	283.9	2962	4498
Late sown varieties							
BG-3	83.6	8.7	37.4	47.54	316.2	2796	4447
DBW-14	87.5	8.8	34.4	44.80	300.1	2598	4121
GW 366	79.9	9.8	35.3	45.70	326.7	2911	4200
K-9107	70.0	8.5	36.3	43.12	303.8	2711	4374
Very late sown varieties							
HI-1563	90.6	8.3	37.8	46.81	285.2	2471	4000
NW-2036	83.0	9.7	30.1	43.61	321.5	2621	3963
Raj-4250	76.0	8.0	31.7	44.78	309.0	2252	3981
WR-544	80.8	9.5	40.1	48.20	291.0	2543	4058
CD (P=0.05)	9.97	1.22	6.2	1.69	38.3	390	583

of rice equivalent yield, rice (M.T.U 1010)–wheat (WR 544) combination gave significantly higher system productivity (7142 kg/ha) which was at par with all other combinations except rice (BVD-110)–wheat (Raj 4229), rice (Pusa Sugandha)–wheat (Raj 4250), rice (Akhchhav)-wheat (DBW 14. Rice (Anjali-104)–wheat (HD 2733) gave minimum system equivalent yield of 5466 kg/ha. In term of economics, rice variety MTU-1010 resulted in significantly higher net return (Rs. 60,386 /ha) and B:C ratio (1.61) over other varieties but it remains at par with Lalat (net return Rs. 55467/ha and B:C 1.47) and Birsamati (net return Rs. 51043/ha and B:C ratio 1.36). Among wheat variety, K-0307 registered significantly higher net returns (Rs.21,288/ha) and benefit: cost ratio (0.49) than rest of the varieties, but remains statistically at par with Raj-4229 (Rs.18,974/ha),. System economics of rice-wheat cropping sequence, rice (MTU1010) and wheat (WR-544) gave highest system net returns (Rs.67,546 /ha) and system B:C ratio (0.83) and being at par with Rice (Lalat) – Wheat (K 9107) which recorded net return of Rs.66,027/ha and BC ratio of 0.81. Lowest system net return of Rs. 44,371 / ha and B:C ratio (0.54) was obtained by BVD (Rice (Akhchhay)– Wheat (DBW 14).

Table 7.3.12.3: Systems productivity and economics of different varieties of rice and wheat at Ranchi

Treatment Cropping system	System productivity (Kg/ha)	*Kharif*		*Rabi*		System	
		Net Returns (Rs/ha)	B : C ratio	Net Returns (Rs./ha)	B:C ratio (Rs./ha)	Net Returns	B:C ratio
Rice (B.V.D. 110)–Wheat (Raj 4229)	6374	31016	0.82	18974	0.43	49989	0.61
Rice (Anjali)–Wheat (HD 2733) 0.57		5466	33808	0.90	707	0.02	46173
Rice (Sahbhagi dhan)–Wheat (K 0307)	6834	37913	1.01	21288	0.49	59201	0.73
Rice (Birsa vikas dhan 203)–Wheat (DBW 39)	6921	46817	1.24	15422	0.35	62239	0.76
Rice (Naveen)–Wheat (BG 3)	6841	48397	1.29	12220	0.28	60617	0.74
Rice (Akhchhay)–Wheat (DBW 14)	6032	36129	0.96	8242	0.19	44371	0.54
Rice (Birsa dhan 201)–Wheat (GW 366) 0.59		6807	45527	1.21	14496	0.33	48304
Rice (Lalat)–Wheat (K 9107) 0.81		7084	55467	1.47	10560	0.24	66027
Rice (Birsamati)–Wheat (HI 1563)	6621	51043	1.36	5751	0.13	56794	0.7
Rice (Birsa vikas sugandha 1)–Wheat (NW 2036)	6468	45006	1.20	8736	0.2	54263	0.67
Rice (Pusa sugandha)–Wheat (Raj 4250)	6124	45459	1.21	1553	0.04	46559	0.57
Rice (M.T.U. 1010)–Wheat (WR 544)	7142	60386	1.61	7160	0.16	67546	0.83
CD (P=0.05)	806	11212	0.26	2903	0.05	13967	0.13

Best Performance varieties (M.T.U.-10) rice and (K0307) wheat under organic farming

Soil nutrient status at the end of cropping cycle (Table 7.3.12.4): There was improvement in soil pH, organic carbon, available N, P and K among varieties of rice and wheat in system mode to their initial values. Soil pH was significantly improved (6.26) in Rice (B.V.D. 110) -Wheat (Raj 4229) combination of their initial value of 5.5. After completion of cropping cycle, higher organic carbon (0.72%) was also recorded in same combination of Rice (B.V.D. 110) -Wheat (Raj 4229) system and it was increased by 71.4% to their initial value of 0.42. Availability of N, P and K in the soil after completion of cropping cycle was found higher in rice (Pusa sugandha)–wheat (Raj 4250) of 264.2, 44.4 and 224.6 kg/ha respectively.

Table 7.3.12.4: Soil nutrient status of different varieties of rice and wheat under organic management practices at Ranchi

Cropping system	pH	OC %	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
Rice (B.V.D. 110)–Wheat (Raj 4229)	6.26	0.72	262.8	44.12	222.2
Rice (Anjali)–Wheat (HD2733)	6.13	0.68	250.3	40.3	205.3
Rice (Sahbhagi dhan)–Wheat (K 0307)	6.07	0.69	255.2	44.2	214.14
Rice (Birsa vikas dhan 203)–Wheat (DBW 39)	6.04	0.66	248.7	39.12	202.3
Rice (Naveen)–Wheat (BG 3)	6.05	0.71	251.1	42.6	211.5
Rice (Akhchhay)–Wheat (DBW 14)	6.15	0.70	259.7	44.2	220.7
Rice (Birsa dhan 201)–Wheat (GW366)	6.02	0.67	249.5	40.2	204.6
Rice (Lalat)–Wheat (K 9107)	5.98	0.69	256.8	43.2	218.5
Rice (Birsamati)–Wheat (HI 1563)	6.07	0.70	256.0	43.4	219.2
Rice (Birsa vikas sugandha 1)–Wheat (NW-2036)	6.03	0.68	252.4	42.2	208.4
Rice (Pusa sugandha)–Wheat (Raj 4250)	5.97	0.71	264.2	44.5	224.6
Rice (M.T.U. 1010)–Wheat (WR 544)	6.04	0.68	251.4	42.1	209.4
CD (P=0.05)	0.28	0.03	8.05	3.84	6.1
Initial	5.5	0.42	230	32.2	162.0

Umiam (Table 7.3.13.1-7.3.13.3)

The experiment consisted of three major crops *viz*., maize, frenchbean and tomato. In Maize, 11 varieties were screened among which eight were composites, one hybrid and two local varieties. French bean consisted of 10 varieties where 8 were improved and 2 local varieties and for tomato crop, 20 varieties/lines were screened in the experiment

Maize (Table 7.3.13.1): Yield attributes and yields of different maize varieties were significantly varied under organic production system. Difference among the varieties for cob length ranged from (11.6-14.8 cm), cob weight (118.6-231.1 g), green cob yield (4100-6300 kg/ha), kernel yield (2600-3700 kg/ha) and Stover yield (6100-8900 kg/ha). Among the varieties, longest cob length (14.8 cm), cob weight (231.1 g), green cob yield (6300 kg/ha), kernel yield (3700 kg/ha and stover yield (8900 kg/ha) was recorded with DA-61-A which is on par with RCM-75 for all the traits.

French bean (Table 7.3.13.2): Among the French bean varieties, yield attribute and yield showed significant variation. Naga Local attained the highest plant height (244.3 cm), pod length (16.20), average pod weight (11.30 g), green pod yield (9100 kg/ha), seed yield (5100 kg/ha) and stover yield (7900 kg/ha) followed by RCM-FB-18 (240.3 cm, 16.2 cm, 10.60 g, 8400, 4000 and 6400 kg/ha respectively). The lowest green pod and seed yield was recorded in Maram (1500 and 1200kg/ha).

Table 7.3.13.1: Yield attributes and yields of different varieties of maize under organic production system at Umiam

Varieties	Cob Length (cm)	Cob weight (g)	Green cob yield (kg/ha)	Kernel yield (kg/ha)	Stover yield (kg/ha)
RCM-1-1	12.5	213.3	5600	3500	7800
RCM-1-2	12.9	208.5	5400	3400	7100
RCM-1-3	13.0	217.0	5800	3500	8500
RCM-75	14.5	226.4	5900	3500	8400
RCM-76	14.4	216.5	5600	3600	8800
Vijay composite	13.5	198.3	4100	2600	6100
Hemant	12.8	199.4	5000	3500	7000
DA 61 A	14.8	231.1	6300	3700	8900
Hybrid (JKMH)	13.4	207.0	5000	3500	7600
Local Yellow	12.9	188.1	4900	3100	7000
Local White	11.6	118.6	4700	3400	7600
CD (P=0.05)	1.21	52.9	683	400	750

Table 7.3.13.2: Evaluation of different varieties of French bean under organic farming at Umiam

Variety	Plant height (cm)	Pod length (cm)	Average pod weight (g/pod)	Green pod yield (Kg/ha)	Seed yield (t/ha)	Stover yield (t/ha)
RCM FB 18	240.3	16.2	10.6	8.4	4.0	6.4
RCM FB-19	213.3	15.0	7.9	5.9	3.5	5.6
RCM FB-37	219.9	15.2	7.2	5.6	2.5	5.3
RCM FB 61	177.8	14.3	6.6	3.5	2.6	5.1
RCM FB-62	226.8	13.4	6.5	5.7	2.7	5.4
RCM FB-80	230.3	15.1	7.6	5.9	3.3	5.0
Nagaland local 1	224.0	13.8	4.8	2.5	2.1	3.6
Nagaland local 3	160.9	14.6	6.1	5.4	3.1	6.2
Maram	114.1	13.3	4.4	1.5	1.2	1.8
Naga local	244.3	16.2	11.3	9.1	5.1	7.9
CD (P=0.05)	17.56	0.81	0.57	0.47	0.56	0.86

Soil chemical and physical properties (Table 7.3.13.3): Soil organic carbon and available N, P and K differ significantly. Maize variety RCM-76 recorded maximum pH and bulk density but did not differ significantly among the maize varieties. Significantly higher soil organic carbon was recoded with variety DA 61A (2.39%) followed by RCM-75 and RCM 1-3 (2.29 and 2.25% respectively) among the varieties of maize. The available N and P status in soil varied significantly and recorded maximum under Local Yellow (220.6 and 24.9 kg/ha respectively) whereas, maximum K was recorded under RCM 1-3 (213.5 kg/ha).

Table 7.3.13.3: Soil physical and chemical properties of different varieties of maize under organic production system at 0-15 cm soil depth at Umiam

Varieties	Soil pH	SOC (%)	Bulk (Mg/cm^3)	Available N (density kg/ha)	Available P (kg/ha)	Available K (kg/ha)
RCM-1-1	5.11	2.17	1.17	214.2	17.8	207.5
RCM-1-2	5.14	2.11	1.12	211.4	16.6	213.5
RCM-1-3	5.06	2.25	1.13	213.9	16.8	209.5
RCM-75	5.11	2.29	1.15	198.4	15.8	207.9
RCM-76	5.18	2.14	1.21	206.4	15.1	201.2
Vijay composite	5.12	2.23	1.15	209.0	17.2	195.8
Hemant	4.81	1.80	1.14	205.6	14.8	194.9
DA 61 A	4.89	2.39	1.16	205.3	14.5	205.5
Hybrid (JKMH-501)	5.13	1.96	1.15	163.4	13.5	194.7
Local Yellow	5.15	2.23	1.14	220.6	24.9	204.4
Local White	5.12	2.17	1.13	215.2	23.9	203.9
CD(*p*=0.05)	NS	0.18	NS	15.43	3.72	12.31

Maize under varietal trail for organic production

Land preparation for maize sowing

Ajmer (Table 7.3.14.1-7.3.14.6)

Seed spice crops coriander and fennel in *rabi* and green gram and cluster bean in *kharif* were evaluated under organic condition. The total eight varieties each crop *i.e.*, coriander, fennel, green gram and cluster was evaluated of their suitability for organic farming.

Green gram (Table 7.3.14.1): There were significant difference in its performance with respect to growth and seed yield of green gram. Among the green gram varieties, Mum-2 performed significantly better for plant height (57.8 cm), number of primary branches (4.3), number of nods/plant (27.2), number of seeds/pod (10.9), also for seed yield and biomass yield. It recorded 798 kg/ha seed yield which was on par with RMG-975 and RMG 62 but significantly higher than other varieties, whereas SML 668 and Ganga-1 produced lower yield of 630 and 617 kg/ha respectively.

Cluster bean (Table 7.3.14.2): Among the cluster bean varieties' significant variation for all the traits was recorded. Though tallest variety recorded RGC-986 (155.5 cm) but variety RGC-1038 performed better among the different cluster bean varieties with highest nos. of primary branch/plant (7.6), pods/plant (70.1), seeds/pod (8.4) resulted in higher seed yield of 1515 kg/ha and it was at par with RGC-1055. Variety RGC-986 recorded lowest performer in terms of number of pods/plant (29.9), numbers of seeds/pod (7.5), seed yield per hectare (647 kg).

Table 7.3.14.1: Performance of green gram varieties under organic management during *kharif* at Ajmer

Treatment	Plant height at harvest (cm)	No. of primary branchesPlant^{-1}	No. of pods/plant	No. of seedspod^{-1}	Seed yield (kg/ha)	Biomass yield (kg/ha)	Harvest Index
RMG-975	57.2	4.2	26.9	10.9	792	2650	23.1
RMG-62	56.7	4.2	21.0	10.8	698	2470	22.2
MSG-118	50.4	3.4	26.1	8.4	648	2278	22.2
RMG-492	56.3	4.1	23.4	9.8	650	2728	19.4
SML-668	44.2	3.7	18.5	9.9	630	2077	23.3
GANGA-1	56.2	4.2	25.1	9.7	617	2007	23.3
IPM-02-3	52.4	4.0	23.4	10.6	653	2282	22.2
MUM-2	57.8	4.3	27.2	10.9	798	2640	23.6
CD(P=0.05)	8.0	0.7	3.6	1.6	123	449	3.5

Table 7.3.14.2: Performance of cluster bean varieties under organic management during *kharif* at Ajmer

Treatment	Plant height at harvest (cm)	No. of primary branchesPlant^{-1}	No. of pods/plant	No. of seeds pod^{-1}	Seed yield (kg/ha)	Biomass yield (kg/ha)	Harvest Index
RGC-936	137.1	3.9	54.1	8.0	1307	3617	26.5
RGC-1001	124.8	3.3	41.0	7.9	1312	3863	25.3
RGC-1003	117.3	4.3	49.7	7.9	1322	4020	24.7
RGC-1038	139.9	7.6	70.1	8.4	1515	4108	27.0
RGC-986	155.5	2.8	29.9	7.5	647	3312	16.4
RGC-1055	124.7	6.5	68.0	8.4	1433	3898	26.8
RGC-1066	133.5	1.7	45.4	8.0	1277	3513	26.6
RGC-12-1	137.9	3.7	57.4	8.2	1280	3483	26.7
CD(P=0.05)	7.5	0.8	11.9	0.5	295	518	3.0

Best performance variety of green gram (MUM-2) and cluster bean (RGC-1038) under organic farming

Coriander (Table 7.3.14.3): significant variation was observed for growth and yield parameter of coriander. Maximum plant height of 102.3 cm was recorded with ACr-1 followed by Azad Dhania-1 (96.6 cm) however, Azad Dhania-1 was found superior which recorded maximum plant height(115.9 cm), primary and secondary branches/plant (7.7 & 22.7), number of umbels/plant (41.9), number of umbellets/umbel (6.2) and seed yield (1671 kg/ha) followed by ACr-1 and Hissar Anand while RCr- 446 been least performing variety which recorded seed yield of 1297 kg/ha.

Fennel (Table 7.3.14.4): Among fennel varieties, GF-12 performed superior with all yield attributes and yield, It recorded highest plant height (162.1 cm), number of primary and secondary branches (12.7 & 22.4), umbels per plant (41.5), umbellets per umbel (27.5) resulted significantly higher seed yield per hectare (3235 kg) which was on par with AF-1, Rajendra Saurabha. GF-2. Variety RF-101 was the least performing variety in terms of seed yield (2817 kg/ha).

Table 7.3.14.3: Performance of coriander varieties under organic management during *rabi* at Ajmer

Treatment	Plant height at harvest (cm)	No. of primary branches /plant	No. of secondary branches/plant	No. of Umbel /plant	No. of umbellate /umbel	Seed yield (kg/ha)
ACr-1	114.7	7.5	22.4	40.1	6.1	1663
Azad Dhania-1	115.9	7.7	22.7	41.9	6.2	1671
RCr- 435	100.4	5.7	18.7	32.9	6.1	1364
RCr- 436	103.0	5.0	18.2	34.5	5.5	1313
RCr- 446	95.4	6.2	19.3	32.2	5.5	1297
RCr- 684	99.7	7.0	19.5	36.8	5.6	1358
Hissar Sugandha	102.7	6.2	18.5	37.5	5.4	1377
Hissar Anand	98.1	6.4	19.9	39.6	6.0	1437
CD (P=0.05)	8.7	0.9	3.0	4.6	0.5	158

Table 7.3.14.4: Performance of fennel varieties under organic management practices during *rabi* at Ajmer

Treatment	Plant height at harvest (cm)	No. of primary branches /plant	No. of secondary branches/plant	No. of Umbel /plant	No. of umbellate /umbel	Seed yield (kg/ha)
AF-1	160.2	12.0	21.9	39.0	27.0	3203
RF-101	149.7	8.1	16.5	29.9	22.3	2817
Co-1	148.4	7.7	17.5	30.3	23.3	2920
Rajendra Saurabha	156.5	8.6	17.9	31.7	23.9	3117
GF-12	162.1	12.7	22.4	41.5	27.5	3235
RF-281	151.3	9.0	20.1	33.5	24.1	2913
RF-125	148.3	10.6	20.1	35.5	24.5	2943
GF-2	154.7	10.7	17.3	31.0	24.9	2993
CD(P=0.05)	9.3	1.3	1.9	5.2	2.5	275

Best performing variety of (Azad Dhania-1) coriander and fennel (AF-12) under organic farming

Nutrient Uptake by coriander and fennel (Table 7.3.14.5): Significant difference in N, P and K uptake were observed after harvesting of coriander and fennel varieties under organic system. Among coriander varieties, ACr-1 and Azad Dhania-1 removed maximum N (51 and 48.4 kg/ha), P (10.1 & 10.2 kg/ha) and K (70.1 and 70.4 kg/ha) and found statistically on par to each other but significantly higher than other varieties of coriander. In case of fennel, N and K uptake was higher in AF-1 which was on par with and GF-12 but significantly higher than other however P was higher in GF 12.

Table 7.3.14.5: Total N, P, K uptake in different varieties of coriander and fennel under organic production system

Treatment	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)
Coriander			
ACr-1	51.0	10.1	70.1
Azad Dhania-1	48.4	10.2	70.4
RCr- 435	36.6	8.5	56.4
RCr- 436	37.3	7.6	54.6
RCr- 446	37.7	7.7	51.6
RCr- 684	34.9	8.0	55.5
Hissar Sugandha	38.0	8.1	56.7
Hissar Anand	39.0	8.0	59.2
CD(P=0.05)	7.6	1.0	7.8
Fennel			
AF-1	98.2	20.3	140.5
RF-101	80.9	17.4	123.3
Co-1	82.7	17.6	122.5
Rajendra Saurabha	84.3	19.6	136.1
GF-12	94.1	20.4	140.1
RF-281	84.3	18.4	132.9
RF-125	81.3	17.9	130.1
GF-02	82.8	17.9	129.1
CD(P=0.05)	12.1	2.2	12.5

Best performing variety of coriander and fennel at Ajmer

Gangtok (Table 7.3.15.1 & 7.3.15.2)

12 varieties of each maize and buckwheat were evaluated for their performance and suitability under organic management in maize-buckwheat cropping system

Maize (Table 7.3.15.1): Variation for yield, ranged from 1470 to 2890 kg/ha. Among the maize varieties, Vivek Sankul -35 performed better in term of grain yield (2890 kg/ha), net return (Rs.72900/ha) and return per rupee invested (2.71) which were followed by RCM -75 and Vivek sankul -31 while lowest yield and net return recorded in KaloMakkai (1420 kg/ha and Rs.14,000/ha). Production efficiency (kg/ha/365), profitability (^{1} /ha/day) and land use efficiency is also higher in Vevek Sankul-35 of 7.91,199.77 and 36.89 respectively followed by RCM-75.

Buckwheat (Table 7.3.15.2): Among the buckwheat varieties, physiological parameter, cholorophyll content was higher in Sangla B-1 of 20.87 closely follwed by IC 15393. Variety PRB-1 attain the maximum plant height of 68.8 cm followed by Sangla B-1. Spike length among the buckwheat varieties did not differ significantly. Though nos. of grains/plant (71.6) recoprded higher in IC 36805 followed by local thethay but 1000-grains weight and days to maturity was higher with IC 49671 of 21.3g and 113 days respectively. Differences among the buckwheat

Table 7.3.15.1: Evaluation of maize composite under organic management condition

Varieties	GrainYield (t/ha)	GrossReturn (×10^{3} /ha)	NetReturn (×10^{3} ^{1} /ha)	Return rupee^{-1} invested (kg/ha/365)	Production efficiency	Profitability^{1} /ha/day	LUE (%)
Seti Makkai	2220	8.89	4.62	2.08	6.09	126.71	28.86
Pahenlo Makkai	2110	8.44	4.18	1.98	5.78	114.53	33.97
Rato Makkai	1720	6.89	2.62	1.62	4.72	71.91	32.88
Baiguney Makkai	2220	8.89	4.62	2.08	6.09	126.71	32.60
Kalo Makkai	1420	5.67	1.40	1.33	3.88	38.43	32.88
Satheya	1470	5.89	1.62	1.38	4.03	44.52	29.95
RCM 1-1	2330	9.33	5.07	2.19	6.39	138.89	30.96
RCM 1-3	1690	6.78	2.51	1.59	4.64	68.87	31.51
RCM 75	2560	10.22	5.96	2.40	7.00	163.24	30.32
Vivek Sankul-31	2560	10.22	5.96	2.40	7.00	163.24	28.86
Vivek Sankul-37	2170	8.67	4.40	2.03	5.94	120.62	28.31
Vivek Sankul-35	2890	11.56	7.29	2.71	7.91	199.77	36.89

varieties for yield ranged from 1013 to 1600 kg/ha. IC 49671 was the highest yielded variety which produced of 1600 kg.\/ha yield and Sangla B1 was the lowest yieldded variety. In terom of economics, net return (Rs73,280/ha), return per rupees invested (2.53), production efficiency (7.31 kg/ha/365), profitability (200.77 ^{1} /ha/day) and land use efficiency (31.0%) was also higher in IC 49671 followed by IC 107929 which was next higher variety.

Table 7.3.15.2: Yield attributes and yields of different varieties of buckwheat under organic production system

Varieties	Chlorophyll content/ leaves	Plant height (cm)	Spike length (cm)	No. of grains/ plant	1000 grain weight(g)	Days to maturity	Grain yield (q/ha)	Net return (Rs./ha)	Return Rupee^{-1}kg/ invested	Production (ha/365)	Profitability^{1} efficiency /ha/day	LUE (%)
Local Meethay	19.95	57.00	1.44	51.80	20.57	112	14.40	62,480	2.16	6.58	171.18	30.7
Local Teethay	18.95	52.00	1.36	61.74	20.23	109	13.73	57,560	1.99	6.28	157.70	29.9
IC 104727	19.77	55.73	1.37	70.86	18.30	113	14.00	59,660	2.06	6.39	163.45	31.0
IC 36805	17.75	49.97	1.46	71.58	19.00	112	13.17	53,990	1.86	6.09	147.92	30.7
IC 109729	17.03	41.83	1.30	61.25	20.10	113	13.60	56,720	1.96	6.21	155.40	31.0
IC 15393	20.47	49.97	1.36	56.36	19.10	113	12.90	52,310	1.81	5.89	143.32	31.0
IC 109433	16.29	58.33	1.33	47.90	19.37	112	15.10	67,227	2.32	6.89	184.18	30.7
IC 49671	15.66	36.67	1.32	67.49	21.23	113	16.00	73,280	2.53	7.31	200.77	31.0
IC 2018742	16.22	49.07	1.40	48.74	20.23	109	11.67	44,540	1.54	5.33	122.03	29.9
PRB-1	15.52	68.33	1.30	47.60	17.73	113	12.17	47,690	1.65	5.56	130.66	31.0
VL- ugal	15.59	57.27	1.33	49.09	17.50	112	11.00	40,340	1.39	5.02	110.52	30.7
Sangla B-1	20.87	62.17	1.36	57.99	18.37	113	10.13	34,880	1.20	4.63	95.56	31.0
CD (P=0.05)	2.22	7.81	NS	6.25	NS	NS	1.54	9751	0.34	0.71	26.71	NS

Best performing variety of maize and buckwheat under organic condition at Gangtok

Sardarkrushinagar (Table 7.3.16.1 – 7.3.16.5)

Eight verities of each crop in groundnut-wheat-green gram system were grown for their performance under organic farming

Groundnut (Table 7.3.16.1): Yield attributes characters, yield and economics showed significant variations among groundnut varieties except plant height which did not differ significantly. Plant height recorded 52.4 cm as lowest to 71.2 cm as highest. Though number of pods and pod weight per plant (25.3 and 10.8 respectively) and number of branches /plants (8.4) was highest in GG 20 SS but, pod yield (1549 kg/ha), net return (Rs 56,178/ha) and net return per rupee invested (1.42) along with higher number

Table 7.3.16.1: Yields attributes and yield of different groundnut varieties under organic farming at SK Nagar

Groundnut varieties	Plant population at harvest (m^{-1} row length)	Number of nodules /plant at 50 DAS	Plant height at harvest (cm)	Number of branches /plant	Number of pods/ plant	Pod weight / plant (g)	Pod yield kg/ha	Haulm yield (kg/ha)	Net return (₹/ha)	NRPRI
GJG-HPS-1(S)	7.7	73.4	55.7	7.0	21.6	10.3	1258	2028	38807	0.98
GG- 20 (SS)	7.3	80.8	58.0	8.4	25.1	10.8	1428	2341	49501	1.25
GG-7 (B)	7.7	80.1	71.2	5.8	20.1	8.6	1152	1826	32068	0.81
TG-37 (A) (B)	7.0	92.8	62.0	6.9	24.5	7.8	1379	2015	45712	1.15
GJG-9 (B)	7.3	82.1	69.9	5.0	19.5	8.5	1184	1924	34238	0.86
GG-5 (B1)	7.3	97.5	65.2	6.6	18.5	10.1	1135	1504	30124	0.76
GJG-17 (S)	7.0	103.8	52.4	8.0	19.8	10.4	1549	2238	56178	1.42
KDG-123 (B)	7.0	75.3	60.2	6.7	18.8	8.4	1256	1872	38231	0.96
CD (P=0.05)	NS	9.60	10.75	1.1	4.25	1.3	380	436		

Table 7.3.16.2: Yield attributes and yield of different wheat varieties during *rabi* at SK Nagar

Wheat varieties	Plant population at harvest (m^{-1} row length)	Plant height at harvest	Effective tiller/ meter row length	Ear head length (cm)	No. of grains / ear head	Test weight (g)	Grain yield kg/ ha	Straw yield kg/ha	Net return (₹/ha)	NRPRI
GW 451	40.0	72.3	2.9	7.8	28.7	34.3	3964	5630	37976	0.55
GW 366	38.0	82.0	2.3	8.8	30.0	32.7	3433	4741	23176	0.33
GW 322	34.3	78.8	2.8	11.0	29.7	38.0	3250	4711	18931	0.27
GW 273	35.7	91.1	2.7	12.5	30.0	35.0	3639	4963	28541	0.41
GW496	37.7	84.6	2.5	11.1	31.7	35.0	3862	5304	34666	0.50
GDW 1255	40.0	73.8	2.4	8.1	30.3	36.1	3624	4830	27803	0.40
GW1139	39.3	75.2	2.8	8.6	31.0	34.7	3604	5170	28386	0.41
HI 8498	40.0	76.8	2.9	8.7	32.7	34.5	3364	4659	21377	0.31
CD (P=0.05)	NS	8.82	NS	1.33	NS	NS	NS	592		

Table 7.3.16.3: Yield attributes and yield of different green gram varieties during *summer* at SK Nagar

Green gram varieties	Plant Population Harvest (m^{-1} row length)	Plant height (cm) at harvest	Number of branches/ plant	Number of pods/ plants	Number of seeds/ pods	100-seed weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Net return (₹/ha)	NRPRI
GM 4	8.7	41.6	6.8	30.4	10.9	36.6	487	904	4577	0.16
Meha	9.0	39.9	6.1	29.4	10.5	37.4	425	883	626	0.02
K 851	9.3	39.5	6.3	29.2	8.9	36.4	357	785	-3927	-0.14
PDM 139	9.0	42.9	6.5	28.8	9.1	35.3	296	747	-7878	-0.27
IPM 410-3	8.0	41.9	6.2	27.0	8.5	34.3	289	766	-8244	-0.29
GAM 5	9.0	42.0	6.3	28.7	10.4	34.8	471	889	3514	-0.12
PKVAKM 4	7.7	40.1	5.1	26.5	9.5	35.2	350	799	-4350	-0.02
BGS 9	8.0	39.0	5.2	26.8	9.2	33.5	347	741	-4708	-0.16
CD (P=0.05)	NS	2.57	1.05	2.49	0.98	NS	82	126		

of nodules/plants (103.8 at 50 DAS) was maximum with GIG-17 followed which was at par with all treatments except GG 7 and GG5.

Wheat (Table 7.3.16.2): Plant height, grain yield, spike length and straw yield showed significant variation among the wheat varieties other parameters such as plant population, effective tiller, nos. of grains/spike and grain yield did not differ significantly. Difference for the plant height ranged in 72.3 – 91.1 cm. GW 451 recorded smallest whereas, GW 273 attain highest height. Spike length was recorded higher in GW 273 of 12.5 cm which was significantly differ rest of varieties. Number of grains/spike was not differ significantly and was in range from 28.7 – 32.7. Grain and straw yield did not vary significantly among different wheat varieties and varies from 3250 to 3964 kg/ha. Maximum yield was found in variety GW-451 (3964 kg/ha) which is higher than other varieties followed by GW 496, GW-273 and GDW-1255. Highest net return and NRPRI was also obtained with GW 451 of Rs 37,976/ha and 0.55).

Green gram (Table 7.3.16.3): Yield attributes characters such as plant population and 1000-grains weight did not differ among the green gram varieties whereas other contributing characters and yield showed significant variations. Differences in plant population (nos.) and plant height (cm) and 100-seeds weight (g) were found in range from 7.7-9.3, 39.0-42.9 and 33.5-37.4 respectively. Nos. of branches, pods and seeds per plant (6.8, 30.4 and 10.9 respectively) recorded maximum in variety GM-4 resulted higher seed and stover yield (487 and 904 kg/ha), net return (Rs 4,577/ha) and NRPRI (0.16) and found best performing variety but been at par to GAM-5.

Best performing variety of (GG-20 SS) groundnut and green gram (GM-4) under organic farming

System equivalent yield and energy indices of groundnut-wheat-green gram system (Table 7.3.16.4): Highest groundnut equivalent yield was obtained in GJG-HPS-1(S) (Groundnut) - GW 451 (Wheat) - GM 4 (Green gram) crop sequence of 3808 kg/ha, which is closely followed by GJG-17(S) (Ground nut) "GW-1139 (wheat) " PKVAKM 4 (green gram) of 3788 kg/ha. Input energy for all the treatments is equal of 43461 MJ/ha. Maximum output energy (2,96,481 MJ/ha), and net energy return (2,53,200 MJ/ha) were also recorded in GJG-HPS-1(S) (Groundnut) - GW 451 (Wheat) - GM 4 (Green gram) closely followed by GJG-17(S) (Ground nut) "GW-1139 (wheat) " PKVAKM 4 (green gram). Energy use efficiency (20.16) and energy productivity (0.38 kg/MJ) was recorded maximum in GJG-17(S) (Ground nut) "GW-1139 (wheat) " PKVAKM 4 (green gram) whereas specific energy (39.86 MJ/kg) was found higher in GJG-9 (B) (ground nut"GW"496 (wheat) " IPM 410-3 (green gram)

Nutrient status (Table 7.3.16. & 7): Soil fertility status and nutrient uptake at the end of crop sequences in the soil ranged N from 168.3-179.5 kg/ha, P ranged from 17.0-20.0 kg/ha and K range was from 175.3-185.6 kg/ha. N, P and K recorded maximum in GG-7 (B) "GW 322"K 851 combination. Soil organic carbon was found to be higher in KDG-123 (B) " HI 8498 " BGS 9 and GJG-17 (S) "GW1139 " PKVAKM 4 (0.26%) and it was increased 36.8% to their initial value. Minimum bulk density (1.49 g/cc) was recorded in also with KDG-123 (B) " HI 8498 " BGS 9 while lower was in GG- 5 (B1) - GW 1255 – GM-5 of 1.29 g/cc. pH value were in range from 7.1 as lowest to 7.45 as highest. Maximum total uptake of N (185 kg/ha), P (30.4 kg/ha) and K (118 kg/ha) was observed in treatment GJG-HPS-1(S) - GW 451 - GM 4 varietal sequence followed by treatment GG- 20 (SS) - GW 366 - Meha varietal sequence.

Table 7.3.16.4: Systems equivalent yield, energy analysis of different varieties for organic farming under groundnut- wheat- green gram crop sequence

Treatment			System equivalent yield (kg/ha)	Input energy (MJ/ha)	Output energy (MJ/ha)	Net energy returns (MJ/ha)	Energy use efficiency	Energy productivity (kg/MJ)	Specific energy (MJ/kg)
Groundnut	Wheat	Green gram							
GJG-HPS-1(S)	GW 451	GM 4	3808	43641	296841	253200	20.09	0.37	27.00
GG- 20 (SS)	GW 366	Meha	3667	43641	275520	231879	20.11	0.37	27.00
GG-7 (B)	GW 322	K 851	3011	43641	250771	207130	17.28	0.32	34.13
TG-37 (A) (B)	GW 273	PDM 139	3547	43641	271900	228259	18.62	0.35	35.89
GJG-9 (B)	GW496	IPM 410-3	3448	43641	277267	233626	18.19	0.33	36.86
GG-5 (B1)	GDW 1255	GM 5	3461	43641	260764	217123	17.56	0.34	28.81
GJG-17 (S)	GW1139	PKVAKM 4	3788	43641	285301	241660	20.16	0.38	31.92
KDG-123 (B)	HI 8498	BGS 9	3347	43641	255071	211430	17.64	0.33	33.81

Table7. 3.16.5: Soil properties after completion of groundnut- wheat- green gram crop sequence under organic farming at S.K. Nagar

Varietal combinations			Available nutrients			SOC	BD	EC	pH	Uptake		
Groundnut	Wheat	Green gram	N (kg/ha)	P (kg/ha)	K (kg/ha)	(%)	(g/cc)	(dSm^{-1})		N	P	K
GJG-HPS-1 (S)	GW 451	GM 4	175.1	20.0	181.6	0.25	1.39	0.09	7.45	185.1	30.4	118.1
GG- 20 (SS)	GW 366	Meha	176.4	17.0	185.6	0.24	1.39	0.07	7.34	178.9	29.7	112.5
GG-7 (B)	GW 322	K 851	179.5	20.0	189.6	0.22	1.42	0.09	7.21	158.8	27.0	103.2
TG-37 (A) (B)	GW 273	PDM 139	174.8	20.0	179.6	0.24	1.40	0.12	7.20	169.7	26.3	107.2
GJG-9 (B)	GW496	IPM 410-3	179.3	18.8	175.3	0.25	1.36	0.13	7.21	171.8	29.6	108.2
GG-5 (B1)	GDW 1255	GM 5	172.7	18.2	182.4	0.25	1.29	0.11	7.10	164.1	26.7	93.9
GJG-17 (S)	GW1139	PKVAKM 4	168.3	20.0	179.8	0.26	1.39	0.09	7.35	180.5	29.8	111.9
KDG-123 (B)	HI 8498	BGS 9	179.5	19.0	180.5	0.26	1.49	0.10	7.36	156.1	25.0	98.3
Initial	**147**	**10.92**	**140**	**0.19**	**1.48**	**0.09**	**7.14**					

Thiruvananthapuram (Table 7.3.17.1-7.3.17.3)

Growth attributes and yield of cassava (Table7.3.17.1): Twelve varieties of cassava were grown under organic management. H-226 attained the maximum height at 6 months after planting (197.8 cm) and significantly higher than Sree Jaya Kalpaka and Sree Swarna. Vellayani Hraswa was the smallest variety (120.3 cm) at 6MAP. Tuber length did not differ significantly among the cassava varieties and recorded in the range from 18.0 cm as minimum length to 25.0 cm as highest length. Tuber girth among the varieties was higher in H-226 (19.05 cm) which was on par with Sree Visakham and Sree Pavithra but significantly higher than other. Though average tuber weight (428 g) was higher in Sree Jaya but maximum yield

(23210 kg/ha) was recorded with CR-24-4 which was significantly higher than others.

Tuber quality of cassava (Table 7.3.17.2 &7.3.17.3): Cassava varieties varied significantly in starch and total sugar contents and H-226 had the highest starch content (30.44%), which was similar to H-165, CR-24-4, Sree Athulya and Sree Visakham. The total sugar content of Sree Visakham was the highest (1.72%), which was on par with CR-24-4, H-226 and H-165, while Kalpaka had the lowest total sugar percentage (0.78%). There was no significant variation in the dry matter content of the tubers among the varieties. Sree Visakham had the highest tuber dry matter content (42.29%), followed by M-4, Sree Pavithra, CR-24-4, Sree Swarna and Vellayani Hraswa.

Soil properties (Table 7.3.17.2): The pH and available K content of soil significantly varied under the impact of the varieties under organic practice. Sree Reksha (CR24.4) had the highest pH (5.37) followed by H-165, Sree Visakham, Sree Pavithra, Sree Athulya and H-165. Electrical conductivity found to be in range from 0.092 as lowest in Kalpaka to 0.214 as highest in Sree Athulya. The organic carbon content of soil did not show any significant difference among the varities, but higher organic carbon content was estimated under Sree Pavithra (1.10%). Available N was higher in H165 (182.9 kg/ha) however, P was higher in H-226. Among the varieties, variety, Sree Pavithra removed maximum and significantly higher available K content (119.54 kg ha^{-1}) from the soil.

Economics (Fig.) Among the varieties evaluated, variety, CR-24-4 (Sree Reksha) generated higher net return (Rs. 1,79,839 ha^{-1}) and B:C ratio (2.07), followed by Sree Vijaya (Rs. 45,161 ha^{-1} net return and 1.27 B:C ratio) under organic mode of cultivation

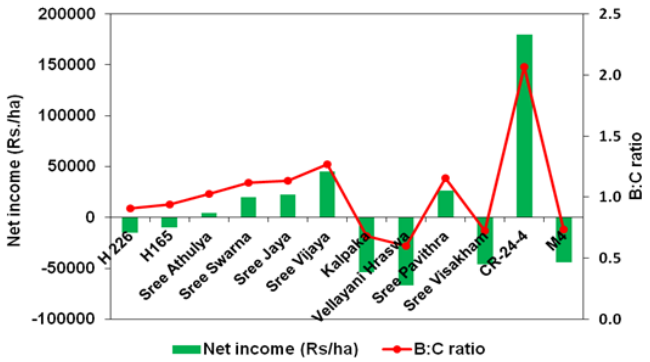


Fig. 16. Economics of cultivation of cassava varieties under organic practice

Table 7.3.17.1: Response for yield and yield attributes of cassava varieties under organic management

Varieties	Yield and yield attributes of cassava.							Biochemical composition of cassava tubers		
	Plant height (cm) at 6 MAP	Tuber length (cm)	Tuber girth (cm)	Average weight of tuber	Tuber yield (t ha^{-1})	Total dry matter production (t ha^{-1})	Harvest index	Dry matter (%)	Starch (% FW)	Total sugars (% FW)
H-226	197.8	20.00	19.05	358.2	10.21	3.93	0.58	36.80	30.44	1.65
H-165	173.9	20.33	15.69	346.3	10.55	2.80	0.45	33.39	26.58	1.42
Sree Athulya	189.8	22.67	14.97	418.1	11.51	3.62	0.42	29.07	24.42	1.19
Sree Swarna	136.0	22.33	5.92	244.9	12.54	5.30	0.43	38.67	20.11	1.08
Sree Jaya	126.7	22.67	6.30	428.0	12.74	5.60	0.65	34.10	20.77	1.07
Sree Vijaya	166.0	18.00	5.72	253.4	14.23	3.48	0.51	32.66	19.60	0.86
Kalpaka	129.9	21.67	6.16	278.9	7.64	2.96	0.33	29.99	18.51	0.78
Vellayani Hraswa	120.3	23.00	6.87	239.0	6.77	4.98	0.54	38.71	21.35	1.10
Sree Pavithra	190.0	25.00	16.60	315.9	12.98	5.78	0.61	38.58	23.15	1.41
Sree Visakham	197.1	21.33	16.20	382.5	8.15	3.31	0.40	42.29	24.33	1.72
CR-24-4	164.8	21.00	15.34	412.8	23.21	7.50	0.68	38.55	24.85	1.71
M-4	190.3	18.33	13.09	361.6	8.27	2.80	0.63	39.71	21.68	1.44
CD (0.05)	39.9	NS	3.004	NS	5.192	1.974	NS	NS	6.509	0.303

Table 7.3.17.2. Response for chemical properties of soil under cassava varieties in organic condition

Varieties	pH	EC	Organic C(%)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
H-226	4.84	0.183	0.95	169.87	211.72	64.29
H-165	5.35	0.139	1.01	182.93	205.50	93.74
Sree Athulya	5.23	0.214	1.02	175.09	144.25	88.74
Sree Swarna	4.80	0.136	0.92	163.59	172.51	78.06
Sree Jaya	4.92	0.107	1.08	140.07	190.23	70.49
Sree Vijaya	4.91	0.111	1.06	164.12	173.14	70.34
Kalpaka	4.73	0.092	0.89	158.89	137.08	79.41
Vellayani Hraswa	4.82	0.108	0.88	110.81	156.92	76.61
Sree Pavithra	5.26	0.141	1.10	180.32	165.90	119.54
Sree Visakham	5.23	0.194	1.01	131.71	198.89	87.55
CR-24-4	5.37	0.191	0.77	177.71	195.35	76.23
M-4	4.72	0.181	0.73	181.89	148.58	82.25
CD (0.05)	0.49	NS	NS	NS	NS	22.03

Udaipur (Table 7.3.18.1-7.3.18.4)

Twelve varieties of maize and wheat grown in maize"wheat system were evaluated.

Yield attributes, yield and economics of different varieties of maize (Table 7.3.18.1): Among the different category of maize varieties, variety, Pratap Hybrid Maize-3 among maize grain varieties, Sugar-75 among sweetcorn varieties, PM-3 among baby corn, VL Amber among popcorn varieties and Navjot among local varieties showed comparative better for yield attributes such as nos. of cobs, nos. of grains in row, grains/row total grains/cob, grains weight/cob and test weight as a result of higher yield and economics. Among the different maize varieties, PHM-3 recorded significantly higher maize yield (6500 kg/ha) as compared to other followed by Sugar-75. Among different maize varieties, Sugar-75 recorded significantly higher gross return (Rs.2,31,614/ha) and net return (Rs. 1,52,794/ ha) however, net return per rupee invested recorded higher with VL amber (2.18)

Yield attributes and yield of wheat (Table 7.3.18.3): Twelve wheat varieties were grown in three group *Triticum aestivum*, *Triticum durum* and local wheat**,** among them, variety HI- 8713 recorded significantly higher number of grains/ear (53.2), grain yield (5900 kg/ha), net return (Rs. 1,41,844 /ha) and NRPRI (3.10) and being best performing variety.

Among *Triticum aestivum* varieties, significantly higher number of grains/ear, ear length, grains yield, net return and NRPRI was recorded in MP-3288 (50.0, 10.45 cm, 4460 kg/ha, Rs. 99,634/ha and 2.18 respectively) as compared to other *aestivum* varieties. Among *Triticum durum* varieties, HI-8713 recorded significantly higher numbers of spikelet/ear, number of grains/ear, grains yield, net return and NRPRI (18.3, 53.2, 5900 kg/ha, Rs.1,41,844/ha and 3.10 respectively) as compared to other *durum* varieties. Among local wheat varieties, C-306 recorded significantly higher numbers of spikelet's /ear, ear length (cm), number of grains/ears, test weight (g), grain yield net return and net return per rupees invested (15.5, 9.5, 44.4, 48.4, 4000 kg/ha, Rs.83,763/ha and 1.83 cm, respectively) as compared to Lok-1.

Table No. 7.3.18 .1: Response of different varieties of maize for yield attributes, yield and economics at Udaipur

Varieties	Number of cobs per plant	Number of grain rows cob	Number of grains per row	Number of grains per cob	Weight of grain per cob (g)	Test weight (g)	Economic yield (kg/ha)	Fodder yield (kg/ha)	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	Net return per rupee invested
Maize (Grain)												
Pratap QPM Hybrid – 1	1.67	15.00	30.33	454.95	84.32	185.33	6050	7850	130785	55870	74915	1.34
PM – 9	1.33	14.33	29.00	415.57	79.10	190.33	4355	7140	101739	55870	45869	0.82
Pratap Hybrid Maize –3	1.67	14.67	30.00	440.1	120.59	264.00	6500	8420	140442	55870	84572	1.51
Sweet corn												
Sugar 75	2.00	14.00	28.33	396.62	36.22	91.33	6210	8885	231614	78820	152794	1.94
Madhula	1.67	12.00	21.00	252	13.94	55.33	4250	6845	162410	78820	83590	1.06
MAHY 103	1.00	12.33	23.33	287.66	19.47	67.67	4050	5852	151345	78820	72525	0.92
Baby corn												
PM- 3	1.33	0.00	0.00	0.00	0.00	0.00	1740	2845	87590	55620	31970	0.57
PM- 5	1.67	0.00	0.00	0.00	0.00	0.00	1224	2085	62042	55620	6422	0.12
Pop corn												
VL Amber	1.67	13.67	33.33	455.62	66.83	146.67	3625	5895	175065	55060	120005	2.18
Amber	1.33	12.67	26.00	329.42	26.79	81.33	1730	2745	83200	55060	28140	0.51
Local varieties												
Navjot	2.00	13.67	26.33	359.93	63.71	177.00	4430	6590	100059	55320	44739	0.81
Farmers selection	1.67	13.33	28.67	382.17	75.41	197.33	4000	6675	94043	55320	38723	0.70
CD (P=0.05)							474	697	14187		8260	0.13

Table 7.3.18.3: Yield attributes of wheat varieties grown under organic farming at Udaipur

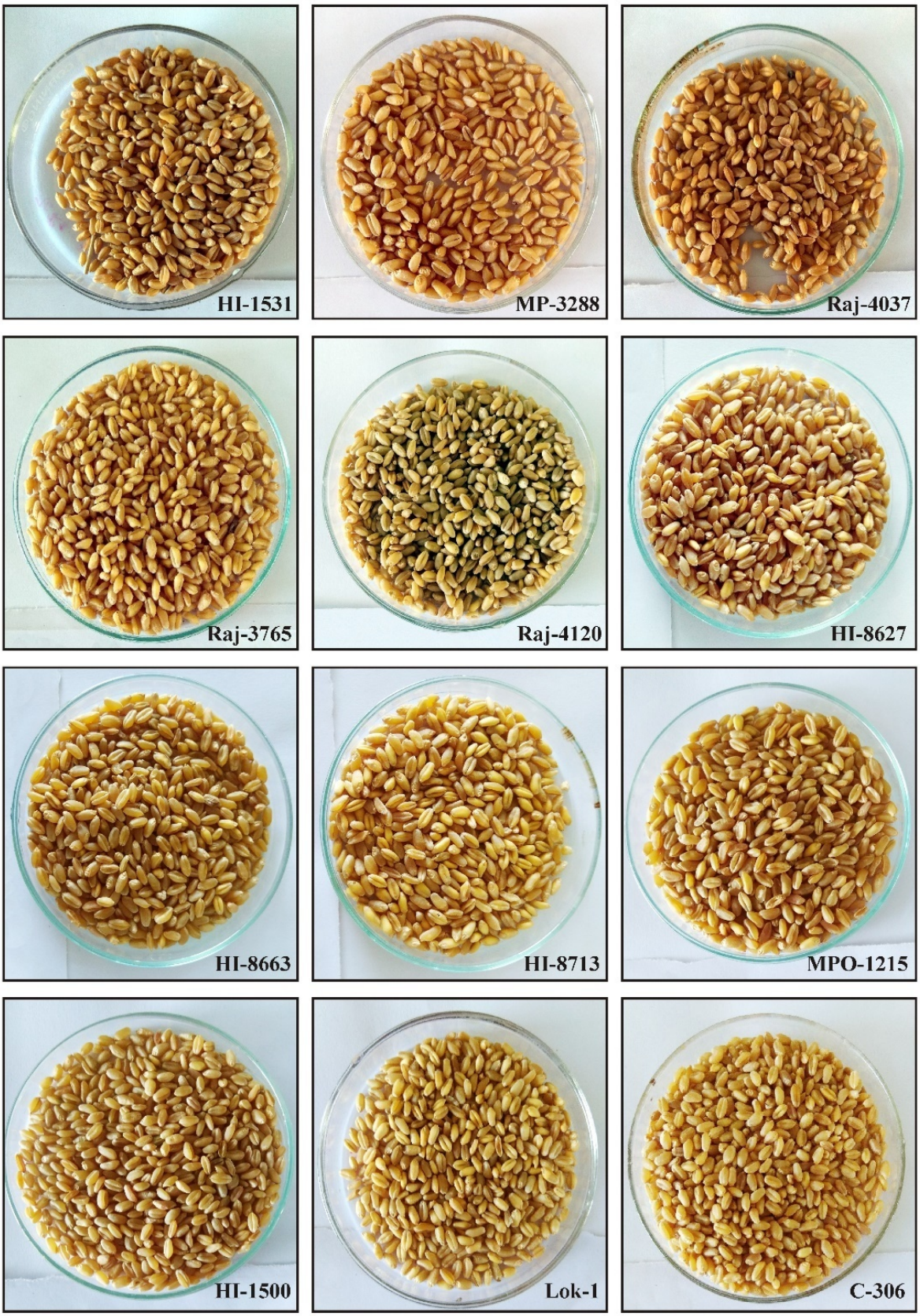
Varieties	Number of spikelet's / ear	Ear length (cm)	Number of grains/ ear	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)	Net return (Rs ha^{-1})	Net return per rupee invested
Triticum aestivum									
HI-1531	18.5	7.4	47.5	47.4	4130	8500	32.70	91024	1.99
MP-3288	17.2	10.45	50	45.5	4460	8750	33.76	99634	2.18
Raj-3765	18	8.9	45.5	48	3350	6845	32.86	64927	1.42
Raj-4037	13.5	7.5	35.2	51.5	4055	7425	35.32	83569	1.83
Raj-4120	13.3	8.15	41.5	51.2	3545	6780	34.33	68866	1.51
Triticum durum									
HI-8627	16.9	7.25	50.5	58.3	4460	8870	33.46	100282	2.19
HI-8663	17.5	6.9	49.4	52	5250	9415	35.80	120605	2.64
HI-8713	18.3	7.25	53.2	57.5	5900	1070	35.54	141844	3.10
MPO-1215	16.5	6.95	39.2	59.6	4155	8425	33.03	91169	1.99
HI-1500	16.9	8.2	40.5	44.5	3350	7500	30.88	68464	1.50
Wheat (Local)									
Lok-1	14	7.65	33.6	46.8	3450	6715	33.94	66425	1.45
C-306	15.5	9.5	44.4	48.4	4000	7685	34.23	83763	1.83
CD (P=0.05)	-	-	-	-	416	792	3.46	13486	0.19

Maize (Pratap Hybrid Maize-3)

Baby corn (PM-5)

Sweet corn (Sugar-75)

Wheat (HI 8773)



Seed samples of different varieties of wheat

7.4: Development of Integrated Organic Farming System models

Objective

- To evaluate the modules of organic production system to develop integrated organic farming system

Farming system modules

Module	Components
Crop	Identified high value crops of organic farming + required quantity of fodder for livestock
Livestock	Cow/Buffalo/Goat/Poultry depending upon the location and size of the model
Complimentary enterprises	Biogas, Vermicompost unit, live fencing, seed/planting material production unit & boundary plantation

Locations: Calicut, Coimbatore, Sardarkrushinagar, Thiruvananthapuram, Udaipur and Umiam,

Year of start: 2013-14

Results

Calicut

The plot with spices, fodder and vegetables combination was established at Chelavoor farm. The crops pepper, turmeric, fodder grasses (Congo signal grass, CO-3, CO-4), tapioca, banana, cowpea, arrow root, coconut, elephant foot yam, yam, maize and pineapple were planted and established. Three cows and their calves were maintaining at IISR farm. Turmeric 480 kg, banana 100 kg, tapioca 75 kg, elephant foot yam and yam 20 kg each, pineapple 10 kg, arrowroot 17 kg, maize 19 kg and vegetable cowpea 10 kg, coconut 2200 nos. were harvested. A profit of Rs 1.23 lakhs was received from one acre. Employment generated man days/year is 415. The highest contribution towards the total net return by milk component of the model which is 86%.

Table 7.4.1: Area, yield and income of IOFS at Calicut

Enterprise	Crop/Livestock	Area(ha)	Area share (%)	Yield (Kg/L/Nos.)	Unit rate (Rs)	Income Kg	Income share (%)
Cropping Systems	Coc	0.04		480kg	25	12000	
	Total	0.36	90			43850	
Livestock (4 Cows)	Milk			4207 L	60	252420	86.0
	Cow dung			2800Kg	2.50	70000	
	Total	0.01	2.5			322420	
Horticulture	Banana	0.01		100 Kg	40	4000	2.3
	Tapioca	0.005		75 Kg	25	1875	
	Yam	0.0025		20 Kg	20	400	
	Elephant foot yam	0.0025		20 Kg	25	500	
	Pineapple	0.0025		10 Kg	40	400	
	Arrow root	0.0025		17 Kg	30	510	
	Maize	0.0025		19 Kg	25	475	
	Veg cow pea	0.0025		10 Kg	50	500	
	Total	0.03	7.5			8660	
Grand Total						374930	100
Total Expenditure (Rs)						251420	
Net Profit (Rs)						123510	
Employment generation Man days/year						415	

Coimbatore

Composition of Organic Farming System Model at TNAU, Coimbatore (0.40 ha)

Components	Net area (m^2)	Treatments / Activities / Plant species
Crop component	3400	**Cropping Systems** 1. Green manure – Bhendi (CO-Bh1) - Maize COH(M)6 (0.12 ha) 2. Green manure - Cotton - Redgram (0.12 ha)3. Fodder grass (Cumbu-Napier variety CO(CN)5) and Desmanthus (0.10 ha)
Agro-forestry	500	Neem *(Azardiracta indica),* Pungam *(Pongamia pinnata),* Gmelina *(Gmelina arborea),* AilaInthus *(Ailanthus excelsia),* Wood Apple (*Feronia elephantum*), Bamboo (*Bambusa vulgaris*), Orchid tree (*Bauhinia sp.*), Mahua (*Madhuca longifolia*), Red bead tree (*Adenanthera pavonina*), Malabar neem (*Melia dubia*), Jamun (*Syzygium cumini*), Mahogany (*Swietenia macrophylla*), Myrobalan (*Terminalia bellerica*), Portia tree (*Thespesia populnea*), Paradise tree (*Simarouba glauca*) and Fig tree (*Ficus glomerata*)
Pest Repellent		Jatropha (*Jatropha curcas*), *Adhatoda* (*Adhatoda vasica*), Yellow oleander
Cafeteria		(*Cascabela thevetia*), Notchi (*Vitex negundo*), Indian laurel (*Calophyllum inophyllum*), Netted custard apple (*Annona reticulata*), Bael (*Aegle marmelos*), Tanner's cassia (*Cassia auriculata*), Karanda (*Carissa carandas*), Paper flower (*Bougainvillea glabra*), Lemon grass (*Cymbopogan citrate*), Brazillian button (*Centratherum punctatum*), Soapnut (*Sapindus emarginatus*), Cathedral Bells (*Kalanchoe pinnata*), Veld grape (*Cissus quadrangularis*), Indian snake root (*Rauwolfia serpentine*), Ringworm Cassia (*Cassia alata*), Indian Aloe (*Aloe vera*), Dyer's oleander *(Wrightia tinctoria*), Bitter albizia *(Albizia amara*), Cekurmanis (*Sauropus androgynus*), Morning glory (*Ipomoea purpurea*), Castor *(Ricinus communis*), Blue Ginger (*Alpinia galangal*), Kalmegh (*Andrographis paniculata*), Nerium *(Nerium oleander*), Century plant *(Agave tequilana*), Climbing brinjal (*Solanum trilobatum*), Madras thorn *(Pithecellobium dulce*), Henna (*Lawsonia inermis*), *Lantana* (*Lantana camara*), Noni (*Morinda citrifolia*), Calotropis (*Calotropis procera*), *Datura* (*Datura metel),* Vetiver (*Chrysopogon zizanioides),* Nithya kalyani (*Catharanthus roseus),* Kalluruki (*Scoparia ducis*), Karpuravalli (*Plectranthus amboinicus*), Thulasi (*Ocimum santum*),Ginger (*Zingiber officinale)*, Turkey berry (*Solanum turvum*), Papaya (*Carica papaya*), Soursop (*Annona muricata*) and Crepe jasmine (*Tabernaemontana divaricata*).
Dairy	20	Heifer calves: 2 Nos.
Manure pit	30	Residue from the crops and manure from Dairy unit will be converted into compost and used as manure for crops
Supporting activities	50	Threshing floor, cattle shed, cow dung pit, cow urine collection unit composting units, nutrition garden etc.
Border plants	-	Banana, glyricidia, coconut, desmanthus, annual moringa, teak and curry leaf
Total	**4000**	

Performance of okra and maize in green manure – bhindi (okra) – maize system: Before raising bhendi, the green manure (*sesbania aculeata*) was raised, and in-situ incorporation was done at the time of flowering. The fresh and dry weight and nutrient contents of the *sesbania aculeata* were estimated for nutrient management. The fresh biomass added was found to be 18.68 t/ha and nutrient added was found as 105.4 kg/ha. The bhendi variety CO(Bh) 4 was used with spacing of 60 x 45cm in ridges. Before sowing, the seeds were treated with biofertilizers and bio-control agents at recommended dose. Soil application of talk-based formulation of *Pseudomonas fluorescens* @ 2.5kg/ha and Azophos @ 1kg/ha was applied in the main field before sowing. Top dressing of vermicompost @ 1t/ha was given on 45DAS followed by foliar application of *Panchagavya* (3%) at weekly intervals. The harvesting starts on 35 DAS and the fruits were harvested in tender stage at alternate days. The fruit yield of bhendi was 13025 kg/ha whereas, the cost of cultivation incurred per hectare was Rs.68730 and the gross return obtained from bhendi crop was Rs.130250/ ha. The net return found to be Rs.61520/ha with benefit cost ratio of as 2.12.

Yield and economics of okra under integrated organic farming system model at Coimbatore

Cropping system	Crop & variety	Yield (kg/ha)	Cost of cultivation (₹ha)	Gross return (₹/ha)	Net return (₹ha)	BCR
Green manure - Bhendi - Maize	Bhendi CO (Bh) 4	13025	68730	130250	61520	2.12

Performance of cotton in green manure – cotton – red gram system: Before raising cotton, green manure (Sesbania aculeata) was raised, and in-situ incorporation was done at the time of flowering. The fresh and dry weight and nutrient contents of the Sesbania aculeata were estimated for nutrient management. The fresh biomass added was found to be 18.85 t/ha and nutrient added was found as 107.3 kg/ha. Cotton variety Surabhi was used in IOFS model and its recorded 1358 kg/ha of seed cotton yield with the gross and net return of Rs. 73,604 and Rs. 24,344/ha respectively.

Yield and economics of cotton under organic farming system model at Coimbatore

Cropping system	Crop	Yield (kg/ha)	Cost of cultivation (₹ha)	Gross return (₹/ha)	Net return (₹ha)	BCR
Green manure- Cotton-Redgram	Cotton (Surabhi)	1358	49260	73604	24344	3.02

Dairy Unit: Two numbers of cross bred Holstein Friesian cows (2 milch animals and 2 calves) are being maintained. Fodder obtained from crop component (Maize and Cumbu Napier) is being fed to the animals. Concentrated feed as per the prescribed ration to the milch animals and calves are being provided. The milk and cow dung yields were quantified, and the incomes were estimated. During 2018 milch animal was culled out due to aging. At present only two heifer calves are being maintained. Hence, there is no milking during 2018-19 and only the cow dung yield has been quantified. Income from cow dung was obtained only Rs 3650 in a year which is 1825 kg in quantity.

Crop residue composting: The crop residues and litters from the IOFS models were subjected to composting with mobile type silpaulin vermicomposting bags. The conversion efficiency with the crop residues collected from IOFS model with silpaulin vermicomposting bags were ranges from 65 to 70 per cent.

Number of Silpaulin bags used	Quantity of cro presidues / used (kg)	Quantity of cow dung added (kg)	Compost yield (kg)	Income realised ₹/ year
3	6340	150	4248	8496

Mobilization of green fodder: The Cumbu Napier CO (CN) 5 was raised in the IOFS model field under 0.10 ha. Fodder grass are harvested at regular intervals and fed to the Cattles. Total 95.4 t/ha was used for feed of cattle in three cutting and on fourth cutting, due to reduction in yield the field was ploughed for replanting with new cuttings.

Green fodder supply: To supplement the protein requirement to the NPOF cattle, Desmanthus (*Deamanthus varigatus*) was grown along the borders, harvested and fed to the cattle. Total 42.5 tonnes/ ha of green fodder was harvest in four cutting.

Kitchen garden: A kitchen garden has been maintained in the IOFS model with the objective to generate additional revenue and also to fulfil the nutrient requirement of the farm family. An area of 200 m2 has been allotted for this purpose. Total 248 kg of cauliflower was harvested with additional revenue of Rs. 2480 was obtained from kitchen garden.

Agroforestry: Agroforestry is one of the components of the integrated farming system hence, it was initiated with the following tree species. The tree name and species, such as Malaivembu (*Melia dubia)* 9 nos., Pungam (*Pongamia pinnata*) 1 no., Perumaram (*Ailanthus excelsia*) 2 nos., Neem (*Azadirachta indica*) 1 no. and Kumil (*Gmelina arborea*) 2 nos. were palnted. The tree species are fertilized with vermicompost, bio-fertilizers and bio-agents.

Perennial border crops: The perennial crops *viz.,* banana, coconut, annual moringa and curry leaf were maintained along the borders of the field with the objective to fulfil the unforeseen expenses of the IOFS (table 36).

Income generation form Perennial border crops of the IOFS model

	Coconut (24 palms)	Banana (14 plants)	Moringa (32 plants)	Curry leaf (12 plants)	Total
Quantity (nos./kg)	2304	34.5	20	93.6	
Revenue (₹)	23040	345	300	2808	**26,493**

Component wise income generated from IOFS model at Coimbatore

Farming System	Area (ha)	Details (Name or value as applicable)
Agricultural Crops		
Cotton	0.12	Rs. 23,518 / ha / annum
Horticultural crops		
Bhendi	0.12	Rs. 65,332 / ha / annum
Dairy	0.10	Rs.73,858 / ha / annum
CO (CN) 5 grass		Rs.2,78,250 / ha / annum
Pest repellent plants		105 plants for insect repellent preparations
Agro-forestry		15 Nos. comprising 5 tree species
Perennial border crops Curry leaf (12 bushes)		Rs. 23,296/ annum from Coconut (24 palms), Banana (14 plants), annual moringa (32 plants) and
Green leaf manure cum border crop (Glyricidia)		227.0 tonnes /ha
Kitchen garden		Rs. 2,171 / annum
Production from IOFS on equivalent basis (t) (Mention the base crop)		2552 kg (Cotton as base crop)
Market input cost excluding labour (Rs)		Rs. 17550/-
Value of recycling excluding family labour (Rs)		Rs. 19,755 / ha / annum
Cost of labour (Rs)		Rs. 30960/ ha/ annum
Total Cost (Rs)		Rs. 247585/- (Average of 5 years)
Net returns (Rs)		Rs. 104924/- (Average of 5 years)
Sustainable Value Index (based on previous 5 years data)		Some components are yet to reach five years to get the SVI

Sardarkrushinagar

Composition of Organic Farming System Model at Sardarkrushinagar (Gujrat)

Sr. No.	Farming system components		Net area (ha)
1	**Crops**	Groundnut Wheat Green gram	0.24
2	**Green Fodder**	Multi cut fodder bajra Fodder Maize + Oat Summer Fodder Bajara	0.15
3	**Livestock + Vermicompost**	Construction of animal shed and purchases of animals is under progress	0.01
4	**Boundary Plantation**	Ardusa Lemon grass Hy. Napier	-
	Total		**0.40**

IOFS model is comprised of different components *viz*., crops (0.24 ha), green fodder crops (0.15 ha), dairy + vermicompost (0.01 ha) and boundary plantation. Net profit ₹ 21,721 was received by crop component and net profit ₹ 25,551 was obtained by green fodder unit. Ardusa, napier grass and lemon grass have been planted around the border and bunds. Total net profit from all the components of IOFS Model was ₹ 48,953 from 0.40 ha area.

Yield (kg/ha) and economics (₹ha) of IOFS Model at Sardarkrushinagar

Sl. No.	Farming system components	Total Area (ha)	Ground nut Equivalent Yield (kg)	Gross Return (₹)	Cost of cultivation (₹)	Net Returns (₹)
1	Crops	0.24	1268	50739	29018	21721
2	Green Fodder	0.15	1256	50226	24675	25551
3	Livestock + Vermicompost	0.01	Construction of animal shed, and purchases of animals is under progress			
4	Boundary Plantation	-	120	4800	3120	1680
Total	0.40	2644	105765	56812	48953	
	Employment generation(Man/days)			0.20		
	System profitability (₹ /day)			134.12		

Energy inputs: Data revealed that maximum output energy (250236 MJ/ha), net energy returns (233500 MJ/ha), energy use efficiency (53.23) were observed in green fodder components (Multicut fodder bajra - Fodder Maize + Oat - Fodder Bajra), while specific energy (48.54 MJ/kg) noted under crop components.

Energy analysis of integrated organic farming systems model (0.4 ha)

Components	Input energy (MJ/ha)	Output energy (MJ/ha)	Net energy returns (MJ/ha)	Energy use efficiency	Energy productivity (kg/MJ)	Specific energy (MJ/kg)
Cropping system	15729	64020	57630	11.92	0.20	48.54
Fodder System	16736	250236	233500	53.23	2.96	3.50
Livestock + Vermicompost	-	-	-	-	-	-
Boundary Plantation	514	27720	27206	53.88	2.99	0.33

Thiruvananthapuram

An Integrated Organic Farming System model was developed at research farm of ICAR-CTCRI, Thiruvananthapuram consisting of food crop components, cassava, vegetable cowpea, maize and fodder grass. The yield of cassava with veg. cowpea was recorded 850 and 22 kg/ha with net return of Rs. 23,005 respectively from the model.

Hybrid maize

Hybrid Napier grass

Food crop components of IOFS

Green manure crop

Farming System	Area (ha)	Details
Crops	Maize (20 cents)Hybrid Napier grass (15 cents)	100 kg4500 kg
Horticulture	Cassava + vegetable cowpea (25 cents)	850 kg22 kg
Dairy	NIL	
Fishery	NIL	
Pest repellent plants	Lemon grass (5 cents)	440 kg
Other components (Please specify)	-	-
Production from IOFS on equivalent basis (t) (Mention the base crop)		4.447 tonnes
Market input cost excluding labour (Rs)		Rs. 12500
Value of recycling excluding family labour (Rs)		-
Cost of labour (Rs)		Rs. 31200
Total Cost (Rs)		Rs. 43700
Gross return (Rs)		Rs. 66705
Net returns (Rs)		Rs. 23005

Udaipur

An integrated farming system for 0.45 ha consisting of field crops in 0.25 ha (sweet corn + blackgram during Kharif and wheat during Rabi), fodder crops in 0.05 ha. (Fodder maize + cowpea during kharif and berseem in Rabi and sesbania green manuring during zaid), Vegetables in 0.10 ha (tomato & brinjal in kharif, cabbage & cauliflower in rabi and okra in zaid), fruit crop in 0.04 ha (guvava) and compost unit in 0.01 ha were evaluated during 2018-19. The total maize equivalent yield of 5536 kg/ha and a net return of Rs. 49649/ha was obtained from the farming system during 2018-19.

Experimental site | Sweet corn + blackgram (2:2) | *T. aestivum* variety Raj-4120

Green manurecrop(Sesbania rostrata) | Guava (Lalit and Shweta) | Okra JKOH-7305

Crops in IOFS Model at AINP-OF, Udaipur

Matka Khad

Bhabhut Amrit Pani

Beejamrut

Fafundnashi

Neemastra

Teekha Sat

Sada Hua Chhach Pani

Teen Ghol Jaiv Keetnashi

Different liquid manures & herbal pesticide used of IOFS model at NPOF, Udaipur

Yield and economics of different components of organic farming system at udaipur

Farming System components		Area (ha)	Yield (kg)	MEY (kg)	Cost of cultivation (Rs)	Gross return (Rs./ha)	Net return (Rs/ha)	Net return per rupee invested
1. Crops								
Kharif	Sweet corn + Blackgram	0.25	610	1198 (98)**	12322	24150	11828	0.96
Rabi	Wheat		1295	1900	11434	38700	27266	2.38
2. Fodder								
Kharif	Fodder Maize + Cowpea	0.05	2500 (160)	958 (160)	6000	14370	8370	1.40
Rabi	Berseem		2500	900	3650	13500	9850	2.69
Zaid	Sesbania							
3. Vegetable								
Kharif	Tomato and Brinjal	0.10	-	-	-	-	-	-
Rabi	Cauliflower and cabbage		50 kg cabbage and 52 kg cauliflower	170	4000	2550	-1450	-0.36
Zaid	Okra		103 kg	410	4000	6150	2150	0.53
4. Fruits	Guava	0.04	Guava is under 4th year of planting					
	Total			5536			49649	
5. Compost unit	NADEP compost	0.01	10000 kg	**Figure in parenthesis indicate actual yield of crop / intercrop. Price: Sweet corn- Rs. 30 /kg; Black gram- Rs. 90 /kg; Fodder Maize- Rs. 5.1/kg; Fodder Cowpea- Rs. 5.4 /kg; Berseem- Rs. 5.4 /kg				
	Vermicompost		4500 kg					
	Compost		7000 kg					
	Vermiwash		1000 lit					
	BD 500		1.6 kg					
	BD 501		1.3 kg					
	Earthworms		350 kg					

Umiam

The IOFS model is comprised of different enterprises such as cereals (rice and maize), pulses (lentil, pea), oilseeds (soybean, rapeseed), vegetable crops (French bean, tomato, carrot, okra, brinjal, cabbage, potato, broccoli, cauliflower, chili, coriander, etc.), fruits (Assam lemon, papaya, peach), dairy unit (a milch cow + calf), fodder crops, central farm pond, farmyard manure pits and vermicomposting unit. A farm pond of 460 m^2 area with average depth of 1.5 m was part of the IOFS model for life saving irrigation and aquaculture. Climbing vegetables such as bottle gourd, chow-chow, cucumber, ridge gourd etc., were grown on a structure created above water bodies in one side of the pond dyke for vertical intensification. Pumpkin was raised in another side of the pond and allowed to crawl on the ground. The washings from the dairy unit were diverted to fish pond for promoting growth of zooplankton and phytoplankton for fish growth. The solid waste from cow shed was used for FYM making and vermicomposting. The total cost of cultivation was recorded at Rs. 56,835/- per year under the IOFS model with an area of 0.43 ha. Maximum expenditure was incurred in crop component of the model with 46.68% of the total cost of cultivation. Dairy unit with one adult cow and one calf registered 37.29 % of the total cost of cultivation, while fishery component recorded 8.62% of the total cost of cultivation. A total net return of Rs. 78,950/- per year was achieved under the IOFS model which is about to Rs. 2,10,814/ha and much higher than the region's farmer common practices of rice mono-cropping or improved practice of rice-vegetables cropping system. The highest contribution towards the total net return was contributed by crop

component of the model (67.21%) followed by dairy (23.24%) and fishery component (15.20%). The fish production was 132 kg. The net return from dairy component was calculated only in terms of milk production since the cow dung produced was recycled back into the model which was used as manure for crop production. The quality of milk obtained under organic management of dairy has been observed in the Integrated Organic Farming System (IOFS) models experiment and was compared to the quality of milk obtained under conventional management.

For 0.43 ha area, the total nutrient requirement for organic crop production has been estimated at nitrogen (N)-67.05 kg, phosphorus (P_2O_5)-23.95 kg and potassium (K_2O)-55.76 kg. On farm nutrient recycling in IFOS could produce an amount of 64.05 kg N, 19.72 kg $P_2O_5$and 55.57 kg K2O. Hence, 95.53% of the total N requirement, 82.34% of the total P_2O_5 requirement and total of 99.66% K_2O requirement could be met within the model itself and only 4.5% of the total N requirement, 17.7 % of the total P2O5 requirement is required to be met from the external source to sustain the model. The nutrient requirement of the model from external source would be reduced substantially with the efficient recycling of pond silt, intercropping with legume, use of bio-fertilizers such as azotobacter, rhizobium, phosphorus solubilizing microorganism etc.

Economics of the IOFS model at Umiam

Farming System components	Total area (ha)	Rice equivalent Yield (t/ha)	Cost (Rs)	Net returns (Rs)	Net return (Rs/ha)
Crops (Cereals, pulses, oilseeds, vegetables, fruits and fodder crops)	0.3745	5.29	32500	46850	-
Dairy (1 milch cow + 1 calf)	0.0036	3.74	29450	26,650	-
Fishery (Composite)	0.046	0.93	4300	9650	-




Different components under IOFS

7.5. Farm waste recycling techniques for organic farming

Objective

- To develop need-based cost-effective new techniques for farm-waste recycling

Locations: Almora, Dharwad and Modipuram

Year of start: 2014-15 (Modipuram); 2015-16 (Almora and Dharwad)

Results

Only Almora and Modipuram reported the results

Almora

Farm wastes were composted with different proportion of raw materials and inoculation of different microbes and earthworm. The total fungal population was highest with inoculation of *Pleurotos sajorcaju* + *Trichoderma harzianum* + *Bio-mineralizer* + *Aspergillus niger* + *Azotobacter spp.* to the 3:1:1 ratio of CR - cereal residue :CDS - Cattle dung slurry :LR - Legume residue during composting (Table 4). The microbial count of *Trichoderma* spp. and *Aspergillus* spp. were highest with inoculation of *P. sajorcaju* + *T. harzianum* to the 3:1:1 ratio of CR:CDS:LR and *P. sajorcaju* + *T. harzianum* + *Bio-mineralizer + *Aspergillus niger* + *Azotobacter spp.* to the 4:1 ratio of CR:CDS, respectively. The highest microbial count treatment recorded 52, 59 and 49% higher population of total fungus, *Trichoderma* spp. and *Aspergillus* spp. compared to control treatment, respectively. Vermicomposting with the 3:1:1 ratio of CR:CDS:LR provided 30 and 5% higher microbial count of total fungus and Trichoderma spp. compared to control treatment, respectively. Addition of legume residue for preparation of composts from farm waste enhanced the total fungal ad *Trichoderma* count (Table 7.5.1.1)

Table 7.5.1.1: Microbial count of composts from farm waste

Treatment	Total fungal population (cfu/g)	Total *Trichoderma* spp. (cfu/g)	Total *Aspergillus* spp. (cfu/g)
Control (CR:CDS [µ]) = 4:1	3.24	2.05	1.11
Vermi-compost (CR:CDS = 4:1)	3.99	2.10	1.02
Vermi-compost (CR:CDS:LR = 3:1:1)	4.21	2.15	1.05
CR:CDS = 4:1 + *Pleurotos sajorcaju* + *Trichoderma harzianum*	4.37	3.21	1.03
CR:CDS:LR = 3:1:1 + *P. sajorcaju* + *T. harzianum*	4.43	3.25	1.10
CR:CDS = 4:1 + *P. sajorcaju* + *T. harzianum* + *Biomineralizer + *Aspergillus niger* + *Azotobacter spp.*	4.85	3.05	1.65
CR:CDS:LR = 3:1:1 + *P. sajorcaju* + *T. harzianum* + *Biomineralizer + *Aspergillus niger* + *Azotobacter spp.*	4.92	3.10	1.59
[µ]CR - Cereal residue			
CDS - Cattle dung slurry			
LR - Legume residue			

*Biomineralizer = Microbial consortia of P & Zn solubilizer and PGPR

Dharwad

Treatments details

Treatments	Description
T_1	Compost culture + 1 ton maize stover
T_2	Compost culture + 1 ton pigeonpea stalk
T_3	Compost culture + 1 ton cotton stalk
T_4	Compost culture + 2/3 ton maize stover +1/3 ton pigeonpea stalk
T_5	Compost culture + 2/3 ton maize stover +1/3 ton cotton stalk
T_6	Waste decomposer + 1 ton maize stover
T_7	Waste decomposer + 1 ton pigeonpea stalk
T_8	Waste decomposer + 1 ton cotton stalk
T_9	Waste decomposer + 2/3 ton maize stover +1/3 ton pigeonpea stalk
T_{10}	Waste decomposer + 2/3 ton maize stover +1/3 ton cotton stalk

Among the compost culture developed by IOF, UAS, Dharwad and waste decomposer developed by NCOF, Ghaziabad, compost culture is much better than waste decomposer in decomposing the pigeon pea stalk and cotton stalk while waste decomposer is on far with compost culture in decomposing maize stover. (Table 7.6.2.1)

Table 7.5.2: Compost yield and its nutrient analysis as influenced by the effect of waste decomposer and compost culture on different farm wastes.

Sl.No.	Treatment details	Weight of waste (composting) (kg)	Compost yield(kg) after120 days	Cost of inputs (Rs) CR+WD+J+CD	N content (%)	P_2O_5 content (%)	K_2O content (%)	Micronutrient (PPM)			
								Zn	Fe	Mn	Cu
1	Maize Stover + Waste decomposer	100	93.6(58.7)	60+5+15+15=95	0.69	0.25	0.52	97	12855	224	14.4
2	Cotton Stalk + Waste decomposer	100	53.7(41.0)	90+5+15+15=125	1.04	0.20	0.40	72	11488	344	14.7
3	Pigeon pea Stalk+ Waste decomposer	100	59.7(18.6)	30+5+15+15=65	0.96	0.21	0.41	18	13045	312	11.6
4	Maize Stover + Cotton stalk + Waste decomposer	66+33	74.0(58.8)	(40+30)+5+15+15=105	0.77	0.23	0.52	14	7680	108	15.1
5	Maize Stover + Pigeon pea Stalk + Waste decomposer	66+33	74.6(57.7)	(40+10)+5+15+15=85	0.90	0.27	0.43	21	2250	477	12.3
				CR+CC+CD							
6	Maize Stover + Compost culture	100	93.1(44.4)	60+20+75=155	0.81	0.29	0.52	36	9283	208	12.9
7	Cotton Stalk + Compost culture	100	55.1(44.0)	90+20+75=185	0.82	0.27	0.44	36	7938	394	5.2
8	Pigeon pea Stalk+ Compost culture	100	71.2(54.2)	30+20+75=125	0.92	0.28	0.36	19	11425	232	10.6
9	Maize Stover + Cotton stalk + Compost culture	66+33	79.9(62.2)	(40+30)+20+75=185	0.88	0.31	0.61	31	11565	216	16.2
10	Maize Stover+ Pigeon pea Stalk+ Compost culture	66+33	82.9(61.8)	(40+10)+20+75=145	0.76	0.30	0.55	25	12788	252	13.6

7.6. Documentation of ITK on organic production, pest & disease management

Objective

- To document popular ITKs in Organic Farming
- To test the documented ITKs

Year of start: 2015-16

Locations: Ajmer, Gangtok and Udaipur

Results:

Ajmer

- Use of broken neem seed *(Azadirachta indica)*, datura (*Datura stramonium*), aak (*Calotropis gigantea*), cow urine, jaggery and khipda leaves in ratio of 3: 3: 3: 3: 1: 4kg each material and soaked in 50 liter of water in big pot and kept for 20-25 days for fermentation. After this process, a prepared solution obtained which was filtered through cloth to obtained desired extract. Then prepare 10% solution for spraying on crop for the management sucking insect pests and mosaic of chili and tomato crop.
- In tomato, chilli and brinjal vegetables, smoke of google gum are released to prevent the flies and improve the flower and fruit setting.
- Maize cob after removal of seed collected, kept in earthen pots having multiple holes around and then put inside the field (Approx. 1 feet depth) in 20-25/ ha in scattered manner to control the termites during cropping season.

Gangtok

A. ITK Cow Dung Extract: Farmers are using well decomposed cow dung extract (10%) and keeping it for 3-4 days then filtering the extract with a cotton cloth before applying to improve the production and productivity of vegetable crops.

Validation: Conducted studies taking following treatments to validate the ITK in broccoli, cauliflower and carrot crop. T1: Cow dung extract (5%); T2: Cow dung extracts (10%), Farmer's Practice; T3: Cow dung extract (15%) and T4: Control (only water spray).

Results: The experiments conducted on cabbage and radish crop growing under low-cost plastic tunnels and red cherry pepper growing under low-cost plastic rain shelters, It was observed that all the treatments have significantly improved the yield of cabbage, red cherry pepper and radish as compared to control during both the year. There was no significant difference observed between farmers practice (T2) and higher doses (T3) applied for cabbage yield (7.3 kg/m^2 and 7.8 kg/m^2, respectively). However, when higher doses (T3) applied then red cherry pepper (1.57 kg/sqm and 1.60 kg/sqm) and radish (6.87 and 6.95kg/sqm) respectively. Lower dose (T1) yield was significantly less than the farmers practice (T2).

Table 7.6.1: Yield of vegetables at Gangtok as influcecal by different ITKs.

Treatment details	Yield of cabbage (kg/sqm)		Yield of Red cherry pepper (kg/sqm)		Yield of Radish (kg/sqm)	
	Y I	Y II	Y I	Y II	Y I	Y II
T_1: Cow urine (5%)	5.5	5.8	1.25	1.28	4.45	4.48
T_2: Cow urine (10%) *Farmer's Practice*	7.3	7.8	1.55	1.58	6.32	6.36
T_3: Cow urine (15%)	7.1	7.5	1.57	1.60	6.87	6.95
T_4: Control (only water spray)	3.1	3.0	0.65	0.63	2.62	2.62

B. ITK Cow Urine: Farmers are using cow urine @ 10% for improving the yield of tomato and cucurbitaceous vegetables.

Validation: Conducted studies with following treatments to validate the ITK. T1: Cow urine (5%); T2: Cow urine (10%) *Farmers Practice*; T3: Cow urine (15%) and T4: Control (only water spray)

Results: All the treatments have significantly improved the yield of tomato, bottle gourd and bitter gourd as compared to control during both the years. There was no significant difference observed between farmers practice (T2) and lower (T1) or higher doses (T3) applied. The yield

of tomato (4.5 and 4.8 kg/plant), bottle gourd (9.05 and 9.20 kg/plant) and bitter gourd (2.62 and 2.65 kg/plant) was highest in the farmers practice (T2) and lower (T1) or higher doses (T3).

Table 7.6.2: Yield of vegetables at Gangtok as influcecal by different ITKs.

Treatment details	Yield of tomato (kg/sqm)		Yield of bottle gourd (kg/sqm)		Yield of bitter gourd (kg/sqm)	
	Y I	Y II	Y I	Y II	Y I	Y II
T_1: Cow urine (5%)	4.00	4.40	8.47	8.55	2.45	2.48
T_2: Cow urine (10%) *Farmer's Practice*	4.50	4.80	9.05	9.20	2.62	2.65
T_3: Cow urine (15%)	3.75	3.82	8.15	8.25	2.40	2.42
T_4: Control (only water spray)	1.50	1.50	3.47	3.48	1.27	1.25

C. ITK: Farmers are managing aphids and fruit borer by spraying 0.2% solution of a mixture of 10% agave extract + 5% cow urine + 2.5% ground chilly. Before spraying all the ingredients were mixed properly in plastic container and kept in shade for 3 days and then from this mixture 0.2% solution is prepared for spray in vegetable crops.

Validation: Conducted a study by taking following treatments to validate the ITK and its effect on the yield of vegetables. (T1: 0.1% solution spray; T2: 0.2% solution spray (*Farmer's Practice)*; T3: 0.5% solution spray and T4: Control (only water spray).

Results revealed that all the treatments have significantly improved the yield of tomato, French bean and Broccoli as compared to control. The significant increase in yield of tomato and broccoli was observed in between the farmer's practice (T2) and the higher doses applied (T3), however, French bean yield was highest in farmer's practice (T2). The graphical representation revealed that T3 was recorded maximum number of aphid population decrease over control in all the crops viz, tomato (80.4%), French bean (79.8%) and broccoli (83.7%) followed by T1 and T2 respectively. Similarly, the maximum number of borer population decrease over control in tomato (75%) and broccoli similarly.

Table 7.6.3: Effect of treatment on yield and percent reduction of aphid and borer among treatment over control

Treatment details	Yield of tomato (kg/plant)		Yield of bottle gourd (kg/plant)		Yield of bitter gourd (kg/plant)		Percent reduction over control			
							Aphid		Fruit borers	
	Y I	Y II	Y I	Y II	Y I	Y II	French bean	Tomato	Tomato	Broccoli
T_1: Cow urine (5%)	3.5	3.7	3.2	3.5	5.0	5.3	70.7	65.8	62.5	67.5
T_2: Cow urine (10%) *Farmer's Practice*	3.7	3.9	4.2	4.5	3.8	4.1	62.8	58.5	54.1	69.6
T_3: Cow urine (15%)	4.6	4.8	3.6	3.8	5.8	6.0	79.8	80.4	75	83.7
T_4: Control (only water spray)	1.2	1.2	1.2	1.1	1.6	1.9	-	-	-	-

Udaipur

ITK 1: Jeevamrut: Jeevamrut is a fermented microbial culture. It provides nutrients, but most importantly, acts as a catalytic agent that promotes the activity of microorganisms in the soil, as well as increases earthworm activity; During the 48-hour fermentation process, the aerobic and anaerobic bacteria present in the cow dung and urine multiply as they eat up organic ingredients (like

pulse flour). A handful of undisturbed soil is also added to the preparation, as inoculation of native species of microbes and organisms. Jeevamrut also helps to prevent fungal and bacterial plant diseases.

Method of preparation of Jeevamrut: 200 litres of water was put in a barrel; 10 kg of fresh desi cow dung was added followed by 10 litres of aged cow's urine; To this 2 kg of jaggery, 2 kg of pulse flour (gram) and a handful of live soil from under canopy of the banyan tree (about 100 g) are added. Stir the solution well and let it ferment for 48 hours in the shade. Now jeevamrut is ready for application. 200 litres of jeevamrut are sufficient for one acre of land (Palekar, 2006).

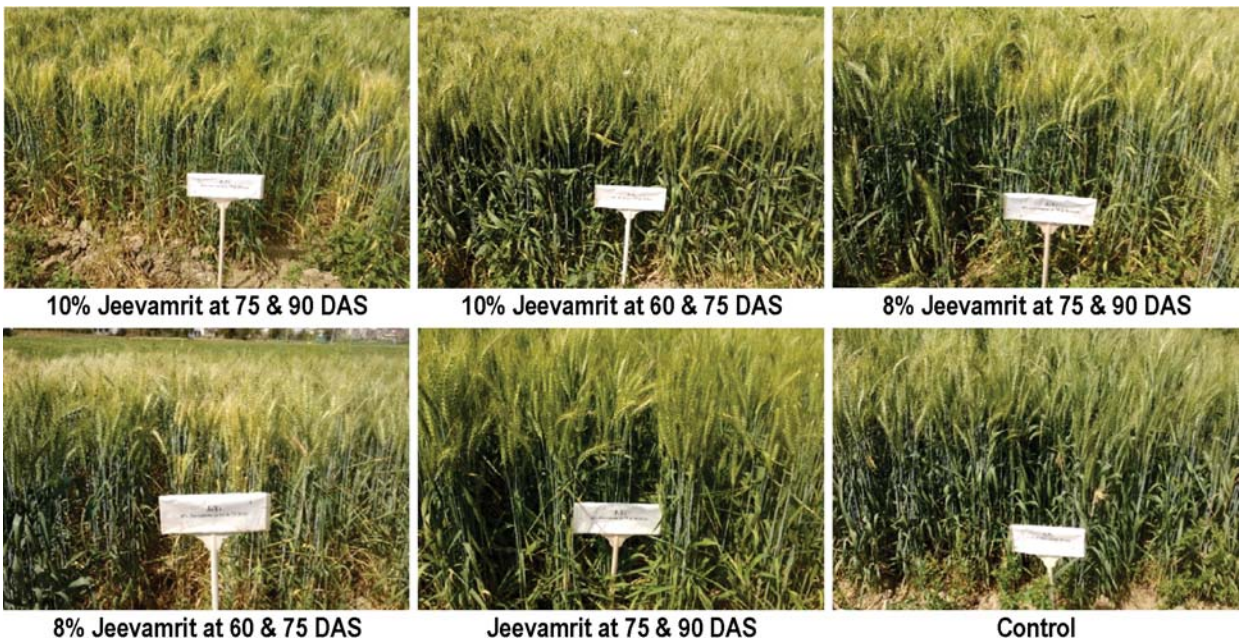
Spray of jeevamrut: Different doses of Jeevamrut were sprayed in experimental plots as per treatment during crop period. Jeevamrut solutions were prepared as per treatment application, for example 2 per cent of Jeevamrut solution prepared by adding 2 litres of Jeevamrut to every 100 litres of water. After dilution the Jeevamrut solution was filtered before using it for spraying.

Validation of ITK Jeevamrut: Effect of Jeevamrut on growth, yield and quality of organic wheat (*Triticum aestivum* L.)

Treatments:

Details of treatments with their symbols and biochemical composition

Treatments		Symbols	Biochemical composition of Properties of Jeevamrit	
(A)	Concentration of Jeevamrut	pH	7.07-7.15	
	Control (Water spray)	J_1	EC (ds/m)	3.40-3.50
	4% Jeevamrut	J_2	N (%)	1.92-1.98
	6% Jeevamrut	J_3	P (%)	0.171-0.178
	8% Jeevamrut	J_4	K (%)	0.282-0.300
	10% Jeevamrut	J_5	Total Bacterial Count (cfu/ml)	6.33×10^8
(B)	Time of application		Total Fungal Count (cfu/ml)	5.1×10^4
	60 DAS	T_1	Total Actinomycetes (cfu/ml)	3×10^5
	75 DAS	T_2	Acid Phosphatase (µg/ml)	0.931034
	90 DAS	T_3	Alkaline Phosphatase (µg/ml)	1.068966
	60&75 DAS	T_4	Dehydrogenase (µg/ml)	2.77193
	75&90 DAS	T_5		



Effect of different concentration of Jeevamrut on wheat at different time of application

Results

Among the different concentration of Jeevamrut, maximum grain and biological yield of wheat was recorded under the 10% concentration of Jeevamrut (4165 kg ha^{-1}& 10350 kg ha^{-1}, respectively). Application of 10% Jeevamrut on wheat gave maximum net return and benefit: cost ratio of Rs. Rs. 100197 ha^{-1}, and 2.12 respectively. Grain yield was also significantly influenced by time of application of Jeevamrut on wheat and recorded higher at 75 & 90 days after sowing of 4151 & 10301 kg ha^{-1} grain and biological yield respectively. Gross return, net return and BC ratio (' 1,46,979, 99,677/ha and 2.11 respectively) was also obtained at 75&90 DAS. (Table 7.6.4)

Table 7.6.4: Effect of concentrations and time of application of jeevamruton yield and harvest index of organic wheat

Treatments	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)	Gross return (₹ha^{-1})	Net return (₹ha^{-1})	Benefit-cost ratio
Concentration of Jeevamrut							
Control	3698	5246	8944	41.4	129772	82537	1.75
4% Jeevamrut	3848	5615	9462	40.7	135807	88524	1.87
6% Jeevamrut	3901	5679	9580	40.7	137617	90310	1.91
8% Jeevamrut	4028	5849	9878	40.8	142040	94708	2.00
10% Jeevamrut	4165	6184	10350	40.3	147552	100197	2.12
CD (P=0.05)	143	210	353	NS			
Time of application							
60 DAS	3738	5420	9159	40.8	131775	84472	1.79
75 DAS	3785	5508	9293	40.7	133522	86219	1.82
90 DAS	3869	5502	9371	41.3	135843	88541	1.87
60&75 DAS	4097	5993	10090	40.6	144669	97367	2.06
75&90 DAS	4151	6149	10301	40.4	146979	99677	2.11
CD (P=0.05)	143	210	353	NS			

ITK 2: Silicon

Treatments detail: The experiment was conducted in RBD (factorial) design with 3 replications, wheat variety Raj 4120 was used for validation of silicon on yield and economics. Treatments imposed are below.

A. Doses of silicon	B. Stages of silicon application
D1: Control (only water spray)	S_1: CRI
D2: 2g/litre water	S_2: Tillering
D3: 4g/litre water	S_3: Jointing
D4: 6g/litre water	
D5: 8g/litre water	

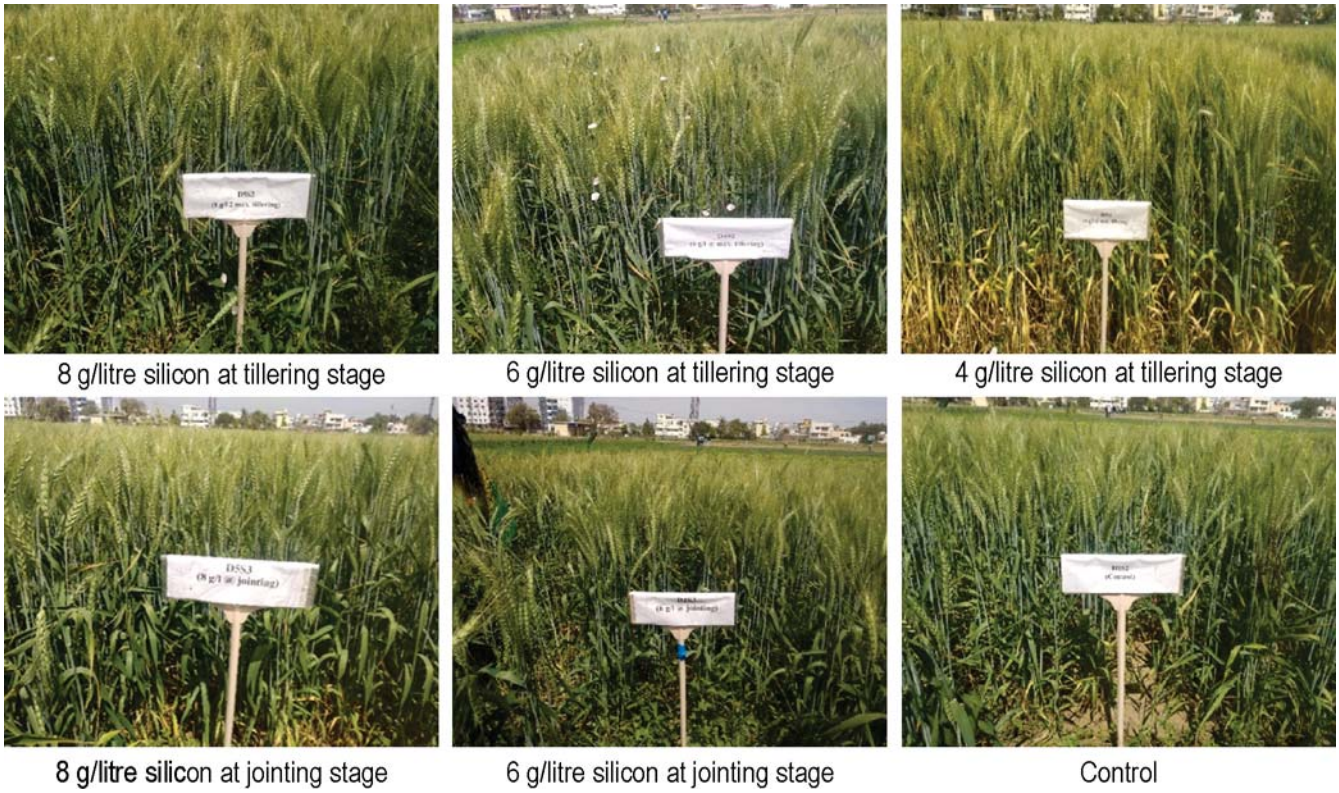
Results

Data revealed that application of 8 g silicon/litre was recorded significantly higher grain and straw yield of wheat (4619 & 6802 kg/ha, respectively) along with highest net return (₹ 1,16,587/ha) and benefit cost ratio (2.40) among the different doses of silicon. Likewise, stages of application of silicon were also significantly influenced on yield and straw yield. Application of silicon at tillering stage resulted in maximum grain yield, straw yield, net return and B:C ratio of 4612 kg/ha, 6604 kg/ha, ₹ 1,15,468/ha and 2.44 respectively (Table 7.6.5).

Table 7.6.5: Effect of silicon on grain, straw& biological yield and harvest index of wheat under organic farming

Treatments	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)	Net return (₹ha^{-1})	Benefit-cost ratio
Doses of silicon						
Control (only water spray)	4192	6036	10228	40.92	100919	2.14
2 g/litre	4302	6130	10432	41.16	104427	2.21
4 g/litre	4347	6139	10486	41.99	105697	2.23
6 g/litre	4538	6708	11246	40.23	113884	2.40
8 g/litre	4619	6802	11421	40.49	116587	2.46
CD (P=0.05)	254	552	581	2.62		
Stages of silicon application						
CRI	4198	6045	10242	41.29	101028	2.13
Tillering	4612	6604	11215	40.97	115468	2.44
Jointing	4389	6441	10830	40.62	108412	2.29
CD (P=0.05)	197	427	450	NS		

Sale price: Wheat seed @ Rs. 28/kg; straw: Rs. 510/qt.



Effect of different concentration of silicon on wheat at different stages

3. ITK: Vermiwash: Effect of vermiwash from different organic resources on growth, yield and quality of organic blackgram (*Vigna mungo* L.)

Treatment details

T_1	Vermiwash from 100% cow dung
T_2	Vermiwash from 100% buffalo dung
T_3	Vermiwash from 50% cow dung + 25% dry farm waste + 25% green farm waste
T_4	Vermiwash from 50% buffalo dung + 25% dry farm waste + 25% green farm waste
T_5	Vermiwash from 90% green waste incubated with 10% cow dung
T_6	Vermiwash from 90% green waste incubated with 10% buffalo dung
T_7	Vermiwash from 90% dry waste incubated with 10% cow dung
T_8	Vermiwash from 90% dry waste incubated with 10% buffalo dung
T_9	Water spray (Control)

This experiment was conducted under RKVY project in RBD design with 3 replications during kharif and variety of black gram PU-31 was taken

Materials required

- A large container made of concrete or plastic bucket.
- Plastic tube/drip/tap
- A collection buckets
- 15-20 days old Cow dung
- broken small pieces of bricks/stones
- Fresh grass as a sieve
- Earthworms

Procedure

Vermiwash was prepared by earthen pot method at Organic Farming Unit, Rajasthan College of Agriculture, Udaipur. An earthen pot with a hole at the base was taken and a rubber pipe was fixed in the hole. First of all, a thin layer of coarse sand is laid in the pot so that the liquid material can percolate through it. Above the sandy layer, 15-20 cm thick layer of cow dung was placed which followed about 15 cm thick layer of straw. The layers of cow dung and straw was repeated until the pot was filled. Water is sprinkled in between the layers to provide moisture. About 1000 epigenic earthworms (*Eisenia foetida)* are put into the pot. One more pot filled with water is placed above it so that drop wise water enters into the pot containing earthworms. Third pot was placed below it. Assembly of these three earthen pots was hanged at a shady place. The vermiwash was collected in the third pot. Foliar spray of vermiwash was done at the rate of 10%.

Details:

T_1	100% Cow dung + Earthworm
T_2	100% Buffalo dung + Earthworm
T_3	50% Cow dung + 25% Dry farm waste + 25% Green farm waste + Earthworm
T_4	50% Buffalo dung + 25% Dry farm waste + 25% Green farm waste + Earthworm
T_5	90% Green waste incubated with 10% Cow dung + Earthworm
T_6	90% Green waste incubated with 10% Buffalo dung + Earthworm
T_7	90% Dry waste incubated with 10% Cow dung + Earthworm
T_8	90% Dry waste incubated with 10% Buffalo dung + Earthworm

Preparation of vermiwash with different treatment: Vermiwash was prepared by earthen pot method. An earthen pot of about 20 L capacity was taken. It was filled up by cow dung, buffalo dung, dry farm waste and green farm waste incubated for 15 days.

Making hole at the bottom of pot

Keeping pieces of stone at the bottom

Putting cow dung in pot

Mixing of earthworms in pot

Filling of water in another pot

Vermiwash collected

Preparation of Vermiwash

Table 7.6.6: Total quantity of animal dung and farm waste used in different treatments

Treatment	Material used					Earthworm(kg)
	Cow dung	Buffalo dung	Dry farm waste	Green farm waste	Total	
T_1	10 kg	-	-	-	10 kg	1 kg
T_2	-	10 kg	-	-	10 kg	1 kg
T_3	5 kg	-	2.5 kg	2.5 kg	10 kg	1 kg
T_4	-	5 kg	2.5 kg	2.5 kg	10 kg	1 kg
T_5	500 g	-	-	5 kg	5.5 kg	1 kg
T_6		500 g	-	5 kg	5.5 kg	1 kg
T_7	600 g	-	6 kg	-	6.6 kg	1 kg
T_8	-	600 g	6 kg	-	6.6 kg	1 kg

Table 7.6.7: Vermiwash produced from different kind of dung and farm waste after 42 days

Treatment	Material quantity of vermiwash produced (Lit)	Vermicompost produced (kg)	No of earthworms	Weight of earthworm(kg)
T1	69.68 lit.	3.300 kg	2655	0.720 kg
T2	74.50 lit.	4.400 kg	4568	1.451 kg
T3	75.73 lit.	4.600 kg	2069	0.962 kg
T4	67.80 lit.	4.100 kg	3519	1.443 kg
T5	64.00 lit.	2.850 kg	1853	0.653 kg
T6	77.64 lit.	3.020 kg	2647	0.820 kg
T7	62.40 lit.	4.740 kg	1661	0.561 kg
T8	64.55 lit.	3.660 kg	2063	0.755 kg

Analysis of vermiwash: Sampling was done on every 7th day and the microbiological and physico-chemical parameters were recorded on 7, 14, 21, 28, 35 & 42 days, respectively.

pH: It is evident from the data presented in Table 7.6.5 that the maximum pH of vermiwash was recorded in 90% green waste incubated with 10% buffalo dung + earthworm (T_6) (8.46) followed by 90% green waste incubated with 10% cow dung + earthworm (T_5) (8.42) under 35 days after collection of vermiwash and the minimum (7.48) in 100% cow dung + earthworm (T_1) under 7 days after collection of vermiwash.

Table 7.6.8: Effect of animal dung and farm waste on pH of vermiwash at different day's interval

Treatments	pH of Vermiwash					
	7 days	14 days	21 days	28 days	35 days	42 days
T1	7.48	7.53	7.59	7.65	7.72	7.69
T2	7.55	7.61	7.67	7.71	7.79	7.75
T3	7.61	7.67	7.71	7.76	7.83	7.78
T4	7.67	7.73	7.77	7.81	7.88	7.80
T5	8.17	8.25	8.31	8.37	8.43	8.39
T6	8.21	8.29	8.36	8.41	8.46	8.42
T7	8.06	8.09	8.13	8.19	8.25	8.21
T8	8.11	8.16	8.19	8.23	8.29	8.24

Electrical conductivity (dS/m): Data showed in table 7.6.6 that the maximum electrical conductivity of vermiwash was recorded in 90% green waste incubated with 10% buffalo dung + earthworm (T_6) (1.92 dS/m) followed by 90% green waste incubated with 10% cow dung + earthworm (T_5) (1.89 dS/m) under 35 days after collection of vermiwash and the minimum (1.19 dS/m) in 100% cow dung + earthworm (T_1) under 7 days after collection of vermiwash.

Table 7.6.9: Effect of animal dung and farm waste on vermiwash EC of vermiwash at different day's interval

Treatments	EC of vermiwash (dS/m)					
	7 days	14 days	21 days	28 days	35 days	42 days
T1	1.19	1.23	1.29	1.35	1.39	1.37
T2	1.24	1.29	1.34	1.41	1.47	1.43
T3	1.29	1.34	1.39	1.49	1.53	1.50
T4	1.33	1.39	1.45	1.56	1.59	1.57
T5	1.59	1.67	1.75	1.80	1.89	1.83
T6	1.65	1.72	1.79	1.85	1.92	1.88
T7	1.49	1.59	1.67	1.71	1.75	1.73
T8	1.51	1.62	1.71	1.76	1.79	1.74

Nitrogen content (%): The critical examination of data reveals that the maximum N content in vermiwash was recorded in 100% cow dung + earthworm (T_1) (0.464%) followed by 50% cow dung + 25% dry farm waste + 25% green farm waste + earthworm (T_3) (0.458%) under 35 days after collection of vermiwash and the minimum (0.408%) in 90% dry waste incubated with 10% buffalo dung + earthworm under 7 days after collection of vermiwash (Table 7.6.10).

Table 7.6.10: Effect of animal dung and farm waste on N content of vermiwash at different day's interval

Treatments	N in content in vermiwash (%)					
	7 days	14 days	21 days	28 days	35 days	42 days
T1	0.448	0.452	0.456	0.460	0.464	0.457
T2	0.423	0.431	0.437	0.441	0.445	0.439
T3	0.436	0.441	0.448	0.452	0.458	0.448
T4	0.421	0.427	0.431	0.436	0.439	0.433
T5	0.418	0.423	0.427	0.432	0.435	0.430
T6	0.415	0.419	0.423	0.427	0.430	0.423
T7	0.412	0.415	0.417	0.420	0.425	0.418
T8	0.408	0.411	0.413	0.417	0.419	0.413

Phosphorus content (%): The perusal of data in Table 7.6.8 showed that the highest P content in vermiwash was recorded in 100% cow dung + earthworm (T_1) (0.530%) followed by 50% cow dung + 25% dry farm waste + 25% green farm waste + earthworm (T_3) (0.525%) under 35 days after collection of vermiwash and the minimum (0.485%) in 90% dry waste incubated with 10% buffalo dung + earthworm under 7 days after collection of vermiwash.

Table 7.6.11: Effect of animal dung and farm waste on P content of vermiwash at different day's interval

Treatments	P content of vermiwash (%)					
	7 days	14 days	21 days	28 days	35 days	42 days
T1	0.512	0.516	0.523	0.526	0.530	0.524
T2	0.505	0.510	0.513	0.519	0.522	0.515
T3	0.508	0.512	0.519	0.522	0.525	0.518
T4	0.503	0.509	0.511	0.515	0.518	0.511
T5	0.500	0.507	0.509	0.513	0.517	0.510
T6	0.499	0.501	0.505	0.508	0.511	0.505
T7	0.492	0.494	0.497	0.501	0.505	0.499
T8	0.485	0.490	0.494	0.499	0.502	0.497

Potassium content (%): Data in Table 7.6.9 indicated that the maximum K content in vermiwash was recorded in 100% cow dung + earthworm (T_1) (0.189%) followed by 50% cow dung + 25% dry farm waste + 25% green farm waste + earthworm (T_3) (0.184%) under 35 days after collection of vermiwash and the minimum (0.140%) in 90% dry waste incubated with 10% buffalo dung + earthworm under 7 days after collection of vermiwash.

Table 7.6.12: Effect of animal dung and farm waste on K content of vermiwash at different day's interval

Treatments	K content of vermiwash (%)					
	7 days	14 days	21 days	28 days	35 days	42 days
T1	0.173	0.177	0.182	0.186	0.189	0.183
T2	0.163	0.167	0.170	0.174	0.178	0.171
T3	0.167	0.171	0.176	0.181	0.184	0.178
T4	0.159	0.162	0.167	0.170	0.173	0.167
T5	0.158	0.160	0.163	0.167	0.169	0.164
T6	0.156	0.159	0.161	0.165	0.167	0.161
T7	0.145	0.149	0.155	0.159	0.162	0.157
T8	0.140	0.143	0.148	0.153	0.157	0.150

Microbial Count and Enzyme Studies: The different different mixture of cow and buffalo dung samples were analysed for total microbial count and enzyme studies using the following methodology.

Microbial Count: The different microbial count was studied in different mixture of cow and buffalo dung samples by serial dilution plate count technique (Aneja, 2003) after 12 -15 days after its preparation on the specific medium viz. LB for total bacterial count, PDA for total fungal count, Actinomycete agar medium for total Actinomycetes fixers were recorded and are listed below (Table 7.6.10). The results indicated that the 50% cow dung+25% dry straw +25% green waste having highest microbial count and 90% dry straw + 10% cow dung has lowest microbial count.

Table 7.6.13: Effect of animal dung and farm waste on bacterial population of vermiwash at different day's interval

Sr. No.	Liquid Manure	Total Bacterial Count	Total Fungal Count	Total Actinomy-cetes
1.	100% cow dung	1.27 x10^8	0.75 x10^5	0.25 x10^5
2.	100% buffalo dung	5.12 x10^8	1.7 x10^5	0.45 x10^5
3.	50% cow dung +25% dry straw +25% green waste	20.07 x 10^8	44.5 x10^5	19.63 x10^5
4.	50% buffalo dung +25% dry straw +25% green waste	19.66 x10^8	15.5 x10^5	7.7 x10^5
5.	90% green waste + 10% cow dung	20 x10^8	7.95 x10^5	3.86 x10^5
6.	90% green waste + 10% buffalo dung	11.5 x10^8	22.26 x10^5	5.48 x10^5
7.	90% dry straw + 10% cow dung	0.54 x10^8	0.25 x10^5	0.05 x10^5
8.	90% dry straw + 10% buffalo dung	1.03 x10^8	1.15 x10^5	0.08 x10^5

Enzyme studies: Acid Phosphatase, Alkaline Phosphatase and Dehydrogenase enzymes were studied in different mixture of cow and buffalo dung samples after 10-15 days of its preparation. The following protocols were followed.

Determination of Phosphatase Activity: Phosphatase activity was measured by the method of Tabatabaei and Bremner (1969). 1 ml of sample was taken in to a 50 ml conical flask. Then 4ml of modified universal buffer (pH 6.5 for acidic phosphatase and pH11 for alkaline phosphatase), 0.25 ml of toluene and 1 ml of 0.115 M p nitrophenyl phosphate (PNP) solution was added to the flask (Skujins, 1985). The flask was swirled for few seconds and then incubated at 37° C for one hour in an incubator. After incubation 1 ml of 0.5 M calcium chloride and 4 ml of 0.5 M sodium hydroxide was added to the mixture. The soil suspension was filtered through Whatman filter paper No. I. The optical density of the filtrate was measured at 430 nm in Hitachi (220) spectrophotometer. Blank was maintained similarly without soil. The phosphatase activity in terms of concentration of p-nitrophenyl in each sample was calculated by a standard curve of p-nitrophenol in water.

Determination of Dehydrogenase Activity: 1 mL was pipetted from each sample into test tubes. Tris buffer (2.5 mL) and TTC-glucose solution (1 mL) were added to the sample tubes (1 mL of distilled water was added to the control tube). The pH was adjusted to 7 using 1.0 N HCl and the test tubes were gently swirled to mix the content. The tubes were incubated in an environmentally controlled incubator at 30ºC for 1 hour. The tubes were removed and centrifuged for 10 minutes to separate the cells from other medium components. TF extraction was carried out three times using 2.5 mL of ethanol each time. All samples were vortexed to disrupt cell walls and leach TF from within cells followed by centrifugation to separate the cells at the bottom. Supernatants from the three extractions were combined and the absorbance of the combined supernatants was measured at 484 nm. The results indicated that the 50% cow dung+25% dry straw +25% green waste having highest enzyme activities which can be correlated with its microbial count (Table 7.6.14)

Table 7.6.14: Effect of animal dung and farm waste on enzymes

S.No.	Liquid Manure	Acid Phosphatase (µg/ml)	Alkaline Phosphatase (µg/ml)	Dehy-drogenase (µg/ml)
1.	100% cow dung	33.41379	7.758621	2.77193
2.	100% buffalo dung	29.34483	7.275862	2.77193
3.	50% cow dung+25% dry straw +25% green waste	72.93103	21.96552	9.614035
4.	50% buffalo dung +25% dry straw +25% green waste	39.06897	21.06897	3.122807
5.	90% green waste + 10% cow dung	56.17241	13.48276	6.45614
6.	90% green waste + 10% buffalo dung	64.37931	7.758621	6.631579
7.	90% dry straw + 10% cow dung	35.55172	15.89655	6.807018
8.	90% dry straw + 10% buffalo dung	34.86207	7.068966	8.736842

Results

Seed Yield: Aapplication of vermiwash from 100% cow dung gave significantly maximum seed and haulm yield of blackgram of 922 kg ha^{-1}& 1971 kg ha^{-1}, respectively. Likewise, application of vermiwash from 100% cow dung gave maximum net returns and B:C ratio (₹76,058 ha^{-1}& 2.84, respectively) in black gram (table 7.6.15).

Table 7.6.15: Effect of vermiwash from different organic resources on yield and economics of organic black gram

	Seed Yield g/ha)	Haulm (kg/ha)	Biological yield (kg/ha)	Harvest index (%)	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	Benefit cost ratio
Vermiwash from 100% cow dung	922	1971	2894	31.58	102878	76058	2.84
Vermiwash from 100% buffalo dung	906	1932	2838	31.61	101002	74182	2.77
Vermiwash from 50% cow dung + 25% dry farm waste + 25% green farm waste	909	1940	2849	31.54	101398	74378	2.75
Vermiwash from 50% buffalo dung + 25% dry farm waste + 25% green farm waste	887	1893	2780	31.55	98889	71869	2.66
Vermiwash from 90% green waste incubated with 10% cow dung	821	1749	2571	31.56	91579	64383	2.37
Vermiwash from 90% green waste incubated with 10% buffalo dung	813	1734	2547	31.48	90695	63499	2.33
Vermiwash from 90% dry waste in cubated with 10% cow dung	804	1722	2526	31.48	89734	62538	2.30
Vermiwash from 90% dry waste incubated with 10% buffalo dung	798	1700	2498	31.49	88978	61782	2.27
Water spray (Control)	646	1396	2042	30.95	72171	46951	1.86
CD (P= 0.05)	96	209	305	NS			

100 % Cow dung

100 % Buffalow dung

Vermiwash from 50% buffalo dung + 25% dry farm waste + 25% green farm waste

90% green waste + 10% cow dung

90% dry waste + 10% cow dung

Control

Effect of different treatments of vermiwash on black gram

ITK 4: Plant products

Effect of plant products on storage of maize grain and black gram seed

Treatment details:

Maize	Black gram
Product and Treatment	
Neem oil	**Mustard Oil**
Neem oil 1%	Mustard Oil 1%
Neem oil 2%	Mustard Oil 2%
Neem oil 3%	Mustard Oil 3%
Control	Control
Maize Cob Powder	**Neem oil**
Maize Cob Powder 1%	Neem oil 1%
Maize Cob Powder 2%	Neem oil 2%
Maize Cob Powder 3%	Neem oil 3%
Control	Control
Dried Neem Leaves	**Dried Neem Leaves**
Dried Neem Leaves 1%	Dried Neem Leaves 1%
Dried Neem Leaves 2%	Dried Neem Leaves 2%
Dried Neem Leaves 3%	Dried Neem Leaves 3%
Control	Control

a. Maintenance of insect culture: The nucleus culture of different stored grains pests (*viz.*; rice weevil and pulse beetle) were obtained from Department of Post-Harvest Technology, CTAE, Udaipur, which was further mass multiplied and maintained throughout the experimental period in the laboratory, Department of Entomology, Rajasthan College of Agriculture, on different stored grains (*viz.*; maize and blackgram). The grains were sterilized at 55º C for 6 hours (Chander and Bhargava, 2010) in order to eliminate both apparent and hidden infestation of insects and mites, if any. These grains were conditioned for a week in an incubator maintaining 28±2º C and 65±5 per cent relative humidity to raise their moisture content. The adults so emerged were used for further experimentation

b. Bio-efficacy: The experiments on the bio-efficacy of different plant product against different stored pests (*viz.*; rice weevil and pulse beetle) was conducted in Completely Randomized Design with three replications in laboratory at Department of Entomology, RCA, Udaipur during 2018-19. There were nine treatments replicated three times. Other than oils, the plant products were dried in shade, powdered in a grinder and passed through 60 mesh size sieves. Different concentration of plant products was mixed with 500 g different stored grains (*viz.*; maize and blackgram grains) to study their bio-efficacy against different stored pests (*viz.*; rice weevil and pulse beetle). Treated 500g grains were kept in 1 lit. capacity of plastic containers and replicated three times under Completely Randomized Design (CRD) and 40 pairs of freshly emerged adults of test insect were released into the treatments. The mouth of containers was covered with muslin cloth and tightened with rubber band. All released adults were removed after 28 days (four weeks) and the grains were allowed to be infested by the next generation of the insect pests and the observations were recorded after 4 weeks of the infestation on the basis of following parameters.

Per cent grain damage: After the completion of experiments, the damaged and healthy grains were counted separately and per cent grain damage was calculated by the following formula:

$$\text{Grain damage (\%)} = \frac{\text{Number of damaged grains}}{\text{Total number of grains used}} \times 100$$

Results

A. Maize (Table 7.6.16)**:**

Grain damage (%): The data recorded on per cent grain damage by rice weevil, *Sitophilus oryzae* (L.) reveals that all the treatments were found significantly superior over control. The per cent grain damage caused by rice weevil ranged from 14.39 to 37.74 per cent in all three sets of treatments. In the set –I, the minimum per cent grain damage 13.36 per cent was recorded in grain treated with neem oil (3%), in set – II, the minimum per cent grain damage 32.45 per cent was recorded in grain treated with maize cob powder (3%) and in set – III, the minimum per cent grain damage 14.39 per cent was recorded in grain treated with dried neem leaves (3%).

B. Black gram (Table 7.6.17):

Grain damage (%): The data recorded on per cent grain damage by pulse beetle, *Callosobruchus chinensis* (L.) reveals that all the treatments were found significantly superior over control. The per cent grain damage caused by pulse beetle ranged from 8.28 to 15.91 per cent in all three sets of treatments. In the set I, the minimum per cent grain damage 9.14 per cent was recorded in grain treated with mustard oil (3%), in set – II, the minimum per cent grain damage 8.28 per cent was recorded in grain treated with neem oil (3%) and in set – III, the minimum per cent grain damage 12.53 per cent was recorded in grain treated with dried neem leaves (3%).

Table 7.6.16: Efficacy of plant products against rice weevil, Sitophilus oryzae of stored grains of Maize

Weight of 100 healthy grains = 18-20 grams Weight of 100 damaged grains = 12-13 grams				
Treatments	**Total No. of Grains in 50 grams**	**Damages Grains**	**Damage %**	**Weight of damaged grains**
A. Neem oil				
Neem oil 1%	319	57	17.87	7.41
Neem oil 2%	302	43	14.24	5.59
Neem oil 3%	292	39	13.36	5.07
Control	325	211	64.92	27.43
B. Maize Cob Powder				
Maize Cob Powder 1%	318	120	37.74	15.60
Maize Cob Powder 2%	312	109	34.94	14.17
Maize Cob Powder 3%	302	98	32.45	12.74
Control	327	200	61.16	26.00
C. Dried Neem Leaves				
Dried Neem Leaves 1%	306	72	23.53	9.36
Dried Neem Leaves 2%	298	53	17.79	6.89
Dried Neem Leaves 3%	285	41	14.39	5.33
Control	331	198	59.82	25.74

Table 7.6.17: Efficacy of plant products against pulse beetle, Callosobruchus chinensis infesting stored grains of black gram

Weight of 100 healthy grains = 6.5 grams Weight of 100 damaged grains = 2.5 grams				
Treatments	**Total No. of Grains in 50 grams**	**Damage Grains grains**	**Damage %**	**Weight of damaged**
A. Mustard Oil				
Mustard Oil 1%	1350	182	13.48	4.55
Mustard Oil 2%	1328	132	9.94	3.30
Mustard Oil 3%	1313	120	9.14	3.00
Control	1405	898	63.91	22.45
B. Neem oil				
Neem oil 1%	1363	172	12.62	4.30
Neem oil 2%	1247	118	9.46	2.95
Neem oil 3%	1352	112	8.28	2.80
Control	1411	856	60.67	21.40
C. Dried Neem Leaves				
Dried Neem Leaves 1%	1402	223	15.91	5.58
Dried Neem Leaves 2%	1398	202	14.45	5.05
Dried Neem Leaves 3%	1357	170	12.53	4.25
Control	1428	806	56.44	20.15

3% Neem oil (Maize)

3% Maize cob powder (Maize)

Maize grain with different treatments

3% Neem oil (Black gram)

3% Maize cob powder (Black gram)

Black gram seed with different treatments

Storage of maize grain and black gram seed

7.7 Evaluation of organic management practices for insect pest in various crops

Objectives:

- To evaluate the organic management practices for reducing the incidence of insect pests in major crops
- To identify the package of insect pest management for organic production system

Year of start: 2015-16

Location: Ajmer, Almora and Gangtok

Ajmer

Results

Evaluation of IPM Modules against aphid infesting coriander and fennel

The relative efficacy of six organic based IPM modules (including control) against aphid on coriander and fennel was evaluated. Observations were recorded from randomly selected five tagged plants per plot right from pests' initiation on crop to harvesting. Result revealed that all IPM modules were found significantly superior over untreated check. The maximum percent reduction in aphid population was recorded in module M_{-3} (garlic extract 10 ml/lit + azadirachtin 0.03% EC @ 5ml/lit + tumba fruit extract 10ml/lit.), which was 75.3% efficient on coriander and 76.4% on fennel followed by M_{-2} (field sanitation + NSKE 5ml/lit + Ker extract 10 ml/li.), where population reduction was 73.47% and 74.15%, both on coriander and fennel respectively.

Evaluation of IPM Modules against thrips infesting coriander and fennel

A similar IPM module was also evaluated for the relative efficacy of six organic based IPM modules (including control) against thrips on coriander and fennel. The results showed that all IPM modules were found significantly superior over control and the maximum percent reduction in thrips population was recorded under IPM module M_{-3} (garlic extract 10 ml/lit + azadirachtin 0.03% EC @ 5ml/lit + tumba fruit extract 10ml/lit.), which was 65.0% efficient on coriander and fennel (70.61%) followed by M_{-2} (field sanitation + NSKE 5ml/lit + Ker extract 10 ml/li.), where population reduction were 63.19 and 68.74 percent on both the crop coriander and fennel respectively.

Almora

Results

organic pest management options for pests of soybean

(Table 7.7.1)

Seven treatments including control was evaluated as organic pest management options for soybean. Results revealed that sucking bug, *Chauliops choprai* infestation counts shows severe infestation of sucking bug (3.00 to 4.00 bugs per leaf as taken average of top, mid and bottom leaves). The average bug reduction was about 0.20 to 0.98 in various treatments. Apart from chemical pesticide, Cartap hydrochloride which registered 84% reduction, melia extract 5 and 10% provided 47 and 43% reduction of soybean sucking bug, respectively. Minimum per cent reduction in soybean found to be with *Beauveria bassiana* 3g/L of 15.99% compared to control (Table 7.7.1).

Table 7.7.1. Effect of organics on the management of sucking bug of soybean

Treatment	Pre-treatment Count	2 DAT	5 DAT	7 DAT	Average	Per cent reduction w.r.t. control
Melia azederach extract 5%	4.00	0.89	0.83	0.61	0.77	46.56
Melia azederach extract 10%	3.56	0.61	0.55	1.05	0.74	43.05
Nimbicidine 3 mL/L	3.00	1.11	0.72	1.11	0.98	10.09
Beauveria bassiana 3g/L	2.61	0.67	0.50	1.22	0.79	15.99
Parthenium extract 5%	3.05	0.85	0.56	1.06	0.82	25.70
Cartap hydrochloride 1g/L	3.56	0.33	0.17	0.11	0.20	84.28
Control	3.00	1.17	1.66	0.45	1.09	

The effect of organic pest management options on aphids in soybean crop revealed that the pre-treatment count has severe incidence of aphids of 33.33 to 50.94 aphids per plant. The incidence was reduced in all the treatments including control drastically to 9.67 to 15.45 aphids per plant. So, the treatment effects are not very clear in this experiment however, per cent reduction w.r.t. control was recorded with *Beauveria bassiana* 3g/L of 36.81% for aphid management (Table 7.7.2).

Table 7.7.2. Effect of organics on the management of aphids on soybean

Treatment	PTC	2 DAT	5 DAT	7 DAT	Average	Per cent Reduction w.r.t. control
Melia azederach extract 5%	37.06	17.89	13.11	10.05	13.68	19.17
Melia azederach extract 10%	33.33	12.05	11.28	11.44	11.59	23.87
Nimbicidine 3 mL/L	35.00	13.72	14.33	10.61	12.88	19.39
Beauveria bassiana 3g/L	50.94	17.39	14.83	11.89	14.70	36.81
Parthenium extract 5%	40.11	14.28	15.83	9.67	13.26	27.63
Cartap hydrochloride 1g/L	34.11	9.72	10.78	14.00	11.50	26.19
Control	37.61	20.84	15.27	15.45	17.18	

Pest incidence in organic production system

The infestation/damage of leaf webber in grain amaranth grown in full organic conditions was 6.6%, whereas it was 12.0% damage in full inorganic plots. Sporadic infestation of grasshoppers was found in finger millet crops. Soybean grown under full organic condition was found to harbour more number of sucking bug, *Chauliops choprai* (11.4 bugs per 3 leaves) and 100% inorganic had the least number of sucking bugs (5.8 bugs per 3 leaves). The infestations of aphids in toria under wheat + *toria* intercropping were 68, 39 and 55 and 47% for application of 100% N requirement of crop through FYM, 75% N requirement of crop through FYM + 3% Panchagavya + Vermiwash, INM and 100% inorganic conditions, respectively. No insect pest incidence was observed in wheat crop (Table 7.7.3).

Table 7.7.3. Infestation of insect under different production systems

Treatment	Amaranth Leaf webber damage (%)	Finger millet Grasshopper damage (%)	Soybean Sucking bug (No/ 3 leaves)	Toria Aphid infestation (%)
100% Organic	6.6	18.8	11.4	68.0
75% Organic + 3% Panchagavya + Vermiwash	10.7	12.6	8.4	38.7
50% Organic + 50% inorganic	9.3	7.0	6.0	54.7

Effect of organics in the management of aphids in toria - *Lab experiments*

An experiment was conducted in the laboratory to evaluate the organic pest management options for the management of aphids in mustard/ toria. The twigs infested with toria aphids were taken to laboratory from the field without any treatment for use in laboratory evaluation. Six different organic treatments were tested against toria aphids in the laboratory, especially three botanical extracts, two bioagents along with commercially available neem oil (Nimbicidine) and chemical pesticide. None of the treatments except the chemical insecticide, acetamiprid was found to reduce the infestation of aphids in mustard considerably. Nimbicidine spray 3 mL/L was found to reduce the aphid infestation by 26.59%. (Table 7.7.4)

Table 7.7.4. Effect of organics on the management of aphids on toria

Treatment	Infested twigs before treatment	Per cent mortality				
		24 hours after treatment	48 hours after treatment	72 hours after treatment	96 hours after treatment	Average
T1 Melia extract 5 %	100	0	1.33	11.67	35.7	12.18
T2 Artemisia 5%	100	0	2.67	10.67	58.3	17.91
T3 Pine extract 5%	100	0	1.33	10.0	50.0	15.33
T4 Nimbicidine 3mL/L	100	2.33	2.67	20.67	80.7	26.59
T5 *Metarhizium anisopliae* 3g/L	100	0	5.33	21.67	69.0	24.00
T6 *Beauveria bassiana* 3g/L	100	0	3.33	15.67	80.0	24.75
T7 Acetamiprid 0.25g/L	100	5.0	66.7	100	100	67.93
T8 Control	100	0	0	13.0	86.7	24.93

Organic management of toria aphids - *Field experiment*

A field experiment was conducted to evaluate the organic pest management options for the management of aphids in mustard/ toria. Pre-treatment count shows severe infestation of aphids up to 100%. None of the treatments, except the chemical insecticide, acetamiprid was found to reduce the infestation of aphids in mustard considerably, i,e. more than 80%. Nimbicidine spray 3 mL/L was found to reduce the aphid infestation by 16.67%. (Table 8). New treatments and treatments with increased dosage are to be tried. Use of predators is to be tried especially of coccinellids and syrphids in the next season (Table 7.7.5).

Table 7.7.5. Effect of organics on the management of aphids in toria

Treatment	Pretreatment count	Per cent Reduction			
		3 DAT	6 DAT	10 DAT	Average
T1 Melia extract 5 %	100	7.0	7.0	7.0	**7.00**
T2 Artemisia 5%	100	4.0	4.0	4.0	**4.00**
T3 Pine extract 5%	93.3	7.0	13.0	13.0	**11.00**
T4 Nimbicidine 3mL/L	100	10.0	10.0	30.0	**16.67**
T5 *Metarhizium anisopliae* 3g/L	100	7.0	20.0	20.0	**15.67**
T6 *Beauveria bassiana* 3g/L	100	10.0	10.0	10.0	**10.00**
T7 Acetamiprid 0.25g/L	100	80.0	80.0	83.0	**81.00**
T8 Control	100	0.0	0.0	0.0	**0.0**

Gangtok

Organic insect pest management in maize-based cropping system

To test the efficacy of the selected bio-pesticides against infestation of army worm and stem borer in maize crop, an experiment was carried out. First year showed that among all the tested bio-pesticides, Spinosad 45 SC showed the best result with the lower per cent leaf feeding by army worm (9.8) and reduction in the per cent dead heart (0.65 %). The second best treatment was *Beauveria bassiana* @ 7 g/l with 14.5 % leaf feeding by army worm and stem borer dead heart (2.98%). The leaf injury rating was lowest in maize plots treated with Spinosad 45 SC (2.5) followed by *Metarhizium anisopliae* @ 5 ml/l (5.2) and Petroleum oil based agrospray @ 10 ml/l (5.8).

Table 7.7.6. Infestation of army worm and stem borer in maize crop as influenced by different biopesticides

Entries	Army worm		Stem borer infestation (%)		Leaf Injury Rating (LIR)
	% Leaf	Leaf feeding feeding rating	Plant infestation (%)	Dead heart (%)	
Neem oil (1500 ppm @ 4 ml/l	20.55	2.4	32.40	5.15	8.2
Beauveriabassiana 7 g/l	14.05	1.5	30.20	2.98	7.0
Metarhiziumanisopliae 5 ml/l	19.87	1.2	35.07	5.40	5.2
Petroleum oil based agrospray @ 10 ml/l	48.52	2.2	50.47	4.8	5.8
Petroleum oil based horticultural spray @ 10 ml/l	18.43	1.2	36.5	4.18	6.0
Bacillus thuringiensis @ 2 g/l	32.45	1.9	24.74	4.52	6.2
Spinosad 45 SC @ 0.3 ml/l	9.8	1.0	8.48	0.65	2.5

Second year study: Among all the various bio-pesticides, Spinosad 45 SC showed the best result in second year study for Stem borer infestation (%) with % damage control or increase in grain yield of maize of3.68 t/ha (Table 7.7.7).

Table 7.7.7. Stem borer infestation in maize crop as influenced by different biopesticides

Entries	Stem borer infestation (%)				
	Insect Score (0-9 scale)	% Damage before spray	% Damage after spray	% Damage control	GY(t/ha)
Neem oil (1500 ppm @ 4 ml/l	3.29	9.01	6.19	68.47	2.72
Beauveria bassiana @7 g/l	1.48	8.28	5.53	73.09	3.38
Metarhizium anisopliae @5 ml/l	3.15	8.55	6.21	69.83	2.95
Petroleum oil based agrospray @ 10 ml/l	4.65	9.83	7.10	65.55	2.08
Petroleum oil based horticultural spray @ 10 ml/l	2.30	7.41	5.92	71.29	3.25
Bacillus thuringiensis @ 2 g/l	4.00	9.60	6.78	67.11	2.58
Spinosad 45 SC @ 0.3 ml/l	1.00	5.61	4.32	79.06	3.68
Control	5.98	9.15	20.55	-	0.95
CD (P=0.05)	0.92	1.08	0.65	-	0.28

Semi looper on maize leaf

Army worm

7.8 Evaluation of organic management practice for diseases in crops

Objective:

- To evaluate the management practices for management of diseases in high value crops
- To identify the suitable package for management of important diseases in selected crops

Year of start: 2015-16

Locations: Three, namely Ajmer (Rajasthan), Coimbatore (Tamil Nadu) and Gangtok (Sikkim).

Results: Only Ajmer centres reported the results

Ajmer

Management of *Sclerotium* rot of coriander

Five different treatments including soil solarization (20 days), *Trichoderma,* neem cake (0.5t/ha), caster cake (0.5t/ha) and control were evaluated with four replications in RBD design. Soil solarization was done in the plots in summer (May-June) for 20 days by covering 100µm polyethylene sheets on ploughed well planned and moist soil. *Trichoderma* @ 2kg /ha, neem cake (0.5t/ha), caster cake (0.5t/ha) were mixed in soil before sowing the coriander crop. The *Sclerotium* rot disease measurement was done throughout the cropping span by counting number of diseased plants and healthy plants separately and then percent disease index (PDI) was calculated. Among the treatments, soil solarization for 20 days was found most effective (PDI 2.98) followed by application of neem cake (PDI 5.72) while percent disease index was recorded maximum (7.88) in control. Total number of weeds per meter square were counted after fifteen days of sowing where the minimum weed count (27.5 nos. m^{-2}) per meter square were in 20 days soil solarization followed by in neem cake (65.5 nos. m^{-2}). Maximum weed m^{-2} (81.3 nos.) recorded in control. Powdery mildew disease on organic coriander was also recorded with the soil solarization which was found most effective (PDI 14.75) followed by castor cake (PDI 17.25) while the disease was recorded maximum (PDI 33.5) in control (Table 7.8.1).

Table 7.8.1: Influence of different treatments on *Sclerotium* rot disease of coriander

Treatments	*Sclerotium* Rot (percent disease index)	Powdery mildew (Percent disease index)	No. of weeds (M^{-2})	Yield(kg/ha)
Soil solarization (20 days)	2.98	14.75	27.50	685
Trichoderma (Soil & Seed App.)	6.93	23.50	79.00	558
Neem cake (0.5 T/ha)	5.72	17.75	65.50	633
Caster cake (0.5 T/ha)	6.73	17.25	67.50	555
Control	7.88	35.50	81.30	400
CD (P=0.05)	1.37	2.82	10.86	74

Management of *Ramularia* blight of fennel (*Foeniculum vulgare*)

Five treatments comprising ariel spray of neem oil (0.5%), castor oil (0.5%), garlic extract (0.5%), onion extract (0.5%) and control were evaluated in fennel under organic condition with four replications in randomized block design. The spray schedule of different botanicals was adopted. In year 2018-19 the weather conditions were found unsuitable and unfavorable for the disease development however, the disease initiated and recorded in lower incidence (Table 7.8.2).

Table7.8.2: Influence of different treatments on weed and seed yield of fennel

Treatments	No. Weeds /m^2	*Ramularia* Blight	Yield kg/ha
Neem oil (0.5%)	78.50	1.50	2560
Castor oil (0.5%)	81.60	2.50	2490
Garlic extract (0.5%)	78.50	2.25	2610
Onion extracts (0.5%)	80.50	2.75	2460
Control	78.30	4.50	2450
CD (P=0.05)	-	0.68	86.0

7.9 Development of scientific organic package for large cardamom

Objective

- Standardization of organic source of nutrients in large cardamom for yield maximization

Location: Gangtok

Year of start: 2015-16

A. Standardization of organic nutrient management package for large cardamom

Among the organic nutrients in the large cardamom, maximum fresh weight of capsule per clump was recorded with application of vermicompost @10 kg/clump + biofertilizer (99.38 g,) followed by vermicompost @7.5 kg/clump + biofertilizer. The dry weight of capsules per clump and the productivity of the large cardamom were also high, *i.e.,* 19.68 g and 441.6 kg/ha, respectively when vermicompost was applied @ 10 kg/clump + biofertilizer.

The soil organic carbon (1.28%), bulk density (1.31 mg/m3), available N, P & K (374.5, 30.42 & 238 kg/ha respectively) was also higher in treatment where vermicompost @10 kg/clump + biofertilizer was applied. Treatment VC @7.5 kg/clump + BF being the next best performing management package in term of productivity, and soil health.

Maximum plant population in the treatment VC @10 kg/clump + BF

Maximum capsules under VC @10 kg/clump + BF

Harvesting of capsule

Sun drying of capsule

Effect organic nutrient management package for large cardamom

Table 7.9.1: Effect organic nutrient management package for large cardamom

	Mature tillers/ bush	Fresh weigh of capsule/	Dry wt. of capsules	Productivity (kg/ha)	SOC %	Bulk density (mg/m^3)	Soil EC (dS/m)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
FYM @ 5 kg/clump + BF	2.84	74.02	14.68	325.5	1.12	1.18	0.34	318.3	28.42	220.6
FYM @7.5 kg/clump + BF	3.12	78.90	15.48	336.1	1.18	1.24	0.34	325.3	28.65	224.6
FYM @ 10 kg/clump + BF	3.47	79.10	16.02	345.6	1.21	1.37	0.36	331.4	28.75	226.7
FYM @ 5 kg + VC @ 2.5 kg/clump + BF	3.75	85.51	16.14	373.4	1.17	1.08	0.32	341.3	28.49	220.8
FYM @7.5 kg + VC @ 2.5 kg/clump + BF	3.88	84.85	17.28	398.5	1.22	1.15	0.34	345.5	28.52	224.9
FYM @10 kg + VC @ 2.5 kg/clump +BF	4.02	95.18	18.51	414.4	1.25	1.12	0.35	365	30.12	234.6
VC @ 5.0 kg/clump + BF	2.81	87.80	17.25	405.6	1.18	1.1	0.37	332.7	28.43	214.5
VC @7.5 kg/clump + BF	2.8	95.77	18.57	424.7	1.18	1.21	0.34	368	30.28	236.4
VC @10 kg/clump + BF	2.9	99.38	19.68	441.2	1.28	1.31	0.36	374.5	30.42	238.7
Control	1.04	35.9	5.71	123.5	1.1	1.05	0.31	275.6	22.41	195.6

B. Response of large cardamom (growth and yield parameters) to soil and foliar application of micronutrients

Data pertaining to balance sheet of micronutrients showed that the available boron under foliar application is much better as compared to soil application. The best soil treatment that increased the yield of large cardamom significantly is 3.0 kg/ha boron, 1.5 kg/ha zinc and 10.0 kg/ha molybdenum as compared to control. Application of boron significantly affected the immature, mature tillers and vegetative buds). Among the foliar application of boron treatments, foliar application of Borax @ 0.20% recorded the maximum values of immature tillers per clump (3.81) and mature tillers per clump (3.54) and vegetative buds per clump (2.75). It might be due to the positive role of boron in meristematic tissue development, whether these were root tips, tips of upper plant parts (Table 7.9.2).

Table 7.9.2. Effect of soil and foliar application of micronutrients in response of large cardamom (growth and yield parameters)

Treatments	Dose	Available Nutrients (mg kg^{-1})	Immature tiller (numbers)	Mature tiller	Vegetative buds (numbers)
Soil application					
T_1 Boron	1.0 kg/ha	0.153	3.16	3.06	2.39
	2.0 kg/ha	0.164	3.21	3.16	2.43
	3.0 kg/ha	0.168	3.30	3.25	2.51
T_2 Zinc	1.0 kg/ha	3.28	2.87	2.92	2.36
	1.5 kg/ha	3.45	3.13	3.11	2.46
	2.0 kg/ha	3.68	3.01	2.99	2.40
T_3 Molybdenum	5.0 kg/ha	0.117	2.73	3	2.27
	7.5 kg/ha	0.121	2.81	3.09	2.32
	10.0 kg/ha	0.122	3.05	3.16	2.41

Treatments	Dose	Available Nutrients (mg kg^{-1})	Immature tiller (numbers)	Mature tiller	Vegetative buds (numbers)
Foliar application					
T_4 Boron	0.10%	0.174	3.64	3.43	2.75
	0.20%	0.175	3.81	3.54	2.75
	0.30%	0.178	3.75	3.38	2.73
T_5 Zinc	0.10%	3.55	3.70	3.30	2.65
	0.25%	3.67	3.77	3.35	2.67
	0.50%	3.75	2.85	3.22	2.59
T_6 Molybdenum	0.05%	0.115	1.99	3.09	2.55
	0.10%	0.116	2.17	3.12	2.63
	0.20%	0.121	1.66	2.1	1.78
T_7 Control	Control	1.05	0.63	0.615	0.52
CD (P=0.05)		-	0.50	0.40	0.27

C. Organic disease management in large cardamom.

Effect of locally available botanicals, commercially available bio control agents and organically permitted fungicides against blight of large cardamom

Results of study: A field experiment was conducted to study the effect of different treatments against various diseases in large cardamom consisting of 11 treatments including control. Total six plants were tags/treatments for taking the observations. It was observed that the botanical extract *Allium sativum* @ 2.5% shows best result to the control leaf bight (3.33%). Among the available biocontrol agents and organically permitted fungicides, lowest disease incidence was also seen in plants treated with *Artemisia vulgaris* 2.5%, *Trichoderma viride* 6.5%, *Pseudomonas fluorescens* 0.25% and Sulfex 0.1%. The severity of disease was maximum in the plants treated with copper hydroxide 0.25% (45.83%), copper oxychloride 0.5% (35%) followed by commercial Neem based 0.3% (30.0%) and Bordeaux mixture 0.25% (29.17%). The leaf blight disease severity of large cardamom was less than 60% in control. However, both the biocontrol agents and botanicals were found to be effective against Leaf blight of Large cardamom with lower disease incidence from 0- 3.33 %.

Table 7.9.3. Effect of locally available botanicals, commercially available bio control agents and organically permitted fungicides against blight of large cardamom

Treatments	Leaf blight (PDI)		
	Disease Free Plants	Disease infected plant	Disease Incidence (%)
T_1 *Allium sativum* 2.5%	6.0	0.2	3.33
T_2 *Artemisia vulgaris* 2.5%	5.16	0.5	8.33
T_3 *Schima wallichii* 2.5%	4.5	1.5	25
T_4 Neem based 0.3%	4	1.8	30
T_5 *Trichoderma viride* 6.5%	5.5	0.5	8.33
T_6 *Pseudomonas fluorescens* 0.25%	5.5	0.5	8.33
T_7 Copper oxychloride 0.5%	3.9	2.1	35
T_8 Copper hydroxide 0.25%	3.25	2.75	45.83
T_9 Bordeaux mixture 0.25%	3.91	1.75	29.17
T_{10} Sulfex	5.5	0.5	8.33
T_{11} Control	2.16	3.5	58.33

D. Organic insect pest management in large cardamom

All the treatments showed effective results to control insect pests over the control. However, *spinosad* 45 SC @ 0.3 ml/l was found to be the most effective to control all the pests (68.29 to 80.10% reduction of infestation over control) followed by neem oil (1500 ppm) @ 4 ml/l (59.32 to 65.64% reduction of infestation over control) and petroleum agrospray @ 10 ml/l (51.21 to 60.10% reduction of infestation over control).

The mean of original data of percent infestation was calculated as percent reduction of infestation over control as per following formula (Abbot's formula, 1925)

$$\text{Percent reduction of infestation} = \frac{C - T}{T} * 100$$

Whereas, C= Control

T= Treatment

Table 7.9.4. Effect of Biopesticides on insect of large cardamom

Treatments Leaf	Dose	Percent reduction in damage over control				
		Tea Mosquito caterpillar damage	Shoot fly bug damage (%)	Root mealy damage (%)	Stem borer bug incidence (%)	damage (%)
Neem oil (1500 ppm)	4 ml/l	64.21	65.12	65.64	*	59.32
Beauveria bassiana	7 g/l	35.29	35.42	40.52	*	37.08
Metarhizium anisopliae	5 ml/l	37.24	41.56	38.28	12.65	40.21
Petroleum oil based agro-spray	2ml/lit	60.10	57.44	55.32	24.12	51.21
Petroleum oil based horticultural spray	10 ml/l	52.14	44.34	48.52	*	46.25
Bacillus thuringiensis	2 g/l	50.25	48.32	51.28	*	52.14
Spinosad 45 SC	0.3 ml/l	80.10	76.24	74.68	*	68.71

Maximum vegetative buds under the foliar application treatment of boron @ 30%

Size of capsule under the foliar application treatment of boron @ 30%

7.10 Morphological and Biochemical Characterization as well as validation of SPNF based organic bio stimulant – Jeevamrit and Ghanjeevamrit

Location: Narendrapur

Preparation of Jeevamrit and Ghan Jeevamrit:

As stated by Gurukul, the *Jeevamrit* was prepared by adding following ingredients as follows: Cow Dung (air-dried) - 5 kg, Cow Urine - 3 litres, Jaggery – 0.750 kg, Pulse Flour - 0.750 kg, Forest Soil - 0.125 kg and Water - 100 litres. Samples were prepared using three different types of forest soils from different agro-climatic regions of West Bengal (i.e, Alipurduar, Shalboni, and Sundarbans). Next, samples were incubated for different periods (0 hour, 48 hours, and 96 hours) for decomposition and were further harvested to study its physico-chemical and biochemical properties.

On the other hand, the *Ghan Jeevamrit* (100 kg) was prepared as follows - Cow Dung (air-dried) - 100 kg, Cow Urine – 2 to 3 litres, Jaggery – 1 kg, Pulse Flour - 1 kg, and Forest Soil - 0.100 kg. Three different samples of *Ghan Jeevamrit* were prepared by using different forest soils as described above, and were divided into small cakes and left for drying for 7 days. Samples were collected after 0 day (as control), 2 and 7 days after decomposition.

Table 7.10.1. The Physico-chemical and Microbiological properties of *Jeevamrit* and *Ghan Jeevamrit* after 2 days and 7 days decomposition respectively

Properties	*Jeevamrit*	*Ghan Jeevamrit*
pH	5.00-7.20	7.59-8.28
Total Organic Carbon	0.27-0.36%	2.95-5.24%
Available N	0.002-0.009%	0.7-0.9%
Available P	0.002-0.004%	0.04-0.05%
Available K	0.0004-0.0009%	0.7-0.9%
Total Bacteria	$0.75\text{-}1.2\times10^{10}$	$2.6\text{-}3.1\times10^{12}$
Total *Bacillus*	$1.8\text{-}3.2\times10^{9}$	$1.9\text{-}2.2\times10^{11}$
Total Actinomycetes	$2.0\text{-}2.5\times10^{8}$	$1.7\text{-}2.0\times10^{10}$
Total Fungi	$1.0\text{-}5.0\times10^{5}$	$1.0\text{-}3.0\times10^{6}$
Total Free-living N-fixers	$0.07\text{-}1.7\times10^{9}$	$3.7\text{-}6.9\times10^{10}$
Total Symbiotic N-fixer	$1.0\text{-}3.0\times10^{7}$	$1.0\text{-}3.0\times10^{8}$
Total Phosphate Solubilizer	$1.4\text{-}3.1\times10^{8}$	$5.3\text{-}6.8\times10^{8}$
Total Potash Solubilizer	$2.0\text{-}5.0\times10^{5}$	$1.0\text{-}6.0\times10^{6}$

Results of *Jeevamrit*:

- Detailed nutrient analysis showed that the *Jeevamrit* has low content of **available N (0.002-0.009%)**, **available P (0.002-0.004%)** and **available K (0.0004-0.0009%)**.
- There is a significant change in the total bacterial population in the samples and the bacterial count is found to be highest in the 48-hour samples.
- It was further observed that there is no significant difference in N-fixers population after days of incubation. On the other hand, the total phosphate solubilizers are abundantly present in 48 hours product.
- A detailed biochemical analyses revealed that ***Staphylococcus auricularis*** exhibited best nitrogen fixing ability. On the other hand, ***Bacillus niacini*** is found to be the best phosphate solubilizing capacity showing about 200% efficiency to solubilize unavailable phosphate.

- Among best Nitrogen fixers and five phosphate solubilizers, ***Bacillus smithii*** exhibited the highest synthetic potential of indolic compounds from this study.

Results of *Ghan Jeevamrit*:

- The detailed nutrient analysis demonstrates that the *Ghan Jeevamrit* has low content of **available N (0.7 to 0.9%)**, available **P (0.04 to 0.05%)** and **available K (0.7 to 0.9%)**.
- However, it was observed from this study that the concentration of available N (largely NH_4^+ form) though gradually increases for the first two periods of incubation (i.e, 0 and 48 hrs), but is found to be depleted significantly after 7 days of decomposition.
- Further studies on microbial dynamics showed that it is enriched with several kinds of plant-beneficial bacteria such as free-living N-fixers, PSBs and KSBs.
- The microbial dynamics showed that the population of total culturable bacteria, actinomycetes and *Bacillus* after 2 days of incubation increases significantly. It was further observed that the plant beneficial microbial population also increases significantly.
- A detailed biochemical characterization revealed that ***Brevundimonas diminuta*** or ***Pseudomonas lemoignei*** exhibited the highest nitrogen fixing ability from this study. On the other hand, ***Bacillus niacini*** and ***Acinetobacter haemolyticus*** showed best P and K-solubilzing efficiency respectively.
- To validate *Ghan Jeevamrutha* as a bio-stimulant, the indolic compound production efficiency of plant-beneficial bacteria was also studied. This result pointed out that ***Bacillus niacini***, an efficient N-fixer, showed the best Indolic compound production among free-living N-fixers.
- In addition, ***Bacillus amyloliquefaciens***, and ***Ralstonia picketti*** showed remarkable Indolic compound production ability.

Conclusion:

- The concentration of different macronutrients (N, P and K) of both *Jeevamrit* and *Ghan Jeevamrit* was found to be low, which suggests that it cannot substitute the application of bulky manures or fertilizers.
- On the other hand, it is found that both of these manures are rich source of several kinds of plant-beneficial bacteria including free-living nitrogen fixers, phosphate and potash solubilizers.
- It was observed that most of the plant-beneficial bacteria belong to either Firmicutes or *Staphylococcus*. It is noteworthy that the Firmicutes contains maximum number of plants growth promoting groups of bacteria which helps to regulate plant growth directly or indirectly.
- A detailed analysis demonstrates these manures are enriched with indolic compound synthetic bacteria.
- Taken together, this study establishes that these manures are rich source of several plant-beneficial bacteria and plant growth regulators and thus, it can be used effectively as a bio-stimulant.

7.11 Evaluation of weed management practices under organic production system

Objectives

- To evaluate the cultural and mechanical weed management practices under organic production system.
- To study the efficacy of non-conventional approaches of weed management using oilcakes under organic production system.
- To find out the economically viable and practically applicable alternative to hand weeding for organic weed management in different cropping systems

Year of start: The experiment was planned and finalized in Annual Group Meeting held during 2016-17 and start in 2017-18.

Locations: Bajaura, Bhopal, Calicut, Coimbatore, Dharwad, Jabalpur, Karjat, Ludhiana, Modipuram, Pantnagar, Raipur, Ranchi and Umiam

Treatments: The treatments may be differed from centre to centre as per their respective cropping systems based on the overall treatment structure given below

Treatments		Treatment details/Management Practice (To be imposed in all crops in the cropping system)
T_1	:	Hand weeding (Two)
T_2	:	One mechanical weeding + one hand weeding
T_3	:	Intercropping with pulses/green manure (location and crop specific intercropping)
T_4	:	Stale seed bed + reduced spacing (up to 22-25%) + mulching with previous crop residues + one HW
T_5	:	Locally available weed mulch (water hyacinth/lantana etc) + one hand pulling
T_6	:	Incorporation of any one of castor / mahua / mustard seed meal / neem cake/ karanj/ tumbha cake/sal de-oiled cake 15 days before planting/sowing @ 5 t/ha + one hand weeding
T_7	:	Soil solarization with 8-25 microns polythene mulch during summer + one HW
T_8 (optional)	:	ITK treatment on weed control practiced by farmers (like mulching with leaf of mango/jackfruit etc.)

Results

The results of 2018-19 for each center are presented and discussed.

Bajaura

Evaluation of weed management practices for black gram – cauliflower- summer squash system under organic condition

Weed management practices in black gram: Seven treatments of weed management practice were evaluated for black gram crop under organic conditions. Significantly lower fresh weed weight (35.3 g/m^2), dry weed weight (4.2 g/m^2), weed density (20.0 number/ m^2) and weed index (0.53%) of black gram was observed with T_4 (Stale seed bed technique + reduced spacing up to 25% +mulching with wheat straw + one hand pulling at 20DAS) at 40 days after sowing resulted in maximum yield (940 kg/ha), net returns (98820 Rs/ha) and B:C (1.38) of black gram followed by T_7 :K-Hand weeding at 20 DAS *fb* mulching (Table 7.11.1.1) .

Table 7.11.1.1: Evaluation of weed management practices for black gram in *kharif* under organic condition at Bajaura

Weed management practices	Yield (kg/ha)	Fresh weed weight40 DAS(g/m^2)	Dry weed weight40 DAS(g/m^2)	Weed density (number/m^2)	Weed index (%)	Net returns Rs/ha	B:C
T_1 Hand weeding (Two) at 20 and 40 DAS	670	41.9	4.5	26.6	29.5(32.8)	50493	0.72
T_2 One Mechanical weeding at 20 DAS+ one Hand weeding at 40 DAS	570	42.5	4.7	29.3	39.9(39.1)	38104	0.59

Weed management practices	Yield (kg/ha)	Fresh weed weight40 DAS(g/m²)	Dry weed weight40 DAS(g/m²)	Weed density (number/m²)	Weed index (%)	Net returns Rs/ha	B:C
T_3 Inter cropping with Sun hemp fb mulching + one hand pulling at 40DAS	720	56.2	6.5	40.0	24.6(29.7)	61781	0.92
T_4 Stale seed bed technique + reduced spacing up to 25% +mulching with wheat straw + one hand pulling at 20DAS	940	35.3	4.2	20.0	0.53(4.1)	98820	1.38.
T_5 Mulching with local weed + hand pulling at 40DAS	740	46.8	5.7	32.0	21.3(27.4)	70896	1.11
T_6 Soil solarisation for 3weeks + hand weeding at 20DAS	670	38.3	4.9	26.6	28.8(32.4)	51483	0.73
T_7 ITK-Hand weeding at 20 DAS fb mulching	820	44.6	5.8	29.3	13.6(21.6)	79353	1.16
CD at 5%	38	8.18	1.15	9.01	2.70	6954	0.09
Value in parentheses is square root transformation							

Weed management practices in cauliflower: Significantly lower fresh dry weed weight (1.13 g/m²), weed density (13.3 number/ m²) and weed index (51.3%) of cauliflower was observed with T5 (Mulching with local weed + hand pulling at 40DAS) resulted in maximum yield of cauliflower curd (5810 kg/ha), net returns (72,400 Rs/ha) and B:C (1.04) of cauliflower followed by T2: One MW at 20 DAT+ one HW at 40 DAT (Table 7.11.1.2).

Table 7.11.1.2: Evaluation of weed management practices for *rabi* cauliflower under organic condition

Weed management practices	Yield (kg/ha)	Fresh weed weight40 DAS(g/m²)	Dry weed weight40 DAS(g/m²)	Weed density (number/m²)	Weed index (%)	Net returns Rs/ha	B:C
T_1 Hand weeding (Two) at 20 and 40 DAT	5080	20.2	2.08	24.0	52.6(46.5)	40327	0.50
T_2 One MW at 20 DAT+ one HW at 40 DAT	5560	17.0	1.62	21.3	61.6(52.0)	55367	0.67
T_3 Inter rows polyethylene mulching	4960	10.2	1.22	16.0	57.0(49.0)	29813	0.32
T_4 Stale seed bed technique+ reduced spacing + mulching + one hand weed pulling at 20DAT	5070	21.2	1.94	18.6	53.0(46.7)	49081	0.59
T_5 Mulching with local weed + hand pulling at 20DAT	5810	13.7	1.13	13.3	51.3(45.7)	72400	1.04
T_6 Soil solarization + hand weeding at 20DAT	5470	15.0	1.54	17.3	54.6(47.7)	32583	0.32
T_7 I TK- FYM Mulching at 10 DAT	2130	22.9	2.68	20.0	55.6(48.3)	55302	0.79
CD at 5%	285	7.77	0.67	NS	NS	7137	0.06

Weed management practices for summer squash: Seven treatments of weed management practice were evaluated for black gram crop under organic conditions. Significantly lower fresh weed weight (16.4 g/m²), dry weed weight (2.0 g/m²), weed density (17.3 number/ m²) and weed index (3.1%) of summer squash was observed with T_4 (Stale seed bed technique + reduced spacing up to 25% +mulching with wheat straw + one hand pulling at 20DAS) 40 days after sowing resulted in maximum yield of (13280 kg/ha), net returns (92,611 Rs/ha) and B:C (1.38) of summer squash followed by T_5 mulching with local + hand pulling at 40 DAT in term of yield, net return and B:C ratio (Table 7.11.1.3).

Table 7.11.1.3: Evaluation of weed management practices for *summer* squash under organic condition

Weed management practices	Yield (kg/ha)	Fresh weed weight40 DAS(g/m²)	Dry weed weight40 DAS(g/m²)	Weed density (number/m²)	Weed index (%)	Net returns Rs/ha	B:C
Hand weeding (Two) at 20 and 40 DAS	5250	20.7	2.5	18.6	52.8 (46.5)	2885	0.04
One Mechanical weeding at 20 DAT + one Hand weeding at 40 DAT	6100	16.9	2.2	17.3	49.2(44.5)	4500	0.06
Inter-cropping in squash with cow pea 1:1 fb *mulching with cowpea biomass* after 20DOS of cowpea	5650	20.8	2.4	21.3	52.2(46.2)	11714	0.178
Stale seed bed technique+ reduced spacing + mulching + one hand weed pulling 20DAT	13280	16.4	2.0	17.3	3.10(9.8)	92611	1.38
Mulching with local + hand pulling at 40 DAT	12000	30.0	3.7	28.0	7.2(15.5)	80489	1.27
Soil solarization + hand weeding at 20DAT	8720	18.7	2.2	20.0	29.6(32.9)	14303	0.15
ITK- FYM Mulching at 10 DAT	10350	18.6	2.30	25.3	16.5(23.9)	66097	1.04
CD at 5%	794	4.50	0.45	5.22	2.54	5865	0.08

Best weed management techniques under organic practice

Bhopal

Evaluation of weed management practices for maize-mustard production system under organic conditions:

Maize: Weed management practice under organic management in Vertisols for maize crop showed that grain yield (4313 kg/ha) was significantly higher with treatment T6- incorporation of cotton seed cake @ 5t/ha at 15 DAS + one hand weeding than all other however, treatment T1, T2, T3, T4 and T7 being on par to each other. T8: ITK treatment on weed control practiced by farmers (mulching with dried leaf of mango @ 5t/ha showed poor performance than rest of the treatments but was statistically on par with control i.e., T9 (Table 7.11.2.1).

Mustard: Mustard grain and total biomass yield were significantly influenced by weed management practices under organic production system. Incorporation of cotton seed cake + one hand weeding (treatment: T6) recorded significantly highest grain yield (1240 kg ha^{-1}) but it was at par with treatment T3: intercropping with chickpea treatment followed by two hand weeding at 25 and 50 DAS (T1), one mechanical weeding at 25 DAS + one hand weeding at 50 DAS (T2), compared to control (T9). However, the weed management practice weed mulch (water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS (T5) and mulching with dried leaf of mango @ 5 t/ha (T8) on par with control (T9). Biological yield of mustard follow the same trend (Table 7.11.2.1).

Table 7.11.2.1: Effect of different weed management practices on grain and biomass yield of maize and mustard under organic production system at Bhopal.

Weed management practice	Maize		Mustard	
	Seed Yield (kg /ha)	Total biomass yield (kg /ha)	Seed yield (kg /ha)	Total biomass yield (kg /ha)
T1 Hand weeding (Two) at 25 and 50 days after sowing	3367	7010	1135	4650
T2 One mechanical weeding at 25 days after sowing + One Hand weeding at 50 days after sowing	3288	6827	1078	4593
T3 Intercropping with Chickpea (1:1)	3660	7342	1208	4813
T4 Stale seed bed + reduced spacing (45 × 20 cm) + mulching with maize straw + one Hand weeding at 40 DAS	3167	6417	987	4310
T5 Locally available weed mulch (Water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS	2953	5883	905	3047
T6 Incorporation of cotton seed cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 40 DAS	4313	7883	1240	4947
T7 Soil solarization with 110 microns polythene mulch during summer + one hand weeding at 40 DAS	3067	6346	934	4180
T8 ITK treatment on weed control practiced by farmers (mulching with dried leaf of mango @ 5t/ha)	2817	5652	847	2787
T9 Control	2643	6253	833	2757
CD (P=0.05)	309	736	72	225

Weed population (weed dry weight (g / M^2)

All the weed management practices were effective in suppressing total weed density and dry matter as compared to weedy check. Minimum weed population and dry weight at 25 and 50 DAS were recorded under treatment two hand weeding (T1) followed by stale seed bed + reduced spacing (45 × 20 cm) + mulching with mustard straw + one hand weeding at 40 DAS (T4) and soil solarization with 110 microns polythene mulch during summer + one hand weeding at 40 DAS (T7). Treatment T2 having one mechanical weeding at 25 days after sowing + one hand weeding at 50 DAS was also found effective in reducing weed as compared to control (Table 7.11.2.2).

Weed control efficiency (WCE %)

Adoption of different weed management practices controlled the weed efficiency as evident from the weed control efficiency, which range from 15.8 to 94.1 per cent at 25 DAS, 12.5 to 95.2 per cent at 50 DAS during *kharif* and 32.3 to 95.1 per cent at 25 DAS, 28.5 to 95.7 per cent at 50 DAS, during *rabi*. Weed control efficiency (WCE) indicates the magnitude of effective reduction of weed dry weight by weed control treatments over un-weeded check. weed control efficiency was highly influenced by different weed control and recorded higher with two hand weeding at 25 and 50 DAS (T1) of 94.1 and 95.2 percent during *kharif* and 95.2 and 95.7 during *rabi* at 25 and 50 DAS respectively and it was at par with T4 (stale seed bed + reduced spacing (45 × 20 cm) + mulching with mustard straw + one Hand weeding at 40 DAS) followed by T7 (soil solarization with 110 microns polythene mulch during summer + one hand weeding at 40 DAS and T2 (One mechanical weeding at 25 days after sowing + One Hand weeding at 50 DAS) (Table 7.11.2.2).

Table 7.11.2.2: Weed control efficiency (WCE %) in *kharif* and *rabi* crops

Treatments	weed dry weight (g / M²) at 25 DAS		Weed Control Efficiency (%) at 25 DAS		weed dry weight (g / M²) at 50 DAS		Weed Control Efficiency (%) at 50 DAS	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
T1	24.0	27.0	94.1	95.1	13.0	20.0	95.2	95.7
T2	55.0	84.0	86.6	84.9	47.0	82.0	82.6	82.3
T3	64.0	92.0	84.4	83.4	43.0	86.0	84.1	81.5
T4	34.0	44.8	91.7	91.9	20.0	52.7	92.6	88.6
T5	131.2	128.0	68.0	76.9	46.5	111.8	82.8	75.9
T6	150.8	170.0	63.2	69.4	54.3	124.7	79.9	73.1
T7	46.3	52.0	88.7	90.6	36.1	63.0	86.6	86.4
T8	345.0	375.9	15.8	32.3	236.0	331.6	12.5	28.5
T9	409.9	555.0	0.0	0.0	269.7	463.9	0.0	0.0

Coimbatore

Adoption of stale seed bed technique with 25 per cent reduced spacing along with mulching of crop residues @ 5 t ha^{-1} registered higher fruit yield of 29700 kg ha^{-1} and net returns of Rs. 291700 ha^{-1}. The intercropping with cowpea and in situ incorporation on 45 DAS was very effective in suppressing weeds recorded higher weed control efficiency at critical crop-weed competition period and at later stages. Cost of cultivation was low in plots adopted with multi-varietal seed technique and in situ incorporation on 45 DAS (Table 7.11.3.1).

Table 7.11.3.1 Yield and economics of bhindi as influenced by weed management practices under organic production system at Coimbatore

Weed management practice	Organic Bhendi		
	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)
Incorporation of de-oiled neem cake @ 2.5 t ha^{-1} on 15 days before sowing + one HW on 45 DAS	14200	155500	57500
One HW on 20 DAS + Spraying per cent aqueous leaf extract of eucalyptus as POE on 30 DAS	16800	145985	106015
HW twice at 20& 45 DAS	18500	150920	126580
Locally available weeds as mulch @ 5 t ha^{-1} + HW on 45 DAS	18900	145520	137980
Inter cropping with cowpea and in situ incorporation on 45 DAS	19500	141200	151300
SSB technique + 25 per cent reduced spacing + mulching with crop residues @ 5 t ha^{-1}	29700	153800	291700
Multi-varietal seed technique and in situ incorporation on 45 DAS	121200	137470	44330
Deep ploughing and mulching with dried mango leaves @ 5 t ha^{-1} + one HW on 45 DAS	152300	148670	79780

Dharwad

Evaluation of weed management practices in maize under organic production system

Treatments

T1 :	Inter cultivation followed by hand weeding at 20 and 40 DAS
T2 :	Cover cropping with Cowpea (1:1) & mulching at 45 DAS
T3 :	Cover cropping with Sun hemp (1:1) & mulching at 45 DAS
T4 :	Cover cropping with Niger (1:1) & mulching at 45 DAS
T5 :	Cover cropping with *Navadhanya (1:1) & mulching at 45 DAS*
T6 :	Mulching with Glyricidia @ 5 t/ ha
T7 :	Mulching with Pongamea @ 5 t/ ha
T8 :	*Mulching with Maize stover @ 5 t/ha*
T9 :	Mulching with Cassia species @ 5 t/ ha
T10 :	Foliar spray of aqueous solution of P. juliflora @ 25% leaf extract at 20 & 40 DAS

Result

Data clearly indicated that the maize grain yield (3318 kg/ ha.) was higher in T1: IC followed by HW at 20 to 40 DAS and was on par with T10: foliar spray of aqueous solution of *Prosofis juliflora* @ 25% leaf extract at 20 and 40 days after sowing (3108 Kg/ha.), T3: cover crops with sun hemp and cowpea in 1:1 row along with mulching with maize stover @5t/ha respectively (3077 and 2920 Kg/ha.) but significantly differ by other treatments. Growth parameters of maize such as Plant height (cm), TDMP /plant (g), cob wt. /plant (g), grain wt. plant (g), 100-grains wt.(g) and dry weed wt. (g/sq.mt.) were also influenced significantly and recorded higher also with IC followed by HW at 20 to 40 DAS of 143.1 cm, 68.8 g, 19.90g, 18.10 g, 24.58g and 28. 6g respectively. It was also observed that weed control efficiency in maize crop was also higher with weed management practice T1 (IC followed by HW at 20 to 40 DAS) which is very effective in suppressing the weeds recorded higher weed control efficiency (83%) and foolowed by T4 (CC with Niger (1:1) & mulching at 45 DAS) of 77% (Table 7.11.4.1).

Cover crops grown and mulched after 45 DAS to control weeds in maize under organic production system at Dharwad

Intercropping of Maize + Sun hemp (1:1)

Intercropping of Maize + Niger (1:1)

Intercropping of Maize + Navadhanya (1:1)

Intercropping of Maize + Cowpea (1:1)

Table 7.11.4.1. Growth parameters of maize and dry weed weight and WCE as influenced by weed management practices under organic farming at Dharwad

Weed management practice		Plant height (cm)	TDMP / plant (g)	Cob wt. / plant (g)	Grain wt. plant (g)	100 grain wt.(g)	Dryweed wt. (g/sq. mt.)	Grain yield (Kg/ha)	Weed control efficiency
T1	IC followed by HW at 20 to 40 DAS	143.1	68.8	19.90	18.10	24.58	28. 6	3318	83
T2	CC with Cowpea (1:1) & mulching at 45 DAS	135.9	64.1	18.55	15.77	24.01	52.7	2846	69
T3	CC with Sun hemp (1:1) & mulching at 45 DAS	141.7	64.2	18.75	16.34	23.99	52.4	3077	69
T4	CC with Niger (1:1) & mulching at 45 DAS	111.6	52.1	14.71	11.38	21.93	38.6	2413	77
T5	*CC with Navadhanya (1:1) & mulching at 45 DAS*	132.1	55.7	15.51	13.89	22.47	43.4	2610	74
T6	Mulching with Glyricidia @ 5 t/ ha	118.9	52.7	14.26	12.41	22.38	104.9	2445	53
T7	Mulching with Pongamea @ 5 t/ ha	133.3	64.27	17.85	15.69	24.13	94.4	2839	64
T8	*Mulching with Maize stover @ 5 t/ha*	132.8	63.6	17.76	17.50	23.96	97.0	2920	58
T9	Mulching with Cassia species @ 5 t/ ha	128.9	56.2	17.02	15.14	22.18	119.5	2430	29
T10	Foliar spray of aqueous solution of P. juliflora @ 25% leaf extract at 20 & 40 DAS	136.3	63.8	17.78	15.84	24.08	96.4	3108	64
	CD (P=0.05)	10.54	5.38	2.28	2.42	1.93	22.12	592	

Crop residues/green leaf manure application @ 5t/ha after germination to control weeds in maize under organic production at Dharwad

Pongamea pinnate green leaf manure after 40 DAS

Maize stover crop residue after 40 DAS

Glyricidia sapium green leaf manure after 40 DAS

Cassia toria green leaf manure after 40 DAS

Jabalpur

Two Hand weeding at 25 and 50 DAS given in rice and garlic as weed control treatments gave more net return, more weed control efficiency and more B:C ratio while maximum productivity of rice and garlic was obtained under incorporation of 5 t/ha mustard oil cake in rice – garlic (both) in addition to nutrient supply as in other treatment. But incorporation of 5t/ha oil cake in rice and mustard was found uneconomical due to higher cost and gave B:C ratio 1.53 which was lower than two hand weeding given in rice and garlic (Table 7.11.5.1).

Table 7.11.5.1: Yield and economics of rice and garlic as influenced by weed management practices under organic condition

Weed management practice	Rice *(kharif)*Garlic *(rabi)*					
	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)
1. Two hand weeding 20 and 40 DAT	5963	57505	77647	10987	126826	147824
2. Cono weeder/Hoeing 20 DAT+ 1 HW at 40 DAT	4852	55731	54419	7390	103676	81074
3. Intercropping with Dhaincha in rice and mustard in Garlic (3:1)	3887	43427	45099	4323	76688	31387
4. Stale seed bed + reduced spacing upto 25% + mulching +one HW	4443	53964	46909	5637	102019	38906
5. Locally available weed mulch + one hand puling	4735	51253	56732	6162	91927	62073
6. Incorporation of mustard oil cake 15 days before sowing @ 5t/ha + one HW	5379	132180	-10457	14377	180471	178929
7. ITK treatment on weed control practices by farmers as mulching with leaf of mango	3420	46384	32990	5930	90724	57526

Karjat

Different weed management practices were evaluated in rice-groundnut system under organic management. Treatments using during *kharif* and *rabi* is given as under. Rice variety Karjat-9 and groundnut variety SB-11 were grown.

Treatments

Treatments	Weed management practice *(Kharif)*	Weed management practice *(Rabi)*
T1	Two hand weeding (HW) at 30 and 50 DAT	Two hand weeding (HW) at 25 and 50 DAS
T2	One mechanical weeding (cono–weeder-30 DAT) + one HW at 50 DAT	One mechanical weeding (Dry land weeder-20 DAS) + one HW at 30 DAS
T3	Inter cropping with green manure – *Sesbania rostrata* (TSR)	Inter cropping (1:1) with pulses –Cowpea var. *K. sadabahar*
T4	Reduced spacing (up to 25% -15x15 cm) + incorporation of previous crop residue + HW at 30 DAT	Stale seedbed + Reduced spacing (up to 25% - 20 x 15 cm) + mulching with previous crop residue + one HW at 30 DAS
T5	Locally available weed mulch (mix weed flora) + one hand pulling at 30 DAT	Locally available weed mulch + one hand pulling at 30 DAS
T6	Incorporation of neem cake 15 days before planting @ 5 t ha^{-1} + one HW at 40 DAT	Incorporation of neem cake 15 days before sowing @ 5 t ha^{-1} + one HW at 30DAS
T7	Soil solarization with 25-micron polythene mulch during summer + one HW at 30 DAT	Soil solarization with 8.25-micron polythene mulch during summer + one HW at 30 DAS
T8	ITK treatment on weed control practiced by farmer (mulching with mixed leaves)	ITK treatment on weed control practiced by farmer (mulching with mixed leaves)

Yield of rice and rabi-hot weather groundnut did not influence by different weed management practices under organic production system. Among the weed management practices in rice and rabi-hot weather groundnut, treatment T4: Reduced spacing (up to 25% -15x15 cm) + incorporation of previous crop residue + HW at 30 DAT during *kharif* and Stale seedbed + reduced spacing (up to 25% - 20 x 15 cm) + mulching with previous crop residue + one HW at 30 DAS during *rabi* recorded maximum yield of rice and groundnut of 4109 and 2651 kg/ha respectively followed by treatment T2 (One mechanical weeding (cono–weeder-30 DAT) + one HW at 50 DAT during *kharif* and One mechanical weeding (Dry land weeder-20 DAS) + one HW at 30 DAS during *rabi*) compare to other weed management practices. Systems equivalent yield, Net return and benefit cost ratio of the system recorded significantly higher also with T4 which is closely followed by T7 (Table7.11.6.1).

Dry matter of weeds (g m^2) of rice and groundnut of 18.52 and 14.77 g m^2 respectively recorded maximum in weed management practice T5 i.e., locally available weed mulch (mix weed flora) + one hand pulling at 30 DAT. Weed control efficiency in rice (64.83 %) recorded higher with weed management practice soil solarization with 25-micron polythene mulch during summer + one HW at 30 DAT (T7) whereas at 50 days it was found higher in treatment T4 (Reduced spacing (up to 25% -15x15 cm) + incorporation of previous crop residue + HW at 30 DAT). Likewise, Treatment T7 found to be most efficient for weed suppressing in ground nut crop of 85.87% (Table 7.11.6.2)

Table 7.11.6.1: Productivity and economics of rice as influenced by weed management practices under organic production system at Karjat

Treatments	Rice yield (kg/ha)		Ground nut yield (kg/ha		system equivalent yield (kg/ha)	Gross returns of the system (Rs. ha^{-1})	Net returns of the system (Rs. ha^{-1})	B:C ratio of the system
	Grain	Straw	Dry pods	Haulm				
T_1	3836	4328	2372	3182	20386	330267	167032	2.023
T_2	3977	4484	2519	3378	21669	351053	196418	2.27
T_3	3272	3713	1784	2398	15934	258137	106479	1.70
T_4	4109	4658	2651	3555	22610	366296	200391	2.20
T_5	2988	3392	1490	2156	13849	224361	-5859	0.97
T_6	3809	4320	2343	3143	20201	327260	163775	2.00
T_7	3696	4193	2225	2986	22527	364944	198409	2.19
T_8	3412	3872	1931	2594	16704	270619	109334	1.67
C.D. at 5%	NS	NS	NS	NS	5777	93595	93595	0.55

Table 7.11.6.2: Effect of weed management practices on dry matter production of weeds and WCE (%) of rice-groundnut crops

Tr. Symbol	Dry matter of weeds (gm^2)				Weed control efficiency			
	Rice		Groundnut		Rice		Groundnut	
	30 DAT	50 DAT	25 DAS	50 DAS	30 DAT	50 DAT	25 DAS	50 DAS
T_1	15.02	13.41	14.77	8.34	53.46	74.44	61.32	84.14
T_2	14.34	11.69	11.12	11.47	55.56	77.72	70.88	78.18
T_3	14.48	10.42	9.14	11.72	55.13	80.14	76.07	77.71
T_4	12.73	8.22	10.45	12.23	60.55	84.33	72.64	76.74
T_5	22.34	18.42	11.45	14.77	30.77	64.89	70.02	71.90
T_6	15.45	13.09	12.33	13.71	52.12	75.05	67.71	73.92
T_7	11.35	11.74	5.14	7.43	64.83	77.62	86.54	85.87
T_8	13.34	11.75	10.81	12.62	58.66	77.60	71.69	75.99
Unweeded control	32.27	52.46	48.19	72.57	—	—	—	—

The soil chemical properties measured after completing of cropping cycle did not influence significantly for soil pH, EC organic carbon, available N and K whereas, Available P_2O_5 recorded significant difference. Among the different weed management practices, maximum organic carbon content (1.13%), available N (241.6 Kg ha^{-1}), available P_2O_5 (19.36 Kg ha^{-1}) and available K_2O (394.2 Kg ha^{-1}) were observed under T6 (Incorporation of neem cake 15 days before planting @ 5 t ha^{-1} + one HW at 40 DAT) which was followed by T3 (Inter cropping (1:1) with pulses –Cowpea var. *K. sadabahar*). (Table 7.12.3.3).

Table 7.11.6.3: Chemical properties of soil after completion of crop cycle of rice-groundnut system

Treatment Symbol	Soil pH	Soil EC (dSm^{-1})	Organic carbon (%)	Available Nitrogen(Kg ha^{-1})	Available P_2O_5(Kg ha^{-1})	Available K_2O(Kg ha^{-1})
T_1	6.74	0.35	1.08	243.3	16.9	373.0
T_2	6.74	0.35	1.09	249.8	17.4	380.6
T_3	6.70	0.35	1.14	259.5	19.9	394.7
T_4	6.60	0.34	1.11	253.3	19.1	387.8
T_5	6.74	0.35	1.12	253.3	19.9	389.8
T_6	6.74	0.36	1.16	261.3	20.5	398.7
T_7	6.75	0.34	1.05	238.9	15.9	369.4
T_8	6.76	0.35	1.01	235.3	15.5	355.9
C. D. at 5 %	NS	NS	NS	NS	1.65	NS

Modipuram

Mustard: Among the different weed management practices, lowest weed density at 20 and 45 DAS was found under soil solarization with 25 µ polythene mulch during summer + one hand weeding at 40 DAS (T7). However highest weed density was recorded under Incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS (T6). No. of branches/plant,

Table 7.11.7.1: Effect of different weed management practices on weed density, yield and economics of maize under organic farming.

Weed management practice	Weed density(no./m^2)		COC (Rs./ha)	Net return (Rs./ha)	B:C ratio
	30 DAS	52 DAS			
T1 Hand weeding at 25 and 50 DAS	9.76 (94)	8.21 (67)	19,880	57,271	2.88
T2 One mechanical weeding at 25 days after sowing+ One Hand weeding at 50 DAS	9.85 (96)	8.82 (77)	17,880	63,825	3.57
T3 Intercropping with Green gram (1:1)	11.09 (122)	8.66 (74)	21,880	105,877	4.84
T4 Stale seed bed + reduced spacing (45×20 cm) + mulching with mustard straw + one Hand weeding at 40 DAS	9.90 (97)	9.22 (84)	24,060	36,363	1.51
T5 Locally available weed mulch (Water hyacinth 4 t/ha dwb) + one hand pulling at 40 DAS	10.31 (105)	9.40 (87)	18,880	74,769	3.96
T6 Incorporation of mustard seed meal 15 days before sowing @ 5t/ha + one hand weeding at 40 DAS	12.82 (164)	11.18 (124)	117,280	39,930	0.34
T7 Soil solarization with 25 µ polythene mulch during summer + one hand weeding at 40 DAS	9.71 (93)	9.91 (97)	37,080	44,940	1.21
T8 ITK for weed control (mulching with eucalyptus leaves @ 5t/ha dwb) and one hand weeding at 40 DAS	10.53 (110)	9.85 (96)	18,880	65,159	3.45

number of siliqua/plant and number of grains/siliqua was recorded highest under management practice T6 i.e. Incorporation of mustard oilcake @ 5t/ha + one hand weeding at 40 DAS. Similarly, highest seed yield (3460 kg/ha) and biological yield was recorded under weed management prctice T6 i.e. Incorporation of mustard oilcake @ 5t/ha + one hand weeding at 40 DAS followed by T3 i.e. Intercropping with chickpea (1:1) (3210 kg/ha). Application of mustard oilcake increased seed yield about 2 times as compared to hand weeding (T1) and mechanical weeding (T2). Application of mustard seed meal might have contributed to better crop nutrition over weed and led to better yield attributes and yield. Highest net returns and B:C ratio was reported under intercropping with chickpea (T3) followed by mulching with Water hyacinth 4 t/ha dwb + one hand weeding at 40 DAS (T5) Table 7.11.7.1.

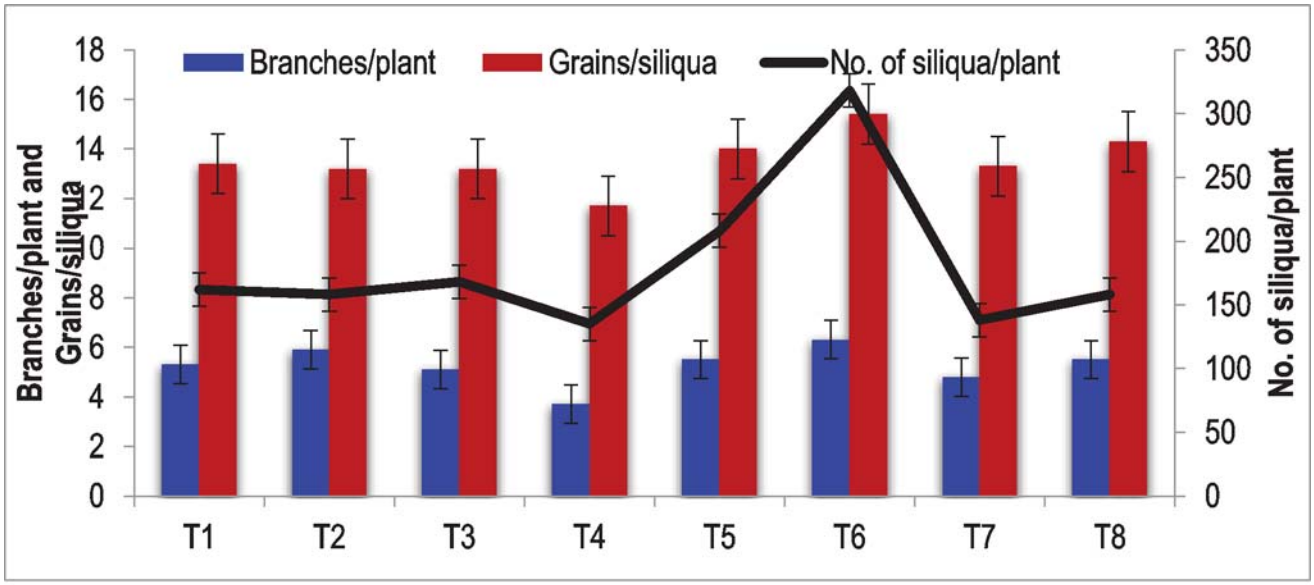
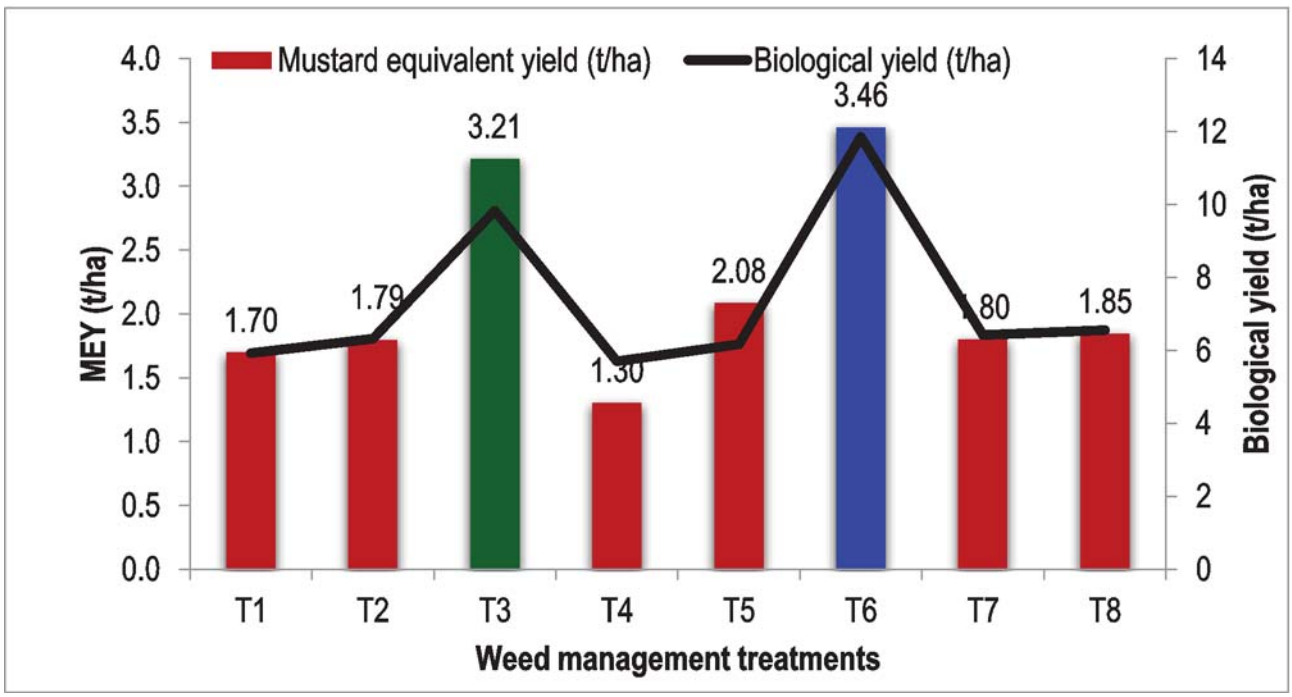
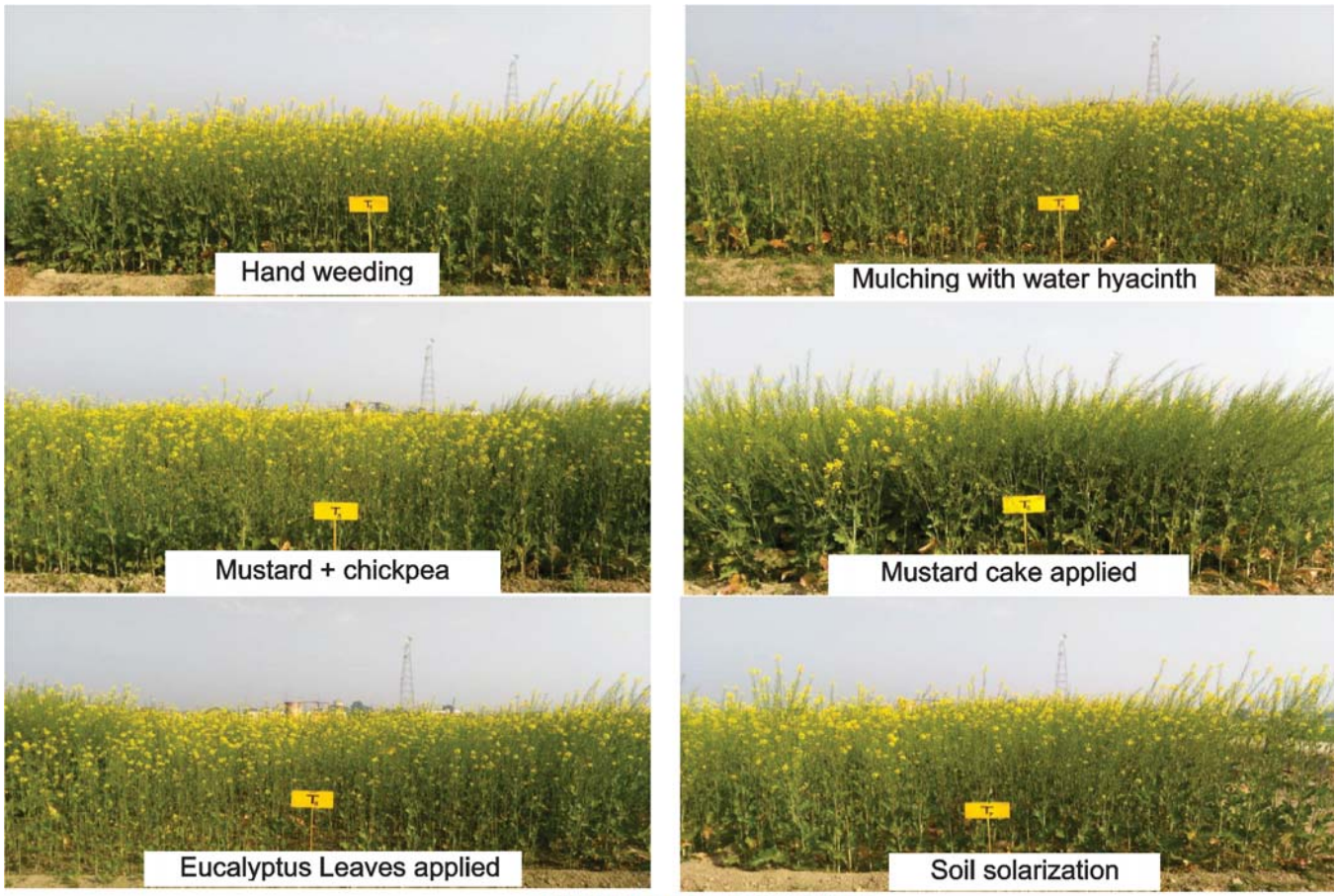
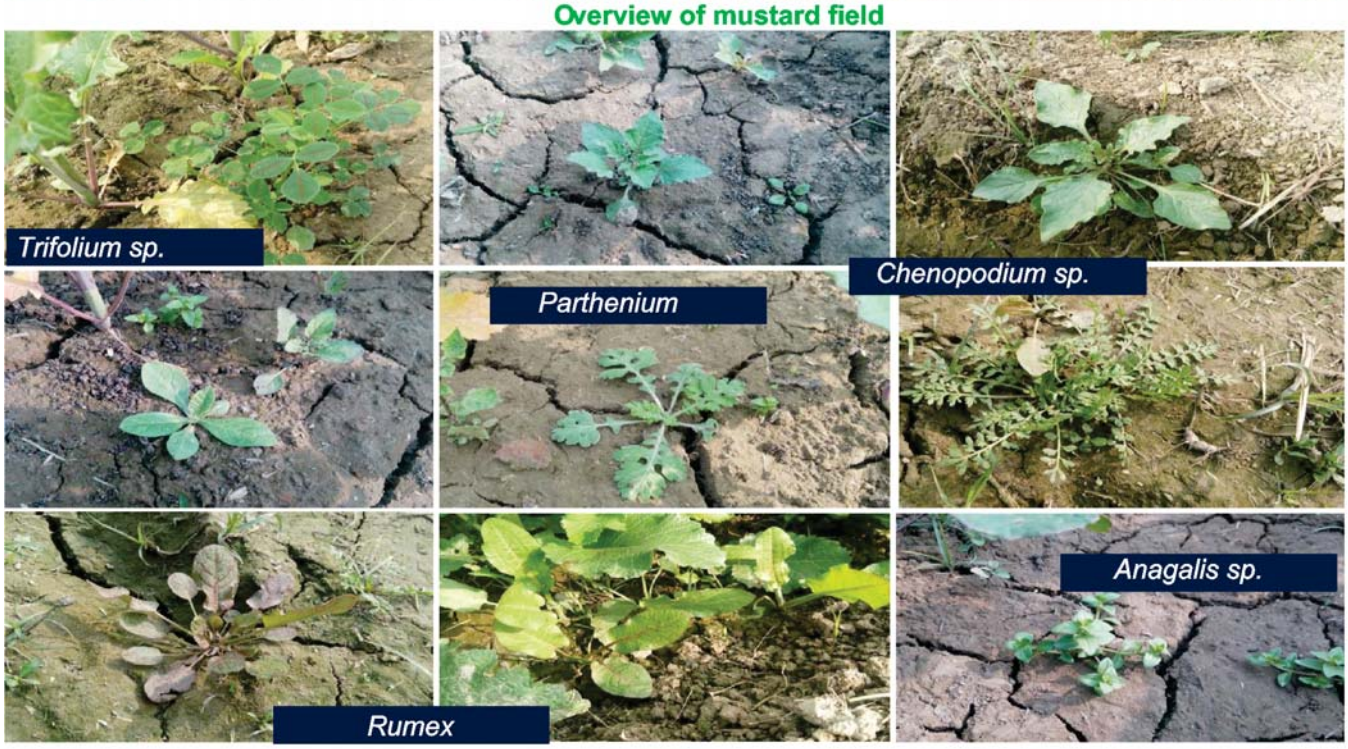


Figure: Yield attributes of mustard under different organic weed management treatments.





Overview of mustard field



Major Weed species found in mustard at Modipuram

Pant Nagar

Weed management practices were evaluated in rice-wheat system under organic production.

Yield and yield attributes of rice as influenced by different weed management practices: Significantly higher plant height (115 cm) was obtained with management practice T5: Sesbania + 2 MW over all other treatments which was on par with T3: DSR + Soybean + 1MW (30 -35 DAT). Effective tillers/m^2 (317) was found higher under T3: DSR + Soybean + 1MW (30 -35 DAT) followed by T5: Sesbania + 2 MW (one way). Grain weight/ panicle (1.29 g) was highest with T1: 2HW (20 & 40 DAT) and T4: Stale bed + 25% reduce spacing compared to all other weed management practices. 1000-grains weight (24.7g) was observed maximum with T8: Eucalyptus oil spray @ 5% which was on par with T1: 2HW (20 & 40 DAT), T3: DSR + Soybean + 1MW (30 -35 DAT) and T4: Stale bed + 25 % reduce spacing of 24.0 g respectively. Grain and straw yield of rice as influenced by of weed management practices differ significantly. The maximum, grain and straw yield (3882 and 4826 kg/ha) was recorded under T5: Sesbania + 2 MW (one way) which was on par with T7: Soil solarization + 1 HW and per cent increase was found 41% than the lowest of management practice T8: Eucalyptus oil spray @ 5% which recorded 3200 kg/ ha of grain yield. Harvest index was not significantly differed and found in range from 0.44 to 0.46. Economic analysis of cropping system managed under varying weed management practices revealed that highest net return (Rs. 90,201/ ha) was recorded in T5 (Sesbania + 2 MW) whereas B: C ratio (3.21) was found in weed management practice T4: Stale bed + 25 % reduce spacing (Table 7.11.8.1).

Weed count and dry weight in rice: Weed count (number/ m^2) and dry weight (g) in rice for different spices such as *Echinochloa colona, Eleusine indica, Molugo stricta, Cyperus iria, Cyperus rotundus* significantly influenced by different weed management practices (Table 7.11.8.2). Minimum count of *E. colona* (1.0 m^{-2}) was observed in T7 (Soil solarization + 1 HW) at 20 DAT while at 40 DAT it was minimum with T8 (Eucalyptus oil spray @ 5%) of 1.0 no./m^2. Although weed count of *Eleusine indica* (4.0 m^{-2}) was lowest with T1 (2HW at 20 & 40 DAT) and T2 (1 MW & 1HW at 20 & 40 DAT) but at 40 DAT it was minimum with T7: Soil solarization + 1 HW (7 nos./m^2). Weed count of *M. stricta* at 20 DAT observed minimum (1.0 m^{-2}) with management practice T2 (1 MW & 1HW at 20 & 40 DAT) while at 40 DAT it recorded minimum (9.0 m^{-2}) with management practice T1, T2 and T7. *Cyperus* iria found to be minimum (9 and 5 m^{-2}) with T7 (Soil solarization + 1 HW) at 20 and 40 DAT respectively. *C. rotundus* (5 and 11.0 m^{-2}) was recorded minimum in T5 (*Sesbania* + 2 MW) followed by T6 (NC @5 t/ha + 1 HW) weed management practices. Dry weight of weeds was significantly influenced by different weed management practices. Minimum dry weight (27.0 g/m^2) of weed at 20 DAT recorded in T5: Sesbania + 2 MW (one way) followed by T6 (NC @5 t/ha + 1 HW; 28.1 gm^{-2}) while at 40 days after transplanting treatment T6 recorded lowest weed dry weight of 25.4 gm^2.

Yield and yield attributes of wheat as influenced by different weed management practices: There was a non-significant variation in yield attributes and yield of wheat during *rabi* except plant height. Among the different weed management practices, maximum plant height (99 cm) was recorded in T3 (Wheat + Kas. methi. + 1MW at 30 -35 DAS) and T6 (NC @5 t/ha + 1 HW). Spike /m^2 (311) was recorded higher in treatment T4: (Stale bed + 25 % red. Spacing+ mulching+ 1 HP (30-45 DAS) and grain weight/ spike (1.28 g) in wheat was recorded higher inT5 (Bio-fuming mustard (30 DAS) + 1MW whereas, spikes/m^2. Test weight *i.e.*1000-grains weight (44.0g) was observed under T7 (1 manual weeding + 1 hand weeding) followed by T3 (Wheat + Kas. methi + 1MW (30 -35 DAS) and T4 (Stale bed + 25% reduce spacing) i.e. 43 g respectively. Yield, straw yield and harvest index of wheat did not influence significantly by different weed management practices. Maximum grain yield (3817 kg/ha) and straw yield (8321 kg/ha) was recorded in T5 (Bio-fuming mustard (30 DAS) + 1 MW) while minimum grain yield (3100 kg/ha) and straw yield (6956 kg/ha) was observed under T 8 (Eucalyptus oil spray@ 5%). Economics of different weed management practices revealed that maximum net return and B:C ratio was recorded in management practice T5 (Bio fuming mustard (30 DAS) + 1 MW) of Rs. 54, 329/ha and 1.66 respectively.

Weed count and dry weight in wheat: Weed count (number/m^2) at various growth stages in wheat was significantly influenced by different weed management practices for weed spices such as *Vicia sativa*, *Medicago denticulate, Melilotus indica, Chenopodium album, Rumax, Comopus Anagallis arvensis, Phalaris minor, Spergella, and Cyperus rotundus*. Minimum weed count of *Vicia sativa* (20 m^{-2}) at 50 DAS observed in T4 (Stale bed + 25 % red. Spacing+ mulching+ 1 HP (30-45 DAS). *Medicago denticulate* reported minimum (67 /m2) with T1 (2HW (30 & 50 DAS)) and T2(1 MW & 1HW (30 & 50 DAS) at the stage of 50 DAS. *Chenopodium album* was found lowest

Table 7.11.8.1: Yield attributes, yield and economics of rice (var. Pusa-1121) as influenced by different weed management practices under organic production system at Pantnagar

Weed management practice	Plant height (cm)	Effective tillers/m²	Grain wt./ panicle (g)	1000-grains wt. (g)	Grain yield (Kg/ha)	Straw yield (Kg/ha)	Harvest Index	Cost of cultivation (Rs./ha)	Net Return (Rs./ha)	B:C Ratio
T1: 2HW (20 & 40 DAT)	102	230	1.29	24.0	3328	4045	0.45	32790	71203	2.17
T2: 1 MW & 1HW (20 & 40 DAT)	100	208	1.09	20.1	3306	2479	0.44	29740	73559	2.47
T3: DSR + Soybean + 1MW (30 -35 DAT)	109	317	1.17	24.0	3517	4206	0.46	30010	79886	2.66
T4: Stale bed + 25 % reduce spacing	106	237	1.29	24.0	3183	4041	0.44	23640	75834	3.21
T5: Sesbania + 2 MW (one way)	115	257	1.20	23.1	3882	4826	0.44	31095	90201	2.90
T6: Neem-cake @5 t/ha + 1 HW	105	229	1.02	21.0	3238	3799	0.46	33190	67988	2.05
T7: Soil solarization + 1 HW	104	225	1.26	23.3	3580	4468	0.44	46995	64871	1.38
T8: Eucalyptus oil spray @ 5%	101	221	1.14	24.3	2757	3200	0.46	24395	61760	2.53
CD(p=0.05)	8.94	22.6	NS	1.46	329.0	NS	NS			

Table 7.11.8.2: Weed count (number/m²) and dry weight (g/m²) in rice at 40 DAS as influenced by different weed management practices under organic production system.

Weed management practice	*Echinochloa colona*		*Eleusine indica*		*Molugo stricta*		*Cyperus iria*		*Cyperus rotundus*		Others weed spp.		Weed dry weight (g)	
	20 DAT	40 DAT	20 DAT	40 DAT	20 DAT	40 DAT	20 DAT	40 DAT	20 DAT	40 DAT	20 DAT	40 DAT	20 DAT	40 DAT
T1: 2HW (20 & 40 DAT)	19.0	24.0	04.0	11.0	04.0	9.0	33.0	29.0	24.0	27.0	40.0	37.0	31.0	30.4
T2: 1 MW & 1HW (20 & 40 DAT)	22.0	33.0	04.0	13.0	01.0	9.0	32.0	35.0	43.0	41.0	28.0	31.0	33.4	31.4
T3: DSR + Soybean + 1MW (30 -35 DAT)	20.0	21.0	29.0	31.0	09.0	15.0	37.0	33.0	29.0	37.0	35.0	39.0	42.4	42.0
T4: Stale bed + 25 % reduce spacing	05.0	15.0	09.0	17.0	15.0	27.0	11.0	17.0	40.0	31.0	15.0	21.0	35.0	32.5
T5: Sesbania + 2 MW (one way)	35.0	20.0	29.0	16.0	11.0	16.0	09.0	12.0	05.0	11.0	33.0	20.0	27.0	28.6
T6: Neem-cake @5 t/ha + 1 HW	33.0	20.0	25.0	12.0	09.0	13.0	12.0	12.0	09.0	13.0	32.0	16.0	28.1	25.4
T7: Soil solarization + 1 HW	04.0	3.0	08.0	7.0	13.0	9.0	05.0	3.0	39.0	17.0	10.0	5.0	30.0	31.2
T8: Eucalyptus oil spray @ 5%	06.0	1.0	06.0	12.0	12.0	13.0	06.0	5.0	41.0	27.0	11.0	12.0	28.1	29.0
CD (P=0.05)	8.20	11.2	6.26	9.0	4.43	NS	6.4	11.6	8.52	11.3	7.4	15.6	5.01	3.63

Table 7.11.8.3: Growth, yield attributes and yield of wheat (Var. UP 2565) as influenced by different weed management practices under organic production system

Weed management practice	Plant height (cm)	Spikes /m²	Grain wt. spike (g)	1000-grains wt. (g)	Grain yield (Kg/ha)	Straw yield (Kg/ha)	Harvest Index	COC (Rs./ha)	Net Return (Rs./ha)	B:C Ratio
T1: 2HW (30 & 50 DAS)	89	305	1.20	42.4	3532	7825	0.45	41305	39265	0.95
T2: 1 MW & 1HW (30 & 50 DAS)	83	264	1.25	42.2	3160	7012	0.45	38255	33825	0.88
T3: Wheat + Kas. methi + 1MW (30 -35 DAS)	99	295	1.24	43.0	3346	7147	0.47	37155	39182	1.05
T4: Stale bed + 25 % red. Spacing+ mulching+ 1 HP (30-45 DAS)	89	311	1.09	43.0	3286	7119	0.47	38570	36388	0.94
T5: Bio fuming mustard (30 DAS) + 1 MW	96	263	1.28	41.0	3817	8321	0.46	32755	54329	1.66
T6: NC @5 t/ha + 1 HW	99	255	1.21	42.0	3506	7742	0.46	41610	38377	0.92
T7: 1 MW + 1 HW	92	269	1.24	44.0	3462	7343	0.47	37305	41668	1.12
T8: Eucalyptus oil spray@ 5%	88	260	1.19	42.1	3100	6956	0.44	34340	36371	1.06
CD (P=0.05)	9.62	NS	NS	NS	NS	NS	NS			

Table 7.11.8.4: Weed density (number/m²) in wheat at 50 DAS as influenced by different weed management practices under organic production system

Weed management practice	*Vicia sativa*		*Medicago denticulata*		*Melilota indica*		*C. album*		*Rumax*		*Comopus*		*Anagelis arvensis*		*Phalaris minor*		*Spergella*		*Cyprus Rotundus*		*Weed dry Wt. (g/m²)*	
	50 DAS	30 DAS	50 DAS	30 DAS	50 DAS	30 DAS	50 DAS	30 DAS	50 DAS	30 DAS	50 DAS	30 DAS	50 DAS	30 DAS	50 DAS	30 DAS	50 DAS	30 DAS	50 DAS	30 DAS	50 DAS	30 DAS	50 DAS
T1: 2HW (30 & 50 DAS)	39.0	40.0	67.0	16.0	27.0	39.0	16.0	7.0	5.0	16.0	23.0	25.0	28.0	7.0	0.0	0.0	6.0	5.0	11.0	9.3	18.4
T2: 1 MW & 1HW (30 & 50 DAS)	24.0	45.0	67.0	21.0	85.0	21.0	4.0	5.0	4.0	7.0	61.0	40.0	45.0	8.0	1.0	3.0	0.0	1.0	27.0	7.4	19.3
T3: Wheat + Kas. methi + 1MW (30-35 DAS)	23.0	39.0	85.0	23.0	40.0	9.0	7.0	3.0	0.0	0.0	11.0	37.0	29.0	5.0	1.0	0.0	1.0	7.0	7.0	11.0	19.0
T4: Stale bed + 25 % red. Spacing+ mulching+ 1 HP (30-45 DAS)	20.0	61.0	84.0	48.0	87.0	27.0	25.0	7.0	5.0	0.0	28.0	60.0	57.0	8.0	5.0	0.0	0.0	11.0	13.0	5.0	32.0
T5: Bio fuming mustard (30 DAS) + 1 MW	21.0	57.0	149.0	45.0	85.0	17.0	16.0	8.0	8.0	4.0	9.0	60.0	98.0	13.0	7.0	0.0	0.0	7.0	17.0	6.3	42.0
T6: NC @5 t/ha + 1 HW	24.0	75.0	97.0	39.0	53.0	4.0	0.0	3.0	0.0	9.0	9.0	87.0	65.0	5.0	1.0	1.0	1.0	8.0	20.0	10.3	24.1
T7: 1 MW + 1 HW	24.0	93.0	68.0	53.0	31.0	16.0	3.0	1.0	0.0	8.0	32.0	43.0	69.0	8.0	1.0	4.0	0.0	3.0	0.0	6.2	24.0
T8: Eucalyptus oil spray@ 5%	28.0	19.0	68.0	16.0	25.0	31.0	19.0	5.0	8.0	1.0	31.0	29.0	63.0	4.0	1.0	0.0	0.0	24.0	1.0	11.5	14.4
CD (P=0.05)	NS	NS	NS	NS	44.8	NS	NS	NS	NS	NS	NS	36.0	NS	NS	NS	NS	NS	NS	NS	NS	NS

with T6: NC @5 t/ha + 1 HW followed by T7 and T3 at 50 DAS. *Phalaris minor* was not seen in treatment T1: 2HW (30 & 50 DAS) at 50 DAS other spice *Anagelis arvensis* was also lowest in the same weed management practice i.e. T1 *Cyperus rotundus* at 50 DAS was observed minimum with T7 (1MW+1 HW) followed by T8 (Eucalyptus oil spray@ 5%) weed management practices (Table 7.11.8.4). Dry weight of weeds (g/m^2) at 30 and 50 DAS as influenced by different weed management practices was non-significant. Minimum dry weight (5.0 g/m2) of weed in wheat crop was recorded with T4: Stale bed + 25 % red. Spacing+ mulching+ 1 HP (30-45 DAS) at 30 DAS whereas, at 50 DAS it was lowest (14.4 g/m^2) of weed recorded with T8 (Eucalyptus oil spray@5%)

Raipur

Evaluation of weed management practices in sweet corn – tomato cropping system under organic production system

Treatments: Sweet corn (*kharif*)–Tomato (*Rabi*): Sweet corn variety Sugar-75 and Tomato variety Laxmi was used

Treatment symbol	Weed management Practices
T_1	Black plastic mulch @ 0.4q/ha
T_2	Paddy straw mulch @ 40 q/ha
T_3	Live mulch with cowpea (1:1) in sweet corn and coriander (1:1) in tomato
T_4	Live mulch with green gram (1:1) in sweet corn and spinach (1:1) in tomato
T_5	Motorized weeding twice at 20 & 40 DAS/DAT
T_6	Mechanical weeding (wheel hoe) twice
T_7	Mechanical weeding (wheel hoe) at 20 DAS and 1 hand weeding at 40 DAS/DAT
T_8	Hand weeding at 20 & 40 DAS/DAT
T_9	Weedy check

Effect of weed management practices yield attributes, yield and net return of sweet corn under organic production system (Table7.11.9.1):

Table: 7.11.9.1: Effect of different weed management practices on growth and yield of sweet corn under organic production system

Weed management practices	Plant height (cm)	Cob length (cm)	Cob weight (g)cob^{-1}	No. of rows cob^{-1}	No. of grains (kg ha^{-1})	Green Cob yield (Rs ha^{-1})	Net return	B:C ratio
T_1- Black plastic mulch @ 0.4q/ha	184.0	17.2	162.1	15.5	490.5	7600	1,04,400	2.22
T_2- Paddy straw mulch @ 40 q/ha	173.2	16.5	151.5	15.3	444.0	6800	1,22,385	3.57
T_3- Live mulch with cowpea (1:1)	166.6	12.3	88.6	14.0	342.5	3230	37,655	1.86
T_4- Live mulch with green gram (1:1)	167.8	13.7	102.7	14.3	353.3	4660	72,120	2.62
T_5- Motorized weeding twice at 20 & 40 DAS	167.5	13.7	110.0	14.5	357.8	5160	84,406	2.89
T_6- Mechanical weeding (wheel hoe) twice	167.8	14.2	118.6	14.5	380.0	5860	98,325	3.04
T_7- Mechanical weeding (wheel hoe) at 20 DAS and 1 hand weeding at 40 DAS	169.3	15.7	127.3	14.8	395.0	6200	1,04,175	3.05
T_8- Hand weeding at 20 & 40 DAS	172.6	16.3	145.3	15.2	432.3	7000	1,188,25	3.12
T_9- Weedy check	158.0	11.7	75.8	13.5	260.6	2200	12,350	1.29
CD (P=0.05)	1.9	0.5	8.4	0.3	58.9	0.95	-	-

Yield attributing characters and yield of sweet corn was affected significantly due to weed management practices. Among weed management practices, growth parameters such as plant height, cob length, cob weight, no. of rows/ cob and No. of grains/cob recorded higher with weed management practice T1 (Black plastic mulch @ 0.4q/ha) of 184.0 cm. 17.2 cm, 162.1 g, 15.5 g and 490.5g respectively. The next best performing practice for weed management was T2 which is paddy straw mulch @ 40 q/ ha. Similarly, significantly higher green cob yield (7600 kg/ha) were also recorded under black polythene mulch treatments i.e., T1 followed by paddy straw mulch and hand weeding twice (T8) over other weed management practices which gave 7000 kg/ha of green cob yield. All these weed management practices produced at par green cob yield of sweet corn. The lowest green cob yield ha^{-1} (2200 kg ha^{-1}) was recorded under weedy check (T9) and reduced the green cob yield to the tune of 71.05% over black plastic mulch (T1). However, the yield reduction due to different weed management treatment was to the tune of 7.8 to 57.50% over the highest yielding treatment. Adoption of paddy straw mulch@ 4 t/ha generated highest net returns (Rs. 1,22,385/ha) with maximum B: C ratio of 3.57 closely followed by hand weeding at 20 & 40 DAS and use of black polythene mulch.

Weed dry weight and weed control efficiency (Table7.11.9.2)**:** Among the weed management practices, application of Black Polythene Mulch resulted in lowest weed dry weight at different stages of crop. Adoption of hand weeding at 20 and 40 DAS (T2) was also recorded significantly minimum weed dry weight at 40 and 60 days after sowing. Weed control efficiency (100%) was higher in black plastic mulch @ 0.4 qha-1 followed by hand weeding twice at 20 &40 DAS and paddy straw mulch. (100, 82.7 and 79.3%) at 40 and 60 DAS respectively.

Table 7.11.9.2: Effect of different weed management practices on total weed dry weight and weed control efficiency in sweet corn under organic production system

Weed management practices	Total weed dry weight (gm^{-2})		Weed control efficiency (%)	
	40 DAS	60 DAS	40 DAS	60 DAS
T_1- Black plastic mulch @ 0.4q/ha	0.71	0.71	100	100
T_2- Paddy straw mulch @ 40 q/ha	3.74	4.37	79.3	83.1
T_3- Live mulch with cowpea (1:1)	6.06	7.75	44.5	27.8
T_4- Live mulch with green gram (1:1)	5.81	7.5	48.8	31.2
T_5- Motorized weeding twice at 20 & 40 DAS	4.96	5.47	63.1	73.3
T_6-Mechanical weeding (wheel hoe) twice	4.68	5.27	65.5	75.2
T_7-Mechanical weeding (wheel hoe) at 20 DAS and 1 hand weeding at 40 DAS	4.89	4.05	64.1	85.6
T_8- Hand weeding at 20 & 40 DAS	3.43	2.99	82.7	92.3
T_9- Weedy check	8.10	10.52	-	-
CD (P=0.05)	0.45	0.72	-	-

Effect of weed management practices on growth and yield of tomato under organic production system (Table 7.11.9.3)

Effect of different weed management practices on growth and yield of tomato under organic production system showed significant effect. The maximum plant (76.9 cm) was observed under Black plastic mulch @ 0.4 q/ha which was on par with straw mulch @ 40 q/ha but significantly higher than other. Significantly higher number of fruits $plant^{-1}$ and fruit weight (51.0 and 47.2 g respectively) was achieved also with management practice T1 (Black plastic mulch @0.4 q ha^{-1}) which was comparable with straw mulch @ 40 q/ha (46.9 and 46.7 g respectively). The lowest number of fruits/plant and fruit weight $plant^{-1}$ was produced under weedy check. Among the different management practices, Block plastic mulch followed by paddy straw mulch resulted in significantly higher fruit yield of tomato (27817 and 25792 kg/ha respectively) and being at par to each other. Both the treatments were superior to other weed management practices. The lowest fruit yield was obtained under weedy check (5250 kg/ha).

Economics of tomato as influenced by weed management practices showed that maximum net return was achieved under paddy straw mulch @ 40 q/ha (Rs 1,99,602) with

highest B: C ratio (4.42). black plastic mulch @ 40 q/ha was the next best treatment and gave net return of Rs 1,81,867 /ha but the B: C ratio was low as 2.89 due to higher cost of cultivation.

Table 7.11.9.3 Effect of different weed management practices on growth and yield of tomato under organic production system

Weed management practices	Plant height (cm)	No. of fruits/ plant	Fruit weight (g)	Fruit yield (kg/ha)	Cost of cultivation (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
Black plastic mulch @ 0.4q/ha	76.9	51.0	47.2	27817	96300	181867	2.89
Paddy straw mulch @ 40 q/ha	69.7	46.9	46.7	25792	58315	199602	4.42
Live mulch with coriander (1:1)	60.7	26.1	35.3	12992	55105	74812	2.36
Live mulch with spinach (1:1)	67.5	28.3	35.8	13950	55105	84395	2.53
Motorized weeding twice at 20 & 40 DAT	56.8	33.2	36.5	15217	55319	96848	2.75
Mechanical weeding (wheel hoe) twice	65.2	35.8	39.6	16983	58850	110983	2.89
Mechanical weeding (wheel hoe) at 20 DAT and 1 hand weeding at 40 DAT	61.2	34.5	39.6	16833	61525	106808	2.74
Hand weeding at 20 & 40 DAT	57.8	43.6	42.5	20825	66875	141375	3.11
Weedy check	59.5	15.7	22.0	5250	53500	-1000	0.98
CD (P=0.05)	6.79	6.84	4.53	3591			

Weed dry weight and weed control efficiency as influenced by weed management practices in tomato (Table 7.11.9.4)**:** Weed dry weight in organically grown tomato crop was affected significantly due to weed management practices. Significantly lower weed dry weight was recorded under Black plastic mulch @ 40 q ha-1 at both the crop stages of 40 and 60 DAT. Similar trend was observed with weed control efficiency which was maximum in Black plastic mulch @ 40 q ha-1 (100%) followed by paddy straw mulch (92.92 and 89.34 % at 40 and 60 DAT respectively).

Table7.11.9.4: Effect of different weed management practices on total weed dry weight and weed control efficiency in tomato under organic production system

Weed management practices	Total weed dry weight (gm^{-2})		Weed control efficiency (%)	
	40 DAS	60 DAS	40 DAS	60 DAS
Black plastic mulch @ 0.4q/ha	0.00	0.00	100.00	100.00
Paddy straw mulch @ 40 q/ha	5.23	18.30	92.92	89.34
Live mulch with coriander (1:1)	33.82	84.84	54.20	50.60
Live mulch with spinach (1:1)	53.37	69.28	27.73	59.66
Motorized weeding twice at 20 & 40 DAT	15.77	7.18	78.65	95.82
Mechanical weeding (wheel hoe) twice	13.60	12.87	81.58	92.51
Mechanical weeding (wheel hoe) at 20 DAS and 1 hand weeding at 40 DAT	17.17	6.04	76.75	96.48
Hand weeding at 20 & 40 DAT	9.24	5.94	87.49	96.54
Weedy check	73.85	171.74	-	-
CD (P=0.05)	13.74	13.38	-	-

Ranchi

Evaluation of weed management practices in rice- wheat system under organic production system

Treatments

Treatments Symbols	Rice (Direct seeded), variety Birsamati	Wheat (K-9107)
T_1	Hand weeding (Two) at 25 and 50 DAS	Hand weeding (Two) at 25 and 50 DAS
T_2	One mechanical weeding at 25 DAS+ One Hand weeding at 50 DAS	One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS
T_3	Intercropping with Dhaincha (broadcasting @50 kg/ha)	Intercropping of wheat + lentil intercropping
T_4	Stale seed bed + 25% higher seed rate + mulching with wheat straw + one Hand weeding at 25 DAS	Stale seed bed + 25% higher seed rate + mulching with rice straw + one Hand weeding at 25 DAS
T_5	Locally available weed mulch + one hand pulling at 25 DAS	Locally available weed mulch + one hand pulling at 25 DAS
T_6	Incorporation of karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	Incorporation of karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS
T_7	Soil solarization with 8-25 microns polythene mulch during summer + one hand weeding +25 DAS	Soil solarization with 8-25 microns polythene mulch during summer + one hand weeding at 25 DAS
T_8	ITK treatment mulching with Karanj leaves etc.	ITK treatment mulching with Karanj leaves etc.
T_9	Without weed control	Without weed control

Yield and yield attributing characters of rice crop under different weed management practices in rice wheat cropping system

Yield and yield attributing character of rice was significantly higher under hand weeding (two) at 25 and 50 DAS (T1) followed by one mechanical weeding at 25 DAS+ one hand weeding at 50 DAS (T2) followed by intercropping with *dhaincha* (broadcasting @50 kg/ha /intercropping of wheat

Table 7.11.10.1: Yield and yield attributing characters of rice crop under different weed management practices

Weed management practices	Effective tillers/m^2	Panicle length (cm)	Filled grain/ panicle	1000-grains wt. (g)	Rice yield (kg/ha)
T1-Hand weeding (Two) at 25 and 50 DAS	270	17.5	80	20.79	2917
T2- One mechanical weeding at 25 DAS + One Handweeding at 50 DAS	263	16.5	73	19.94	2610
T3-Incorporation with Dhaincha (broadcasting @50 kg/ha)	267	16.8	77	20.70	2709
T4-Stale seed bed + 25% higher seed rate+ mulching with wheat straw + one hand weeding at 25DAS	243	16.2	72	20.28	2217
T5-Locally available weed mulch + one hand pulling at 25 DAS	198	15.4	60	19.65	1671
T6-Incorporation of Karanj cake 15 days before planting/ sowing @ 5t/ha + one hand weeding at 25 DAS	205	15.5	63	19.90	1742
T7-Soil solarization with 8–25-micron polythene mulch during summer + one hand weeding + 25 DAS	240	15.9	68	20.25	2146
T8-ITK treatment mulching with Karanj leaves etc	137	14.7	57	19.52	1029
T9-Weedy check	121	14.1	52	19.22	883
CD (P=0.05 %)	21.3	1.4	9.5	NS	9.9

+ lentil intercropping (T3) and stale seed bed + 25% higher seed rate + mulching with wheat straw + one hand weeding at 25 DAS (T4). Maximum grain yield of rice (2917 kg/ha) was obtained with 2 hand weeding at 25 & 50DAS (T1) which was significantly superior over all the weed management practices except T2 of 2709 kg/ha (intercropping with *dhaincha* (broadcasting @50 kg/ha) which was on par with each other. Length of panicle filled grain/panicle and 1000 grain wt. were produced higher under hand weeding (two) at 25 and 50 DAS followed by One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS, Incorporation with Dhaincha (broadcasting @50 kg/ha) and Stale seed bed + 25% higher seed rate+ mulching with wheat straw + one hand weeding at 25 DAS.

Yield and yield attributing characters of wheat crop under different weed management practices in rice wheat cropping system.

Wheat (7.12.8.2)**:** Yield and yield attributing characters of wheat significantly affected by weed management practices. Maximum number of spike/m^2 (282) was obtained in stale seed bed + 25% higher seed rate+ mulching with wheat straw + one hand weeding at 25DAS (T4) which was significantly superior over rest of the weed management practices except hand weeding (Two) at 25 and 50 DAS (275 /m2) (T1) and one mechanical weeding at 25 DAS + one hand weeding at 50 DAS (273 /m2) (T2). Maximum spike length, grains /spike, 1000-grains wt. recorded highest in hand weeding (Two) at 25 and 50 DAS (T1) which was significantly superior over rest of the weed management practices except one mechanical weeding at 25 DAS + one Hand weeding at 50 DAS (T2).

Table 7.11.10.2: Yield and yield attributing characters of wheat crop under different weed management

Weed management practices	No. of spike/m^2	Spike length (cm)	No. of grains/spike	1000-grains wt. (g)	Wheat yield (kg/ha)
T1-Hand weeding (Two) at 25 and 50 DAS	275	8.33	34	44.10	2238
T2- One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS	273	7.73	33	43.04	2031
T3-Incorporation with Dhaincha (broadcasting @50 kg/ha)	243	6.43	29	42.70	1700
T4-Stale seed bed + 25% higher seed rate+ mulching with wheat straw + one hand weeding at 25DAS	282	6.43	30	42.34	1912
T5-Locally available weed mulch + one hand pulling at 25 DAS	203	6.07	28	42.54	1529
T6-Incorporation of Karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	199	5.87	27	42.00	1408
T7-Soil solarization with 8–25-micron polythene mulch during summer + one hand weeding + 25 DAS	248	6.60	29	42.87	1815
T8-ITK treatment mulching with Karanj leaves etc	144	5.10	24	41.89	1240
T9-Weedy check	125	4.83	22	41.40	910
CD (P=0.05 %)	29.9	1.02	4.42	2.09	229

Dry matter accumulation of weeds in both the season *kharif* and *rabi* at 20 days to 40 days as influenced by weed management practices increased with advancement of crop age. Significantly minimum dry weight of weeds per unit area among different weed management practices in rice and wheat was recorded in T1: Hand weeding (Two) at 25 and 50 DAS followed by T2- One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS.

Table 7.11.10.3: Dry matter accumulation of weeds (g/m2) in rice-wheat cropping system under different weed management practices.

Weed management practices	Kharif		Rabi	
	Weed dry wt.(g/m^2) 25 DAT	Weed dry wt.(g/m^2) 40 DAT	Weed dry wt.(g/m^2) 25 DAT	Weed dry wt.(g/m^2) 40 DAT
T1-Hand weeding (Two) at 25 and 50 DAS	19.69	27.32	9.11	17.27
T2- One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS	24.16	31.54	11.20	26.20
T3-Incorporation with Dhaincha (broadcasting @50 kg/ha)	22.08	31.02	15.27	29.30
T4-Stale seed bed + 25% higher seed rate+ mulching with wheat straw + one hand weeding at 25DAS	26.40	33.43	14.33	23.39
T5-Locally available weed mulch + one hand pulling at 25 DAS	32.61	38.05	16.16	30.37
T6-Incorporation of Karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	29.96	37.78	17.05	31.56
T7-Soil solarization with 8–25-micron polythene mulch during summer + one hand weeding + 25 DAS	27.48	34.97	13.85	27.22
T8-ITK treatment mulching with Karanj leaves etc	35.29	40.39	22.21	34.26
T9-Weedy check	39.49	45.74	24.46	38.52
CD (P=0.05 %)	3.61	3.48	2.34	3.80

Soil nutrient status in rice-wheat cropping system under different weed management practices (Table 7.11.10.4): There was improvement in soil pH, OC, available N and P in all weed management practices from its initial values but in case of available K, the values in all weed management practices from its initial values found to be lower. However, weedy check plot recorded the least buildup in soil nutrient status i.e., soil pH, and OC.

Table 7.11.10.4: Soil nutrient status under different weed management practices in rice-wheat cropping system at the end of cropping cycle.

Weed management practices	pH	Organ carbon (%)	Available N(kg/ha)	Available P(kg/ha)	Available K(kg/ha)
Hand weeding (Two) at 25 and 50 DAS	6.11	0.64	236.70	28.45	123.45
One mechanical weeding at 25 DAS+ One Hand weeding at 50 DAS	6.00	0.62	243.83	31.41	124.12
Intercropping with Dhaincha (broadcasting @50 kg/ha) /Intercropping of wheat + lentil intercropping	5.96	0.60	247.89	33.48	131.35
Stale seed bed + 25% higher seed rate + mulching with wheat straw + one Hand weeding at 25 DAS	5.98	0.61	246.89	32.82	127.41
Locally available weed mulch + one hand pulling at 25 DAS	5.96	0.60	247.66	33.18	130.33
Incorporation of karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	5.89	0.57	253.60	34.58	137.25
Soil solarization with 8-25 microns polythene mulch during summer + one hand weeding +25 DAS	5.92	0.59	252.93	34.03	136.42
ITK treatment mulching with Karanj leaves etc.	5.87	0.56	257.15	35.59	146.64
Weedy check	5.84	0.53	261.00	36.75	148.68
CD (P=0.05)	0.29	0.05	8.00	2.13	2.97
Initial	5.85	0.54	236.34	25.95	162.56

System productivity and profitability (Table 7.11.10.5)**:** System productivity of rice weed system influenced by different weed management practices. Among management practices, hand weeding (two) at 25 and 50 DAS (T1) recorded maximum system productivity (52.70 q/ha) in term of rice equivalent which was statistically at par with one mechanical weeding at 25 DAS + one Hand weeding (T2) at 50 DAS (47.46 q/ha) but significantly differ from other. Treatment T1 (Hand weeding (Two) at 25 and 50 DAS) also recorded significantly highest net returns (48781 Rs/ha) which was superior to rest of the treatments among the weed management practices. B: C ratio (0.81) was recorded highest in T1 (Hand weeding (Two) at 25 and 50 DAS) and treatment T3: Incorporation with Dhaincha (broadcasting @50 kg/ha) in kharif/ intercropping with lentil (@40kg/ha). The lowest net return and B: C ratio was obtained in treatment T9.

Table 7.11.10.5: System productivity, net return and B: C ratio of rice-wheat cropping system under different weed management practices

Rice (Direct seeded)	System	*Kharif*		*Rabi*		System	
	productivity (kg/ha)	Net returns (Rs./ha)	B:C ratio	Net returns (Rs./ha)	B:C ratio	Net returns (Rs./ha)	B:C ratio
T1-Hand weeding (Two) at 25 and 50 DAS	5270	34289	1.14	14491	0.48	48781	0.81
T2- One mechanical weeding at 25 DAS + One Hand weeding at 50 DAS	4746	29771	1.05	11959	0.41	41730	0.73
T3-Incorporation with Dhaincha (broadcasting @50 kg/ha) in kharif/ intercropping with lentil (@40kg/ha)	4496	33681	1.27	8652	0.34	42333	0.81
T4-Stale seed bed + 25% higher seed rate + mulching with wheat straw + one hand weeding at 25DAS	4228	20863	0.73	10318	0.36	31181	0.55
T5-Locally available weed mulch + one hand pulling at 25 DAS	3279	10092	0.36	1547	0.19	15080	0.28
T6-Incorporation of Karanj cake 15 days before planting/sowing @ 5t/ha + one hand weeding at 25 DAS	3223	-17741	-0.31	-30407	-0.52	-48148	-0.42
T7-Soil solarization with 8–25-micron polythene mulch during summer + one hand weeding + 25 DAS	4055	19867	0.71	7688	0.27	27554	0.48
T8-ITK treatment mulching with Karanj leaves etc.	2334	-4184	-0.15	-2207	-0.04	-5273	-0.10
T9-Weedy check	1840	-4424	-0.18	-6681	-0.26	-11105	-0.22
CD (P=0.05)	549	2415	0.11	366	0.02	2874	0.06

Umiam (Table 7.11.11.1)

Among different weed management practices in maize, intercropping with soybean followed by soil solarization + one hand weeding recorded relatively higher maize grain yield of maize (4930 kg/ha) as compared to other weed control treatments. As the maximum temperature of the experiment area (Umiam centre) does not go beyond 32-33 degrees in general, soil solarization could not give desired results as expected. Maize intercropping with soybean also recorded the highest net returns due to higher maize yield owing sparing of fixed N from atmosphere from associated soybean, maize equivalent yield and less weed problem. Incorporation of neem cake @ 5t/ha + one hand weeding recorded negative income (-Rs. 61,000/ha) due to high market price of neem cake (Rs. 20/kg).

Table 7.11.11.1: Weed management practices under organic production system

Weed management practices	Yield (kg/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)
Hand weeding	4280	34500	29700
One mechanical weeding +one hand weeding	3990	38600	21250
Intercropping with soybean	4930	35800	38150
Stale seed bed+ reduced spacing (upto 25%) +mulching with previous crop residues+ one hand weeding	4150	42970	19280
Locally available weed mulch+one hand pulling	4370	38500	27050
Incorporation of neem cake @ 5t/ha+one hand weeding	4580	129700	-61000
Soil solarization +one hand weeding	4110	43200	18450
ITK treatment on weed control practiced by farmers	3680	35050	20150
CD (*p*=0.05)	-	-	-

Udaipur (Table 7.11.12.1 to 7.11.12.7)

Weed flora and Weed density: The major broadleaf weeds in the experimental fields were *Digera arvenris* (kalinjra), *Trianthema partulacastrum* (patharchata), *Physalis minima* (Popati) and *Commehina bengalensis* (bokna). The grassy weeds were *Echinochloa colona* (jungle rice), *Dinebra retroflexa* (viper grass) and *Setaria glauca* (Foxtail). Weed density recorded at 30 & 60 DAS and at harvest of sweet corn was significantly influenced by organic weed management practices. Weed density of monocots and dicot were recorded significantly lower in plastic mulch either with summer ploughing, sowing after stale seed bed preparation or soil solarization. All these treatments of plastic mulch were at par and significantly superior over other treatments like soil solarization with one hand weeding either with or without straw mulch (5 t/ha), sesbania as smothering crop with hand weeding or pre-emergence application of herbicide with straw mulch (5 t/ha), summer ploughing and stale seed bed with one hand weeding at 20 DAS.

Weed dry matter: Weed dry matter recorded at 30 DAS and 60 DAS was significantly influenced by organic weed management practices. All the three treatments of plastic mulch either with soil solarization, summer ploughing and stale seed bed techniques proved equally effective in reduction of weed dry matter. Plastic mulch in different combinations proved most effective and recorded 95-100 % per cent reduction in total weed dry matter at 60 DAS and at harvest, in comparison to weedy check.

Yield attributes yield and economics: Growth and yield attributes of fennel was significantly affected by organic weed management practices. Among various organic weed management treatments, maximum number of cobs per plant (1.47) and grain weight per cob (97.85 g) were recorded with soil solarization with plastic mulch, results of all these attributes were found at par with summer ploughing + plastic mulch, stale seed bed preparation + plastic mulch. These three treatments of plastic mulch at sowing with different agronomic practices were found significantly superior over other treatments of experiment.

Among different organic weed management treatments, maximum values of seed yield (4110 kg/ha) of sweet corn were recorded with crop sown with treatment of stale seed bed with plastic mulch, which was at par with plastic mulch with soil solarization + plastic mulch and summer ploughing + plastic mulch. Application of plastic mulch with stale seed bed, summer ploughing, and soil solarization recorded 211.36, 205.30 and 200% respectively, increase in yield over weedy check (1320 kgha). A similar trend of superiority of plastic mulch with different agronomic practices was observed in straw yield of sweet corn. Among organic weed management practices, highest net return (Rs. 62,746/ha) and B: C ratio (1.62) was recorded with stale seed bed with plastic mulch.

Table 7.11.12.1: Effect of organic weed management practices on weed density at 30 DAS of *kharif* sweet corn at Udaipur

Treatment	Weed density (No./m²)								
	Echinochloa colona	*Digera arvensis*	*Triantema portulacastrum*	*Commelina benghalensis*	*Physilis minima*	*Setaria gluca*	*Dinebra retroflexa*	*Chloris barbata*	*Dactylectunum aegypticum*
Summer ploughing + 1 hand weeding at 20 DAS	3.62 (12.58)	1.93 (3.21)	2.69 (6.73)	2.10 (4.02)	1.78 (2.67)	1.97 (3.40)	1.36 (0.67)	1.67 (2.30)	1.83 (2.86)
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	2.81 (7.41)	1.75 (2.57)	2.17 (4.25)	1.31 (1.32)	1.94 (3.32)	1.72 (2.45)	1.59 (1.39)	1.26 (1.09)	1.78 (2.65)
Summer ploughing + plastic mulch at sowing	1.25 (1.09)	1.19 (0.96)	1.41 (1.67)	2.67 (6.63)	1.56 (1.98)	1.08 (0.68)	1.08 (0.71)	1.04 (0.59)	1.08 (0.67)
Stale seed bed preparation + 1 Hand Weeding at 20DAS	3.39 (11.02)	1.94 (3.28)	2.53 (5.92)	2.18 (4.30)	1.87 (2.98)	1.62 (2.14)	1.37 (0.95)	1.30 (1.19)	1.62 (2.14)
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	3.09 (9.04)	1.76 (2.59)	2.01 (3.54)	1.34 (1.32)	2.02 (3.66)	1.69 (2.35)	1.10 (2.54)	1.58 (1.99)	1.42 (1.53)
Stale seed bed preparation + plastic mulch at sowing	1.27 (1.33)	1.22 (0.99)	0.99 (0.54)	2.61 (6.30)	1.48 (1.82)	1.22 (1.03)	1.19 (1.830	1.45 (1.62)	1.09 (0.68)
Soil solarization + 1 hand weeding	3.35 (10.71)	1.84 (2.89)	2.28 (4.69)	2.48 (5.63)	2.27 (4.68)	1.91 (3.16)	1.74 (0.27)	1.71 (2.66)	1.63 (2.14)
Soil solarization + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	2.85 (7.68)	1.58 (1.99)	2.01 (3.54)	1.67 (2.33)	2.27 (4.67)	1.63 (2.14)	1.52 (0.67)	2.01 (3.60)	1.56 (1.94)
Soil solarization + plastic mulch at sowing	0.92 (0.34)	1.22 (0.99)	1.15 (0.82)	2.64 (6.46)	1.01 (0.54)	1.23 (1.02)	0.88 (0.68)	0.89 (0.30)	1.03 (0.57)
Sesbania as smothering crop in between rows and used same Sesbaina as mulch after 30 days + 1 HW at 40 DAS	3.03 (8.67)	2.15 (4.17)	2.45 (5.51)	2.19 (4.31)	1.92 (3.18)	1.76 (2.60)	1.08 (4.39)	1.51 (1.79)	1.83 (2.87)
Pendimethalin 1000 ml /atrazine500g fb straw mulching (5 t/ha) at 20 DAS	2.65 (6.53)	1.22 (0.99)	1.66 (2.24)	3.57 (12.27)	2.34 (4.97)	1.09 (0.68)	1.08 (0.12)	1.55 (2.00)	1.31 (1.22)
Weedy check	5.75 (32.64)	2.83 (7.50)	3.70 (13.26)	3.58 (12.33)	2.34 (5.00)	2.41 (5.30)	2.21 (0.35)	2.25 (4.58)	2.09 (3.88)
LSD (P= 0.05%)	7.80	5.87	10.46	8.75	11.40	5.30	6.28	13.82	5.39

Data subjected to $\sqrt{x+0.5}$ transformation and figures in parenthesis are original weed count per sq.m

Table 7.11.12.2: Effect of organic weed management practices on weed density at 60 DAS of *kharif* sweet corn

Treatment	Weed density (No./m²)								
	Echinochloa colona	*Digera arvensis*	*Triantema portulacastrum*	*Commelina benghalensis*	*Physilis minima*	*Setaria gluca*	*Dinebra retroflexa*	*Chloris barbata*	*Dactylectunum aegypticum*
Summer ploughing + 1 hand weeding at 20 DAS	2.57 (6.08)	2.32 (4.97)	1.94 (1.07)	1.79 (2.72)	1.46 (1.65)	1.48 (1.70)	1.09 (0.68)	1.28 (1.15)	1.37 (1.38)
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	1.98 (3.43)	1.14 (0.80)	1.46 (5.04)	1.53 (1.84)	1.14 (0.79)	1.11 (0.73)	1.05 (0.61)	0.91 (0.33)	1.13 (0.77)
Summer ploughing + plastic mulch at sowing	1.80 (2.76)	0.99 (0.47)	1.25 (1.58)	1.13 (0.79)	1.00 (0.55)	0.85 (0.22)	0.85 (0.22)	0.83 (0.20)	0.80 (0.14)
Stale seed bed preparation + 1 Hand Weeding at 20DAS	3.14 (9.39)	1.85 (2.94)	2.35 (1.07)	2.54 (5.94)	1.99 (3.48)	1.54 (1.870	1.31 (1.22)	1.24 (1.04)	1.52 (1.82)
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	1.96 (3.35)	1.17 (0.88)	1.44 (4.34)	1.48 (1.68)	1.22 (0.980	1.13 (0.77)	0.86 (0.24)	1.08 (0.66)	1.00 (0.49)
Stale seed bed preparation + plastic mulch at sowing	1.86 (2.96)	1.31 (1.25)	1.25 (2.43)	1.42 (1.53)	1.18 (0.90)	1.01 (0.53)	0.86 (0.24)	1.60 (2.06)	0.94 (0.41)
Soil solarization + 1 hand weeding	2.70 (6.79)	1.99 (3.48)	2.20 (0.90)	2.58 (6.14)	1.95 (3.31)	1.87 (3.00)	1.71 (2.42)	1.20 (0.94)	1.58 (1.99)
Soil solarization + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	2.88 (7.81)	1.35 (1.31)	1.71 (6.07)	2.05 (3.72)	1.87 (3.01)	1.37 (1.38)	1.30 (1.18)	0.94 (0.38)	1.31 (1.22)
Soil solarization + plastic mulch at sowing	1.37 (1.37)	0.97 (0.49)	1.18 (1.31)	1.28 (1.23)	1.12 (0.75)	0.97 (0.49)	0.98 (0.46)	0.92 (0.34)	0.71 (0.00)
Sesbania as smothering crop in between rows and used same Sesbaina as mulch after 30 days + 1 HW at 40 DAS	3.17 (9.55)	2.56 (6.17)	2.56 (14.60)	2.83 (7.49)	2.21 (4.38)	2.05 (3.69)	1.12 (0.76)	1.59 (2.02)	1.91 (3.15)
Pendimethalin 1000 ml /atrazine500g fb straw mulching (5 t/ha) at 20 DAS	2.08 (3.82)	1.99 (3.61)	1.35 (0.25)	1.81 (2.78)	1.31 (1.24)	0.95 (0.410	0.95 (0.41)	0.95 (0.40)	1.10 (0.72)
Weedy check	6.04 (35.95)	3.02 (8.64)	3.88 (0.72)	3.83 (4.21)	2.47 (5.61)	2.55 (5.99)	2.34 (4.99)	2.13 (4.04)	2.18 (4.27)
LSD (P= 0.05%)	3.54	13.64	3.60	6.71	7.53	5.64	3.10	2.89	5.31

Data subjected to $\sqrt{x+0.5}$ transformation and figures in parenthesis are original weed count per sq.m

Table 7.11.12.3: Effect of organic weed management practices on yield attributes, yield and net return of sweet corn

Treatments	No. of cobs/ plant	Cob weight/ plant(g)	Grain weight/ cob (g)	1000 seed weigh (g)	Green Cub yield (t/ha)	Straw yield (t/ha)	Biological yield (t/ha)	Harvest index	Net return (Rs/ha)	B:C ratio
Summer ploughing + 1 hand weeding at 20 DAS	1.15	84.14	53.55	84.84	2.08	3.08	5.16	40.33	27974	1.19
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	1.28	86.65	67.10	86.88	3.01	4.69	7.70	39.17	45709	1.56
Summer ploughing + plastic mulch at sowing	1.40	96.39	88.12	84.47	4.03	5.91	9.94	40.51	60885	1.58
Stale seed bed preparation + 1 Hand Weeding at 20DAS	1.18	82.93	61.38	86.13	1.99	2.84	4.83	41.24	25490	1.09
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	1.30	91.53	73.91	88.00	2.94	4.52	7.46	39.43	44484	1.55
Stale seed bed preparation + plastic mulch at sowing	1.44	102.73	95.56	97.20	4.11	5.99	10.11	40.70	62746	1.62
Soil solarization + 1 hand weeding	1.18	84.99	54.76	82.39	2.47	3.83	6.30	39.25	32204	1.10
Soil solarization + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	1.25	86.91	63.52	84.84	3.07	5.02	8.09	38.06	38455	1.00
Soil solarization + plastic mulch at sowing	1.47	106.99	97.85	97.03	3.96	5.76	9.72	40.74	54097	1.24
Sesbania as smothering crop in between rows and used same Sesbaina as mulch after 30 days + 1 HW at 40 DAS	1.12	86.74	49.90	83.96	1.83	2.83	4.67	39.30	25134	1.23
Pendimethalin 1000 ml /atrazine500g fb straw mulching (5 t/ha) at 20 DAS	1.36	89.89	80.58	88.71	2.93	4.34	7.28	40.30	44479	1.59
Weedy check	1.11	62.13	48.69	77.17	1.32	2.08	3.39	38.80	16093	0.96
LSD (P= 0.05%)	0.09	7.91	5.40	5.63	0.21	0.40	0.59	1.35	-	-

Fennel

Weed flora and weed density

The major broadleaf weeds in the experimental fields were *Chenopodium album, Chenopodium murale, Fumaria parviflora, Convolulus arvensis, Melilotus albaand Malwa parviflora. The grassy weed and sedges were Phalaris minor and Cyperus rotundus.* Weed density in fennel at 60 DAS and at harvest was significantly influenced by organic weed management practices. Weed density of monocots and dicot was recorded significantly lower in plastic mulch either with soil solarization, summer ploughing and sowing after stale seed bed preparation or. All these treatments of plastic mulch were at par and significantly superior over other treatments like soil solarization with one hand weeding either with or without straw mulch (5 t/ha), sesbania as smothering crop with hand weeding or pre-emergence application of herbicide with straw mulch (5 t/ha), summer ploughing and stale seed bed with one hand weeding at 20 DAS.

Weed dry matter

Weed dry matter recorded at 60 DAS and at harvest was significantly influenced by organic weed management practices. All the three treatments of plastic mulch either with soil solarization, summer ploughing and stale seed bed techniques proved equally effective in reduction of weed dry matter. Plastic mulch in different combinations proved most effective and recorded 95-100 % per cent reduction in total weed dry matter at 60 DAS and at harvest, in comparison to weedy check.

Yield attributes and yield of fennel

Growth and yield attributes of fennel were significantly influenced by organic weed management practices. Maximum height of plants of the crop were recorded when weeds were managed by soil solarization with plastic mulch at sowing (188.00 cm). Among various organic weed management treatments, maximum number of branches per plant (6.49), number of umbels per plant (13.46) and number of umbelets per umbel (19.97) were recorded with soil solarization with plastic mulch as compared to other treatments. These three treatments of plastic mulch at sowing with different agronomic practices were found significantly superior over other treatments of experiment.

Among different organic weed management treatments, maximum seed yield (1436 kg/ha) of fennel was recorded with crop sown with treatment of soil solarization with plastic mulch, which was at par with plastic mulch with summer ploughing and stale seed bed. Application of plastic mulch with soil solarization, stale seed bed and summer ploughing recorded 241.90, 233.80 and 231.42 % respectively, increase in yield over weedy check (420 kg/ha). A similar trend of superiority of plastic mulch with different agronomic practices was observed in straw yield of fennel. All the organic weed management treatments proved statistically superior over weedy check. Among organic weed management practices, highest net return (Rs. 66,129/ha) and B: C (1.71) was recorded in stale seed bed with plastic mulch.

Table 7.12.12.4: Effect of organic weed management practices on weed density at 60 DAS in fennel

Treatment	Weed density (No./m²)						
	Chenopodiun album	*Chenopodiun murale*	*Fumeria parviflora*	*Convolvulus arvensis*	*Phalaris minor*	*Melilotusalba*	*Malwa parviflora*
Summer ploughing + 1 hand weeding at 20 DAS	3.89(14.67)	3.24(9.99)	3.47(11.52)	1.56(1.92)	1.58(1.99)	2.04(3.68)	1.25(1.07)
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	3.07(8.96)	2.24(4.54)	3.19(9.68)	1.02(0.54)	0.94(0.38)	1.09(0.70)	1.18(0.90)
Summer ploughing + plastic mulch at sowing	2.05(3.71)	1.35(1.35)	0.71(0.00)	0.71(0.00)	0.73(0.04)	0.78(0.12)	1.02(0.53)
Stale seed bed preparation + 1 Hand Weeding at 20DAS	3.81(14.27)	2.64(6.48)	4.08(16.13)	1.56(1.92)	2.13(4.06)	2.21(4.36)	1.27(1.11)
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	2.93(8.06)	2.03(3.63)	3.29(10.32)	1.02(0.54)	1.07(0.64)	1.20(0.94)	0.90(0.32)
Stale seed bed preparation + plastic mulch at sowing	0.71(0.00)	1.49(1.73)	0.71(0.00)	0.71(0.00)	0.78(0.11)	0.97(0.43)	1.11(0.76)
Soil solarization + 1 hand weeding	2.02(3.60)	2.42(5.36)	4.08(16.13)	1.56(1.92)	2.08(3.83)	2.65(6.52)	1.59(2.03)
Soil solarization + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	2.20(4.33)	2.31(4.84)	2.76(7.10)	1.25(1.08)	1.57(1.97)	1.47(1.67)	1.15(0.82)
Soil solarization + plastic mulch at sowing	0.71(0.00)	1.63(2.14)	0.71(0.00)	0.71(0.00)	1.17(0.87)	1.73(2.50)	0.85(0.22)
Sesbania as smothering crop in between rows and used same Sesbaina as mulch after 30 days + 1 HW at 40 DAS	2.33(4.93)	2.44(5.45)	2.87(7.74)	1.25(1.08)	1.89(3.06)	2.30(4.77)	0.89(0.30)
Pendimethalin 1000 ml fb straw mulching (5 t/ha) a t 20 DAS	2.24(4.53)	3.53(11.99)	2.93(8.12)	1.16(0.85)	1.62(2.13)	1.16(0.84)	0.99(0.48)
Weedy check	5.95(34.93)	4.60(20.66)	4.65(21.33)	1.78(2.67)	2.70(6.81)	3.63(12.69)	1.94
LSD (P= 0.05%)	1.23	0.94	2.69	0.13	0.38	0.43	0.27

Data subjected to transformation and figures in parenthesis are original weed count per sq.m

Table 7.11.12.5: Effect of organic weed management practices on weed density at harvest in fennel

Treatment	Weed density (No./m²)						
	Chenopodiun album	*Chenopodiun murale*	*Fumeria parviflora*	*Convolvulus arvensis*	*Phalaris minor*	*Melilotusalba*	*Malwa parviflora*
Summer ploughing + 1 hand weeding at 20 DAS	4.34(18.33)	3.60(12.49)	3.47(11.52)	1.56(1.92)	1.58(1.99)	2.04(3.68)	1.25(18.33)
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	4.53(20.00)	3.26(10.14)	4.22(17.28)	1.21(0.96)	1.09(0.68)	1.32(1.24)	1.45(20.00)
Summer ploughing + plastic mulch at sowing	2.27(4.63)	1.46(1.69)	0.71(0.00)	0.71(0.00)	0.73(0.04)	0.78(0.12)	1.02(4.63)
Stale seed bed preparation + 1 Hand Weeding at 20DAS	4.28(17.83)	2.93(8.10)	4.08(16.13)	1.56(1.92)	2.13(4.06)	2.21(4.36)	1.27(17.83)

Treatment	Weed density (No./m²)						
	Chenopodiun album	*Chenopodiun murale*	*Fumeria parviflora*	*Convolvulus arvensis*	*Phalaris minor*	*Melilotusalba*	*Malwa parviflora*
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	4.30(18.00)	2.93(8.10)	4.35(18.43)	1.21(0.96)	1.28(1.15)	1.47(1.68)	1.03(18.00)
Stale seed bed preparation + plastic mulch at sowing	0.71(0.00)	1.63(2.16)	0.71(0.00)	0.71(0.00)	0.78(0.11)	0.97(0.43)	1.11(0.00)
Soil solarization +1 hand weeding	2.23(4.50)	2.68(6.69)	4.08(16.13)	1.56(1.92)	2.08(3.83)	2.65(6.52)	1.59(4.50)
Soil solarization + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	3.19(9.67)	3.36(10.81)	3.63(12.67)	1.56(1.92)	2.00(3.51)	1.87(2.99)	1.40(9.67)
Soil solarization + plastic mulch at sowing	0.71(0.00)	1.78(2.68)	0.71(0.00)	0.71(0.00)	1.17(0.87)	1.73(2.50)	0.85(0.00)
Sesbania as smothering crop in between rows and used same Sesbaina as mulch after 30 days + 1 HW at 40 DAS	3.39(0.71	3.55(12.16)	3.78(13.82)	1.55(1.92)	2.44(5.46)	3.00(8.52)	1.02(11.00)
Pendimethalin 1000 ml fb straw mulching (5 t/ha) at 20 DAS	2.48(5.67)	3.93(14.99)	3.12(9.22)	1.21(0.96)	1.71(2.42)	1.20(0.95)	1.02(5.67)
Weedy check	6.64(43.67)	5.13(25.83)	4.83(23.04)	1.84(2.88)	2.80(7.35)	3.77(13.71)	2.00(43.67)
LSD (P= 0.05%)	1.75	1.42	2.90	0.17	0.42	0.48	1.75

Table 7.11.12.6: Effect of organic weed management practices on growth &yield attributes of fennel

Treatments	Plant height at harvest (cm)	No. of branches per plant	No .of umbels per plant	No. of umbelets per umbel
Summer ploughing + 1 hand weeding at 20 DAS	101.00	5.48	12.38	18.18
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	145.00	12.84	18.31	18.31
Summer ploughing + plastic mulch at sowing	165.00	18.16	21.09	21.09
Stale seed bed preparation + 1 Hand Weeding at 20DAS	122.00	12.46	17.94	17.94
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	149.00	14.10	19.09	19.09
Stale seed bed preparation + plastic mulch at sowing	166.00	17.96	20.96	20.96
Soil solarization + 1 hand weeding	106.00	15.00	19.22	19.22
Soil solarization + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	139.00	15.70	19.86	19.86
Soil solarization + plastic mulch at sowing	188.00	19.73	22.09	22.09
Sesbania as smothering crop in between rows and used same Sesbaina as mulch after 30 days + 1 HW at 40 DAS	104.00	12.92	18.49	18.49
Pendimethalin 1000 ml /atrazine500g fb straw mulching (5 t/ha) at 20 DAS	152.00	13.71	18.91	18.91
Weedy check	94.00	8.64	13.05	13.05
LSD (P= 0.05%)	19.22	2.09	1.71	1.71

Data subjected to( ) transformation and figures in parenthesis are original weed count per sq.m

Table 7.11.12.7: Effect of organic weed management practices on yield and economics of fennel

Treatments	Seed yield (t/ha)	Straw yield (t/ha)	Biological yield (kg/ha)	Harvest index	Net Returns (Rs/ha)	B/C Ratio
Summer ploughing + 1 hand weeding at 20 DAS	0.77	2.37	2.94	26.18	34784	1.48
Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	0.91	2.17	3.29	27.74	39363	1.34
Summer ploughing + plastic mulch at sowing	1.39	2.62	4.48	31.03	65140	1.69
Stale seed bed preparation + 1 Hand Weeding at 20DAS	0.83	2.02	2.98	27.78	38745	1.65
Stale seed bed preparation + straw mulch (5 t/ha) at 20 DAS +1 hand weeding at 40 DAS	0.93	1.80	3.25	28.74	41296	1.44
Stale seed bed preparation + plastic mulch at sowing	1.40	2.58	4.71	29.78	66129	1.71
Soil solarization + 1 hand weeding	0.95	2.50	3.60	26.35	42178	1.44
Soil solarization + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS	0.94	1.94	3.09	30.54	31660	0.82
Soil solarization + plastic mulch at sowing	1.44	2.65	4.40	32.61	63020	1.45
Sesbania as smothering crop in between rows and used same Sesbaina as mulch after 30 days + 1 HW at 40 DAS	0.65	2.06	3.77	17.18	31234	1.53
Pendimethalin 1000 ml fb straw mulching (5 t/ha) at 20 DAS	0.94	2.40	3.71	25.21	43124	1.54
Weedy check	0.42	0.86	1.53	27.42	14900	0.89
LSD (P= 0.05%)	0.14	0.32	0.40	2.78	-	-

Soil solarization + plastic mulch at sowing

Sesbania as green manuring 30 DAS + 1 HW at 40 DAS

Stale seed bed + 1 HW at 40 DAS

Stale seed bed + plastic mulch at sowing in Sweet corn

Summer ploughing + straw mulch (5 t/ha) at 20 DAS+1 hand weeding at 40 DAS

Field view of experimental site

Effect of organic weed management practices in sweet corn and fennel at Udaipur

7.12: Evaluation of concoctions of Natural Farming in Basmati Rice-Wheat system

Objectives

- To study the natural farming practices on productivity and economics of basmati rice-wheat system
- To evaluate the natural farming practices on soil health and environment

Year of Start: *Rabi* 2017-18.

Locations: Ludhiana (Punjab), Modipuram (Uttar Pradesh), Pantnagar (Uttarakhand) under AI-NPOF and Kurukshetra (Haryana) under AICRP-IFS

Cropping system: Basmati rice-wheat at Ludhiana, Modipuram and Pantnagar and coarse rice-wheat at Kurukshetra

Treatment details

The following six common treatments were evaluated with four replications.

T1:	Control
T2:	AI-NPOF developed package
T3:	Gurukul package (Beejamrit, jeevamrit and Ghanjeecamrit) product supplied by Gurukul Kurukshetra
T4:	Locally prepared Gurukul products (Beejamrit, jeevamrit and Ghanjeevamrit) (Prepared at centre)
T5:	Location specific improved Gurukul products (Beejamrit, jeevamrit and Ghanjeevamrit) (prepared at centre)
T6:	Integrated crop management (50% organic + 50% inorganic)

Major practices adopted under natural farming (T3 to T 5)

Rice

- Green manuring with moong/ dhaincha during summer season.
- Ghanjeevamrit @ 250 kg/ha.
- Jeevamrit application at one week after transplanting and 30 days after first application with irrigation water.
- One time cow urine (1:1 cow urine and water) application.
- One foliar spray of Agniastra at 75 DAT.

Wheat

- Ghanjeevamrit @ 250 kg/ha.
- Jeevamrit (200 lit./acre) with irrigation water for 2 to 3 times.
- Cow urine (1:1) application at maximum tillering stage.
- Fermented lassi spray at 15 days before harvesting.

Results

The results of 2018-19 for each center are presented and discussed

Ludhiana (Table 7.12.1.1—7.12.1.4)

For basmati rice, the experimental field was green manured with sunnhemp crop (irrespective of treatments). The Gurukul products i.e., Ghanjeevamrit, Beejamrit, Jeevamrit, cow urine and biopesticides (*Agniastra, Neemastra*) were procured from Gurukul, Kurukshetra, Haryana. The local organic inputs were prepared at research farm of the School of Organic Farming. The local organic products were enriched with bio-fertilizers to obtain the improved organic products. In integrated nutrient management, 50 per cent N to wheat was applied through FYM and 50 per cent through chemical fertilizer whereas in pesticide free treatment, no synthetic pesticides were used. Basmati rice variety Punjab Basmati 5 and Wheat variety Unnat PBW 343 was undertaken.

Basmati rice

No significant variation among the different concoctions of natural farming was observed. Panicle length and grains/ panicle recorded maximum under integrated crop management (25.8 cm and 59 nos. respectively) however 1000-grains weight (26.8 g) of rice recorded maximum with improved ZBNF product. Highest grain yield of basmati rice (3250 kg/ha) was recorded in integrated nutrient management & pesticide free treatment followed by integrated crop management (3240 kg/ha). Gurukul package produced 60 kg of more rice over to NPOF package per hectare in the first year.

Table 7.12.1.1: Growth and yield attributing characters of basmati rice as affected by various concoctions of natural farming practices in basmati rice-wheat system

Treatments	Plant height (cm)	Effective length tillers/m^2	Panicle panicle (cm)	Grains per weight	1000 grains (g)	Grain yield (q/ha)	Straw yield (q/ha)
NPOF Package	113.3	337.7	24.9	58.0	24.6	3150	7260
Gurukul package (ZBNF)	114.2	336.3	25.4	58.2	24.4	3210	7460
Locally prepared (ZBNF)	114.6	328.7	24.4	57.1	25.5	3130	7520
Improved products (ZBNF)	113.9	334.0	25.3	55.8	26.4	3180	7720
Integrated crop management (50:50)	114.1	337.7	25.8	59.0	25.1	3240	7260
Integrated nutrient management + Pesticide free	112.7	338.3	25.6	59.2	24.6	3250	7720
Control (Unfertilized)	113.7	335.3	25.3	59.4	25.3	3170	7460
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS

Wheat

Significant variation for yield and attributing characters among the concoctions of natural farming input was observed except 1000-grans weight. Among concoctions of natural farming input, integrated crop managements followed by integrated nutrient management (pesticide free) resulted the significantly higher plant height (93.5 and 92.8 cm), number of effective tillers/m^2 (356.3 and 345), spike length (10.3 and 9.7 cm), number of grains per spike (39.9 and 39.2) respectively. The highest thousand-grain weight (42.0 and 41.8 g) was also observed in ICM 50:50 followed by INM + pesticide free, however the differences among all the treatments were non-significant.

Maximum grain yield of wheat (4460 kg/ha) was obtained under integrated crop managements, which was statistically at par with integrated nutrient management + pesticide free but significantly higher than all other concoctions of natural input management practices. The reduction under improved ZBNF treatments found to be 52.3-57.3 per cent compared to integrated crop managements and integrated nutrient management (pesticide free) respectively. Straw yield followed the same trend.

Table 7.12.1.2: Growth and yield attributing characters of wheat as affected by various zero budget farming practices

Treatments	Plant height (cm)	Effective tillers/m^2	Spike length (cm)	Grains per spike	1000 grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
NPOF Package	84.2	244.3	9.4	38.3	40.9	2360	44.00
Gurukul package (ZBNF)	76.9	226.0	8.9	35.6	40.6	1990	3260
Locally prepared (ZBNF)	78.9	223.0	8.9	32.4	40.8	1910	3190
Improved products (ZBNF)	79.5	218.3	8.7	29.5	40.7	1900	2820
Integrated crop management (50:50)	93.5	356.3	10.3	39.9	42.0	4460	6630
Integrated nutrient management + Pesticide free	92.8	345.0	9.7	39.2	41.8	4390	5320
Control (Unfertilized)	76.5	207.7	8.4	28.6	39.4	1710	2420
CD (P=0.05)	6.6	11.9	0.7	5.7	NS	450	310

Economics of rice wheat system under various zero budget natural farming practices

In basmati rice, highest gross returns of Rs 1,12,350/ha were obtained with ZBNF (Gurukul) practice followed by ZBNF (Improved) which gave Rs. 1,11,300/ha however, highest net returns (Rs 82,900 per ha) were observed in control plot followed by NPOF package 982,000/ha) due to comparable yield, lowest cost of cultivation and premium price of organic produce. In case of wheat, highest gross (Rs 81,880 and 80,776/ha respectively) and net returns (Rs 56,111 and 49007/ha) were obtained in ICM 50:50 closely followed by INM + pesticide free which was due to higher grain yields and low cost of cultivation under these treatments. Minimum net returns (Rs 6665 per ha) were observed in NPOF treatment, which was due to very high cost of cultivation in this treatment. Rice-wheat cropping system as whole recorded highest gross return under Integrated crop management (50:50) of Rs. 1,156,131 closely followed by Integrated nutrient management + pesticide free of Rs. 1,10,257/ha owing to lower cost of cultivation and high economic yield of rice and wheat with the same practice.

Table 7.12.1.3: Economics of basmati rice-wheat system under various zero budget natural farming practices

Treatments	Basmati rice			Wheat			System		
	Gross returns	Cost of cultivation	Net returns	Gross returns	Cost of cultivation	Net returns	Gross returns	Cost of cultivation	Net returns
NPOF Package	110250	28250	82000	54280	47615	6665	164530	75865	88665
Gurukul package (ZBNF)	112350	32695	79655	45770	29225	16545	158120	61920	96200
Locally prepared (ZBNF)	109550	32695	76855	43930	29225	14705	153480	61920	91560
Improved products (ZBNF)	111300	32970	78330	43700	29625	14075	155000	62595	92405
Integrated crop management (50:50)	90720	30700	60020	81880	25769	56111	172600	56469	116131
Integrated nutrient management + Pesticide free	91000	29750	61250	80776	31769	49007	171776	61519	110257
Control (Unfertilized)	110950	28050	82900	39330	23715	15615	150280	51765	98515

*25 per cent price premium on NPOF, ZBNF treatments and control

Effect of zero budget farming practices on soil chemical properties

Among various concoctions of natural farming input practices, lowest EC was recorded in NPOF and Gurukul (ZBNF) whereas maximum EC found to be in local ZBNF. The maximum value of soil organic carbon was recorded

Table 7.12.1.4: Effect of zero budget farming practices on soil chemical properties (0-15cm) in basmati rice-wheat system at the end of one cropping cycle

Treatment	EC (mmhos/cm)	OC (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
NPOF Package	0.28	0.57	113.8	99.8	305.8
Gurukul (ZBNF)	0.27	0.54	98.1	90.7	298.1
Local (ZBNF)	0.34	0.56	100.5	90.7	291.8
Improved (ZBNF)	0.28	0.53	111.0	91.7	297.6
ICM 50:50	0.30	0.57	111.1	97.3	294.1
INM+ Pesticide free	0.31	0.56	107.3	98.8	299.4
Control	0.28	0.52	90.5	90.4	282.1

in integrated crop management (50:50) and NPOF treatments (0.57, each) and it was minimum under the control. The soil available nitrogen was highest in NPOF package and was followed by integrated crop management (50:50) and Improved (ZBNF). The soil available phosphorous was highest in NPOF package and was lowest in control. The soil available potassium was highest in NPOF and was lowest in control. The soil EC was highest in Local (ZBNF) and was lowest in Improved.

Modipuram (Table 7.12.2.1—7.12.2.5)

Basmati rice

Growth and yield attributes

Growth parameters of basmati rice significantly affected due to the various concoctions of natural farming practices. Basmati rice attain the maximum plant height with integrated crop management (50% organic + 50% inorganic) followed by organic farming package (NPOF.) Moreover, maximum number of tillers per meter row length were also recorded under integrated crop management (50% organic + 50% inorganic) followed by NPOF. Number of effective tillers was reduced by 32.0% and 20.8% under Gurukul package (ZBNF) compared to ICM and NPOF, respectively. Similarly, SPAD meter reading and NDVI (Normalized difference vegetation index) value was found highest under ICM followed by organic farming package.

Yield attributing characters of basmati rice such as panicle weight, panicle length and 1000-grains weight were significantly varied by different natural farming practices. Heaviest panicle weight 1.48 g and longest panicle 24.5 cm were registered under integrated crop management (50% organic + 50% inorganic) and found statistically at par with organic farming package. 1000-grains weight was found significantly lower under control and Gurukul package as compared to ICM and organic farming package (NPOF).

Highest productivity of basmati rice was recorded under integrated crop management (50% organic + 50% inorganic) followed by organic farming package. Yield gap between ICM and organic farming package was found significantly and gap between ICM and Gurukul practice was increased during second year as compared to first year of experimentation. Grain yield of basmati rice was reduced by 18.6%, 37.7%, 31.8%, 41.8% and 39.9% under organic farming package, Gurukul package (Product supplied by Gurukul), Locally prepared Gurukul products, Location specific improved products and control as compared to integrated crop management (50% organic + 50% inorganic), respectively.

Table 7.12.2.1: Growth and yield attributes of basmati rice as affected by different nutrient management practices of natural farming

Treatments	SPAD meter reading 60 DAT	NDVI value at 60 DAT	Plant height at harvest (cm)	No. of tillers at harvest (m/r/l)	Panicle weight (g)	Panicle length (cm)	1000-grains weight (g)	Rice grain yield (kg/ha)
Control	27.9	0.514	69.3	38.4	0.84	20.4	28.9	2303
NPOF	32.6	0.647	81.3	49.9	1.24	23.5	31.5	3104
Gurukul package (Product supplied by Gurukul)	28.4	0.527	69.7	39.5	0.95	20.4	28.9	2377
Locally prepared Gurukul products	28.5	0.539	70.2	39.4	0.96	20.9	28.5	2452
Location specific improved products	31.2	0.549	74.1	41.7	1.01	21.7	29.0	2601
Integrated crop management (50% organic + 50% inorganic)	34.8	0.694	95.2	58.1	1.48	24.5	32.0	3813
CD (P=0.05)	2.87	0.037	3.65	1.78	0.383	2.17	1.99	275

Wheat

Growth and yield attributes

Plant height of wheat was found highest under integrated crop management (99.0 cm) followed by organic farming package (80.9 cm) and least under control. Similarly, number of tillers/m.r.l. at harvest in wheat were recorded highest under ICM followed by organic farming package. Number of tillers was reduced by 30.9% and 8.5% under Gurukul package (product supplied by Gurukul) at harvest

as compared to ICM and organic farming package, respectively. Leaf area index (LAI) of wheat at 50 DAS was also found maximum under ICM 6.27 followed by organic farming package 5.18. Spike length 13.3 cm and number of grains/spikes 62.9 was found highest under ICM (13.3) cm followed by organic farming package (12.2 cm). Number of grains/spike was found 24.3% lower under Gurukul package (Product supplied by Gurukul) treatment as compared to ICM.

Grain yield of wheat was recorded highest under ICM (4807 kg/ha). Grain yield of wheat was reduced by 44.2%, 68.8%, 66.4%, and 63% under organic farming package, Gurukul package (Product supplied by Gurukul), Locally prepared Gurukul products and Location specific improved products as compared to ICM, respectively.

Table 7.12.2.2: Growth and yield parameters of wheat as affected by different nutrient management practices

Treatments	Plant height (cm)at harvest	Leaf area index at 50 DAS	No. of tillers atharvest	Spike length (cm)	No. of grains/ spike	Wheat grain yield (kg/ha)
Control	74.7	3.55	62	11.8	44.9	1283
NPOF	80.9	5.18	71	12.2	51.7	2347
Gurukul package (Product supplied by Gurukul)	75.1	3.65	65	11.9	47.6	1313
Locally prepared Gurukul products	76.0	4.52	64	11.7	47.0	1411
Location specific improved products	78.2	4.40	61	12.0	48.2	1557
Integrated crop management (50% organic + 50% inorganic)	99.0	6.27	94	13.3	62.9	4205
CD (P=0.05)	4.5	0.90	11.3	0.73	4.43	413

System productivity and economics

System rice equivalent yield of 6695 kg/ha was found highest under integrated crop management (50% organic + 50% inorganic) followed by organic farming package (4513 kg/ha). In comparison to ICM, system REY was reduced by 32.6%, 55.0%, 54.7%, 48.6% and 59.0% under organic farming package, ZBNF-G, ZBNF-GC, ZBNF-IG and control respectively.

System cost of cultivation of Rs. 93,730/ha was obtained maximum under organic farming package followed by ICM and least under control. Cost of cultivation was found 14.0%, 23.1% and 22.2% lower under ICM, ZBNF-G/GC and ZBNF-IG as compared to organic farming package, respectively. Highest gross return (Rs. 2,18,728/ha) and net return (Rs.1,38,086/ha) was received under ICM followed by organic farming package. As compared to ICM, net return was reduced by 44.1%, 67.2%, 67.5% and 57.2% under organic farming package, ZBNF-G, ZBNF-GC and ZBNF-IG, respectively.

Table 7.12.2.3: Productivity and economics of basmati rice-wheat systems as affected by different nutrient management practices

Treatment	System yield (Rice Equivalent) (kg/ha)	Cost of cultivation (Rs./ha)	Gross returns* (Rs./ha)	Net Returns (Rs./ha)	B:C ratio
Control	2748	62230	107493	45263	1.73
NPOF	4513	93730	170909	77179	1.82
Gurukul package (Product supplied by Gurukul)	3015	72100	117349	45249	1.63
Locally prepared Gurukul products	3030	72100	116965	44865	1.62
Location specific improved products	3444	72900	132044	59144	1.81
Integrated crop management (50% organic + 50% inorganic)	6695	80642	218728	138086	2.71

Soil chemical properties

Organic carbon content of soil was significantly affected by the different management practices. Highest soil organic carbon 0.60% was found under organic farming package and ICM while least was under ZBNF treatments. Available nitrogen N was found statistically at par among all the treatment but numerically higher under organic farming practices. Similarly, available phosphorus 32.1 kg/ha, available potassium 221 kg/ha and iron 34.3 ppm in soil were found highest under organic farming practices.

Table 7.12.2.4: Chemical properties of soil as affected by different natural farming management practices

Treatment	Soil pH	EC (ds/m)	OC (%)	Avail. N (kg/ha)	Avail. P (kg/ha)	Avail. K (kg/ha)	Zn (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)
Control	8.16	0.81	0.58	159	20.19	185	1.13	29.2	8.04	2.73
NPOF	8.13	0.82	0.60	166	32.14	221	1.42	34.3	9.41	3.78
Gurukul package (Product supplied by Gurukul)	8.24	0.75	0.55	156	18.56	191	1.18	33.6	9.14	3.05
Locally prepared Gurukul products	8.20	0.72	0.57	154	23.07	194	1.23	32.5	7.99	2.80
Location specific improved products	8.22	0.74	0.53	155	18.97	197	1.31	30.3	8.52	2.90
Integrated crop management (50% organic + 50% inorganic)	8.15	0.77	0.60	162	28.11	188	1.43	27.8	8.30	2.92
CD (P=0.05)	0.070	0.069	0.045	NS	5.62	20.0	NS	4.32	NS	NS

Soil biological properties

Among the different management practices, highest population of bacteria, fungi and actinomycetes and Glomalin content were found highest under organic farming practices. Organic farming practices also resulted in the highest activity of different soil enzymes namely dehydrogenase, phosphatase, urease and â-glucosidase which are crucial for soil nutrient mineralization. Population of bacteria, fungi and actinomycetes was found higher under ZBNF treatments as compared to control.

Table 7.12.2.5: Biological properties of soil as affected by different nutrient management practices

Treatments	Population of different microbial groups			Glomalin content (mg/kg dry soil)	Enzyme activities in soil			
	Bacteria ($x10^7$CF/ g soil)	Fungi ($x10^4$CFU/ g soil)	Actinomycetes $x10^6$CFU/ (g soil)		Dehydrogenase (µg TPF/g dry soil/h)	Phosphatase (µg pNP /g dry soil/h)	ß-glucosidase (µg pNP/g (dry soil/h)	Urease (mg urea/ g soil/h)
Control	0.98	3.66	1.83	341	14.41±1.41	35.02±3.79	14.56±1.42	5.90±0.76
NPOF	1.33	5.81	2.83	546	25.24±1.78	56.04±5.09	16.88±1.09	10.90±0.98
Gurukul package by Gurukul)	1							
Locally prepared Gurukul products	1.06	4.70	2.13	456	14.20±1.79	42.95±5.35	14.75±0.95	9.16±0.89
Location specific improved products	1.02	4.67	2.05	373	19.51±2.59	44.12±3.65	14.61±2.07	9.66±1.07
Integrated crop management (50% organic + 50% inorganic)	1.02	5.32	2.02	431	20.77±2.71	53.89±4.49	16.15±0.49	10.02±1.12

Overview of wheat under natural farming experiment at Modipuram

Pant Nagar (Table 7.12.3.1—7.12.3.4)

Performance of basmati rice as influenced by various concoctions of natural faming input

Rice variety Pant basmati-1 was taken in the experiment. Highest plant height (134 cm), tillers/m^2 (269) were recorded with Integrated treatment compared to all other practices, while test weight i.e. 1000-grans-weight (25.0 g) recorded highest with control, gurukul package improved and integrated followed by gurukul package (24.4 g). Among the management practice of natural farming, significantly higher grain yield (4191 kg/ha) of rice recorded with integrated crop management. Gurukul packages from Kurukshetra, locally prepared and improved found to be

Table 7.12.3.1: Growth and yield attributes of rice as influenced by different natural farming concoctions

Treatments	Plant height (cm)	tillers/ m^2	1000-grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index	CoC (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Control	131	229	25.0	2487	4265	0.37	26742	50987	1.91
AI-NPOF Package	130	257	23.3	3860	5450	0.42	36452	84163	2.31
Gurukul package (from Kurukshetra)	132	245	24.4	3263	4841	0.40	33237	68742	2.07
Gurukul package" Locally prepared	131	246	24.2	3320	5258	0.39	34082	69678	2.04
Gurukul package" Improved	131	249	25.0	3445	5108	0.40	34487	73159	2.12
Integrated Crop Management (50% organic+:50% inorganic)	134	269	25.0	4191	5867	0.41	37675	67100	1.78
CD(P=0.05)	NS	15.6	0.64	321.4	NS	NS	-	-	-

statistically on par and found significantly lower than NPOF and ICM. Reduction in yield as compared to ICM recorded with Gurukul packages i.e. from Kurukshetra, locally prepared and improved to the tune of 22.1, 20.8 and 17.8% respectively. Economics of different management practice of natural farming revealed that net return (Rs. 84,163) and B:C ratio (2.31) was observed with NPOF package followed by Gurukul package" Improved

Performance of wheat as influenced by various concoctions of natural faming input

Wheat variety UP 2565 was taken in the experiment. Highest plant height (100 cm), spikes/m^2, grain yield (5068 kg/ha), straw yield (5476 kg/ha) and harvest index (0.48) were recorded in integrated crop management. However, test weight (1000-grains) was observed maximum of 45.0g with AI-NPOF package. Gurukul package resulted in 29.6% decrease yield compared to AI-NPOF package. Economic analysis of different treatment showed that maximum net return (Rs. 51625/ha) was observed with AI-NPOF package, however, highest B: C ratio (1.74) was recorded by Control.

Table 7.12.3.3: Growth and yield attributes of wheat (UP 2565) as influenced by different natural farming concoctions

Treatments	Plant height (cm)	tillers/ m^2	1000-grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index	CoC (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Control	95.0	226	43.3	2514	3184	0.44	20905	36447	1.74
AI-NPOF Package	96.0	280	45.0	3685	4398	0.45	32430	51625	1.59
Gurukul package (from Kurukshetra)	94.0	251	44.1	2595	3315	0.44	22995	36189	1.57
Gurukul package" Locally prepared	98.1	257	44.0	2627	3215	0.45	23840	36082	1.51
Gurukul package" Improved	93.0	239	43.0	2618	3070	0.46	24245	35464	1.46
Integrated Crop Management (50% organic+:50% inorganic)	100	283	43.0	5068	5476	0.48	31478	63820	2.03
CD (P=0.05)	NS	17.3	NS	326.7	442.2	NS	-	-	-

Data pertaining to organic carbon, availability of nitrogen, phosphorus & potassium were influenced by different natural farming practices and maximum organic carbon (1.37 kg/ha), availability of nitrogen (378 kg/ha), available phosphorus (35.0 kg/ha) and available potassium (236 kg/ha) and total nitrogen uptake (99.0 kg/ha), phosphorus uptake (23.0 kg/ha) & potassium uptake (80 kg/ha) by wheat were recorded in integrated crop management (50% organic + 50% inorganic) followed by AI-NPOF package.

Table 7.12.3.4: Organic carbonj, Available and Uptake N, P and K by different of wheat (UP 2565) as influenced by different natural farming concoctions

Treatments	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)	Total N Uptake (kg/ha)	Total P Uptake (kg/ha)	Total K Uptake (kg/ha)
Control	1.22	329	32.0	233	48.3	11.0	42.0
AI-NPOF Package	1.29	353	34.0	234	71.3	18.0	63.0
Gurukul package (from Kurukshetra)	1.35	348	34.0	234	52.0	12.0	45.0
Gurukul package" Locally prepared	1.35	366	32.0	235	52.0	12.2	44.0
Gurukul package" Improved	1.35	349	33.0	235	51.30	11.0	44.0
Integrated Crop Management (50% organic+:50% inorganic)	1.37	378	35.0	236	99.0	23.0	80.0
CD(P=0.05)	1.48	3.80	0.90	1.30	1.19	0.57	1.45

Kurukshetra (Table 7.12.4.1)

Among various concoctions of natural farming practices, maximum grain yield (3850 kg/ha), Cost of cultivation (Rs 8,2484/ha), gross return (Rs 1,12,491/ha), net return (Rs 30,007/ha) and B: C ratio 0.36 was recorded under integrated crop management (50% organic+ 50% inorganic). AINP-OF package outperformed after integrated crop management. Integrated crop management package resulted in 42.6% higher yield than Gurukul package whereas AINPOF was higher to the tune of 17.2% by Gurukul package.

Table 7.12.4.1: Growth and yield attributes of wheat (HD-2967) as influenced by different natural farming concoctions

Treatments	Grain yield ($kgha^{-1}$)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:c ratio
Control	1750	34770	38990	4220	0.12
AI-NPOF Package	2666	25642	-7872	-33514	-1.31
Gurukul package (from Kurukshetra)	2208	40662	49493	8831	0.22
Gurukul package" Locally prepared	2083	40662	46214	5552	0.14
Gurukul package" Improved	2125	40662	47330	6668	0.16
Integrated Crop Management (50% organic+:50% inorganic)	3850	82484	112491	30007	0.36

7.13 Cluster based demonstration of Organic Farming Package under Tribal Sub Plan (TSP)

Location: Umiam

Organic food production through integrated farming system- cluster approach

ICAR Research Complex for NEH Region has initially selected a village "Mynsain" of Ri-Bhoi District for disseminating organic production technology in cluster approach. Mynsain village is located in Umsning Tehsil of Ri-Bhoi district in Meghalaya. The sensitization meeting with the villagers including village head (Headman), member of the SHGs, Department of agriculture (Gram Sabath) was organized, subsequently a group of farmers visited the ICAR, Umiam, to get first hand exposure to various technologies to be demonstrated under the programme. The improved seeds like Maize, Groundnut, French bean and some vegetables seeds were distributed to the farmers. The Survey (PRA) and farmers training were conducted to initiate the programme. As there is much awareness among the public about the organic produce, the adopted farmers may get premier price say 10 % higher than the conventionally produced items. 100 farmers were selected in first phase in a compact area for demonstration of organic farming practices through a model village concept. Considering the overwhelming response of farmers of the mentioned village, we have expanded the coverage area by including two more nearby villages (Pynthor and Umden Umbathiang) in cluster approach under the NPOF Project. These newly adopted villages are neighbors of Mynsain village. The component of the Model village would be as follows-

Soil Fertility status

For determining soil fertility status, 160 soil samples were collected at a depth of 0-15cm and 15-30 cm. Available N, P, SOC and pH of the soil at lowland condition were recorded to be 214.2±2 kg/ha, 9.5±5.1 kg/ha, 1.62±0.61 mg/kg and 4.96± 0.66, respectively for 0-15 cm depth and 188.3±2 kg/ha, 12.1±5.4 kg/ha, 1.33±.0.56 mg/kg and 4.89±0.66, respectively for 15-30 cm soil depth. Similarly, the available N, P, SOC and pH of the soil at upland condition were recorded at 208.4 ± 3 kg/ha, 23.1±2.5 kg/ha, 1.45±3.42 mg/kg and 4.86±0.64 pH, respectively, for 0-15 cm soil depth and 171.1±2 kg/ha, 9.4±2.2 kg/ha, 1.05±0.54 mg/kg and 5.01±0.65, respectively for 15-30 cm soil depth.

Development of farm pond and composite fish culture for adding value to various farming activities:

The ponds were developed to promote IOFS models as well as for achieving diversification of their farm enterprises and water from ponds were used to serve domestic and livestock water supplies as well as irrigation for high-value crops and vegetables during lean period. Application of lime (2t/ha) and FYM (10t/ha) was performed after the pond was constructed for enhancing the soil fertility. As the famers took keen interest on composite fish culture, a total of 150kg fingerlings consisting of catla (30%), grass carp (30%) and common carp (40%) were released during the year 2018-19 in the existing ponds constructed in Mynsain village in previous years. The body weight of fingerlings varied from 17-82 g at the time of release. Construction of ponds in the newly adopted villages will also be initiated and the list of beneficiary farmers, village and the geographical coordinates of the demonstration sites have been provided in table below:

List of beneficiary for pond and their geographical location of the demonstration site

Sl.No.	Name of beneficiary	Area of pond (m^2)	Latitude (N)	Longitude (E)
1	Sharmila Rynghang	350	092^{0}01.045	25^{0}44.245
2	Thissilon Rynghang	335	092^{0}00.543	25^{0}44.450
3	Mishin Rympei	450	092^{0}01.412	25^{0}44.346
4	Pynsngewthiang Rynghang	400	092^{0}01.125	25^{0}44.331
5	Deimarkynti Matlang	310	092^{0}01.221	25^{0}44.342
6	Therimon Rynghang	365	092^{0}01.138	25^{0}44.531
7	Debinus Nongsiej	370	092'00.655	25'44.175
8	Blianda Lapang	500	092'00.384	25'44.188

'Jalkund' Low- cost rainwater harvesting structure

Meghalaya is basically an agricultural state and about 80% of the population depends entirely on agriculture for their livelihood. The state is blessed with abundant rainfall during monsoon season but due to lack of irrigation facilities and inappropriate water harvesting infrastructures, it faces major challenges of available water resource during the off monsoon periods and cultivation during the dry months is generally limited. The bulk of agriculture in the State is rain fed and only 18.5% of the cultivated area is irrigated resulting in mono-cropping and low cropping intensity. The trend on cultivation will change for the better once water is provided during the lean period and will subsequently contribute to socio-economic upliftment of the farmers. Thus, there is potential to increase agricultural productivity through both increasing the area under surface water irrigation and improving water management in rain fed farming systems. Keeping this in view,low cost 'jalkund 'technology was introduced in the adopted villages with the main goal of securing water supply during the lean period in order to provide critical irrigation to high value winter crops to minimize crop failure during dry months, supply drinking water and domestic water for animals and people respectively and enhance crop diversification.

List of some beneficiaries for *Jalkund* and their geographical locations.

Sl.No.	Name of beneficiary	Latitude (N)	Longitude (E)	Multiple use
1	Willfort Rynghang	092^{0}01.301	25^{0}44.442	For cultivation of vegetables (Bottle gourd, broccoli, bottle gourd, pumpkin, cabbage) and rearing of pigs
2	Debora Rynghang	092^{0}01.235	25^{0}44.325	For cultivation of vegetables (Broccoli, chilli, cabbage, cauliflower, pumpkin) and rearing of pigs
3	Melis Rympei	092^{0}01.246	25^{0}44.453	For cultivation of vegetables (Bottle gourd, broccoli, pumpkin, French bean)
4	Bliona Matlang	092^{0}00.223	25^{0}44.524	For cultivation of vegetables (Pumpkin, lettuce, cabbage, cauliflower) and vermicomposting unit
5	Shianti Rynghang	092^{0}01.450	25^{0}44.456	For cultivation of vegetables (Broccoli, chilli, pumpkin, bottle gourd, tomato) and vermicomposting unit
6	Sankilda Lapang	092^{0}00.525	25^{0}44.132	For cultivation of vegetables (Chilli, broccoli, cauliflower, cabbage, lettuce) and for rearing of poultry
7	Dariti Lyngdoh	092^{0}01.324	25^{0}44.523	For cultivation of vegetables (pumpkin, cabbage, cauliflower, lettuce,) and for piggery.
8	Prolan Rympei	092^{0}00.523	25^{0}44.374	For cultivation of vegetables (Cabbage, cauliflower, lettuce, French bean) and vermicomposting unit
9	Melina Rynghang	092^{0}00.087	25^{0}44.256	For cultivation of vegetables (Broccoli, chilli, tomato, cabbage, lettuce, French bean) and for rearing of poultry
10	Phliabia Sun	092^{0}01.134	25^{0}44.532	For cultivation of vegetables (Broccoli, bottle gourd, pumpkin, cabbage, lettuce) for rearing pig.
11	Bansaki Rynghang	092^{0}01.253	25^{0}44.518	For cultivation of vegetables (Bottle gourd, pumpkin, cabbage) and rearing of pigs
12	Baiahunlang Shadap	092^{0}01.214	25^{0}44.545	For cultivation of vegetables (Bottle gourd, broccoli, chilli, cabbage, cauliflower, lettuce) and rearing of pigs
13	Bathiang Nongkharai	092^{0}00.625	25^{0}44.411	For cultivation of vegetables (Bottle gourd, broccoli, pumpkin, tomato, French bean) and rearing of poultry
14	Elisha Rynghang	092^{0}01.114	25^{0}44.489	For cultivation of vegetables (Pumpkin, cabbage, cauliflower, lettuce) and vermicomposting unit
15	Phyrnai Nongkharai	092^{0}01.216	25^{0}44.543	For cultivation of vegetables (Chilli, pumpkin, bottle gourd, tomato) and vermicomposting unit

Sl.No.	Name of beneficiary	Latitude (N)	Longitude (E)	Multiple use
16	Aplang Rynghang	092^{0}01.312	25^{0}44.565	For cultivation of vegetables (Chilli, broccoli, cauliflower, cabbage, lettuce) and for rearing of pigs
17	Welkin Shadap	092^{0}00.478	25^{0}44.435	For cultivation of vegetables (pumpkin, cabbage, cauliflower, lettuce,) and for poultry.
18	Plentisha Mukhim	092^{0}01.357	25^{0}44.533	For cultivation of vegetables (Cabbage, cauliflower, lettuce, French bean) and poultry
19	Landreform Rynghang	092^{0}01.154	25^{0}44.546	For cultivation of vegetables (Broccoli, chilli, tomato, cabbage, cauliflower, French bean) and for rearing of pigs
20	Sirianda Lyngdoh	092^{0}01.122	25^{0}44.589	For cultivation of vegetables (Broccoli, bottle gourd, pumpkin, cabbage, cauliflower, lettuce) for rearing pigs and poultry

C. Vermicomposting as a feasible technology for farm households

Organic waste can constitute as much as 70% of the total solid waste stream in any rural community. Crop residues constitute an abundant but underutilized source of renewable biomass in agriculture. Burning agro-residues in the field is considered a cheap and easy means of disposal of excess residues. Furthermore, farm households generate large amounts of manure that can pose a threat to the environment, especially watercourses, if not well managed because of nutrient overloading. Selected organic waste can be transformed into organically beneficial products through the application of innovative approaches for the reuse of these resources for energy, organic fertilizers, and animal feed ultimately improving the quality of life of the people.

Vermi-beds

Vermi Beds are unique and latest technology for earthworm farming. It is very portable, low cost, easy to handle and install and provision for collection of Vermi-wash. 15 numbers each of such beds of the size 12'x'4' x 2' were distributed to the three (3) villages during the year 2018-19 for vermicomposting, which can produce about 1200kgs to 1500kgs of vermicompost. Vermi-beds can be done on a small scale by farmers with household organic wastes. Crop residues and agricultural wastes are collected by the farmers and filled in the vermibeds for decomposition processes.

D. Land Development and modification

Raised and Sunken beds

Farmers in the three villages conventionally cultivate crops like vegetables (tomato, cabbage, cauliflower, carrot, etc.), ginger, turmeric etc., in buns (raised bed of 1 m width, 8–10 m long and 30–50 cm height) especially in uplands. These crops are normally raised on the temporary buns (raised beds) while the sunken area (area between the two raised beds) is usually left unutilized. Some farmers also grow vegetables in lowland fields by forming buns after *kharif* rice, but the sunken area is left unutilized. After the vegetables are harvested, the buns are broken down and leveled for rice cultivation. As a result, farmers incur repeated expenditure every year for making fresh buns. Therefore, the introduction of land configuration through RSB technology was initiated in farmers' fields to address the advantages of this technology in providing an alternative approach for promotion of crop diversification, increasing productivity and enhancing income. Field demonstrations were conducted to give farmers a clear idea to construct the raised and sunken beds.

Layout

- The surface soil layer of each sunken bed was removed and deposited on the adjacent raised beds to a height of about 30cm.
- The raised beds were leveled in such a way that 50% of run-off water from half of the raised bed will drain off into the intervening sunken beds. Standard width ratio of raised and sunken bed is 1:1.25 as given in the following table.

The dimensions of the raised beds constructed in villages were 0.75-1m in breadth, 10m in length and 0.3-0.5m in height and the drainage channel (sunken bed) varied from 0.2-0.5m. A total of 24113.4m2 area had been brought under vegetable cultivation in lowland through raised and sunken beds land configuration. Vegetables such as tomato (Var. Avinash, Rocky) French bean (var. Naga local) potato (var. Kufri megha) carrot (var. New Kuroda), broccoli (var. Green magic), lettuce etc were grown by the farmers on raised beds.

List of beneficiaries for raised and sunken bed technology

Sl. No.	Name of beneficiary	Area (m^2)	Crops grown					
			Pre-kharif		*Kharif*		*Rabi*	
			Raised	Sunken	Raised	Sunken	Raised	Sunken
1	Buromshai Lyngdoh	2283.5	Potato, tomato	Fallow	Chilli, French bean	-	Broccoli, cabbage	Pea
2	Meselin Kyrsian	2462.1	Potato, French bean, tomato	Pea	Soybean, okra,	Rice	Lettuce, cabbage	Lentil
3	Judi Shadap	3104.5	Potato, tomato	Pea	Chilli, French bean	Rice	Carrot, broccoli cauliflower	Lentil
4	Rangdondor Makhroh	1833.2	Tomato, Potato, French bean	Fallow	Brinjal, French bean	Rice	Cabbage, broccoli, cauliflower	Pea
5	Mirinda Lapang	1656.3	Potato, carrot	Fallow	Chilli, French bean	Rice	Cabbage, broccoli, lettuce	Fallow
6	Pyrshang Makhroh	1970.3	Potato, Tomato, carrot	Fallow	Brinjal, okra	Rice	Cabbage, broccoli	
7	Ympher Nongsiej	2150.3	Tomato, French bean	Pea		-	Cabbage, cauliflower	
8	Darious Lapang	1976.0	Carrot, potato	Fallow	Okra, chilli, French bean	Rice	Cabbage, broccoli	Fallow
9	Trias Lapang	1950.8	Carrot, potato	Fallow	Chilli, brinjal		Cabbage, broccoli, lettuce	Fallow
10	Ambor Makhroh	2156.0	Tomato, French bean	Pea	Chilli, okra, groundnut	Rice	Cabbage, broccoli, carrot	Pea

The intervention of raised and sunken bed system has proven to be immensely beneficial for the farmers as the system has resulted in enhanced cop production and productivity of rice during kharif due to prolonged submergence of water in sunken beds and effective rainwater harvesting for the lean period. Also, the technology has also provided effective utilization of land by reducing tillage of the cultivated area thus saving labour, farmer's energy, conservation of moisture and improving soil health. The system also generated additional income for the farmers as well as boosting employment generation as two or more crops were raised in a year as compared to their traditional practice of monocropping.

E. Fruit trees plantation

Pineapple plantation

The gently sloping landforms on the hill slopes of Mynsain village are suitable for pineapple cultivation. In order to promote organic fruit production, one farmer Mrs. Trias

Intercropping of pineapple with blackgram

Makhroh having an area of about 1 acre was given two thousand five hundred numbers of pineapple suckers (Var. kew) for planting during monsoon of the year 2018.The plantation was carried out across the slope to ensure higher yield by reducing soil loss. Planting was done at a spacing of 30 x 60 x 90 cm in double row method of planting, i.e. suckers were planted at a distance of 30 cm from plant to plant in the line and 60 cm in between two lines and 90 cm between two double rows. Well rotten FYM @ 1kg/pit was applied at the time of planting. Intercropping of greengram in between two rows of pineapple was done to maintain soil fertility. Mrs. Makhroh narrated that she was able to sell around 3000 pineapples @ Rs. 30 to Rs. 50 per pineapple, while 450 to 500 ripe pineapples were evenly sliced, packed and sold at Rs. 10 per packet wherein a single pineapple produces 15 to 18 packets.

G. Livestock production

(i) Poultry

Backyard poultry is a handy enterprise with low-cost initial investment, but high economic return with guaranteed protein deficiency improvement among the poor. However, the potentiality of indigenous birds in terms of egg production is only 70 to 80 eggs/ bird/ year and meat production is also very less. Therefore in order to increase the socio-economic status as well as livelihood and nutritional security condition of the traditional farmers, during the year 2018-19, 1000 nos. poultry chicks (Breed-Vanaraja & Gramapriya) and 5 bags poultry feed were distributed to 15 beneficiaries. An average of 18-20 eggs was being produced by each poultry bird per month. The average weight of the poultry birds was 3 kg. The farmers could also sell the poultry birds for meat purpose at an average price Rs. 300 per kg. On an average expenditure incurred in the investment of poultry house was Rs 9000/-.

The performance of these birds in the selected villages indicates that they are suitable for backyard rearing and have considerably higher production potential (high egg laying capacity @ 200 to 230 egg/ bird/ year and higher weight gains) than the local birds which made the farmers to come forward with keen interest of rearing them for better income generation.

List and income of beneficiaries incurred from poultry rearing

Sl. no.	Name of Beneficiary	No.of birds received	No of birds survived	No of poultry birds sold / year	Amount (Rs)*(A)	No. of eggs sold/ year	Amount (Rs)*(B)	Net income
1	Witness Rympei	80	72	70	14400	200	1600	8200
2	Pher Rynghang	80	75	24	14400	150	1200	7900
3	Hermen Rynghang	50	35	25	9000	100	800	5000
4	Balasyrpai Rympei	50	37	31	9000	170	1360	5180
5	Prinda Kurbah	60	55	25	10800	180	1440	6120
6	Banrihun Rani	80	74	28	14400	200	1600	8100
7	Reading Syngkli	80	78	26	14400	190	1520	7960
8	Nison Lapang	60	54	25	10800	150	1200	6000
9	Aikylluid Rympei	80	75	20	14400	140	1120	7760
10	Ebanker Rynghang	80	74	21	14400	180	1440	7920
11	Monsing Tamang	60	54	29	10800	260	2080	6440
12	Bathiangtam Nongkharai	80	93	27	14400	220	1760	8080
13	Komaiseen Nongbsap	50	44	20	9000	180	1440	5220
14	Siewdor Rynghang	60	52	22	10800	130	1040	5920
15	Jackstarfill Makhroh	50	45	33	9000	150	1200	5100
		1000	**917**	**426**	**180000**	**2600**	**20800**	**100900**

*(A) Selling price of one bird @ Rs 180/kg and average weight of one bird=2.5kg
*(B) Selling price of one egg@ Rs 8/kg

(ii) Introduction of improved pig variety and low-cost housing system

The system of pig production in the adopted villages lacks scientific orientation due to poor technological back up and farmers follow traditional practices. This offers ample opportunities for improvement in pig farming for sustainable livelihood and nutritional security since this farming practice generates bulky organic manure to aid crop production and productivity under organic farming. In order to address the importance of organic farming in the village, ICAR Umiam under the NPOF Project developed and validated a technology termed as "Pig farming under deep litter with low cost housing system". A total of 10 farmers were selected for the demonstration of the intervention in the NPOF adopted villages. Farmers were given training cum exposure visit at the ICAR Animal Division Research Farm to get an idea and develop an understanding about the intervention. In this technology, the institute recommended a pig shed (pigsty) of 10 feet length and 7 feet width for piglets upto fattening stage or a sow with piglets upto weaning stage. A minimum of 1 foot deep litter materials consisting of either saw dust or rice husk is maintained at the floor of the sty. The bedding material is to be maintained for one month after which it should be replaced with fresh bedding material depending upon the state of decomposition of the litter. In addition to the improved technology of housing system, improved pig breed (Lumsniang) was also introduced in the villages. This breed is developed by crossing Khasi local pig (Sniang Megha) with exotic pig Hampshire. It has 25% genetic inheritance of Khasi local and 75% genetic inheritance of Hampshire. During the year 2018-19, each village received 30 nos. improved breeds which gave higher productivity and income. After one year, 5 pigs with an average weight of 60 kg had been sold by the farmers at an average price of Rs 200/- per kg.

H. Improved Rice production

During the year 2018-19, ICAR Umiam under the NPOF project has successfully introduced improved rice production technology to the farmers in the three adopted villages.

Variety: Shahsarang 1 (lowland)

Cultivation method: Integrated crop management

Spacing: 20 x 20 cm

Seedlings age: 20 days

No. of seedlings/hill:2

The purpose of introducing the high yielding variety (Shahsarang-1) and improved production technology to the farmers was to increase the rice production and productivity with the aadoption of improved production technology. Training and demonstrations were given to the farmers on organic package of practices for rice and line transplanting of rice. A total area of 6 hectares was brought under organic rice production.

Demonstration online transplanting of rice in farmer's field

Improved rice variety (Shahsarang-1)

I. Organic Vegetables and Crop Production

Important cropping systems, which were found to be economically better or at par with conventional system were being introduced in the adopted villages under Network Project on Organic Farming with the goal of conserving soil and water and sustaining crop production as well as promoting crop diversification as an important option in sustainable agricultural system. Some of the cropping systems that were introduced are carrot/ rice (pre kharif) – rice (kharif), potato/


Community nursery for vegetable crops like cabbage, cauliflower, broccoli, chilly etc.

rice (pre kharif) – rice (kharif), tomato/ rice (pre kharif) – rice (kharif), French bean/ rice (pre kharif) – rice (kharif) etc.

The farmers were provided with improved quality seeds of cereals, pulses, vegetables as well as spices with proper recommendation of organic management practices for enhancing their income and productivity.

- Nutrient source: For spices application of FYM was applied @ 2kg/m2 and for cereals and vegetables application of FYM @ 10-15 t/ha. Also vermin-compost and pig manure were used by some farmers as nutrient sources for cultivation of crops.
- Weed management: Hand weeding hoeing.
- Pest and disease management: Regular monitoring of the fields was followed and spraying of neembicidine @ 3ml/litre.

Beneficiary farmers were trained for nursery raising and scientific methods of vegetable cultivation. Community nurseries were formed in the villages during the year 2015-2018 for raising seedlings of cole crops like cabbage, broccoli and cauliflower. This activity was found to be very crucial because it helps in increasing germination percentage and producing healthy seedlings in off season to raise early crop for higher profit.

(a) Leguminous crops

Leguminous crops like groundnut, soybean etc. were cultivated in newly constructed terraces to enhance soil

Fig: Groundnut in farmer's field

Area and production of groundnut in farmers' fields

Sl. no.	Farmer's Name	Area (m^2)	Production (kg)	Production (kg/m^2)	Production (t/ha)
1	Pynskhem Kharsohnoh	140	30.05	0.21	2.146
2	Banisha Kurbah	90	10.52	0.12	1.169
3	Balasyrpai Rympei	130	19.9	0.15	1.531
4	Thmubha Rynghang	120	17.51	0.15	1.459
5	Phibar Kyrsian	125	18.25	0.15	1.460
6	Bathiang Nongkharai	100	12.13	0.12	1.213
7	Penshisha Rynghang	105	13.57	0.13	1.292
8	Diamond Nongkharai	110	15.14	0.14	1.376
9	Elisha Rynghang	120	21.50	0.18	1.792
10	Sharmila Rynghang	125	24.50	0.20	1.960
Mean	**116.5 ± 26.50**	**18.31 ± 8.09**	**0. 15± 0.08**	**1.54 ± 0.53**	

fertility. Groundnut (Var. ICGS 76 @ 150 kg) and Soybean (Var.JS-81@ 150 kg) were cultivated as trials in farmer's fields at various locations and it was found that 820 kg of groundnut could be produced from an area of 3000 square meter.

J. Integrated Organic Farming System (IOFS) Model

The organic farming technology standardized by ICAR Umiam under Network Project On Organic Farming has been disseminated to three villages viz., Mynsain, Pynthor and Umden Umbathiang and demonstrated to 330 households covering an area of about 300 ha. In addition to the existing IOFS models, 2 more beneficiaries were selected during the year 2018-19, for developing the IOFS model. The IOFS model promotes crop diversification thereby improving the farmers' livelihood and providing food security round the year along with enhancement of soil fertility and generating employment for the farmers. Furthermore, outputs of one enterprise component are used as inputs for other related enterprises wherever feasible. Thereby, very little amount of nutrient is required to be met from external sources which can be reduced substantially with the recycling of pond silt, intercropping with legume, use of bio-fertilizers in crop production.

Interventions under IOFS

- For improving the livelihood of the farmers, technological intervention such as zero tillage for cultivation of crops viz., vegetable pea, mustard, cole crops and introduction of HYV crops (maize var.DA-61A and rice var. Shahsarang and Bhalum-1) were made.
- Farmers were also encouraged to grow fodder crops such as Napier, Congo signal and Guinea grass on terrace risers. The objective of growing fodder crops is to bring back degraded lands under cultivation for improving the soil fertility and for supplying green fodder as a feed to milch animals, thereby providing required nutrients for milk production and health of dairy animals.
- Low cost micro storage structures (Jalkund) with 250 GSM Silpaulin linings of 30,000 litres capacity for live saving irrigation were constructed. These structures were constructed to enable the farmers to harvest rainwater during the rainy season and subsequently use the water during dry periods as well as to provide critical irrigation to high value winter crop.
- The ponds were constructed for adding value to other farming activities in which water from ponds can serve as domestic and livestock water supplies as well as rearing of fish.
- Introduction of improved pig varieties (75% Hampshire and 25% mixed local) and poultry birds (Breed-Vanaraja & Gramapriya) which gave higher productivity and income.
- In addition, fruit tree plantation such as assam lemon and sweet orange were also initiated for enhancing the income of the farmers.
- Hedge row species such as Tephrosia and Crotolaria spp were also grown around the farm which served as a purpose of fencing, soil and water conservation and

List of farmers for IFS model

Sl.No	Farmers	Farming Components	NRM
1	Skola Kurbah	Vegetables + Turmeric+Ginger+ Poultry +Pisciculture	Pond
2	Trias Makroh	Vegetables + Fruit Trees(Assam lemon , sweet orange,papaya + Piggery + Pisciculture	Jalkund
3	Jril Makroh	Vegetables + Piggery + Dairy+Pisciculture	Jalkund
4	Arjun Chettri	Vegetables + Piggery + Poultry + Apiculture	Jalkund
5	Rias Makhroh	Rice + Vegetables + Piggery +Pisciculture	Pond
6	R Dohtdong	Vegetables +Fruit Trees + Piggery + Poultry	Jalkund
7	Ailin Nongrang	Vegetables + Turmeric+ Piggery + Dairy	Jalkund
8	Lestonia Mawlong	Rice+Vegetables + Piggery + Apiculture	Jalkund
9	Lawan Nongbri	Vegetables + Piggery + Pisciculture	Jalkund
10	Trian Thabah	Fruit Trees (Assam lemon , Pomelo) + Vegetables + Piggery+Poultry	Pond
11	Hynniew Rynghang	Vegetables + Fruit Trees + Pisciculture + Poultry	Jalkund
12	Sharmila Rynghang	Vegetables + Piggery + Poultry	Pond

supply of nutrient rich green leaf manure. The interspaces were used for growing crops thereby increasing production.

- A vermicomposting unit was constructed to recycle on-farm biomass to increase the fertility of the soil.

Currently, twelve farmers in the adopted villages have started practicing Integrated Farming System (IFS) + cultivation of crops organically. They have integrated cereal crops (Rice, Maize), Vegetables (Tomato, French bean, Potato, Lettuce, Carrot) along with Livestock (Dairy/ Piggery) and also water harvesting structures (Jalkund) etc. in the system.

Fig: Training cum demonstration programme on " Organic rice seed production"

Fig: One day Training on "Integrated Organic Farming System in cluster approach"

Inspection of farmers field (soil borne insect pests)

field Day

Organic outlet

Vegetables sold at the outlet

Input distribution cum field demonstration programme on promotion of organic farming under Tribal Sub Plan (TSP)

PUBLICATIONS/HUMAN REOURCE DEVELOPMENT AND WORKSHOPS/MEETINGS

8

8.1 Publications

8.1.1 Research Papers

Bhopal

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8.1.2 Popular article/folders/ Palmphletp

Bhopal

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- Chetana Sinha and Dr. Sunil Kumar (2019) Dalhani faslo ke liye rhizobium taral jaiv-urvarak. C.G. Krishi Vaniki
- Chetana Sinha and Dr. Sunil Kumar (2019) Dairy udyog me Bhais palan ka mahatav. C.G. Krishi Vaniki
- Chetana Sinha and Dr. Sunil Kumar (2019) Mitti parishan kab, kyu aur kaise kare. C.G. Krishi Vaniki
- Dr. S.S. Porte, Dr. Komal singh kerram and Kritika Dongre (2019) Kisan bhai Dhan ke khet me hari khad ka pryog kab aur kaise kare. C.G. Krishi Vaniki
- Kritika Dongre, Dr. D.S. Thakur and Dr. S.S. Porte (2019) Kisan bhai, Jimikand ka achaar vaigyanik takniki se banakar adhik labh kaise paye. C.G. Krishi Vaniki

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8.1.3 Books/ Book Chapter/ Bulletins/Mannual

Bhopal

- Arti Mathur, Sanjeev Kumar Mathur, Rakesh Mehta, Singh A Band A SubbaRao (2018). Characterization of Biological Parameters in Different Compost Products made from Water hyacinth. Published In: Abstracts/ Proceedings of International Conference on Science and Environmental Sustainability for a Peaceful Society held during January, 19-21, 2019, Organized by

Janparishad, Bhopal, pp, 127-132.

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- Singh A B, J K Thakur and M C Manna (2019). Nutrient Management Strategies under Organic Production System. Published In: Proceedings of International Symposium on Edible Alliums: Challenges and Opportunities held during February, 09-12, 2019 at YASHADA, Pune, pp 93-102.

Coimbatore

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Ludhiana

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Pantnagar

- Gangadhar Nanda, D.K.Singh, Subhash Chandra and D.C. Kala (2018). Legumes for enhancing the performance of cereal based cropping systems- An overview. P69-76.

Ajmer

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- G. Lal, A. S. Panwar, N.K. Meena, N. Ravisankar, M.K. Choudhary & Neha Shekhawat. 2019. Organic Farming of Fennel. Published by Dr. Gopal Lal, Director& PI, AI-NPOF, ICAR-NRCSS, Ajmer, Pp 1-15.
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- जी. लाल, एस.एन. सक्सेना, वाइ. के. शर्मा, एस.एस. मीणा, एस. लाल, एम. डी. मीणा, ए.के. वर्मा,एवं एन. चौधरी. 2019. बीजीय मसाला की जैविक एंव आधुनिक उत्पादन तकनिकिया। पकाशकः डॉ गोपाल
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Udaipur

- S.K. Sharma, Roshan Choudhary, GajananadJat, R. S. Choudhary, Amit Triwedi, B.G. Chhipa, Hemant Swami, R. K. Jain and S. K. Yadav (2019) Bulletin: Knowledge and skill development in organic farming, IDP, NAHEP MPUAT, Udaipur.
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- S.K. Sharma, Roshan Choudhary, GajanandJat, R.S. Choudhary, B.G. Chhipa (June, 2019) Compendium-ICAR- CAFT on Organic Farming on "Research and Development in Organic Farming: Current Status and Way Forward" CAFT on Organic Farming.
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- S.K. Sharma, Roshan Choudhary, AbheyDashora, B. G. Chhipa, S. M.Mathur, Rekjha Vyas, A. K. Mehta and Garima Vaishnava (May, 2018) Bulletin: Intellectual Property Creation, Development and Management, IDP, NAHEP MPUAT, Udaipur.
- S.K. Sharma, Roshan Choudhary, AbheyDashora, B. G. Chhipa, S. M.Mathur, Rekjha Vyas and A. K. Mehta (May, 2018) Bulletin: 100 questions & Answers on IPRs, IDP, NAHEP MPUAT, Udaipur.
- S.K. Sharma, Roshan Choudhary, B.G. Chhipa, R.S. Choudhary, MeenuSrivastva, Lokesh Gupta, Amit Kumar &Garima (March, 2019) Bulletin: Motivation and Work Culture Standii for Better Performance & Institutional output, IDP, NAHEP MPUAT, Udaipur.
- S.K. Sharma, Lokesh Gupta, Rekha Vyas, Roshan Choudhary, N. L. Dangi and Amit Kumar (30-31 May, 2019) Bulletin: Enhancing Professionalism in Agriculture Sector, IDP, NAHEP MPUAT, Udaipur.
- S. K. Sharma, Lokesh Gupta, Rekha Vyas, Roshan Choudhary and Amit Kumar (30-31 May, 2019) Bulletin: Updation of Academic Professionalism, IDP, NAHEP MPUAT, Udaipur

8.2 Participation in International/National Conferences/Paper presented/ Abstracts Meeting / Seminar/ Symposium/ Workshop.

Jabalpur

- Arvind Ahirwal, Nisha Sapre, K.K. Agrawal and R.P. Sahu 2018. Efficacy of pyroxasulfone 5% + pendimethalin 40% ready mixture for ontrolling weeds in soybean. ISWS Golden Jubilee International Conference on "*Weeds and Society: Challenges and Opportunities*", ICAR-Directorate of Weed Research, Jabalpur, India during 21-24 November 2018.
- Bankerlang Khongwir, R.P. Sahu, M.L. Kewat and Rajendra Patel 2018. Bio-efficacy of bispyric-sodium in growth and yield of transplanted rice – A review. ISWS Golden Jubilee International Conference on "*Weeds and Society: Challenges and Opportunities*", ICAR-Directorate of Weed Research, Jabalpur, India during 21-24 November 2018.
- Bermaiya Uma, Jain Namrata, Sahu M P and Jain Vinamarta 2018. Pre and post emergence herbicides for weed control in soybean. In ISWS Golden Jubilee International conference on "Weeds and Society p. 103: Challenges and Opportunities", ICAR- Directorate of Weed Research, Jabalpur, India during 21-24 November, 2018. p- 208.
- Dr. V.K. Shukla attended the Quinquennial Review Teams (QRT) meeting of QRT of ICAR-IIFSR (including AICRP-IFS and NPOF) at RARI, Durgapur, Jaipur during 10-11 October,2018
- Dr. V.K. Shukla attended the "V Biennial Workshop (XXXIII of project) of "AICRP on Integrated Farming Systems" at University of Agricultural Sciences, Bengaluru (Karnataka) during 20-23 December 2018-Updated list of Guests from UAS, Bengaluru.
- Dr. V.K. Shukla attended and presented research paper entitled "Doubling the income of small and marginal farmers through integrated farming systems modal for their sustainability, profitability and economic viability" in the National Symposium on "Integrated Farming Systems for 3Es" (Ecological sustainability, Enhanced productivity and Economic prosperity) organized by UAS, Bengaluru, IIFSR, Modipuram and Indian Society of Agronomy, ICAR and CIMMYT New Delhi on 23-24 December 2018, at UAS, GKVK, Bengaluru.
- Jain Namrata, Shukla VK, Ghode BD and Sahu RP 2019. On-Farm crop response to plant nutrients in pre-dominant cropping system of Katni district of Madhya Pradesh. *In*: National Seminar on Innovative Approaches for Rural and Agriculture Advancement at JNKVV, College of Agriculture, Tikamgarh, M.P. during 10-11 January, 2019. p. 127
- Rajul Soni, Rajendra Prasad Sahu, Shobha Sondhia and Jitendra Patidar 2018. Efficacy of pyribenzoxim against weeds in direct-seeded rice under

Kymoreplateau and Satpura hills. ISWS Golden Jubilee International Conference on "*Weeds and Society: Challenges and Opportunities*", ICAR-Directorate of Weed Research, Jabalpur, India during 21-24 November 2018.

- Sahu Rajendra Prasad, Shukla V.K., Vishwakarma S.K. and Jha G.(2018). Doubling the income of small and marginal farmers through integrated farming Extended summaries presented in XXI Biennial National Symposium on "Doubling Farmers' Income Through Agronomic Interventions Under Changing Scenario" co organized by Indian Society of Agronomy, New Delhi Indian Council of Agricultural Research, New Delhi Maharana Pratap University of Agriculture & Technology, Udaipur, Rajasthan 24–26 October, 2018 at MPUAT, Udaipur, Rajasthan pp 356.
- Shukla V. K., Vishwakarma S. K., Sahu Rajendra Prasad and Patel Balram (2018)." Doubling the income of small and marginal farmers through integrated farming systems modal for their sustainability, profitability and economic viability." Souvenir and abstracts presented in National Symposium on Integrated Farming Systems for 3Es. Co-organized by UAS, Bengaluru, IIFSR, Modipuram and Indian Society of Agonomy, ICAR and CIMMYT New Delhi on 23-24 December 2018, at UAS, GKVK, Bengaluru pp 225
- Shukla V.K., Vishwakarma S.K., Sahu R.P. and Jha G. (2018). Study of IPNS on soil properties under rice - wheat cropping system at Kymore Plateau and Satpura Hills zone of Madhya Pradesh. Extended summaries presented in XXI Biennial National Symposium on "Doubling Farmers' Income Through Agronomic Interventions Under Changing Scenario" co organized by Indian Society of Agronomy, New Delhi Indian Council of Agricultural Research, New Delhi Maharana Pratap University of Agriculture & Technology, Udaipur, Rajasthan 24–26 October, 2018 at MPUAT, Udaipur, Rajasthan pp 60.
- Vishwakarma S.K., Shukla V.K., Sahu R. P. and. Jha G. (2018). Long-term effect of integrated nutrient management on productivity of rice- wheat cropping system at Kymore Plateau and Satpura Hills of Madhya Pradesh. Extended summaries presented in XXI Biennial National Symposium on "Doubling Farmers' Income Through Agronomic Interventions Under Changing Scenario" co organized by Indian Society of Agronomy, New Delhi Indian Council of Agricultural Research, New Delhi Maharana Pratap University of Agriculture & Technology, Udaipur, Rajasthan 24–26 October, 2018 at MPUAT, Udaipur, Rajasthan pp 61.

Ludhiana

- Annual workshop of Network Project on Organic Farming, TNAU, Coimbatore, 27 to 29 Nov. 2018.
- Brainstorming session on Certificate Course on Plant Health Management (PHM) in organic farming, NIPHM, Hyderabad, 10 to 11 May 2019.
- Brainstorming on Indigenous organic practices including zero budget natural farming (ZBNF) vs scientific organic farming, TNAU, Coimbatore& ICAR-IIFSR, 28 Nov. 2018.
- Discussion on Organic Farming, Markfed, Punjab, Chandigarh, 16 January 2019.
- Group discussion on Zero Budget Natural Farming (ZBNF) in states, Deptt of Agriculture and Cooperative, GOI, New Delhi, 11 Dec. 2018.
- QRT workshop of NPOF and AICRP-IFS, SKUAST, Jammu, 22 to 23 Nov. 2018.
- Training cum workshop of PAU Crop Residue Managers Association (PAU Ludhiana-CRMA), PAU Ludhiana, 20 Dec. 2018
- Workshop on "Strategic and long term impacts of organic agriculture", 18 to 21 Sept. 2018, FiBL, Frick, Switzerland.
- Workshop on Zero Budget Natural Farming (ZBNF), Gurukul Institute, Kurkshetra, Haryana, 8 Oct. 2018.

Pantnagar

- D.K.Singh, Shilpi Gupta, Gangadhar Nanda, Yogesh Sharma, V.V. Singh and Dipti Bisarya (2018). Crop nutrition and their impact on soil health under organic production systems in tarai conditions of Uttarakhand, India. In 20th International conference on soil science and plant nutrition (ICSSPN-2018) organized by World academy of science, Engineering and tech. Paris, (France) during Jan. 25-26 2019.
- D.K.Singh, Shilpi Gupta and Yogesh Sharma (2017). Productivity and changes in soil after one decade of comparing organic and chemical production systems under subtropical conditions of Uttarakhand

(India). In International Conference on Organic Agriculture in Tropics (ORGATROP-2017) August 20-24 at University of Gadjah Mada, Yogyakarta (Indonesia)

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- Ravi, Y. Verma, A.K., Choudhary, N., and Lal, G. 2018. Suitable medicinal plants for arid and semi arid regions under changing climate scenario. In: 1st International conference on "Climate change and adaptive crop protection for sustainable agrihorticulture land scape", organized by SPPS, ICAR-NCIPM, New Delhi & ISSS during 20-22 December, at ICAR-NRCSS, Ajmer (Rajasthan). Pp.133.
- Sharma, M., Choudhary, S., Meena, R.D., Lal, G. and Verma, A.K. 2018. Characterization of gamma rays induced fennel mutants using morphological and molecular markers. In: 1st International conference on "Climate change and adaptive crop
- Vishal, M.K., Lal, G., Kant, K., Choudhary, S., Verma, A.K., Khan, M.A. and Meena, M.D. 2018. Assessing approachability and uses of ICT and other effective medium of information dissemination to seed spices growers- Cumin and coriander of Western India:
- Vishal, M.K., Lal, G., Balai, S., Kumar, S. and Sharma, S. 2018. Assessing approachability and usage of ICT and other medium of information dissemination to seed spices growers-cumin and coriander of western India: A case study. In: 1st International conference on "Climate change and adaptive crop protection for sustainable agrihorticulture land scape", organized by SPPS, ICAR-NCIPM, New Delhi & ISSS during 20-22 December, at ICAR-NRCSS, Ajmer (Rajasthan), Pp. 86.

Udaipur

- Dr.Gajanand Jat participated in the 21 days ICAR-Summer School on "Doubling Farmers Income: Technology Interventions in Agriculture" 07- 27 September, 2018 at Rajasthan College of Agriculture, Udaipur
- Dr. Roshan Choudhary, Assistant Professor, Department of Agronomy, RCA, MPUAT, Udaipur participated in Oral Presentation on topic "Three Tier Management Practices for Effective Weed Management in Sweet Corn" in the 27th Asian-Pacific Weed Science Society Conference (APWSS-2019) during 3-6 September 2019 at Kuching, Sarawak Malaysia.
- Dr. S. K. Sharma, PI, NPOF visited Western Sydney University, Sydney (Australia) from 22nd June to 3rd July, 2019 to discuss and initiate intensive collaboration in teaching, research, student exchange and short programs in the discipline of agriculture.
- Dr. S.K. Sharma & Dr. Roshan Choudhary attended QRT meeting of NPOF, 10 to 11 October, 2018 at RARI, Durgapura.
- Dr. S.K. Sharma & Dr. Roshan Choudhary Attended Annual Group Meeting of NPOF, TNAU, Coimbatore during 27-29 Nov., 2018.
- Dr. S.K. Sharma & Dr. Roshan Choudhary participated in National Symposium on "Doubling farmers income through agronomic interventions under changing scenario" organized by ISA & MPUAT, 24-26 Oct, 2018 at Udaipur.
- Dr. S.K. Sharma, Dr. Devendra Jain, Dr. Amit Trivedi, Dr. Roshan Choudhary and Dr. Gajanand Jat participated in Launch-cum-Orientation programme of IDP, NAHEP, and MPUAT on 01 Jan, 2019.
- Dr. S.K. Sharma, Dr. Devendra Jain and Dr. Roshan attended training programme on "Interaction on

designing hands on tsraining and experiential learning" 18 April, 2019 at MPUAT under IDP, NAHEP, New Delhi.

- Dr. Roshan Choudhary and Dr.Gajanand Jat participated in Workshop on "Academic excellence through building partnership and resource generation" organized by ICAR-at NAARM under NAHEP, 30th April to 01st May, 2019.
- Dr. S. K. Sharma participated and presented Lead paper on entitled on Good Agricultural Practices for Horticulture Production, 18-19 Feb., 2019 at College of Horticulture and Forestry, Jhalawar, Rajasthan.
- Dr. S.K. Sharma, Dr. Roshan Choudhary and Dr.Gajanand Jat participated in the Zero Budget Natural Farming Programme (Organic Farming), 7-8 October, 2018 at Gurukul, Kurukshetra, Harayana
- Dr. S.K. Sharma participated in Brainstorming session on Organic Farming and designing course content and modalities to launch certificate course on Plant health management in organic farming system, 13th May, 2019 at NIPHM, Rajendranagar, Hyderabad
- Dr. S.K. Sharma participated in one day meeting for validating the results and examining the weaknesses of SPNF model, 10 May, 2019 at PJTSAU, Hyderabad

Training/workshop /programme conducted:

Bhopal

- Dr A B Singh had given training on "Organic farming and Soil health" to the 30 extension officers on dated 28/07/2018, arranged by State Institute of Agriculture Extension & Training, Bhopal.
- Dr A B Singh had given training on "Organic Farming System Approach" to the 35 candidates of Agri-Clinic and Agri- Business on dated 01/08/2018, arranged by Centre for Advanced Research & Development, Bhopal, Madhya Pradesh.
- Dr A B Singh had given training on "Organic Farming System Approach" to the 62 students of Agri-Clinic and Agri- Business Centre Scheme on dated 06/12/2018, arranged by Indo-Europen Chamber of Commerce & Industry, Bhopal, Madhya Pradesh.
- Dr A B Singh had given training on "Organic Farming " to the 35 candidates of Agri-Clinic and Agri- Business on dated 20/12/2018, arranged by Centre for Advanced Research & Development, Bhopal, Madhya Pradesh
- Dr A B Singh had given training on "Organic Farming, demonstration along with techniques of soil testing" to the 20 candidates of Agri-Clinic and Agri- Business on dated 22/12/2018, arranged by Centre for Entrepreneurship Development , Madhya Pradesh (CEDMAP).
- Dr A B Singh had given training on "Organic Farming" to the 20 candidates of Agri-Clinic and Agri- Business on dated 18/12/2018, arranged by Centre for Entrepreneurship Development, Madhya Pradesh (CEDMAP).
- Dr A B Singh had given training on "Vermicomposting technique" to the Green House Operator under Prime Minister Skill Development Programme Training on dated 20/11/2018, arranged by KVK, ICAR-CIAE, Bhopal
- Dr A B Singh had given training on "Different Organic & In Organic source of Nutrients and Different practices of INM and Balance use of fertilizers" to the Extension Officer/ Agriculture Officers on dated 25/05/2018, arranged by State Institute of Agriculture Extension & Training, Bhopal.
- Dr A B Singh had given training on "Organic farming What, Why and how? Different Components of Organic Farming" to the Krishak Mitra/Didi on dated 08/10/2018 arranged by State Extension & Training Centre Obedullaganj, Distt.Raisen.
- Dr A B Singh had given training on "Organic Farming & Soil health management" For Diploma in Agricultural Extension Services for Input Dealers (DAESI) programme, organized by Indo-Europen Chamber of Commerce & Industry, Bhopal (Madhya Pradesh) on dated 16/10/2018.
- Dr A B Singh had given training on "Organic Farming and Composting techniques" to the farmers of Department of Agriculture (ATMA), Coimbatore, Tamil nadu, arranged by ICAR-IISS, Bhopal during 29-31, October, 2018.
- Dr A. B. Singh One day Workshop on Strategies to improve Agricultural Extension in Madhya Pradesh SIEAT, Bhopal, 4th July, 2018.
- Dr A. B. Singh, 13th Annual Group Meeting of NPOF,

TNAU, Coimbatore, November 27-29, 2018.

- Dr A. B. Singh, Second Meeting of QRT-ICAR-IIFSR in relation to Organic farming, Rajasthan Agricultural Research Institute, October, 10-11, 2018.
- Dr A. B. Singh, Dr Brij Lal Lakaria, 83rd Annual Convention of Indian Society of Soil Science, Anand Agricultural University, Anand, November, 27-30, 2018.
- Dr A. B. Singh Janparishad's 6th International Conference on "Science and Environmental Sustainability for a Peaceful Society, JANPARISHAD, State Museum, Bhopal, January, 19-21, 2019.
- Dr A. B. Singh Global Clean Up Congress-2018, TNAU Coimbatore, October, 22-24, 2018.
- Dr A. B. Singh International Symposium on Edible Alliums: Challenges and Opportunities, YashwantraoChavan Academy of Development Administration, Pune, February, 9-12, 2019.
- Dr A B Singh, Dr Asha Sahu and Dr R H Wanjari, Global Organic Convention on Natural Resource Management for Sustainable Agriculture, Soil Health and Quality food, Hotel Le Meridian Nagpur, September, 15-17, 2019.
- Dr A B Singh Workshop on Kharif crops, GulabGraden Bhopal, 22 August, 2019.

Coimbatore

- Automated Weather Forecasting –Web through App, Dr.R.Jansirani, ACRC, TNAU, Coimbatore
- Information and communication technologies for empowering farm women, Dr.A.Bharani, 1-6.Feb. 2019, NAARM, Hyderabad
- Jansirani, R (2018) Technology based development of organic agriculture- a critical study, International national conference on Invigorating Transformation of Farm Extension towards Sustainable Development- Futuristic Challenges and Prospects during March 9 & 10, 2018 at TNAU Coimbatore. Pp 322.
- Jansirani, R (2018) Organic agriculture and gender equality-an analytical study, International national conference on Invigorating Transformation of Farm Extension towards Sustainable Development- Futuristic Challenges and Prospects during March 9 & 10, 2018 at TNAU Coimbatore. Pp 361.
- One day farmers training programme on Organic Farming System, Dr. K. Ganesan, 27.4.2018, ADA. Periyanayakkan, Palayam.
- Somasundaram.E (2018) Assessment of system and productivity and economics of organic crops, CIMMYT Bengaluru from 23.12.18 to 24.12.18.

Ludhiana

- Farmers' training on Good Agricultural Practices (GAP) in basmati rice, 30 May 2019, participants' no-60.
- Organic farming: Standards and Certification. In: Training on Organic farming and production of Medicinal, Aromatic and Spice crops. 13-18.05.19. STRY, PAMETI & SOF, PAU Ludhiana, 13-18 May19, participants' no-12.
- Organic farming and production of medicinal and aromatic plants.In collaboration with Pameti, 25 Feb. to 02 March 2019, participants' no-20.
- Training on 'Organic farming & Vermicomposting for farmers and farm women'.PAU Ludhiana. SDC, PAU Ludhiana (Technical Coordinator) 25-26 July 19, participants' no.-15.
- Training camp for PAU- Organic Farming Club, PAU Ludhiana (Coordinator), 18 July 2019, and participants' no-65.
- Interactive session on Medicinal and aromatic plants with American business delegation and Garrysun USA, 24 May 2019.
- Training camp for 'PAU-Organic Farming Club' at PAU, Ludhiana (Programme Associate Director), 18 April 2019, and participants' no-66.
- Training on 'Good Agricultural Practices in summer Moong' at KVK Sangrur under DBT-KISAN project, 08 April 2019, participants' no-35.
- Training on 'Good Agricultural Practices in summer Moong' at KVK Sangrur under DBT-KISAN project, 05 April 2019, participants' no-40.
- Training on 'Good Agricultural Practices in summer Moong' at KVK Ferozepur under DBT-KISAN project, 04 April 2019, participants' no-30.
- Skill development training course on Organic Grower. Skill Development Centre, PAU Ludhiana. (Course

Director), 18 to 20 March 2019, participants' no-18.

- Status of Agro biodiversity in Punjab.In: Panel discussion on traditional crop varieties of Punjab by PG Science City & Punjab Biodiversity Board, 22 May 2019 and participants no- 200
- Training camp for PAU- Organic Farming Club, PAU Ludhiana (Programme Associate Director), 30 January 2019, and participants' no-40.

Ranchi

- 03 days on campus training Programme was organized from 11th March to 13th March, 2019 on "organic Farming" under Tribal Sub Plan (TSP), Network Project on Organic Farming for awareness and improvement about organic farming to increase adoption at village levels. Total beneficiaries: 50 Tribal farmers (Male – 32, Female- 18.

Umiam

- Cultivation of mushroom in organic farming, ICAR Research Complex for NEH Region, Umiam, 28-30th January, 2019, beneficiaries no 20.
- Integrated pest management in organic farming, Mynsain, Pynthor and Umden Umbathiang, 21-23rd January, 2019, beneficiaries no 80.
- Integrated organic farming system (IOFS) for livelihood security and doubling of farmer's income, ICAR Research Complex for NEH Region, Umiam, 14th November, 2018, beneficiaries no 80
- No-till organic pulse production in rice fallow for improving soil health and cropping intensity, Mynsain village, 16h November, 2018, beneficiaries no 28.
- Organic seed certification system/participatory guarantee system, Pynthor village, 02nd August, 2018, beneficiaries no 40.
- Participatory Seed Production" in *Kharif* 2018, Mynsain village, 24th October, 2018, beneficiaries no 30.

Udaipur

- किसान खेत पर अधिकतम लाभ के लिए जैविक प्रबंधन रणनीतियां at Directorate of Research, MPUAT, Udaipur, 25th July, 2018 and no of participants 30.
- जैविक कृषि की उन्नत तकनीके तथा मृदा स्वास्थ्य प्रबंधन at Directorate of Research, MPUAT, Udaipur, 5th December, 2018 and no of participants 42.
- IDP, NAHEP, New Delhi, Opportunities of entrepreneurship in organic farming for graduates of Agriculture University and no. of participants 75.
- IDP, NAHEP, New Delhi. Better institutional work environment & competing values for optimal performance of employees and no. of participants 103.
- IDP, NAHEP, New Delhi. Updation of Academic Professionalism among University Teachers: A Step towards New Professionalism and no. of participants 70.
- IDP, NAHEP, New Delhi. Two days workshop on Intellectual Property Creation, Development and Management and no. of participants 56.
- On farm trainings on Improved Method of Vegetable Cultivation, 17th August, 2018 and no. of participants 35.
- On farm trainings Crop Management Practices, 15th November, 2018 and no. of participants 45.
- On farm trainings on Liquid Manure Preparation & Spray, 13th February, 2019 and no. of participants 30.
- Organized CAFT- 21 days Training Programme, "Recent advances and innovation in organic agriculture" during 5-25 sept Gangadhar Nanda, D.K.Singh, Subhash Chandra and D.C. Kala (2018). Legumes for enhancing the performance of cereal based cropping systems- An overview. P69-76ember, 2018 at DoR, MPUAT, Udaipur and no. of participants 25.
- Organized CAFT- 21 days Training Programme, Research and Development in Organic Farming: Current Status and Way Forward"01-21 June, 2019 at DoR, MPUAT, Udaipur and no. of participants 26.

List of Radio talk/Television talks

Bhopal

- Dr. A. B. Singh had given Radio talk on "Kenchua Khad Kheti keliye Vardan 08/10/2018 at Prasar Bharati, All India Radio Bhopal
- Dr A B Singh had give live telecast programme on "Hari Khad ki upyogita" on Doordarshan Kendra, Bhopal, Madhya Pradesh.

Jabalpur

- TV Talk given by Dr. P. B. Sharma for News 18 on dated 03.08.2018 and 06.08.2018. Topic: Dhan Ganna Evam Soybean mai samayik Krishi Karya
- अलसी की उन्नत कृषि कार्यमाला। कार्यक्रम कृषि विश्वविद्यालय से खेतो तक। Dated 22.10.2018 by Dr. S. K. Vishwakarma Radio talk
- ग्रीष्म कालीन मूगं व उडद की उन्नत कृषि कार्यमाला। कार्यक्रम कृषि विश्वविद्यालय से खेतो तक। Dated 18.02.2019 by Dr. S. K. Vishwakarma Radio talk

AWARDS

Coimbatore

- Dr. E. Somasundaram, Recognized for the special lecture on organic production of cereals and millets during the National Seminar on Prospects of Organic Farming at School of Agriculture and Animal Sciences, Gandhigram University. Tamil Nadu.
- Dr. E. Somasundaram Awarded for the best presentation on Scientific evaluation of organic paddy varieties at Paddy Festival – CREARE, Thiruthuraipoondi, Tamil Nadu during 21-22, May, 2018.
- Dr. E. Somasundaram Recognized for the special lecture on organic production of cereals and millets during the National Seminar on Prospects of Organic Farming at Gandhigram University, Tamil Nadu.
- Dr. E. Somasundaram Outstanding Scientist Award VD Goods International New Delhi (Medal and certificate).

Udaipur

- Appreciation award to Dr. S. K. Sharma and team by Hon'ble Vice-Chancellor, MPUAT, Udaipur during Republic day, 2019 for outstanding work in organic farming
- Appreciation award to Dr. S. K. Sharma by Hon'ble Vice-Chancellor, MPUAT, Udaipur during Independence Day, 2019 for outstanding work in conservation of genetic lac resources.
- Best Centre Award under Network Project on Organic Farming at National level for the year 2017-18 at Annual Group Meeting, TNAU, Coimbatore for significant contribution in Organic Farming.
- Best Poster Presentation award to Dr. Hari Singh, G. L. Meena, M. K. Jangid, S. K. Sharma and B. G. Chhipa on paper entitled Income and employment generation through various interventions of farming systems in Southern Rajasthan in the National Seminar on Entrepreneurship & innovation in Agriculture for Socio-economic empowerment of Farmers organised by ICAR-NAHEP, SKRAU, Bikaner from 12-13 March, 2019.
- Best Centre Award under Cooperating Centre of Network Project on Conservation of Lac Insect Genetic Resources at National level in Sixth Coordination Committee Meeting for the year 2018-19 at Annual Group Meeting, MPUAT, Udaipur for Lac Museum cum Laboratory and Lac Host Plant Gene Bank at Department of Entomology, RCA, MPUAT, Udaipur.

Lead paper

Udaipur

- Sharma, S.K., Choudhary, Roshan and Jat, Gajanand. Productivity and economics of maize based cropping systems under organic production system in India. *In Proceedings*: 5th International conference on agriculture (AGRICO) on innovations in agriculture for a sustainable future during 16-17 August, 2018, Colombo, Sri Lanka.
- Sharma, S.K., Choudhary, Roshan, Jat, Gajanand and Ravishankar, N. Strategies for achieving sustainable food systems through organic agriculture.*In Proceedings*: XXI Biennial National Symposium of Indian Society of Agronomy, 24–26 October, 2018 at MPUAT, Udaipur, Rajasthan. Page no. 96-103.
- Sharma, S.K., Choudhary, Roshan, Yadav, S. K. and Jain, Ravindra. Productivity and economics of maize based cropping systems under organic. *In Proceedings*: XXI BiennialNational Symposium of Indian Society of Agronomy, 24–26 October, 2018 at MPUAT, Udaipur, Rajasthan. Page no. 526-528.

Lecturers

Jabalpur

- An expert (Dr. Akhilesh Gupta, FNAE, CHIEF Vigilance Officer & Head, Strategic Programmes, Large Initiation and Coordinated Action Enabler, Deptt. Of Science & Technology, New Delhi) lecture on "Weather Forecasting & Climate Change" at Manthan, DRS, JNKVV, Jabalpur on dated 24-11-

2018.

- Chana Utpadan Taknik in ATMA Pathshala at Bijori and Dulhakheda villages of Patan, Jabalpur on dated 27-1-2019.
- Dr. S. K. Vishwakarma delivered the lecture to the SMS of the Agriculture Department M.P. on "Enhancing productivity of different crops through integrated nutrient management" at Mahatma Gandhi State Rural Institute for Agriculture Development, Adhartal Jabalpur on dated 05.08.2018.
- Dr S. K. Vishwakarma delivered the lecture to the extension workers of the MPRL on "Integrated Nutrient Management" At Mahatma Gandhi State Institute of Rural Development, Adhartal, Jabalpur on 01.10 2018.
- Dr. S. K. Vishwakarma delivered the lecture to the extension workers of the MPRL on "Integrated Nutrient Management" At Mahatma Gandhi State Institute of Rural Development, Adhartal, Jabalpur on 15.11.2018.
- Dr. S. K. Vishwakarma delivered the lecture to the extension workers of the MPRL on "Integrated Nutrient Management" At Mahatma Gandhi State Institute of Rural Development, Adhartal, Jabalpur on 22.11.2018.
- Dr. S. K. Vishwakarma delivered the lecture to the extension workers of the MPRL on "Integrated Nutrient Management" At Mahatma Gandhi State Institute of Rural Development, Adhartal, Jabalpur on 29.12 2018.
- Dr. S. K. Vishwakarma delivered the lecture to the extension workers of the MPRL on "Integrated Farming Systems" for enhancing the productivity and net monetary returns of the farmers at Farmers Training Centre, Adhartal, Jabalpur on 28. 01 2019.
- E-Tv Anndata 05 programmes on Crop production technology, IFS i.e. "Kapas, mungphalli, dalon ki Unnat Taknik" etc. and related aspects on dated 2-6-2018- to Dec. 2018 (6:00am broadcasting) and recording on dt. 28-5-2018 to Dec. 2018.
- Farmers welfare workshop on doubling the income of farmers at Panagar Block of Jabalpur as a Scientist and lectures delivered on organic farming on dated 05 May 2018. (No. Collector/Gram Swarojgar Abhiyan/2018-19/275 JBP dt. 27.04.18)
- Tilhan Utpadan in BPD manage programme at JNKVV, Jabalpur during the month of Aug, 2018.
- Year round Fodder production, bhusa making plan for Instructional Dairy Unit

Ludhiana

- Chemical free farming. In: 'Paryawarn 2.0' Organized by Sojhi Charitable and Welfare Society and LM Thapar School of Management, DeraBassi, Punjab, 13 March, 2019.
- Entrepreneurship in organic farming. In: winter School on farmersempowerment through entrepreneurship ventures. 1-21.02.19, DEE, PAU Ludhiana, 18 Feb, 2019
- Natural Farming. In: Kisan Seminar by Guru Sahib Cheritable Society, Khosa Pando, Moga, 18 March 2019
- Organic agriculture in the food basket of india: Prospects& challenges. In: Workshop on 'Strategic and long term impacts of organic agriculture' 18-21.09.18, Frick Switzerland, 20 Sept. 2018.
- Organic farming: Organic crop management.In: Certificate course on Organic Farming, 09 Oct. 2018 and participants no- 30.
- Organic farming: Standards and certification.In: Organic farming & Production of Medicinal and Aromatic plants, DEE, PAU Ludhiana, 9 Oct., 2018, and participants no-16
- Organic farming: Introduction, Concept and Principles, In: Certificate course on Organic Farming, 2 Oct, 2018 and participants no- 30.
- Organic farming: Certification.In: Skill development training course on Organic Grower. Skill Development Centre, PAU Ludhiana, 9 April 2019 and participants no- 18.
- Organic farming and Integrated farming systems. In: innovative Framers' Meet by CII at Abohar, 28 May 2018.
- Organic farming: Current research and limitations in Punjab. In: CAFT on Organic Farming, MPUAT, Udaipur, Rajasthan, 10 June 2019.
- PAU Interventions on Organic Farming, In: Session on organic farming for safe & sustainable future in 13th Agro-Tech Fair at Chandigarh organized by CII from 2 Dec., 2018.
- Role of organic farming for enhancing soil health, food security and farm income.In: CAFT on Natural Resource

Management – A Step towards doubling farm income. 10-30 10.18, Deptt of Soil Science, PAU Ludhiana, 11 Oct., 2018.

- Status of Agrobiodiversity in Punjab.In: Panel discussion on traditional crop varieties of Punjab by PG Science City & Punjab Biodiversity Board, 22 May 2019.
- TOT Training on Organic Farming. Organized by PBRI in collaboration with ASCI & NSDC, GOI, 14 Dec., 2018 and participants no- 20.

Raipur

- Dr. M.C. Bhambri - Member of Chhattisgarh Organic Certification Committee –CGCERT
- Dr. M.C. Bhambri - Member of State Government Executive Committee for Soil Health and Sustainable Agriculture & PKVY

Udaipur

- Dr. Roshan Choudhary, Dr. S.K. Sharma and Dr. R.S. Choudhary NADEP Compost Method of Preparation and Uses, CAFT on Org. Farming, 1-21 June, 2019
- Dr. Roshan Choudhary, Dr. S. K. Sharma and Dr. R. S. Choudhary Vermicomposting in Organic Farming, CAFT on Org. Farming, 1-21 June, 2019
- Dr. Roshan Choudhary, Dr. S.K. Sharma and Dr. R. S. Choudhary Methods & Strategies for Use of Vermicomposting in Organic Farming, CAFT on Org. Farming, 5- 25 Sept., 2018
- Dr. R. S. Choudhary and Dr. Roshan Choudhary Recent Approaches of Organic Pulse Production: Issues and Management, CAFT on Org. Farming, 5- 25 Sept., 2018
- Dr. S.K. Sharma and Dr. Roshan Choudhary Use of Panchagavya in Organic Farming, CAFT on Org. Farming, 5- 25 Sept., 2018
- Dr. Roshan Choudhary, Dr. S.K. Sharma and Dr. R. S. Choudhary Utilising Organic Agriculture to Adapt to Changing Ecology and Climate, CAFT on Org. Farming, 5- 25 Sept., 2018
- Dr. S.K. Sharma, Dr. Roshan Choudhary, Dr. R.S. Choudhary and Dr. S.K. Yadav Policies Supporting the Development of Organic Agriculture in the World, CAFT on Organic Farming, 1-21 June, 2019
- Dr. S.K. Sharma, Dr. Roshan Choudhary and Dr. R.S. Choudary and Dr.Gajanand Recent Developments in Public Standards and Legislation in Organic Agriculture, CAFT on Org. Farming, 1-21 June, 2019
- Dr. S. K. Sharma, Dr. Roshan Choudhary, Dr. R.S. Choudhary and Dr. S.K. Yadav Potential of Organic Agriculture to Mitigate and Adapt to Climate Change, CAFT on Org. Farming, 1-21 June, 2019
- Dr. S.K. Sharma and Dr. Roshan Choudhary Organic Agriculture: History, Concept and Principles, CAFT on Org. Farming, 5- 25 Sept., 2018
- Dr. S.K. Sharma and Dr. Roshan Choudhary Prospects of Organic Agriculture in 21st Century, CAFT on Org. Farming, 5- 25 Sept., 2018
- Dr. S.K. Sharma and Dr. Roshan Choudhary Organic Certification: Need, Methods and Recent Developments, CAFT on Org. Farming, 5- 25 Sept., 2018
- Dr. Roshan Choudhary and Dr. S.K. SharmaNADEP Compost for Organic Farming, CAFT on Org. Farming, 5- 25 Sept., 2018
- Dr. S.K. Sharma and Dr. Roshan Choudhary PROM: Concept & Strategies to Use as an Organic Alternative to Phosphatic Chemical Fertilizers, CAFT on Org. Farming, 5- 25 Sept., 2018

8.3 Human Resource Development

Details of M.Sc. and Ph.D degree awarded based on the project work

Jabalpur

1. M. Sc. Students guided

Name of student	Chairman/ Co-chairman	Title of thesis	Remark
1. Rajul soni	Chairman Dr. R P Sahu	Evaluation of weed control spectrum of pyribenzoxim in direct seeded rice (*Oryza sativa* L.) under Kymore Plateau and satpura Hills	Completed
2. Govind K. Mory	Chairman Dr. R P Sahu	Evaluation of weed control spectrum of pyribenzoxim in transplanted rice (*Oryza sativa* L.) under Kymore Plateau and satpura Hills	Completed
3. Bankerlang Khengwir	Chairman Dr. R P Sahu	Effect of weed control treatments on growth and yield of transplanted rice	
4. Shyamali Upadhyay	Chairman Dr. R P Sahu	Evaluation of nicosulfuron (SL-950) 6% OD in maize crop against weeds	Completed
5. Pinki Mehra	Chairman Dr. R P Sahu	Performance of rice varieties under organic farming	Continue
6. Kuldeep Singh Sallam	Chairman Dr. V K Shukla	Evaluation of different scented rice varieties under organic farming.	Completed
7. Mahendra Anjana	Co-chairman Dr. V K Shukla	Productivity and grain quality parameters of different varieties of rice	Completed

Ph. D Students Guided

Name of student	Chairman/ Co-chairman	Title of thesis	Remark
1. Vijay Kumar	ChairmanDr. V K Shukla	Intensification and diversification of rice based cropping systems for Central India	Continue

Raipur

S. No.	Name	M. Sc. (Ag)		Ph. D	
		Chairman	Member	Chairman	Member
1	Dr. M.C. Bhambri, Chief Agronomist	3	1	4	1
2	Dr. Sunil Kumar, Sr. scientist (Agronomy)	2	4	2	2
3	Dr. S.S. Porte, Sr. scientist (Soil science)	2	8	1	7

Coimbatore

Name of the Training	Name of the Scientist	Date	Sponsor	Host Institution
Attended Global organic meet at CMS College, Kottayam, Kerala to present key note address on 'Emerging trends in organic agriculture'	Dr.E.Somasundaram	22.04.2018	CMS College, Kottayam	CMS College,Kottayam
Regional Workshop on Indigenous Cotton	Dr. K. Ganesan	10.4.2018	Sahaja Samrudha and ARS, Kovilpatti	ARS, Kovilpatti
Attended in rice seed festival and presented topic on Role	Dr. E.Somasundaram Dr. K. Ganesan	21.5.18 to 22.5.18	Organic paddy growers association	Thiruthuraipoondi of TNAU in organic agriculture
Organic farming conference at Perumbalur	Dr. E. Somasundaram Professor and Head	23.10.18	TNAU Board member, Perambalur	TNAU Board member, Perambalur
Workshop on Harnessing the plant hyperaccumlators to phytoremediate the heavy metals contaminated soils	Dr. A. Bharani Asst.Prof.(ENS)	21.10.18	Dept. of Environmental Sciences organized by TNAU a	Dept. of Environmental Sciences organized by TNAU at Hotel Le Meridien, Coimbatore
Global Clean-Up Congress 2018 on 22.10.2018 & 23.10.2018 to present a paper on Enhancing the growth and productivity of radish under organic farming practices	Dr.A.Bharani Asst.Prof. (ENS) Dr.E.Somasundaram Professor and Head	22.10.18	CRC CARE, New Castle, Australia	Dept. of Environmental Sciences organized by TNAU at Hotel Le Meridien, Coimbatore
Networking workshop on Balancing climate, Biodiversity, food security towards global alliance	Dr. R. Sunitha	18.03.2019 to 20.03.2019	Hotel Poppy's, Coimbatore	
Second Grantmanship workshop	Dr. R. Sunitha	29.03.2019 and 30.03.2019	DST	Directorate of Research, TNAU, CBE
XIII Annual Group meeting 2018	Dr. E. Somasundaram Dr. R. Jansirani Dr. A. Bharani Dr. K. Ganesan	27.11.18 To 29.11.18	ICAR- IIFSR, Modipuram	Dept.of SOA, TNAU
Workshop on Curriculum development for sustainable agriculture	Dr. E.Somasundaram Dr. R.Jansirani Dr. A. Bharani Dr. K. Ganesan	16.7.2018	PG Dean,	TNAU, Cbe
Workshop on Biodegradation of plastics	Dr.A.Bharani	14.07.2018	Isha Yoga Centre	Isha Yoga Centre Coimbatore
Interactive Discussion on Organic farming	Dr. E.Somasundaram	16.07.2018	CODISSIA	CODISSIA Coimbatore
How to get externally project funds	Dr. A. Bharani Dr. K. Ganesan	21.1.2019	DST	CPMB,TNAU Coimbatore

Udaipur

A. Visits: During 2018-19, 75 exposure visits and training of farmers, extension functionaries and other stakeholders were conducted and 3025stakeholders participated in these programmes (Table 14.1 and Fig 14.1).

Table: 14.1 : Technology dissemination (Visits)

S. No.	Date	Visitors address/ Institutes / Place	Type of Beneficiaries (Farmers/Govt. Officials/ Scientist)
1.	25th July 2018	A.G.R.I. New Delhi	40 Farmers
2.	01stAugust 2018	Expo visit, Sikar, Rajasthan	50 farmers
3.	28th August 2018	ATMA,Sikar, Rajasthan	40 farmers
4.	01st September 2018	Inter state Expo visit	25 farmers
5.	12th September 2018	Barmer, Rajasthan	15 Assistant Agriculture Officer
6.	13th September 2018	Bhanpura, Mandsaur	35 farmers
7.	16th September 2018	ATMA, Naguar, Rajasthan	41 Farmers
8.	17th September 2018	ATMA, Naguar, Rajasthan	48 Farmers
9.	18th September 2018	ATMA, Bharuch, Gujarat	48 Farmers
10.	25th September 2018	ATMA, Bharuch, Gujarat	30 Farmers
11.	08th October 2018	UDWDP, Pitthorgarh, Uttarkhand.	8 Participaints
12.	11th October 2018	ATMA, Jobner, Rajasthan	45 farmers
13.	16th October 2018	College of Agriculture, JAU, Junagarh, Gujrat	118 Students
14.	18th October 2018	College of Agriculture, JAU, Junagarh, Gujrat	36 Students
15.	23th October 2018	Assistant Director of Agriculture, Bhuj-Kutch, Gujarat	N A Chaudhary
16.	26th October 2018	Traiving at HiTech Horticulture, Udaipur	11 farmers
17.	04th December 2018	College of Agriculture, AAU, Anand, Gujarat	55 Students
18.	12th December 2018	Farmers Training Centre, Navsari, Gujarat	50 farmers
19.	14th December 2018	ATMA ,Dungarpur, Rajasthan	40 farmers
20.	14th December 2018	FTC, Farmer, Surendarnagar, Gujarat	36 farmers
21.	15th December 2018	STRC, Kumbhalgarh, Rajasmand, Rajasthan	15 farmers
22.	18th December 2018	ATMA, Ahemdabad (Gujrat)	35 farmers
23.	18th December 2018	ATMA, Chota Udepur (Gujrat)	40 farmers
24.	18th December 2018	ATMA, Ajmer, Rajasthan	47 Female farmers
25.	21th December 2018	ATMA, Gir Somnath (Gujrat)	40 farmers
26.	24th December 2018	ATMA, Navsari (Gujrat)	53 farmers
27.	26th December 2018	FTC, Farmer, Surendarnagar, Gujarat	35 farmers
28.	27th December 2018	FTC, Farmer, Junagarh, Gujarat	35 farmers
29.	27th December 2018	FTC, Farmer, Amrali, Gujarat	34 farmers
30.	28th December 2018	Rama Vikas Khand, Jhabhua, M.P.	13 Farmers
31.	28th December 2018	Sanskar Bharti, Sr. Sec. School, Bijolia, Bhilwara, Rajasthan	33 Students
32.	02nd January 2019	ATMA, Junagarh, Gujarat	36 Farmers
33.	02nd January 2019	ATMA, Junagarh, (Gujrat)	40 farmers
34.	08th January 2018	RACP, Interstate Expo visit, Bundi, Rajasthan	35 farmers
35.	08th January 2018	ATMA, Junagarh, (Gujrat)	38 farmers
36.	09th January 2019	ATMA, Dahod, Gujarat	54 participants
37.	11th January 2019	ATMA Interstate Expo visit, Alwar (Raj.)	43 participants

S. No.	Date	Visitors address/ Institutes / Place	Type of Beneficiaries (Farmers/Govt. Officials/ Scientist)
38.	15th January 2019	Winter School Participaints of CDFST, Udaipur, Rajasthan	20 Participaints
39.	16th January 2019	Horticulture Department Farmers Tour, Rajkot, (Gujrat)	50 farmers
40.	16th January 2019	Farmer Visit, Jhunjhnu, Rajasthan	29 farmers
41.	17th January 2019	ATMA, Jamnagar, Gujarat	35 farmers
42.	21th January 2019	S V Deshmukh Krishi Mahavidhalaya, Amrawati	40 Students
43.	22th January 2019	ATMA, Tonk, Rajasthan	35 farmers
44.	23th January 2019	Inter state Farmers Training, Badgaon, Udaipur, Rajasthan	25 farmers
45.	28th January 2019	Assistant Agriculture Officers, Rajasthan	10 Officers
46.	30th January 2019	Rajivika Dungarpur Block, Rajasthan	30 Members
47.	31stJanuary 2019	ATMA Bundi, Rajasthan	50 Farmers
48.	1stFebruary 2019	ATMA Bundi, Rajasthan	45 Farmers
49.	02ndFebruary 2019	Farmers Visit, Lunkaransar, Bikaner,Rajasthan	35 farmers
50.	05th February 2019	FTC, ATMA, Amreli)	40 farmers
51.	05th February 2019	ATMA Udaipur, (Raj.)	50 farmers
52.	06th February 2019	FTC Junagarh, Gujarat	35 farmers
53.	07th February 2019	ATMA, Pali, Rajasthan	35 farmers
54.	07th February 2019	ATMA Udaipur, (Raj.)	60 farmers
55.	07th February 2019	Royal Institute, Udaipur	150 Students
56.	12th February 2019	ATMA Udaipur, (Raj.)	50 farmers
57.	12th February 2019	Mukhymantri Khet Teerth Yojna, Mandsaur, MP	24 farmers
58.	12th February 2019	ATMA, Tapi, Gujarat	107 Farmers
59.	14th February 2019	ATMA, Bhuj-Kutch, Gujarat	45 farmers
60.	14th February 2019	ATMA, Dev Bhumi, Gujarat	37 farmers
61.	19th February 2019	Farmer Training & Visit by IFFCO, Udaipur, Chhitorgarh, Bhilwara, Banswara etc.	35 Farmers
62.	22th February 2019	DAESI group, Bhilwara	20 Participaints
63.	22th February 2019	Farmers Visit, Jhadol Palasiya & Kotda, Udaipur	35 Farmers
64.	26th February 2019	Farmerv Training Centre, Valsad, Gujarat	51 Farmers
65.	26th February 2019	PKVY, Udaipur, Rajasthan	100 Farmers
66.	27th February 2019	ATMA Jaipur, Rajasthan	47 Farmers
67.	01st March 2019	Maryada Seva Sansthan, Banswara, Rajasthan	22 farmers
68.	01th March 2019	Sanskar Bharti Sr, Sec. School, Bijolia, Bhilwara, Rajasthan	40 Students
69.	01st March 2019	ATMA, Tonk, Rajasthan	35 farmers
70.	02ndMarch 2019	ATMA, Neemach, M.P.	25 Farmers students
71.	06th March 2019	ATMA, Morbi, Gujarat	35 farmers
72.	13thMarch 2019	ATMA, Dabwali, Haryana	35 farmers
73.	16th March 201	ATMA, Jhajjar Hisar, Hariyana	55 farmers
74.	18th March 2019	C H& F, Jhalawar, Rajasthan	24 Students
75.	18th March 2019	Training under National Horticulture Mission at Horticulture Office, Udaipur	25 Participaints
		Total	**3035**

Farm women from ATMA, Bharuch (Gujrat) 18th September 2018

Farmers of Bhanpura, Mandsaur, M.P.13th September 2018

Farmers of ATMA Jobner(Raj)11th October 2018

Farm Women from ATMA, Jamnagar, (Gujarat),17th January 2019

Farmer Training Centre, Tapi (Gujrat) 12th February 2019

Farmer Training Centre, by IFFCO (Rajasthan)19th February 2019

Dr. N.S. Rathore, DDG, ICAR New Delhi

Dr. A.K. Padhee Director, Country Relations and Business Affairs - New Delhi, ICRISAT

Dr. B.C. Badhal, J.S. to Chief Minister

Prof. A. K. Singh, Former DDG, ICAR, New Delhi

Dr. P. K. Singh, Director, ICAR-DWR, Jabalpur

Dr. R. C. Ojha, Director, Seema Minerals & Metal, Udaipur

Fig. 14.2 : Dignitaries visits at NPOF Udaipur

A. Dignitaries visits: The details of dignitaries visiting organic farming experiments and unit are given in table 14.2 and Fig. 14.2

Table: 14.2 : Dignitaries visits

S. No.	Date	Govt. Officials/Scientist
1.	16th July 2018	Dr. P S Rathore, Vice-Chancellor, S.K.A.U, Jobner, Jaipur.
2.	05th August 2018	Dr. A. K. Vyas, ADG (HRDG), New Delhi
3.	05th August 2018	Dr. Y. S. Shivay, Principal Scientist, Division of Agronomy, IARI, New Delhi
4.	24th September 2018	Dr. B C Badhal, JS to CM, Jaipur
5.	27th October 2018	Dr. S K Rantaray, Principal Scientist, ICAR-IIWM, BBSR
6.	03rd December 2018	Dr. S K Chauhan, Dean, College of Economics Commerce & Management, Eternal University, Baru Sahib, H.P.
7.	02nd January 2019	Dr. N S Rathore, DDG, ICAR, New Delhi
8.	19thJanuary 2019	Dr. A. K. Padhee, IAS, Director Country Relations, ICRISAT, New Delhi.
9.	02nd February 2019	Prof. A. K. Singh, Secretary, NAAS, NASC, New Delhi

Technology demonstration through exhibition in Kisan mela and other programmes:

- A one day training programme of 25 Government officials of Udaipur, Dungarpur & Banswara district on **"Strategies for incresing productiovity through organic farming"** was organised during 07.01.2019 under Rashtriya Krishi Vikas Yojana on Organic Farming at Directorate of Research, MPUAT, Udaipur.

- A one day training programme on **"Strategies for incresing productiovity through organic farming"** was organized during 30.01.2019 under Rashtriya Krishi Vikas Yojana on Organic Farming at Directorate of Research, MPUAT, Udaipur. 15 Government officials of Bhilwara, Chittorgarh and Bhilwara district participated in the training programme.

- Two days Workshop was organized on **Intellectual Property Creation, Development and Management** on 3-4 May, 2019 by Nodal Officer IDP (Social &

Environment Component), at Directorate of Research, MPUAT, Udaipur. The inaugural session was chaired by Hon'ble Vice Chancellor, MPUAT & Chief Guest was Vinita Bohra, IAS, MD, RTADCOFL, Udaipur. About 53 Scientists attended the training programme.

- Two days, workshop on **Updation of Academic Professionalism among University Teachers: A Step towards New Professionalismunder** IDP, /NAHEP, ICAR, New Delhi on 30 – 31 May, 2019. The inaugural session chaired by Hon'ble Vice Chancellor, MPUAT & Chief Guest was Dr. N.S. Rathore, Deputy Director General (Agricultural Education) ICAR, New Delhi. Dr. S.S. Chahal, Ex-Vice Chancellor, MPUAT, Udaipur, Dr. S.L. Mehta, Ex-Vice Chancellor, MPUAT, Udaipur,Dr. N.C. Patel, Vice Chancellor, AAU, Anand participated as experts in the training programme. About 110 Scientists were present in the workshop.

- ICAR Sponsored 21 days Centre for Advance Faculty Training (CAFT) programme entitled "**Research and Development in Organic Farming: Current Status and Way Forward**" was organized during 1-21 June, 2019 at Directorate of Research, MPUAT, Udaipur Dr. N. S. Rathore, DDG (Education), ICAR, New Delhi and Dr. R. C. Ojha, Managing Director, Seema Metals and Minerals, Udaipur were present during the Inaugural function held on June 1, 2019 and Prof. J. P. Sharma, Hon'ble Vice-Chancellor, MPUAT, Udaipur and Dr. Abhay Vyas, ADG – ICAR (HRM) were Guest during the Valedictory Function held on 21 June, 2019. Twenty-six scientists of 13 different institutes of 9 states (Gujrat, Uttar Pradesh, Maharashtra, Hariyana, Karnataka, Odisa, Rajasthan, Madhya Pradesh & New Delhi) participated in the CAFT training programmes. Eminent Resource persons delivered 51 lectures including exposure of scientists to field and laboratory work during the training programme.

- ICAR Sponsored 21 days CAFT training programme entitled **"Recent Advances and Innovations in Modern Organic Agriculture"** was organized during 5-25 September, 2018 at Directorate of Research, MPUAT, Udaipur. Prof. U. S. Sharma, Hon'ble Vice-Chancellor, MPUAT, Udaipur and Dr. N. S. Rathore, DDG (Education), ICAR, New Delhi were present during the Inaugural function held on September 6, 2018 and Dr. S. L. Mehta, Former Vice-Chancellor, MPUAT, Udaipur was the Chief Guest during the Valedictory

Function held on September 25, 2018. Twenty-five scientists of 11 disciplines from 12 different institutes of 7 states (Gujrat, M.P., A.P., Hariyana, Jammu & Kashmir, Maharashtra and Rajasthan) participated in the CAFT training programmes. Eminent Resource persons delivered 52 lectures including exposure of scientists to field and laboratory work during the training programme.

- A one day training programme on **"Best Technologies and Soil Health Management on Organic Farming"** December 5, 2018 at MPUAT, Udaipur under RKVY Project on Organic Inputs. 30 farmers from 4 villages of Jhadol tehsil of Udaipur district participated in this training programme. The training programme was inaugurated by Prof. U. S. Sharma, Hon'ble Vice Chancellor, MPUAT, Udaipur. Dr. S.K. Sharma, ZDR, ARS, Udaipur acted as Organizing Secretary of the training.

- Celebration of **"World Soil Day"** on December 5, 2018 at MPUAT, Udaipur. 90 Scietinsts, students & farmers were participated in this programme. The programme was inaugurated by Prof. U. S. Sharma, Hon'ble Vice Chancellor, MPUAT, Udaipur.

- Two Days Awareness Programme on Entrepreneurship & Skill Development on **"Opportunities of Entrepreneurship in Organic Farming for Graduates of Agriculture University"** during 27-28 Feb., 2019.

- 56 exposure visits and training of farmers, extension functionaries and other stakeholders from June, 2018 to June, 2019 at Organic Farming Unit MPUAT, Udaipur. Total number of visitors are 2160.
- Exhibition Organic Farming during Jal Shakti Abhiyan Mela at Vallabhnagar on 3 September, 2019 and total number of participants were 1285.

8.2.1 Sponsored training organised for farmers

Bhopal

- Dr A B Singh had given training on "Organic Farming" to the 25 candidates of Agri-Clinic and Agri- Business on dated 10/01/2019, arranged by Centre for Entrepreneurship Development, Madhya Pradesh (CEDMAP).
- Dr A B Singh had given training on "Composting of municipal solid waste, animal and farm wastes for entrepreneurship development to the 31 students of B Sc. Agriculture VIII semester of Mahatma Phule KrishiVidypeeth College of Agriculture, Pune.

- Dr A B Singh had given training on "Vermicomposting, organic farming and soil health to the 52 SC farmers from Khamkheda and Bhairopura village under SC and ST programme at ICAR- IISS Bhopal on dated 14/03/ 2019.
- Dr A B Singh had given training on "Organic farming and soil health" to the farmers in KisanSangosthi, arranged by Project Director, ATMA, Bhopal at Farmer Training Block Berasia. 100 Farmers were participated in the sangosthi.
- Organized One day farmers Scientist interaction meet at Badharkha village- Bhopal under NICRA project and MGMG programme on 24/01/2019.
- Organized World Soil Day-2018 on 5th December, 2018 at Perwalia Sadak, Bhopal (Madhya Pradesh) and Agricultural Education day on 6th December, 2018 at ICAR-IISS, Bhopal.
- Organized National Productivity Week during February 12-18, 2019 at ICAR-IISS, Bhopal. Dr A B Singh had given training on Importance of organic farming to the farmers under capacity building programme under ATMA scheme at Tarawali village, Berasia Block, Distt. Bhopal on 04/01/2019.
- Organized One day farmers Scientist interaction meet **on "**Jaivik Khad, Mridhya Swathya Evam Santuleet Podhan Prabandhan" for 50 farmers at ICAR-IISS, Bhopal under CA, Farmer FIRST and MGMG programme on 15/01/2019.
- Organized the field visit and Farmer Scientist Interaction Meet at PerwaliaSadak village on 09/09/2018 under SAARC Regional Training on Integrated Nutrient Management for Improving Soil Health and Crop Productivity.
- Organized Live telecast programme on the occasion of launching "PM Kisan Samman NidhiYojana on 24th February at ICAR-CIAE Auditorium to create awareness to the farmers of the State.
- Organized the visit of Grass root Field exposure visit of 30 participants of India-UK Water Centre, IISER Bhopal at Perwalia Sadak Bhopal on 25/02/2019.
- Organized Kisan Diwas on 23rd December, 2018 at ICAR-IISS, Bhopal.
- Organized One day Special training on Soil Testing: Entrepreneurship Development on dated 06/03/2019 at ICAR-IISS Bhopal Sponsored by Mahatma Phule Krishi Vidypeeth College of Agriculture, Pune, Biocare India Pvt. Ltd. Nagpur and Pelican Equipments Chennai.31 Students were participated in the training.
- Organized One day Special training on Soil and Water Clinic on dated 12/03/2019 at ICAR-IISS Bhopal Sponsored by Sadguru College of Agriculture Mirajgaon, Ahmednagar Affiliated to Mahatma Phule Krishi Vidypeeth, Rahuri. 37 Students and 03 staffs were participated in the training.
- Organized One day farmers Scientist interaction meet on "Jaivik Khad, Mridhya Swathya Evam Santuleet Podhan Prabandhan" for 52 SC farmers from Khamkheda and Bhairopura village under SC & ST programme on 14/03/2019.
- Organized One day field day activity on farmer's field on 26/03/2019 at Khamkheda village under Farmer First project. Around 100 farmers were participated in the field day activity.
- Organized One day field day activity on farmer's field dated 27/03/2019 at Bhairopura village under Farmer First project. Around 50 farmers were participated in the field day activity.
- Organized One day field day activity on farmer's field dated 27/03/2019 at KarondKhurd village under Farmer First project and MGMG programme. Around 60 farmers were participated in the field day activity.
- Organized One day farmers training on "Jaivik Khad, Mridhya Swathya Evam Santuleet Podhan Prabandhan" for 80 SC farmers from KarondKhurd, Golkhedi, KhamkhedaPerwaliaSadak and Mugalia Hat village under SCSP programme at ICAR-IISS, Bhopal.

Jabalpur

- Conducted training on tribal sub-plan at Village Saraswahi of Manpur block of Umaria on 07-03-2019 with 57 farmers and 03 scientists.
- Conducted training on tribal sub-plan at Krishi Vigyan Kendra, Umaria on 29-03-2019 with 55 farmers of Saraswahi, Dabroha, Kacharwar and Baderi villages and 04 scientists.
- Organized training for preparation of *rabi* crops on 16-10-2018 (World Food day) to the 25 farmers of Ufri village of karkeli block of Umaria district.

- Organized training for preparation of *rabi* crops on 31-10-2018 to the 28 farmers of Saraswahi village of Manpur block of Umaria district.

Gangtok

- Dr. Ravikant Avasthe, Farmer Field Day on Rajmash, ICAR- NOFRI, Tadong, Sikkim and KVK east Sikkim and beneficiaries farmers 40.
- Dr. Ravikant Avasthe, Technological Intervention cum Input Distribution Programme for Doubling the Farmer's Income (DFI), ICAR- NOFRI, Tadong, Sikkim and KVK east Sikkim, 07/03/2019 and beneficiaries farmers 40.
- Dr. Ravikant Avasthe, Training cum Input Support Programme for Promoting Improved Technology of Maize Production under NEH Region, ICAR- NOFRI, Tadong, Sikkim, 23/03/2019, KVK, East Sikkim, and beneficiaries farmers 50.
- Dr. Ravikant Avasthe, Three days training programme on organic farming for farmers of Sikkim, ICAR- NOFRI, Tadong, Sikkim, March, 25-27 2019, ICAR- NOFRI and beneficiaries farmers 30.

Linkage and collaborations

Coimbotore

Name of ICAR institute/AICRP	Name of study/experiment/training undertaken
13th Annual Group Meeting on Organic Farming were conducted at TNAU with coordination of IIFSR-Modipuram	Annual Group Meeting on Organic Farming
Dept. of Agronomy, TNAU, Coimbatore	Biocharacterization of cow dung and cow's urine from *Desi* and *Exotic* breeds
Director of Agriculture, ATMA,Andaman &Nicobar Islands	Organic Agriculture training
Project Director/JDA, ATMA SAMETI, Coimbatore	Skill Training on Organic Agriculture to Rural Youth
SAMETI, KudumiyanmalaiPudukkotai, Tamil Nadu	Organic Agriculture training
Department of Bio Technology,AVS college, Salem, Tamil Nadu.	Skill training on Organic Agriculture

Udaipur

S. No.	Collaboration with	Purpose
1.	AICRP on Weed Management, MPUAT, Udaipur	• Experiment on organic weed management in Sweet corn • Experiment on organic weed management in Fennel
2.	AICRP on IFS, MPUAT, Udaipur	Geo-referenced on – farm characterization of organic growers of Rajasthan.
3.	NGO: Kadam Organics, Udaipur	Capacity building of farmers on organic farming. Conducted two training programmes of farmers
4.	All India Network Project on Soil Biodiversity and Biofertilizers	CFU analysis and molecular characterization
5.	Rajasthan College of Agriculture, MPUAT, Udaipur	• Productivity, Profitability, seed and quality of different types of maize wheat varieties grown under organic farming (Ph. D. thesis) • Effect of Jeevamrut on Growth, Yield and Quality of Organic Wheat (M. Sc. Thesis) • Management of alternaria blight in organic green gram. • Variability of *Alternaria spp.* and management of anthrachnose, alternaria leaf spot and powdery mildew of organic blackgram (*Vigna mungo* L.). • Effect of Silicon on Growth, Yield and Quality of Organic Wheat (M. Sc. Thesis) • Effect of Vermiwash from different organic resources on growth, yield and quality of organic blackgram (M. Sc. Thesis) • Studies on Nutrient Management through Organic Practices in Clusterbean(Ph. D. thesis)
6.	Big Medicine Cheritable Trust	Organization of training/capacity building on organic farming and permaculture.
7.	Banyan Roots	• Farmer capacity building and promotion of organic farming among farmers and consumers. • To provide market linkage to organic growers
8.	RKVY, State Government, Rajasthan	Research and training on various aspects of organic farming during 2018-19.
9.	Madhyantar Start up, udaipur	To provide marketing linkage to organic growers
10.	Seema Metals & Minerals, Udaipur	Research and awareness on use of silica in organic agriculture.
11.	AICRP on EAAI	• Biochar production • Bio oil extraction machine fabrication

APPENDIX 9

Details of crops and varieties used in evaluation of organic, inorganic and integrated production systems for crops and cropping systems at various locations

Location	Crop	Variety
Bajaura	Black gram (*Kharif*)	Palampur- 93
	Lady's Finger (*Kharif*)	P-8
	Tomato (*Kharif*)	Hybrid 2853
	Cauliflower (*Rabi*)	PSBK-1
	Pea (*Rabi*)	Azad P-1
	French bean (*Summer*)	Vaishnavi 264
	Tomato (*Summer*)	Hybrid Himalaya
	Summer Squash (*Summer*)	Australian Green
Bhopal	Soybean	JS-335
	Durum wheat	HI-8498 (Malwa Shakti)
	Mustard	Pusa Bold
	Chickpea	JG-130
	Linseed	JL-9
Calicut	Ginger	Varada, Rejatha and Mahima
	Turmeric	Prathibha , Alleppey Supreme,Varna, Sobha, Sona, Kanthi, Suvarna, Sudarsana, Kedaram, Prabha, Pragathi
	Black Pepper	Sreekara, Panniyur-1
Coimbatore	G M (Daincha)	Local
	Brinijal	CO-2
	Pearl millet	CO-10
	Chillies	Ananya
	Barnyard millet	MDU 1
	Tomato	Sivam
	Finger millet	CO-15
Dharwad	Pigeonpea	TS-3R
	Greengram	DGGV 2
	Sorghum	M 35-1
	Groundnut	GPBD 4
	Hy. cotton	DHH 1062
	Maize	Arjun
	Chickpea	A 1
	Safflower	A 1
Karjat	Rice	Karjat–4
	Brinijal	Krishna F1
	Chickpea	Vijay
	Field bean	Konkanwal-1

Location	Crop	Variety
	Onion (White)	Alibag local
Jabalpur	Basmati rice	Pusa Basmati -1
	Wheat	MPO-JW-1215
	Chickpea	JG-14
	Berseem	JB - 1
	Vegetable pea	Arkel
	Maize	African Tall
	Sorghum fodder	MP Chari
Ludhiana	Basmati rice	Panjab basmati 1509
	Clusterbean	HG 365
	Summer Moong	SML 832
	Soyabean	SL 958
	Wheat	PBW343
	Chickpea	PBG 7
Modipuram	Basmati rice	PB-6
	Coarse rice	Saket-4
	Maize Grain	Bajaura pop corn/
	Green cob	Madhuri sweet corn
	Wheat	HI - 8498
	Okra	Arka Anamika
	Potato	Chipsona-3
	Barley	DWRB-91
	Green gram	Pusavishal
	Mustard	Pusa bold
Pantnagar	*Sesbania*	Pant Ses-1
	Basmati rice	Pusa basmati-1
	Wheat	UP-2572
	Chickpea	Pant kabuli chana-1
	Vegetable Pea	Arkel
	Potato	Kufri jyoti
	Coriander	Harit RS-5
Raipur	Soybean	JS – 9752
	Maize	Sugar-75
	Vegetable pea	Pant sabji matar" (PSM 3)
	Chilli	Agnirekha
	Onion	Nasik red
Ranchi	Rice	Birsamati
	Wheat	K- 9107
	Onion	Arka niketan
	Potato	Kufri Ashoka
	Okra	Aprajita
Umiam	Rice (sunken bed) *kharif*	Megha Aromatic-2, Lampnah, Ngoba, Shahsarang-1
	Broccoli	Green Magic
	Carrot	New Koroda
	Potato	Kufri jyoti

Location	Crop	Variety
	French bean	Naga local
	Tomato	Rocky
	New Centres	
Ajmer	Green gram	SML-668
	Fennel	-
	Cluster bean	RGC-1038
	Coriander	-
Gangtok	Maize	RCM-1-1
	Ginger	*Gorubuthane*
	Turmeric	RCT-10
	Soybean	RCS-1-10
	Buckwheat	Local Teethay
	Rajmash	SKR-57
	Blackgram	SK-PD-3 (Pahenlo dal)
	Toria	TS-38
Narendrapur	Paddy	Satabdi/Pusa Basmati 1
	Brocolli	Princess
	Capsicum	California wonder
	Mustard	B9
	French Beans	Falguni
	Green gram	Samrat
	Sesame	Tilotomma
Sardar Krushinagar	Groundnut	TG 37
	Kharif Green gram	GM 4
	Wheat	GW 451
	Fennel	GF 12
	Summer Green gram	GM 4
	Vegetable cowpea	Swati
Thiruvananthapuram	Cassava	Sree Vijaya
	Groundnut	Co-7
	Taro	Sree Kiran
	Black gram	Co-6
	Green gram	Co-8
	Vegetable cowpea	Anaswara
Udaipur	Sweet corn	Sugar 75
	Blackgram	PU 31
	Maize	PHM-3
	Fodder Maize	Pratap Makka 6
	Cowpea	Doli
	Clusterbean	Gayatri-71
	Wheat (Durum)	HI 8713
	Wheat (Aestivum)	Raj 4120
	Gram	GNG 1581
	Fenugreek	RMT-305
	Soyabean	RKS-24

ANNEXURES 10

Contact Address of NPOF Centres (as on 31 March 2019)

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Principal Investigators at different Centres

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ACRONYMS

ALE : Aquous leaf extract

ASE : Aquous seed extract

BBF : Broad bed and furrow

B: C : Benefit: Cost

BD : Biodynamic

CC : Cost of cultivation

CDM : Cowdung manure

Cu : Copper

DSR : Direct seeded rice

DTPA : Diethylene triamine penta acetic acid

EC : Enriched compost

ECe : Electrical conductivity

Fe : Iron

FB : Flat bed

FYM : Farmyard manure

GLM : Green leaf manure

GM : Green manure

GR : Gross returns

IOFS : Integrated organic farming system

ITK : Indigenous technical knowledge

K : Potassium

KC : Karanj cake

Mn : Manganese

MOP : Muriate of potash

N : Nitrogen

NC : Neem coated

NEOC : Nonedible oil cakes

NPV : Nuclear Polyhedrosis virus

NR : Net returns

NRPRI : Net return per rupee invested

OC : Organic carbon

P : Phosphorus

PG : Panchagavya

pH : Negative logarithum of hydrogenion concentration

PPM : Parts per million

RBD : Randomized block design

RP : Rock phosphate

RSB : Raised and sunken bed

SRI : System of rice intensification

SSP : Single super phosphate

TSP : Tribal sub plan

VC : Vermicompost

Zn : Zinc

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