वार्षिक प्रतिवेदन
Annual Report

2012-13

भाकृअनुप
ICAR

जैविक खेती नेटवर्क परियोजना
Network Project on Organic Farming

कृषि प्रणाली अनुसंधान परियोजना निदेशालय
मोदीपुरम, मेरठ-250 110 (उ.प्र.), भारत

Project Directorate for Farming Systems Research
Modipuram, Meerut – 250 110 (U.P.), India

Milestones

1952-53	Stewart Scheme of Simple Fertilizer Trials on Cultivators' Fields
1955-56	Model Agronomic Experiment Scheme
1968	All India Coordinated Agronomic Research Project (AICARP)
1989	PDCSR with AICRP on CS and its HQs at Modipuram
2004	Addition of Network Project on Organic Farming (NPOF)
2010	PDFSR with AICRP on IFS and NPOF

Mandate

- To undertake basic and strategic research in integrated farming system on production technologies for improving productivity and resource use efficiencies.
- To develop efficient, economically viable and environmentally sustainable integrated farming system models for different farming situations.
- To undertake on-farm testing, verification and refinement of system-based farm production technologies.
- To undertake human resource development and capacity building in integrated farming system.
- To act as a repository of information on all aspects of farming systems research and development.
- To coordinate and monitor integrated farming systems research in the country.

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NETWORK PROJECT ON ORGANIC FARMING

Project Directorate for Farming Systems Research
(Indian Council of Agricultural Research)
Modipuram, Meerut – 250 110, India

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Important Notes:

- This compilation is a joint contribution of all the scientists involved in Network Project on Organic Farming (NPOF) at 13 centres and PDFSR, Modipuram (report writing, compilation, editing and printing).
- The report is based on experimental data generated during *kharif*, *rabi* and *summer* seasons of 2011-12. The other details are relevant up to 31 March 2013.
- The report includes both processed and semi-processed data, generated in different experiments under NPOF. As such no material/ data should be reproduced in any form without prior written permission of the Project Director, Project Directorate for Farming Systems Research and due credit to the concerned scientist (s).

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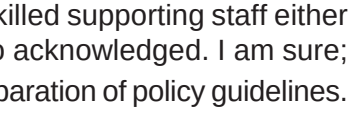
Network Project on Organic Farming (NPOF) is operating in 12 states with 13 co-operating centres. I take this opportunity to record my sincere thanks to **Dr S. Ayyappan**, Secretary, Department of Agricultural Research and Education and Director General, Indian Council of Agricultural Research, New Delhi for offering critical comments and guidance during reviews. I extend my gratitude to **Dr. A.K. Sikka**, Deputy Director General (Natural Resource Management) for his ideas and efforts throughout the year for the development of the Directorate and Network Project on Organic Farming (NPOF) in particular. The time to time guidance received from **Dr B. Mohankumar**, Assistant Director General (Agronomy and Agroforestry) is appreciable. Scientific inputs received from **Quinquennial Review Team (QRT), Research Advisory Committee (RAC)** and **Institute Management Committee (IMC)** are thankfully acknowledged as those inputs provided immense help in taking new initiatives, shaping and improvement of the programme over the period of time.

I am highly thankful to each and every one of the scientists and research fellows involved in the project at 13 centres for taking the pain to conduct the field experiments, lab analysis and generating data. The sincere efforts put forth by **Dr. N. Ravisankar**, Principal Scientist deserves appreciation for drafting and editing of the report. Thanks and appreciations are also due to **Dr. Kamta Prasad**, Programme Facilitator (Co-ordination Unit) for extending the cooperation in preparation of report. I extend my appreciation to **Mr. K. P. Singh** and **Dr Vipin Kumar**, Assistant Chief Technical Officer for their cooperation in compilation of the data, and its statistical analysis.

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 also acknowledged. I am sure; the significant findings obtained from the experiments will go in a long way in preparation of policy guidelines.



(B. GANGWAR)
Project Director

CONTENTS

lkjk'k

कृषि प्रणाली अनुसंधान परियोजना निदेशालय में जैविक खेती में अनुसंधान हेतु नेटवर्क प्रोजेक्ट की शुरूआत 2004–05 में की गयी थी। इस हेतु पूरे देश में 12 प्रदेशों में स्थित 13 केन्द्रों पर अनुसंधान किया जा रहा है, तथा कृ0प्र0अनु0परि0 निदेशालय समन्वयन केन्द्र का कार्य कर रहा है। विगत आठ वर्षो में जैविक खेती परियोजना में कई महत्वपूर्ण शोध कार्य हुए है। वर्ष 2012–13 की प्रमुख शोध उपलब्धियों का सारांश निम्नवत् है।

tSfod] jklk;fud vkj ,dh—r izca/ku mRiknu i.kkfy;ksa dk lkis{k eY;kadu

- **ctkjk** में एकीकृत प्रबंधन द्वारा टमाटर की उल्लेखनीय पैदावार 4120 किग्रा/है० दर्ज की गई। इसके अनुसरण में कार्बनिक पद्धति के तहत उपज 3700 किग्रा/है० पाई गई। फूलगोभी समतुल्य उपज सभी में एकीकृत प्रबंधन के तहत अधिक दर्ज की गई। मक्का–लहसुन प्रणाली की समतुल्य उपज 37701 किग्रा/है० सबसे अधिक दर्ज की गई।
- अकार्बनिक पैकेज की तुलना में जैविक पद्धति के अधीन **Hkkiky** में अधिक उपज दर्ज की गई जोकि 21.1, 10, 21. 4, 60 और 26.6% वृद्धि क्रमशः सोयाबीन, गेहूँ, सरसों, चना और अलसी में होना पाया गया। सोयाबीन–चना और सोयाबीन–गेहूँ प्रणाली अन्य प्रणालीयो की तुलना में बेहतर होनी पायी गयी।
- **dkyhdV** में अकार्बनिक पद्धति के तहत अदरक के प्रकन्द की अधिक उपज दर्ज की गई जबकि हल्दी और काली मिर्च ने एकीकृत प्रबंधन पद्धति के अधीन बेहतर पर्दशन किया। अदरक की उपज में क्रमशः अकार्बनिक की तुलना में जैविक और एकीकृत पैकेज के तहत 39.3 और 21.8% कमी पाई गई।
- **dk;EcVj** में मूल्यांकन की गई सभी फसलों ने एकीकृत प्रबंधन के अधीन अच्छा प्रदर्शन किया, मिर्च और बैगंन को छोड़कर जिन्होंने अकार्बनिक पद्धति के तहत अच्छी उपज दर्ज की। एकीकृत की तुलना मे जैविक पैकेज के अधीन उपज में गिरावट क्रमशः सूरजमुखी, मक्का, बैगन, और कपास के लिये 17.2, 18.1, 16.8 और 12.7% होना पया गया। विभिन्न प्रणालीयों में कपास–मक्का–मूंग (19260 किग्रा/है०) कपास बराबर उपज बेहतर पाई गई।
- अकार्बनिक की तुलना में जैविक पैकेज के साथ उपज मे वृद्धि 36.9, 42.8, 46.5, 42, 27.2, 21.7, 51.9, और 24.7: क्रमशः मक्का चना, मटर, मूंगफली, ज्वार, आलू सोयाबीन और गेहूँ के लिये अधिक होना पाया गया था। **/kkjokM** में मूंगफली–सोयाबीन और कपास+मटर प्रणाली में सबसे अधिक समकक्ष उपज क्रमशः 2896 और 2430 किग्रा/है० दर्ज की गई।
- **tcyiqj** में जैविक और एकीकृत पैकेज के साथ बासमती चावल में उपज की कमी क्रमशः 10.5 और 5.3% होना पाया गया। बासमती चावल सममुल्य उपज क्रमशः बासमती चावल–सबजी मटर–ज्वार और बासमती चावल–गेहूँ–मूंग प्रणाली में 7074 और 6656 किग्रा/है० के साथ अन्य प्रणालीयो की तुलना में अधिक दर्ज की गई।
- **djtV** में खरीफ के मौसम में धान की पैदावार सबसे अधिक अकार्बनिक पद्धति के तहत दर्ज की गई जिसके बाद एकीकृत प्रबंधन के अधीन पैदावार हुई। यहाँ पर अकार्बनिक की तुलना में जैविक और एकीकृत पद्धति के अर्न्तगत पैदावार में क्रमशः 25.3 और 14.9% की गिरावट दर्ज की गई। चावल–मूंगफली और चावल–डेलीकास (सेम हरीफली) प्रणाली समतुल्य उपज में दूसरों से बेहतर होना पाई गयी।
- **yf/k;kuk** में चना, गेहूँ और ग्रीष्म मूंग की उपज एकीकृत पद्धति के तहत अधिक उपज दर्ज की। अकार्बनिक की तुलना में जैविक के अधीन खरीफ के दौरान मक्का और हल्दी में 100 प्रतिशत से अधिक वृद्धि देखी गई। रबी में बासमती चावल की उपज में केवल 3.3% की वृद्धि दर्ज हुई जबकि मक्का में 46.7% की वृद्धि दर्ज की गई। जैविक पद्धति के अधीन अकार्बनिक की तुलना में आलू और प्याज की पैदावार मे क्रमशः 28.9 और 40% की वृद्धि देखी गई। धान समतुल्य उपज के समबंध में हल्दी प्याज (7781 किग्रा/है०) और बासमती धान–गेहूँ–ग्रीष्म मूंग (5814 किग्रा/है०) अन्य प्रणालियों की तुलना में बेहतर पाई गयी।
- **eknhiqje** में विभन्न फसलों के बीच में, बासमती धान भूटे के लिये, मक्का, मूंग ने जैविक पैकेज के तहत अधिक उपज दर्ज की जबकि दानो के लिये मक्का, आलू, भिन्डी, जों, सरसों और मूली की अपेक्षाकृत अधिक उपज एकीकृत पैकेज के तहत दर्ज की गई। गेहूँ की उपज में 15% तक की वृद्धि जैविक के अधीन पाई गई जबकि 21% तक की वृद्धि

एकीकृत पद्धति के अधीन होना पाया गया था। अकार्बनिक की तुलना में जैविक के अधीन बासमती चावल की उपज मे 20.3% की वृद्धि दर्ज की गयी। मक्का–आलू–भिण्डी प्रणाली ने धान समतुल्य उपज 29037 किग्रा/है० अपेक्षाकृत अधिक उपज दर्ज की थी।

- **iruxj** में खरीफ के दौरान जैविक पैकेज के तहत बासमती चावल की उपज में 18.3% की वृद्धि हुई थी। सरसों की उपज एकीकृत पद्धति के तहत 1992 किग्रा/है० दर्ज की गई थी। सब्जी मटर और मसूर ने जैविक पैकेज के अधीन क्रमशः 6272 और 1702 किग्रा/है० के साथ बेहतर प्रर्दशन किया, उसके बाद एकीकृत पद्धति के तहत क्रमशः 5860 और 1697 किग्रा/है० की उपज दर्ज की थी। बासमती धान–सब्जीमटर–ढैंचा को छोड़कर अन्य सभी प्रणालियों में जैविक पद्धति के अर्न्तगत अधिक बासमती धान समतुल्य उपज प्राप्त की थी।
- **jk;ijh** में खरीफ में सोयाबीन की औसत पैदावार एकीकृत पद्धति के अधीन 1223 किग्रा/है० अपेक्षाकृत अधिक पाई गई इसके बाद जैविक पद्धति (1081 किग्रा/है०) तथा अकार्बनिक प्रबंधन पद्धति (1064 किग्रा/है०) का स्थान था। रायपुर में जिन अन्य फसलों का मूल्यांकन किया गया, उनमें जैविक प्रबंधन के अधीन बरसीम की अधिक पैदावार दर्ज की गई जबकि ईसवगोल और प्याज की पैदावार अकार्बनिक पद्धति के अधीन अपेक्षाकृत अधिक प्राप्त की गई। कुसुम की पैदावार एकीकृत पैकेज के अधीन बेहतर पाई गई। सोयाबीन समतुल्य उपज के अर्न्तगत सोयाबीन–बरसीम प्रणाली ने एकीकृत पैकेज के तहत अच्छा प्रदर्शन किया जबकि सोयाबीन–प्याज ने अकार्बनिक पद्धति के अधीन उच्च समतुल्य उपज दर्ज की थी।
- **jkph** में खरीफ धान की जैविक पद्धति के अधीन औसतन उपज 4028 किग्रा/है० प्राप्त की गई जो कि एकीकृत प्रबंधन के तहत हुई पैदावार की तुलना मे 6.7% अधिक तथा अकार्बनिक पैकज के तहत पैदा की गई उपज से 15.8% अधिक थी। अकार्बनिक की तुलना मे जैविक के अधीन 27.8 और 6% अपेक्षाकृत अधिक वृद्धि क्रमशः आलू और प्याज मे दर्ज की थी। धान–आलू प्रणाली द्वारा 12707 किग्रा0/है० धान समतुल्य पैदावार कर बेहतर प्रर्दशन होना पाया गया था।
- **mfe;e** में रबी के दौरान एकीकृत प्रबंधन पद्धति के अधीन बोई गई गाजर, आलू, फ्रेंचबीन और टमाटर जैसी सब्जियों की बेहतर पैदावार दर्ज की गई जो अकार्बनिक की तुलना में क्रमशः 69.9, 19.4, 28.4 और 15.4% अधिक थी। अन्य की तुलना में धान–फैचंबीन प्रणाली ने 19092 किग्रा/है० की दर से उच्च धान बराबर उपज दर्ज की जबकि धान–गाजर ने जैविक पद्धति के तहत उच्च समतुल्य उपज प्राप्त की।

ik"kd rRoksa gsrq fofHkUu tSfod lkezh dk eY;kadu

- **ctkjk** में गोबर की खाद+बायोडायनेमिक+पचंगव्य के प्रयोग से धनिया और फूलगोभी की उपज क्रमशः 5643 और 11150 किग्रा/है० अधिकतम उपज दर्ज की। मटर की उच्च उपज गोबर की खाद+बायोडायनेमिक+पचंगव्य अकेले के साथ पाई गई जो गोबर की खाद+बायोडायनेमिक+पचंगव्य की तुलना में 96% अधिक थी। टमाटर द्वारा अधिकतम उपज रॉकफास्फेट समृद्ध गोबर की खाद +वर्मी कम्पोरट (1:1) के प्रयोग द्वारा दर्ज की गई थी जो गोबर की खाद+बायोडायनेमिक अकेले की तुलना में 25% अधिक होना पाया था।
- सोयाबीन–गेहूँ और मक्का–चना प्रणाली की उपज में उल्लेखनीय वृद्धि जैविक खाद अकेले की तुलना में बायोडायनेमिक और पचंगव्य के प्रयोग के कारण पाई गई थी। हाँलाकि जैविक खाद +पचंगव्य+बायोडायनेमिक के संयुक्त प्रयोग से सभी फसलों में अधिक उपज दर्ज की गई तथा जैविक खाद अकेले की तुलना मे 17, 411, 393 और 273 किग्रा/है० अधिक उपज **Hkkiky** में क्रमशः सोयाबीन, गेहूँ, मक्का और चना में दर्ज की गई।
- **dkyhdV** में अदरक के प्रकन्द की उल्लेखनीय अधिकतम उपज 7100 किग्रा/है० गोबर की खाद+पचंगव्य+रॉकफास्फेट के साथ प्राप्त की गई जो कि पूर्ण नियन्त्रण पद्धति से 69.1% अधिक है। हल्दी के प्रकन्द की उल्लेखनीय उपज गोबर की खाद+नीमखली+2 वर्मी कम्पोस्ट+पचंगव्य+ बायोडानेमिक+रॉकफास्फेट के साथ 12150 किग्रा/है० प्राप्त की इसके बाद उपज गोबर की खाद +बायोडायनेमिक+पचंगव्य+रॉकफास्फेट के साथ 11800 किग्रा/है० देखी गई।
- **dk;EcVj** में गोबर की खाद+अखाद्य खली+प्रत्येक आधा नत्रजन की दर पर+पचंगव्य के माध्यम से पोषक तत्वों का प्रयोग करने पर कपास (1501) मक्का (3569 किग्रा/है०), मिर्च (4841 किग्रा/है०) और सुरजमुखी (1369 किग्रा/है०) अपेक्षाक त अधिक पैदावार देने वाला पाया गया। यहां पर सभी फसलों के लिये गोबर की खाद+अखाद्य खली प्रत्येक नत्रजन के लिये आधी दर पर अकेले में बराबरी पर थी।

- /kkjokM में उपज में समृद्ध कम्पोस्ट वर्मी कम्पोस्ट+हरी पत्तीयो की खाद+बायोडायनेमिक+पचंगव्य स्प्रे करने पर नियन्यण के मुकाबले मूगंफली, ज्वार, मक्का और चना मे 50.7, 38.5, 69.3 और 42.9% क्रमशः उपज में वृद्धि होना पाया गया था। मिर्च के समंबध में समृद्ध कम्पोस्ट (ई सी)+वर्मी कम्पोस्ट+हरी पतियो की खाद+बायोडायनेमिक स्प्रे 12 ग्राम प्रति हैक्टेयर की दर से 741 किग्रा अपेक्षाकृत अधिक उपज होना पाया गया जबकि प्याज के कन्द की उपज ई.सी.+वर्मी कम्पोस्ट+ हरी पतियो की खाद+बायोडायनेमिक के तहत अधिक थी।
- tcyiqj में वर्मी कम्पोस्ट+गोबर की खाद+अखाद्य खली प्रत्येक एक तिहाई नत्रजन+पचंगव्य के उपयोग से अनाज की अधिकतम पैदावार (बासमती चावल, गेहूँ और बरसीम बीज क्रमशः 3743, 3700 और 232 किग्रा./है०) हुई। विभन्न प्रणालियों के मध्य बासमती चावल की उपज, बासमती धान–बरसीम के साथ (3325 किग्रा/है०) अधिक होना पाया गया इसकी तुलना मे बासमती धान–डयूरम गेहूँ–हरी खाद के साथ अनाज का उपज 3280 किग्रा/है० होनी पायी गयी।
- djtV में धान–लाल कद्दू और धान–ककडी प्रणाली ने गोबर की खाद+धान का भूसा+लाइरिसीडिया पत्तीया प्रत्येक एक तिहाई नत्रजन की दर से उपयोग करने पर खरीफ मे अधिक उपज दर्ज की गई और रबी में गोबर की खाद+नीम खली+वर्मी कम्पोस्ट प्रत्येक एक तिहाई की दर से के साथ–साथ पचंगव्य छिडकॉव का प्रयोग करने पर धान और लाल कद्दू तथा धान और ककडी की उपज क्रमशः 3565, 13094 किग्रा/है० और 3735, व 11649 किग्रा/है० दर्ज की गई थी।
- yf/k;kuk में गोबर की खाद+पचंगव्य+बायोडायनेमिक पद्धति का प्रयोग करने पर मक्का के दाने की अपेक्षाकृत अधिकतम उपज 5877 किग्रा/है० दर्ज की गई जबकि गेहूँ में उच्च उपज 3300 किग्रा/है० गोबर की खाद+बायोडायनेमिक के प्रयोग करने पर प्राप्त हुई। पचंगव्य के साथ गोबर की खाद मिलाने अथवा बायोडायनेमिक पद्धतियों की तुलना में गर्मीयों में मूंग की अधिक पैदावार करने के लिये केवल गोबर की खाद पर्याप्त थी।
- iruxj में गोबर की खाद+वर्मी कम्पोक्ट+एनसी+ईसी के उपयोग की तुलना में गोबर की खाद +वर्मी कम्पोस्ट+एनसी+ईसी प्रत्येक एक चौथाई की दर से +बायोडायनेमिक+पचंगव्य के उपयोग से बासमती धान की पैदावार में 180 किग्रा/है० अपेक्षाकृत वृद्धि पाई गई। सब्जी मटर में 8955 किग्रा./है० की उल्लेखनीय उपज गोबर की खाद+वर्मी कम्पोस्ट +एन सी +ई सी प्रत्येक की दर से+बायोडायनेमिक+पचंगव्य के साथ दर्ज की गई थी।
- jk;iqj में यद्यपि धान की अधिकतमतम उपज (4256 किग्रा./है०) और चना (1375 किग्रा/हैं०) बायोडायनेमिक+समृद्ध कम्पोस्ट+गाय की गोबर की खाद (सीडीएम)+अखाद्य खली प्रत्येक एक तिहाई के नत्रजन की दर से+पचंगव्य के प्रयोग करने पर दर्ज की गई थी तथापि ईसी+सीडी एम+एनईओसी प्रत्येक के एक तिहाई नत्रजन की दर से+पचंगव्य और ईसी+ सीडीएम+एनईओसी प्रत्येक के एक तिहाई नत्रजन की दर से अकेले धान–चना प्रणाली में दोनों फसलों के लिये पैदावार बराबरी पर दर्ज हुई थी।
- jkph में केचुआ बाद खाद किरंज खली+बायोडायनेमिक विनिर्मित पदार्थ+पचंगव्य के साथ सभी फसलों की अधिक पैदावार जैसे धान, गेहूँ और आलू क्रमशः 4270, 2332 और 6967 किग्रा/है० दर्ज की गई।
- गोबर की खाद+केचुआ खाद+पचंगव्य के उपयोग से अनाज और हरी गुल्ली के लिये मक्का (क्रमशः 3677 और 713 किग्रा/है०) और फैचंबीन (1240 किग्रा/है०) की अधिक पैदावार दर्ज की गई। किन्तु गोबर की खाद+वर्मी कम्पोस्ट अकेले प्रयोग करने पर उपज बराबरी पर थी।

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- ctkjk% टमाटर में फल छेदक और फल सड़न का प्रकोप लिपेल (बेसेलस थ्रुनजेनसिस 1.0 किलोग्राम प्रति हैक्टेयर की दर से प्रयोग करने पर नियन्त्रण की तुलना में कम था खरीफ मे टमाटर की अधिक उपज (10597 किग्रा/है०) लिपेल (थ्रुनजेनसिस उपजाति कुरसताकि, 1.0 किग्रा/है० के प्रयोग से सिद्ध हुई थी तथा डेरेक (एम. एजेडा आर्क 2.5% एक्वंयस लीफ एक्सट्रक्ट (एएलई)+कारवी (रायलेसिनेरिया) 2.5% की दर से ए एल ई+गोमूत्र (3%) के विशेष इलाज के रूप मे फलछेदक 1.65% व अन्य कारक 18.2% कम घटना होना पाया गया था। जिस कारण फलछेदक, फलसड़न व अन्य कारक के साथ भी उपज में कमी नहीं दर्ज हो पाई थी।
- dkyhdV में अदरक अन्तः पादप जीवाणु (जीई बी 18 और आईआईएसआर 6, 8, 13, 51, 151 और पीबी 21 और पी1 एआर 6 कल्चर) और अदरक राइजोबैक्टीरिया के साथ पूर्ण नियन्त्रण की तुलना में बना छेदक का प्रकोप कम था इससे कालीकट में 68.2, 64.6 और 59.2% की क्रमशः प्रकोप में कमी देखी गई।

- **ekneh ije** में ग्रीष्म जुताई और हरी खाद अनुपचारित भूखण्डों की तुलना में उन भूखण्डों में जिनमें ग्रीष्म जुताई और हरी खाद शामिल की गई थी में बासमती धान क्रमशः 3450 और 3860 किग्रा/है०, चना 963 और 1297 किग्रा/है० तथा सरसों 712 और 977 किग्रा/है० की अपेक्षाकृत अधिक पैदावार दर्ज की गई।
- **mfe;e** से मक्का की आरम्भिक अवस्था में डेरीसोम 3 मिली./लीटर+10% की दर से पचंगव्य और 3% की दर से गोमूत्र के उपयोग से मोनोलेप्टा (0.47%) माइलो सेरस (0.93%) और लीफ फोल्डर (0.40%) के कम मामले पाये गये जबकि एपिलेचना (0.20%) की घटनाऐ पचंगव्य 3% की दर से +लॉनटाना 10%+वर्मी वाश 10% के उपयों से कम होनी पाई गई। सोयाबीन रस्ट मे पचंगव्य 3% की दर से+लानटाना 10% की दर से +वर्मी वाश 10% की दर के उपयोग करने पर 29.7% के स्तर तक नियत्रित होना पाया गया था।

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- **dk;EcVj** में चावल और उड़द दोनों में खरपतवार मुक्त स्थिति में अपेक्षाकृत अधिक पैदावार (क्रमशः 4213 और 863 किग्रा/है०) दर्ज की गई इसके बाद दो हाथ निराई+खरपतवार की 3–4 पत्ती की अवस्था पर ऐक्वियस पत्ती सत्त के स्प्रे के सयोंजन द्वारा उस खण्ड में तुलना में, जहां खरपतवार नियंत्रित नहीं की गई थी में चावल और उड़द की पैदावार मे 88 और 163% की वृद्धि दर्ज की गई।
- **/kkjokM** में केसिया और प्रोसोपिस जूलीफ्लोरा का एक्वियस छिडकॉव खरपतवार उगने के बाद (पोस्ट इमरजेन्स) और पूर्व उगने (प्री इमरजेन्स) पारथेनियम अनुपयोग के तौर पर अधिक प्रभावी पाया गया था। एक्वियस पत्ती के सत्त का जलीय छिड़काव पूर्व उगने (प्री इमरजेन्स) की तुलना में पोस्ट इमरजेन्स पर अधिक प्रभावी था।
- **tcyij** में खरपतवार मुक्त स्थिति में धान (4584 किग्रा/है०) और गेहूँ (4351 किग्रा/है०) की अपेक्षाकृत अधिक पैदावार दर्ज की गई। इसके बाद दो निराई हाथ से खरपतवार की + 3–4 पत्ती की अवस्था पर छिडकाव के संयोजन से धान और गेहूँ की क्रमशः 108 और 181% अधिक अनाज की उपज जहां खरपतवार नियंत्रित नहीं किया गया था की तुलना में दर्ज की थी।
- **yf/k;kuk** में अधिक धनत्व रोपण+25–30 दिन रोपण उपरान्त हाथ की निराई से खरपतवार के कुल शुष्कवजन (8.1 ग्राम/वर्ग मीटर) मे अधिकतम कमी दर्ज की गई जो 25–30 दिन व 40–45 दिन बुआई उपरान्त तथा वर्ग रोपण+वीडर के साथ बराबरी पर था।
- **iruxj** में तीनों प्रणालीयों में 25–30 दिन रोपण बाद एक गिराई हाथ द्वारा खरीफ में तथा दो निराई 25–30 दिन और 40–45 रोपण बाद करने पर धास और प्रतृण की गिनती में रबी के दौरान उलेखनीय कमी पायी गयी। फसल प्रणालियो के उस पार, कुल धास और प्रतृण तथा चौडी पत्ती वाले खतपतवार मे 90.6 और 77.2% की कमी क्रमशः एक निराई हाथ द्वारा खरीफ मे और दो निराई हाथ द्वारा रबी मे करने पर पायी गयी थी।
- **jk;ij** में कुल खरपतवार की गिनती में 68 प्रतिशत की कमी वर्ग रोपण व कोनोवीडर के प्रयोग से देखी गई जबकि सरसों मे दो निराई हाथ द्वारा 25–30 और 40–45 दिन रोपाई के बाद करने पर 85% की कमी पाई गई थी ।
- **jkph** में दोनों प्रणालीयों में खरपतवार के शुष्कवजन में उल्लेखनीय कमी दो निराई हाथ से 25 और 40 दिन रोपड/बुआई के बाद करने पर तथा एक्वियम पत्ती के सत्त के छिड़काव के साथ दर्ज की गई। एक औसत के तौर पर खरपतवार रहित की तुलना में धान में 87.2% गेहूँ में 77.7% और अलसी में 83.5% की कमी पाई गई। अकेले एक्बियस पत्ती के सत्त के छिड़काव से धान, गेहूँ और अलसी में क्रमशः 34.8, 42.6 और 51.1% तक की कमी दर्ज की गई।
- मक्का (हरे भूट्टे वाली) और सरसों की अधिकतम उपज, ताजे यूपैटोंरियम एमब्रोसिया 10 टन/है० की दर से (भूसयोजन के बाद) के साथ प्राप्त की थी। इसके बाद लेन्टाना के एक्वियस पत्ती के सत्त के और पाईन प्रजाति के खरपतवार की 3–4 पत्ती की अवस्था पर स्प्रे करने के साथ की **mfe;e** में ताजे यूपैटोरिदम/एब्रोसिया को पलवारने से खरपतवार मुक्त और खरपतवार नियत्रित की तुलना मे क्रमशः मक्का में 19.4% और 29.8% और सरसो में 39.5 और 66.8% की वृद्धि पाई गई थी।

ABSTRACT

Network Project on Organic Farming (NPOF) started in 2004-05 with 13 co-operating centres covering 12 states. The salient research achievements during the year are presented below:

Evaluation of organic, inorganic and Integrated Management (IM) production system

- Tomato recorded higher yield under integrated (4120 kg ha^{-1}) followed by organic (3700 kg ha^{-1}). In terms of cauliflower equivalent yield, all the systems registered higher yield under integrated package. Among the systems evaluated, maize-garlic registered significantly higher equivalent yield of 37701 kg ha^{-1} at **Bajaura**.

- Soybean, wheat, mustard, chickpea and linseed recorded significantly higher yield with organic package compared to inorganic and the yield increase was found to be 21.1, 10, 21.4, 60 and 26.6% respectively. Among the systems, soybean chickpea (1916 kg ha^{-1}) and soybean-wheat (1830 kg ha^{-1}) was found to be better than other systems at **Bhopal.**

- At **Calicut,** Ginger recorded higher rhizome yield under inorganic package while turmeric and black pepper performed better under integrated package. The yield reduction in ginger was found to be 39.3% and 21.8% under organic and integrated package compared to inorganic respectively.

- At **Coimbatore**, all the crops evaluated performed better under integrated package except chilli and brinjal which recorded higher yield under inorganic package**.** The drop in yield under organic package over integrated was found to be 17.2, 18.1, 16.8 and 12.7% for sunflower, maize, brinjal and cotton respectively. Among the systems, cotton-maize-green gram was found to be better (19260 kg ha^{-1}).

- The yield increase with organic was found to be 36.9, 42.8, 46.5, 42.0, 27.2, 21.7, 51.9 and 24.7% for maize, chickpea, pea, groundnut, sorghum, potato, soybean and wheat respectively over inorganic. Groundnut-sorghum and cotton+pea registered higher maize equivalent yield (2896 and 2340 kg ha^{-1} respectively) at **Dharwad.**

- At **Jabalpur**, the reduction of yield in basmati rice with organic and integrated package was found to be 10.5 and 5.3% respectively. Basmati rice-vegetable pea-sorghum and basmati rice-wheat-green gram recorded higher basmati rice equivalent yield of 7074 and 6656 kg ha^{-1} respectively than other systems.

- *Kharif* rice registered significantly higher yield under inorganic followed by integrated package. Yield drop observed with organic and integrated package was found to be 25.3 and 14.9% respectively. Rice-groundnut and rice-delichous bean (for green pod) was found to be better than others at **Karjat** in term of rice equivalent yield.

- Gram, wheat and summer moong registered higher yield under integrated package at **Ludhiana**. More than 100% increase in yield under organic over inorganic was observed in cotton and turmeric during *kharif*. Basmati rice recorded only 3.3% increase whereas maize recorded 46.7%. In *rabi*, an increase in yield of onion and potato by 28.9 and 40% under organic over inorganic package was observed. In term of basmati rice equivalent yield, turmeric-onion (7781 kg ha^{-1}) and basmati rice-wheat summer moong (5814 kg ha^{-1}) was found to be better than other systems.

- Among the various crops in the systems at **Modipuram**, basmati rice, maize for cob and green gram recorded higher yield under organic system while maize for grain, potato, okra, barley, mustard and radish have recorded higher yield under integrated package. Wheat registered increase in yield to the tune of 15% with organic package while, the increase was found to be 21% under integrated. Basmati

rice recorded 20.3% higher yield under organic compared to inorganic package. Maize-potato-okra system recorded higher basmati rice equivalent yield of 29037 kg ha^{-1}.

- At **Pantnagar,** the yield increase of basmati rice during *kharif* under organic package over inorganic was 18.3%. *Brassica napus* recorded higher yield (1992 kg ha^{-1}) under integrated package. Vegetable pea and lentil performed better (6272 and 1702 kg ha^{-1}) under organic followed by integrated (5864 and 1697 kg ha^{-1}). In term of basmati rice equivalent yield, all the systems recorded higher yield under organic except basmati rice-vegetable pea-sesbania system. Basmati rice-lentil-sesbania (GM) recorded higher basmati rice equivalent yield (8898 kg ha^{-1}) among the systems.

- Mean yield of soybean in *kharif* was found to be higher under integrated package (1223 kg ha^{-1}) followed by organic (1081 kg ha^{-1}) and inorganic (1064 kg ha^{-1}). Among the other crops evaluated, berseem registered higher yield under organic package while isabgol and onion registered higher yield under inorganic package. Safflower performed better under integrated package. In term of soybean equivalent yield, soybean-berseem was found to be better under integrated while soybean-onion recorded higher equivalent yield under inorganic package at **Raipur**.

- Rice recorded higher mean grain yield of 4028 kg ha^{-1} during *kharif* under organic package which is 6.7% higher than integrated package and 15.8% higher than inorganic. Potato and linseed recorded 27.8 and 6% increase in yield under organic over inorganic package. Rice-potato was found to be better in term of rice equivalent yield (12707 kg ha^{-1}) at **Ranchi**.

- All the vegetables crops like, carrot, potato, frenchbean and tomato recorded 69.9, 19.4, 24.8 and 15.4% higher yield with integrated over inorganic package, Among the systems, rice-frenchbean systems recorded higher rice equivalent yield (19092 kg ha^{-1}) while rice-carrot system recorded higher yield under organic package at **Umiam**.

Evaluation of source of nutrients for organic package

- At **Bajaura,** application of FYM+biodynamic+panchgavya recorded higher yield of coriander (5463 kg ha^{-1}) and cauliflower (11150 kg ha^{-1}). The higher yield of pea was observed with FYM+BD alone, its increase over FYM+BD+Panchagvya was 96 %. Tomato recorded higher yield under rock phosphate enriched FYM+VC (1:1) application and the increase over FYM+BD alone was found to be 25%.

- The yield increase due to biodynamic and panchgavya practice over organic manure alone was found to be significant in soybean-wheat and maize-chickpea systems. However, combined application of OM+PG+BD registered higher yield in all crops and the yield increase over organic manure alone was found to be 17, 411, 393 and 273 kg ha^{-1} in soybean, wheat, maize and chickpea respectively at **Bhopal**.

- At **Calicut**, significantly higher rhizome yield of ginger (7100 kg ha^{-1}) was observed with FYM+PG+RP which is 69.1% higher than absolute control.. Significantly higher rhizome yield of turmeric was observed with FYM+NC+2VC+PG+BD+RP (12150 kg ha^{-1}) followed by FYM+BD+PG+RP (11800 kg ha^{-1}).

- Application of nutrient through FYM+NEOC @ ½ N each+ panchgavya gave higher yield of cotton (1501 kg ha^{-1}), maize (3569 kgha^{-1}), chillies (4841 kg ha^{-1}) and sunflower (1369 kg ha^{-1}) which was on par with FYM + NEOC @ ½ N each alone for all the crops at **Coimbatore**.

- The yield increase in EC+VC+GLM+biodynamic+Panchgavya spray was found to be 50.7, 38.5, 69.3 and 42.9% in groundnut, sorghum, maize and chickpea respectively over control. In case of chilli, EC+VC+GLM+biodynamic spray @ 12g ha^{-1} registered higher yield of 741 kg ha^{-1} while in onion higher bulb yield was obtained with EC+VC+GLM+biodynamic (741kg ha^{-1}) at **Dharwad**.

- Application of nutrients through VC+FYM+NEOF @ 1/3 N each+Panchgavya recorded higher grain yield (3743, 3700 and 232 kg of basmati rice, wheat and berseem seed ha^{-1}) followed by VC + FYM + NEOF @ 1/3 N each. Among the systems, grain yield of basmati rice obtained with basmati rice-berseem was found to be higher (3325 kg ha^{-1}) compared to basmati rice-duram wheat-green manure (3280 kg ha^{-1}) at **Jabalpur**.

- At **Karjat,** rice-red pumpkin and rice-cucumber systems have recorded higher yield with application of FYM+rice straw+ *lyricidia* leaves @ 1/3rd each of N during *kharif* and FYM + neem cake + vermicompost @ 1/3 each of N during *rabi* along with spray of Panchgavya (3565, 13094 kg ha^{-1} of rice-red pumpkin and 3735, 11649 kg ha^{-1} of rice-cucumber respectively).

- At **Ludhiana**, application of FYM+panchgavya+biodynamic packages recorded higher grain yield of maize (5877 kg ha^{-1}), while in wheat FYM+BD recorded higher yield (3300 kg ha^{-1}). Application of FYM alone was sufficient in summer moong to realize higher yield compared to combining FYM with PG or biodynamic practices.

- Application of FYM+VC+NC+EC @ ¼ N each +BD+Panchgavya recorded an increase in yield to the tune of 180 kg ha^{-1} in basmati rice compared to application of FYM+VC+NC+EC alone. Significantly higher yield of 8955 kg ha^{-1} in vegetable pea was recorded with FYM+VC+NC+EC @ ¼ N each+BD+Panchagavya at **Pantnagar.**

- At **Raipur**, though application of biodynamic practice + EC + CDM + NEOC @ 1/3 N each + PG recorded higher yield of rice (4256 kg ha^{-1}) and chickpea (1375 kg ha^{-1}), it was at par with application of + EC + CDM + NEOC @ 1/3 N each + PG and EC + CDM + NEOC @ 1/3 N each alone in both the crops of rice-chickpea system.

- At **Ranchi**, all the crops recorded higher yield with Vermicompost+KC+biodynamic preparation +PG (4270, 2332 and 6967 kg ha^{-1} in rice, wheat potato respectively).

- Application of FYM+VC+PG recorded numerically higher yield in maize for grain and green cobs (713 kg ha^{-1}) and frenchbean (1240 kg ha^{-1}) respectively but the same was on par with application of FYM+VC alone at **Umiam**.

Pest and disease management under organic farming

- Infestation of fruit borer and fruit rot in tomato was lower in application of lipel (*Bacillus thuringiensis* sub sp. kurstaki) @ 1 kg ha^{-1}. Compared to control, higher tomato yield of 10597 kg ha^{-1} was realized with application of Lipel (*Bacillus thuringiensis* sub sp. kurstaki) @ 1 kg/ha in *Kharif* and Darek (*M. azedarach* (2.5% ALE) + karvi (*Roylea cinerea*) @ 2.5% aqueous leaf extract+cow urine (3%) as this particular treatment recorded lower incidence of all (fruit borer: 1.63%, other factors 18.2%) and yield loss due to fruit borer, fruit rot and other factors were also less at **Bajaura**.

- Shoot borer infestation in ginger was lower with ginger endophytic bacteria (GEB 18 and IISR 6, 51,853, Pb21 and P1AR6 cultures) and ginger rhizobacteria (GRB 58) compared to absolute control. The reduction in infestation was observed to be 68.2, 64.6 and 59.2% respectively at **Calicut**.

- At **Modipuram**, summer ploughing and green manure incorporated plots recorded higher grain yield of basmati rice (3450 and 3860 kg ha^{-1}respectively) chick pea (963 and 1297 kg ha^{-1}) and mustard (772 and 977 kg ha^{-1}) compared to untreated plots of summers ploughing and green manure.

- Application of derisom (3 ml/l) +panchagavya @ 10% and cow urine 3% recorded lower incidence of monolapta (0.47%), mylloceros (0.93%) and leaf folder (0.40%) in early stage of maize while epilechna incidence (0.20%) was found to be reduced through application of panchagavya @ 3%+ lantana 10%

+vermi wash 10%. Soybean rust was found to be controlled to the level of 29.7% with the application of panchagavya @ 3% +lantana @ 10% +vermiwash @ 10% at **Umiam**.

Weed management under organic farming

- At **Coimbatore**, in both rice and blackgram higher yield (4213 and 863 kg ha^{-1} respectively) recorded under weed free condition followed by combination of two hand weeding+spray of aqueous leaf extract at 3-4 leaf stage of weeds which recorded 88 and 163% increase in yield of rice and blackgram over un-weeded control.

- Aqueous spray of cassia and *prosopis juliflora* as post emergent was found to be more effective than pre or post emergence application of parthenium. Post emergence spray of aqueous leaf extract was found to be better than pre emergence application at **Dharwad**

- At **Jabalpur** weed free recorded higher grain yield of rice (4584 kg ha^{-1}) and wheat (4351 kg ha^{-1}) followed by combination of two hand weeding + spray at 3-4 leaf stage of weeds which recorded 108 and 181% higher grain yield of rice and wheat respectively compared to Unwedded check

- High density planting + hand weeding at 25-30 DAT recorded maximum reduction of total dry weight of weeds (8.1 gm^{-2}) which was on par with hand weeding at 25-30 DAT and 45-50 DAT and square planting + weeder in rice at **Ludhiana**.

- Grasses and sedges count during *kharif* and broad leaved weeds count during *rabi* was found to be significantly lower in all the three systems with one hand weeding at 25-30 DAT during *kharif* and 2 hand weeding at 25-30 and 45-50 DAS during *rabi*. Across the cropping systems, the reduction of total grasses & sedges and broad leaved weeds was found to be 90.6 and 77.2 % respectively due to 1 hand weeding during *kharif* and 2 hands weeding during *rabi* at **Pantnagar**.

- Maximum reduction in total weed count was observed with use of conoweeder with square planting in 68% in rice while in mustard it was found 85% with 2 hand weeding at 25-30 and 45-50 at **Raipur**.

- At **Ranchi** two hand hoeing at 25 and 40 DAS/DAT with use of aqueous leaf extract registered significantly lower weed dry weight in both the system. (On an average reduction of 87.2% in rice, 77.7% in wheat and 83.5% in linseed compared to unweeded control). Spray of aqueous leaf extract alone recorded reduction in yield to the tune of 34.8%, 42.6% and 51.1% in rice, wheat and linseed respectively.

- In both maize (green cobs) and mustard, mulching with fresh eupatorium ambrosia @ 10 t ha^{-1} (after earthing up) recorded higher yield followed by aqueous leaf extract spray of lantana and pine spp. at 3-4 leaf stage of weed. The increase in yield under mulching with fresh Eupatorium/Ambrosia was found to be 19.4 and 29.8% in maize and 39.5 and 66.8% in mustard over weed free and weedy checks respectively at **Umiam**.

1. INTRODUCTION

Organic agriculture is a production system, which avoids or largely excludes the use of synthetic compounded fertilizers, pesticides, growth regulators and livestock feed additives. To the maximum extent possible, organic farming system relies on crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients and to control insects, weeds and other pests.

Organic farming systems offer some solutions to the problems, currently besetting the agricultural sector of industrialized/ green revolution countries. The broader aims of organic farming are; sustainability of natural resource, minimizing cost of cultivation, providing healthy food, augmentation of farm profits and improving soil health. Although, in the market place to provide clarity on the organic claim the organic agriculture requires certification, but broadly speaking, any system using the methods of organic agriculture and being based on four basic principles – the principle of health, the principle of ecology, the principle of fairness, and the principle of care; may be classified as organic agriculture.

Presently, organic agriculture is practiced in 162 countries and 37 m ha of land are managed organically by 1.8 million farm households. The global sales of organic food and drink reached 62.9 billion US dollors in 2011. The regions with the largest areas of organically managed agricultural land are Oceania (12.1 million hectares of 33 percent of the global organic farmland), Europe (10.6 million hectares or 29 percent of the global organic farmland) and Latin America (6.8 million hectares or 23 percent). On a global level, the organic agricultural land area increased by three percent compared with 2010. The countries with the most organic agricultural land are Australia (12 million hectares), Argentina (3.8 million hectares) and the United States (1.9 million hectares). The highest shares of organic agricultural land are in the Falkland Islands (35.9 percent), Liechtenstein (29.3 percent) and Austria (19.7 percent). The countries with the highest numbers of producers are India, Uganda and Mexico. India has traditionally been a country of organic agriculture, but the growth of modern scientific, input intensive agriculture has pushed it to wall. But with the increasing awareness about the safety and quality of foods, long term sustainability of the system and accumulating evidences of being equally productive, the organic farming has emerged as an alternative system of farming which not only addresses the quality and sustainability concerns, but also ensures a profitable livelihood option. Emerging from 42,000 ha under certified organic farming during 2003-04, the organic agriculture has grown almost 29 fold during the last 5 years. By March 2010 India, has brought more than 4.54 million ha area under organic certification process. Out of this cultivated area accounts for 1.18 million ha while remaining 3.36 million ha is wild forest harvest collection area.

In order to develop a package of practices for organic farming including plant protection in a system mode, a Network Project on Organic Farming (NPOF) was initiated during 2004-05 by Indian Council of Agricultural Research (ICAR), New Delhi with Project Directorate for Farming Systems Research (PDFSR) as lead centre. In order to bring out the packages comprising of nutrient, pest and disease management in various crops and cropping systems, four experiments were conducted during the year at 13 locations (refer front cover). The objectives along with significant findings of all the experiments are presented in the subsequent sections.

2. OBJECTIVES AND METHODOLOGY

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 organic inputs, especially organic manures and bio-agents. Cropping systems, which are under evaluation, involve cereal crops (mainly basmati rice, *durum* and *aestivum* wheats, sorghum and maize), pulses and oilseeds (chickpea, lentil, green gram, soybean, mustard, and groundnut), spices (black pepper, ginger, turmeric, chillies, onion, and garlic), fruits (papaya, and mango), vegetables (potato, okra, baby corn, cowpea, pea, tomato, and cauliflower), cotton, fodder crops (sorghum, maize, pearl millet, oat, cow pea and berseem), and medicinal plants (Isabgol and mentha). The details of varieties used in the experimentation at each centre is given in appendix. During 2011-12, following four experiments were undertaken at different centers:

I. Evaluation of different production system in various cropping systems on soil health, crop productivity, quality and profitability

II. Management of soil fertility using various organic inputs in prominent cropping systems

III. Pest and disease management in cropping system under organic farming

IV. Weed management in cropping system under organic farming

The treatment details of each experiment at various locations are presented in chapter 7 at respective tables. General guidelines and standards for organic production, as suggested under National Standards for Organic Production (NSOP), formed as 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 purpose, 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 manure 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 2011-12 at 13 research centers of SAUs/ ICAR Institutes. The details of centres are given below in the order of results presented in the chapter 7.

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

4. SOIL AND CLIMATE

Soil type, weather, latitude and longitude of the various centres (2011-12)

S. No.	Name of centre	Soil Type	Weather				Latitude (N)	Longi-tude (E)
			Rainfall (mm)	Tempera-ture (°C)		R.H (%)		
				Max.	Min.			
1.	Bajura	Silty loam	954.6	25.1	10.52	64.89	31.8°	77°
2.	Bhopal	Vertisols, Clayey Montmorillonite/smectite type	-	-	-	-	23°18’	77°24’
3.	Calicut	Clay loam, ustic Humitropept					11°34’	75°48’
4.	Coimbatore	Udic, Rhodustalfs, fine loamy red and sandy soil	789.3	29.83	21.31	85.56	11°	77°
5.	Dharwad	Vertic inceptisoles	926.3	30.27	18.19	65.97	15°26’	75°07’
6.	Jabalpur	Vertisoils, Chromusterts	1901.8	31.47	16.76	61.73	23°90’	79°90’
7.	Karjat	Haplustults udic-fluvents, red soil	4417.4	33.77	20.53	69.55	18°33’	77°03’
8.	Ludhiana	Ustochrepts-Ustic pramments association, alluvial, sandy & sandy loam	1070.5	29.41	17.29	69	30°56’	75°52’
9.	Modipuram	Alluvium Soil Typic ustochrept	637.6	29.76	16.23	72.76	29°4’	77°46’
10.	Pantnagar	Hapludolls, very deep alluvium coarse loomy soils	2118.6	29.39	17.03	70.68	29°08’	79°05’
11.	Raipur	Ochraquals association, deep black soil	1360.1	32.94	20.35	60.68	21°16’	81°36’
12.	Ranchi	Ultic Palesustalfs, very deep soils	2271.60	29.44	16.06	71.00	23°17’	85°19’
13.	Umiam	Clay loam	2005.30	26.32	14.00	74.75	25°41’	91°54’

Initial nutrient status of soil

S.No.	Centre (kg/ha)	OC % (kg/ha)	N (kg/ha)	P (ppm)	K (ppm)	S (ppm)	Fe	Zn
Experiment 1								
1.	Bajaura	-	-	-	-	-	-	-
2.	Bhopal	0.36	130.43	7.06	370.27	2.99 Kg/ha	4.88	0.40
3.	Calicut	2.00	120ppm	6.80ppm	164ppm	-	46.0	0.54
4.	Coimbatore	0.60	269	17.9	690	-	29.6 kg/ha	4.5 kg/ha
5.	Dharwad	0.41	250	23	330	20.0 Kg/ha	7.5 mg/kg	0.8 mg/kg
6.	Jabalpur	0.7	264	12.6	282	9.8 mg/kg	2.37mg/kg	0.32mg/kg
7.	Karjat	1.14	230	20	327			
8.	Ludhiana	-	-	-	-	-	-	-
9.	Modipuram	-	-	-	-	-	-	-
10.	Pantnagar	0.65	238	16.7	156	29.3 Kg/ha	30.24	0.84
11.	Raipur	0.64	237	13	274	-	-	-
12.	Ranchi	0.38	-	-	-	-	-	-
13.	Umiam	1.32	185.61	10.36	165.10	-	-	-
Experiment 2								
1.	Bajaura	-	-	-	-	-	-	-
2.	Bhopal	-	-	-	-	-	-	-
3.	Calicut	2.00	120ppm	6.80ppm	164ppm	-	46.0	0.54
4.	Coimbatore	0.68	258	22.9	698.3	-	31.63 kg/ha	3.59 kg/ha
5.	Dharwad	0.41	250	23	330	20.0 Kg/ha	7.5 mg/kg	0.8 mg/kg
6.	Jabalpur	0.68	263	12.6	296	9.6 mg/kg	2.39mg/kg	0.35mg/kg
7.	Karjat	1.16	194	15	346			
8.	Ludhiana	-	-	-	-	-	-	-
9.	Modipuram	-	-	-	-	-	-	-
10.	Pantnagar	0.65	238	16.7	156	29.3 Kg/ha		
11.	Raipur	0.61	248	16.2	252	-	-	-
12.	Ranchi	0.46						
13.	Umiam	1.8	255.61	9.19	232.1	-	-	-
Experiment 3								
1.	Calicut	2.00	120ppm	6.80ppm	164ppm	-	46.0	0.54
2.	Karjat	0.85	220	23	379		-	-
3.	Umiam	2.4	232.1		230.6	-	-	-
Experiment 4								
1.	Coimbatore	0.48	258	15.2	568	-	23.2 kg/ha	5.20 kg/ha
2.	Jabalpur	0.62	259	12.5	265	8.9 mg/kg	2.55mg/kg	0.39mg/kg
3.	Pantnagar	0.65	238	16.7	156	29.3 Kg/ha	-	-
4.	Raipur	0.66	220	16.2	260	-	-	-
5.	Umiam	-	-	-	-	-	-	-

5. MANPOWER

No regular post in any category have been provided and the responsibility was assigned to a Scientist, nominated as Principal Investigator of NPOF by the parent institute/university (Names and contact addresses of PIs are given in annexure I). The Scientist of related discipline were also involved in the research programme by the respective institution. For technical support, two senior fellows (as contractual staff) have been provided at each centre.

6. BUDGET

A total budget of NPOF was released to 13 centers during 2011-12. The centre wise allocation funds are given below.

(₹ in lakhs)

S. No.	Centre	Recurring			Non Recurring	TSP Component	Total
		Contractual services	Travelling allowances	Recurring contingency			
1.	Bajaura	2.50	0.20	2.42	3.00	6.00	14.12
2.	Bhopal	2.50	0.15	2.42	0.00	6.00	11.07
3.	Calicut	4.50	0.20	4.42	3.00	0.00	12.12
4.	Coimbatore	3.50	0.20	3.42	3.00	0.00	10.12
5.	Dharwad	2.50	0.15	2.42	0.00	5.00	10.07
6.	Jabalpur	2.50	0.20	2.42	0.00	7.00	12.12
7.	Karjat	2.50	0.15	2.42	0.00	5.00	10.07
8.	Ludhiana	2.50	0.15	3.42	3.00	0.00	9.07
9.	Modipuram	5.08	0.29	4.30	3.00	0.00	12.67
10.	Pantnagar	2.50	0.20	2.42	0.00	8.00	13.12
11.	Raipur	2.50	0.15	2.42	3.00	3.00	11.07
12.	Ranchi	2.50	0.15	2.42	0.00	3.00	8.07
13.	Umiam	2.50	0.20	2.82	3.00	7.00	15.52
	Total	**38.08**	**2.39**	**37.74**	**21.00**	**50.00**	**149.21**

7. RESEARCH RESULTS

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

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

Objectives

The experiment was conducted at all the 13 locations with the following objectives.

- To study the impact of organic, inorganic and integrated management packages on crop productivity and soil health.
- To study the impact of various packages on soil microbial population 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 in Modipuram and Umiam where it was started during 2005-06. The cropping system adopted remained almost same for all the years in each centres except Ludhiana where the cropping system was changed during 2008-09 in one set of experiments as Ludhiana centre evaluated two set of cropping systems.

Treatments: The experiment was conducted in split plot design as un-replicated trial. However, Raipur, Calicut, Karjat, Ludhiana (II set), Bhopal, Pantnagar and Umiam centres have conducted the experiment with three replications.

Three crop management packages viz., organic, inorganic and integrated were assigned to main plots which were common to all the centres, while the centre specific cropping systems were assigned to sub plots. The number of cropping systems ranged from 3 (Coimbatore and Calicut) to as high as 5 (Ludhiana and Dharwad) in various centres. The details of cropping systems are given in Table1 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.

Eco-system	Centre (state)
Arid	Dharwad (Karnataka) Ludhiana (Punjab)
Semi-Arid	Coimbatore (Tamil Nadu)
Sub-Arid	Modipuram (Uttar Pradesh) Raipur (Chattisgarh) Bhopal (Madhya Pradesh) Jabalpur (Madhya Pradesh) Pantnagar (Uttarakhand) Ranchi (Jharkhand)
Humid	Bajaura (Himachal Pradesh) Umiam (Meghalaya)
Coastal	Calicut (Kerala) Karjat (Maharashtra)

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				
	Vermicompost	1.72	0.26	1.31
	FYM	2.25	0.28	2.11
	Urea	46.00	-	-
	SSP	-	16.00	-
	MOP	-	-	58.00
	Rockphosphate	-	34.00	-
Bhopal				
Calicut				
	Farm Yard Manure	0.67	0.17	0.64
	Neem cake	1.67	0.19	1.70
	Ash	-	0.23	7.0
	Vermicompost	0.79	0.20	0.58
	Green leaf manure	2.62	0.09	0.62
	Rajphos	-	18.5	-
	Urea	46	-	-
	MOP	58		
Coimbatore				
	FYM	0.51	0.20	0.50
	Vermi compost	0.50	0.40	0.98
	Neem cake	3.25	0.60	1.10
Dharwad				
	Enriched compost	0.6	0.55	.52
	Vermicompost	1.0	0.69	0.28
	Gliricidia	0.5	0.32	1.15
	FYM	0.5	0.27	0.41
Jabalpur				
Karjat				
	F.Y.M.	0.50	0.25	0.50
	Neem cake	5.20	1.00	1.40
	Vermicompost	2.00	1.00	1.50
	Glyricidia green leaves	2.74	0.50	1.15
	Paddy straw	1.20	0.16	1.14
Ludhiana				
Modipuram				
Pantnagar				
Raipur				
	Enriched compost	0.35	0.70	0.85
	Cow dung manure	0.55	0.45	0.80
	Non Edible Oil Cakes (NEOC)	4.5	0.70	1.60
	Rock phosphate	23		
	GM	2.25	0.40	1.50
Ranchi				
	FYM	0.5	0.3	0.5
	VC	1.2	0.45	1.4
	KC	4.0	1.0	1.0
	Urea	46	-	-
	SSP	-	16	-
	MOP	-	-	60
Umiam				
	F.Y.M.	1.01	0.56	1.00
	Vermicompost	1.52	0.62	1.01
	Rock phosphate	-	16.0	-
	Tephrosia *spp*	3.31	0.44	1.46

Results

The parameter wise result of 2011-12 for each centre are presented and discussed.

Grain and straw yield (Table 1-2 and Fig. 1)

Bajaura: The general performance of cauliflower, frenchbean and maize was found to be better under integrated followed by organic package. Tomato recorded higher yield under integrated (4120 kg ha^{-1}) followed by organic (3700 kg ha^{-1}). Tomato recorded yield increase of more than 1.5 times with organic package, but under integrated package it was observed more than 1.8 times over inorganic. Maize and garlic registered 43.7% and 36.7% higher yield under integrated package over inorganic. Straw yield also registered similar trend. In term of cauliflower equivalent yield, all the systems registered higher yield under integrated package. Among the systems evaluated, maize-garlic was found to be better as it registered significantly higher yield of 37701 kg ha^{-1}.

Bhopal: In *kharif*, soybean recorded 21.1 and 15.4% higher grains yield under organic over inorganic and integrated respectively. In *rabi,* wheat, mustard, chickpea and linseed recorded significantly higher yield with organic package compared to inorganic and the yield increase was found to be 10, 21.4, 60 and 26.6% respectively. Organic package resulted in significantly higher soybean equivalent yield in all the systems followed by integrated package. Among the systems, soybean chickpea (1916 kg ha^{-1}) and soybean-wheat (1830 kg ha^{-1}) was found to be better than other systems

Monitoring of NPOF experiment at Bhopal by Director, IIFS, Bhopal

Performance of chickpea crop under organic management at Bhopal

Calicut: Ginger recorded higher rhizome yield under inorganic package while turmeric and black pepper performed better under integrated package. The yield reduction in ginger was found to be 39.3% and

Ginger under integrated management at Calicut

Ginger under organic management with PGPR inoculation at Calicut

Table 1. Influence of organic, inorganic and integrated packages on yield and equivalent yield (kg/ha) of crops

Cropping system/package	Grain yield									Equivalent yield			
	Organic			Inorganic			Integrated						
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	Organic	Inorganic	Integrated	Mean
Bajaura													
Cauliflower-pea-tomato	7570	10185	3700	7287	6173	1457	16211	8716	4120	21455	14917	29047	21806
Frenchbean-cauliflower-french bean	2095	9667	7191	1101	12493	6214	1598	15095	9055	22096	21460	28145	23900
Cauliflower-pea-cauliflower	7213	10185	1813	7168	4167	358	16062	10574	1374	19211	11693	28010	19638
Maize-garlic	5654	10838		4761	12200		6845	16680		31618	34309	47176	37701
Mean										23595	20595	33095	
Bhopal													
Soybean-wheat	381	3136	-	295	2851	-	311	3016	-	1950	1721	1820	1830
Soybean-mustard	355	1022	-	272	842	-	238	967	-	1329	1074	1158	1187
Soybean-chickpea	325	2098	-	275	1311	-	272	1842	-	2273	1493	1983	1916
Soybean-linseed	249	1080	-	240	853	-	314	900	-	1518	1243	1372	1377
Mean										1767	1383	1583	
	Kharif		***Rabi***										
	SEm±	CD	SEm±	CD									
Input	6.75	26.5	33.6	132									
Cropping	11.3	33.6	35.6	106									
Cropping X Input	20	58.1	61.7	183									
Input X Cropping	18.3	56.6	63.1	205									
Calicut													
Ginger	5946			9792			7654			5933	6860	7590	6794
Turmeric	8950			8975			10350			8825	8900	10390	9372
Black pepper	775			438			975			775	438	975	729
	Kharif		**Rabi**										
	SEm±	CD	SEm±	CD									
Input	104	316											
Cropping	86.3	247											
Cropping X Input	150	428											
Input X Cropping	160	471											

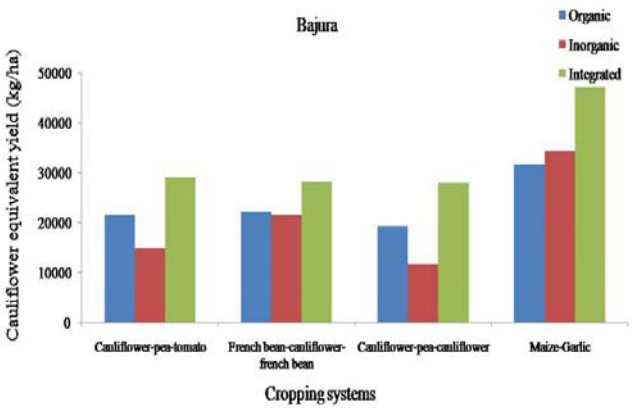
Cropping system/package	Grain yield									Equivalent yield			
	Organic			Inorganic			Integrated						
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	Organic	Inorganic	Integrated	Mean
Coimbatore													
Cotton-maize-green manure	1515	4144		1558	4733		1723	5060	-	15328	20490	21963	19260
Chillies-sunflower-green manure	3812	1602		4370	1730		4086	1895	-	5734	6446	6360	6180
Brinjal-sunflower-green manure	9378	1395		12823	1630		11272	1725	-	11122	14861	13428	13137
Mean										10728	13932	13917	
Dharwad													
Maize-chickpea	4700	964		3433	697		4293	817	-	7399	5385	1645	4810
Cotton+[ea	1475 (2782)			867 (1899)			1357 (2699)		-	2727	1722	2572	2340
Groundnut-sorghum	3683	1178		2593	926		3418	1115	-	4076	2902	2842	3273
Potato-chickpea	5123	1137		4211	774		4502	844	-	8307	6378	1716	5467
Soybean-wheat	3227	1137		2125	912		2534	1087	-	3847	2647	1720	2738
Mean										5271	3802	2099	
Jabalpur													
Basmati rice-D.wheat-green manure	3525	3453	-	4020	4219	-	3712	3855	-	6287	7129	6553	6656
Basmati rice-chickpea-sesamem	3358	1275	229	3641	1395	311	3510	1294	268	5028	5968	5636	5544
Basmati rice-berseem	3256	210	-	3590	250	-	3410	230	-	4096	4906	4621	4541
Basmati rice-veg.pea-sorghum	3158	3873	43827	3600	4419	47858	3425	4219	44572	6244	7689	7288	7074
Mean										5414	6423	6024	
Karjat													
Rice-groundnut	3412	2584		4243	2837		3613	2807		9396	10546	9851	9931
Rice-maize (sweet corn for cob)	2217	9613		3319	17521		2841	14708		4544	7796	6600	6314
Rice-mustard	2704	863		3559	1066		2715	1076		4612	5929	5107	5216
Rice-dolichos bean (for green pod vegetable)	2780	4950		3746	5529		3477	5287		7730	9275	8764	8590
Mean										6571	8387	7581	

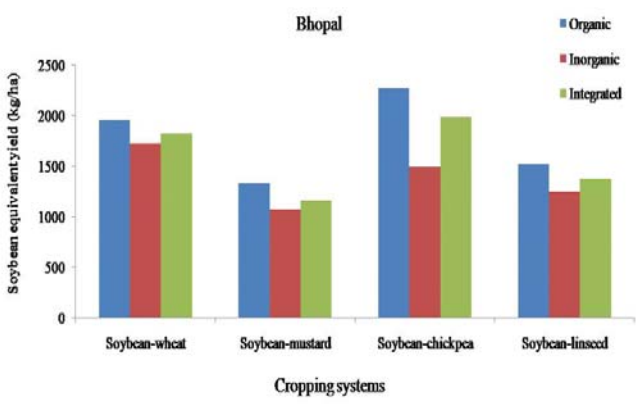
Cropping system/package	Grain yield									Equivalent yield			
	Organic			Inorganic			Integrated						
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	Organic	Inorganic	Integrated	Mean
	Kharif		***Rabi***										
	SEm±	CD	SEm±	CD									
Input	107	312	91	265									
Cropping	123	360	105	307									
Cropping X Input	NS	NS	NS	NS									
Input X Cropping	214	NS	182	531									
Ludhiana I													
Cotton-gram(D)	1570	1540	-	680	1460	-	1170	1520	-	3116	2145	2695	2652
Maize(PP)-gram(K)	2420	1350	-	1660	1500	-	2200	1600	-	1811	1703	1946	1820
Basmati rice-wheat-summer moong	3160	4050	1040	3060	4620	1120	2810	4840	1120	5735	5935	5771	5814
Turmeric-onion	28650	18050	-	10950	14000	-	20250	17040	-	10007	5346	7991	7781
Maize-potato-summer moong	5810	20440	1160	3960	14600	11.4	4930	19500	1050	6491	4874	5955	5773
Mean										5432	4001	4872	
Ludhiana II													
Sorghum-berseem	35150	64350	-	28650	53675	-	33850	60500	-				
Maize-berseem-bajra	38300	65425	34600	40150	54775	33000	38350	63075	36100				
Maize-berseem-maize+cowpea	37900	66675	42550	40050	56375	37700	37550	61400	34950				
Sorghum+guar-oats-cowpea	45400	43775	31500	38250	48500	26275	42500	44750	28525				
	Kharif		***Rabi***		***Summer***								
	SEm±	CD	SEm±	CD	SEm±	CD							
Input	1190	NS	602	2083	1797	N.S.							
Cropping	968	2806	1377	3995	1452	4314							
Cropping X Input	1675	4861	2385	6920	3112	N.S.							
Input X Cropping	1876	5865	2151	6336	2728	N.S.							

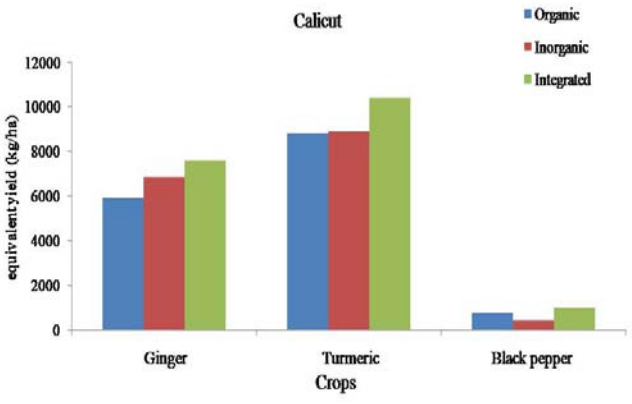
Cropping system/package	Grain yield									Equivalent yield			
	Organic			Inorganic			Integrated						
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	Organic	Inorganic	Integrated	Mean
Modipuram													
Basmati rice-wheat-*sesbania* GM	3560	4070		2960	3540		3350	4280		7670	7670	6530	7290
Rice-barley+mustard-green gram	4260	2565 (385)	871	3860	2356 (338)	694	4180	2790 (412)	855	9250	9330	8100	8893
Maize (cob)-potato-okra	4860	21300	27400	4430	18600	21700	4760	21800	28000	30620	30290	26200	29037
Maize -mustard+radish-*Sesbania* GM	9060	694 (14200)		8330	589 (12200)		9620	744 (15300)		8580	9170	7610	8453
Mean										14030	14115	12110	
Pantnagar													
Basmati rice-wheat-*sesbania* (green manuring)	3571	4103		2950	4363		3245	4398		5818	5339	5653	5604
Basmati rice-lentil-*sesbania* (green manuring)	4038	1702		3337	1572		3885	1697		9548	8109	9036	8898
Basmati rice-vegetable pea-*Sesbania* (green manuring)	3873	6272		3354	5619		3710	5864		5306	5529	5980	5605
Basmati rice-brassica napus-*sesbania* (green manuring)	3373	1777		2911	1864		3158	1992		4938	4553	4912	4801
Mean										6403	5883	6395	
	Kharif		***Rabi***										
	SEm±	CD	SEm±	CD									
Input	54.5	214	79.2	NS									
Cropping	38.4	114	115	343									
Cropping X Input	66.5	NS	200	NS									
Input X Cropping	79.2	NS	190	NS									
Raipur													
Soybean-berseem	1118	36619		1111	32524		1314	35452		118299	131206	143123	130876
Soybean-Isabgol	1106	279		1076	335		1206	312		1771	2073	2133	1992
Soybean-onion	1038	13262		1036	16381		1189	15643		11648	17417	16832	15299
Soybean-safflower	1062	1204		1034	1233		1185	1451		1928	2144	2491	2188
Mean										33412	38210	41145	

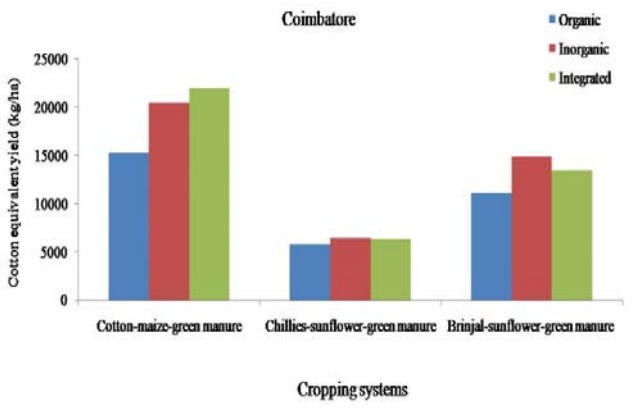
Cropping system/package	Grain yield									Equivalent yield			
	Organic			Inorganic			Integrated						
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	Organic	Inorganic	Integrated	Mean
	Kharif		***Rabi***										
	SEm±	CD	SEm±	CD									
Input	20.8	72	520	NS									
Cropping	17.6	51	665	1929									
Cropping X Input	30.4	NS	1151	NS									
Input X Cropping	33.6	NS	1225	NS									
Ranchi													
Rice - wheat	4120	1950		3530	2410		3820	2220		6151	6040	6133	6108
Rice - potato	4290	19300		3720	15100		3960	17900		13940	11270	12910	12707
Rice - linseed	3980	795		3350	750		3740	766		4894	4225	4634	4584
Rice - lentil	3720	649		3310	713		3580	735		5072	4795	5111	4993
Mean										7514	6583	7197	
Umiam													
Rice -carrot	3243	11967		3171	6851		3294	11638		9227	6977	9759	8654
Rice -potato	3058	14512		3251	12326		3290	14720		7847	7771	8688	8102
Rice-frenchbean	3343	9428		3356	7803		3502	9735		18664	17444	21079	19062
Rice-tomato	3120	13136		3259	11709		3404	13514		12315	12366	13915	12865
Mean										12013	11140	13360	
	Kharif		***Rabi***										
	SEm±	CD	SEm±	CD									
Input	140	NS	231	905									
Cropping	90.5	NS	178	530									
Cropping X Input	157	NS	309	919									
Input X Cropping	195	NS	354	1193									

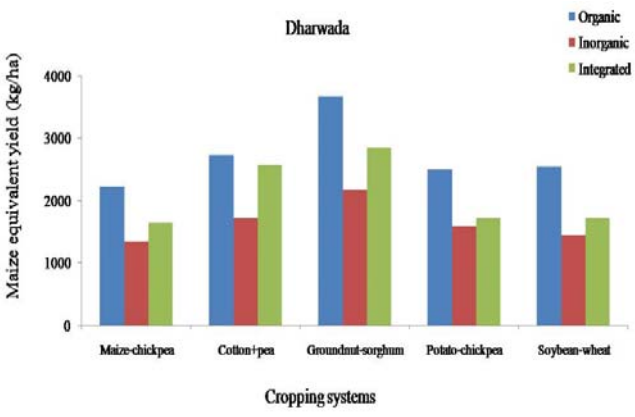
( ) Figures in parenthesis are yield of inter crops

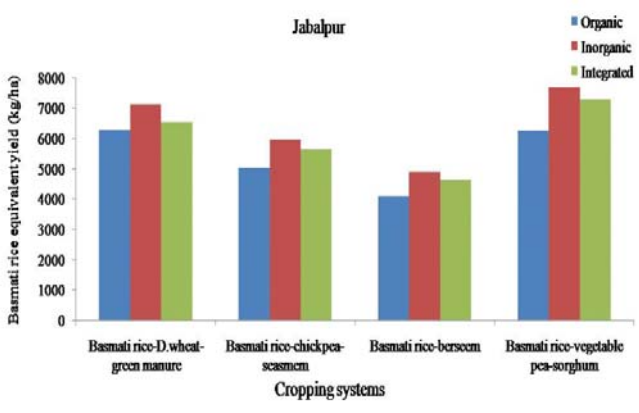

Bajura
Organic
Inorganic
Integrated
Cauliflower equivalent yield (kg/ha)
50000
40000
30000
20000
10000
0
Cauliflower-pea-tomato
French bean-cauliflower-french bean
Cauliflower-pea-cauliflower
Maize-Garlic
Cropping systems

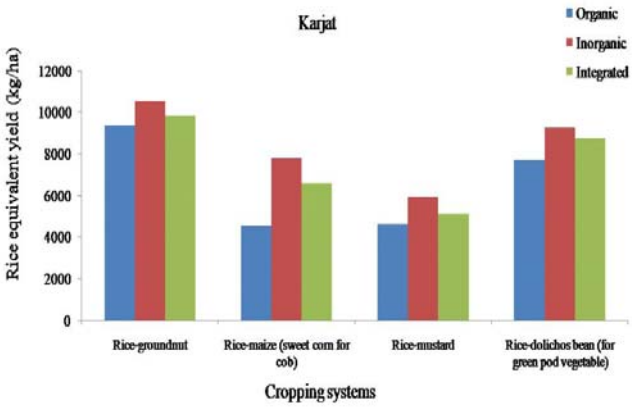

Bhopal
Organic
Inorganic
Integrated
Soybean equivalent yield (kg/ha)
2500
2000
1500
1000
500
0
Soybean-wheat
Soybean-mustard
Soybean-chickpea
Soybean-linseed
Cropping systems

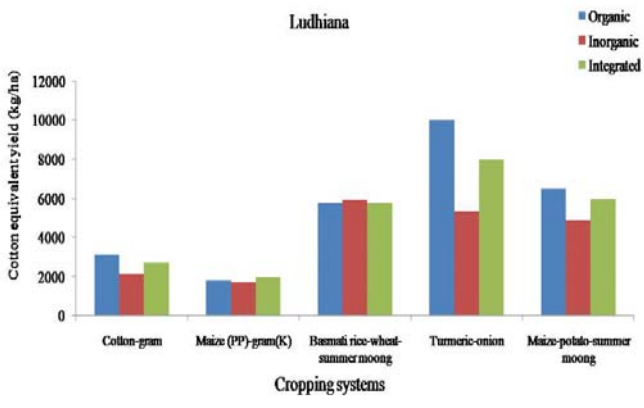

Calicut
Organic
Inorganic
Integrated
equivalent yield (kg/ha)
12000
10000
8000
6000
4000
2000
0
Ginger
Turmeric
Black pepper
Crops


Coimbatore
Organic
Inorganic
Integrated
Cotton equivalent yield (kg/ha)
25000
20000
15000
10000
5000
0
Cotton-maize-green manure
Chillies-sunflower-green manure
Brinjal-sunflower-green manure
Cropping systems


Dharwada
Organic
Inorganic
Integrated
Maize equivalent yield (kg/ha)
4000
3000
2000
1000
0
Maize-chickpea
Cotton+pea
Groundnut-sorghum
Potato-chickpea
Soybean-wheat
Cropping systems


Jabalpur
Organic
Inorganic
Integrated
Basmati rice equivalent yield (kg/ha)
8000
7000
6000
5000
4000
3000
2000
1000
0
Basmati rice-D.wheat-green manure
Basmati rice-chickpea-scasmem
Basmati rice-berseem
Basmati rice-vegetable pea-sorghum
Cropping systems


Karjat
Organic
Inorganic
Integrated
Rice equivalent yield (kg/ha)
12000
10000
8000
6000
4000
2000
0
Rice-groundnut
Rice-maize (sweet corn for cob)
Rice-mustard
Rice-dolichos bean (for green pod vegetable)
Cropping systems


Ludhiana
Organic
Inorganic
Integrated
Cotton equivalent yield (kg/ha)
12000
10000
8000
6000
4000
2000
0
Cotton-gram
Maize (PP)-gram(K)
Basmati rice-wheat-summer moong
Turmeric-onion
Maize-potato-summer moong
Cropping systems

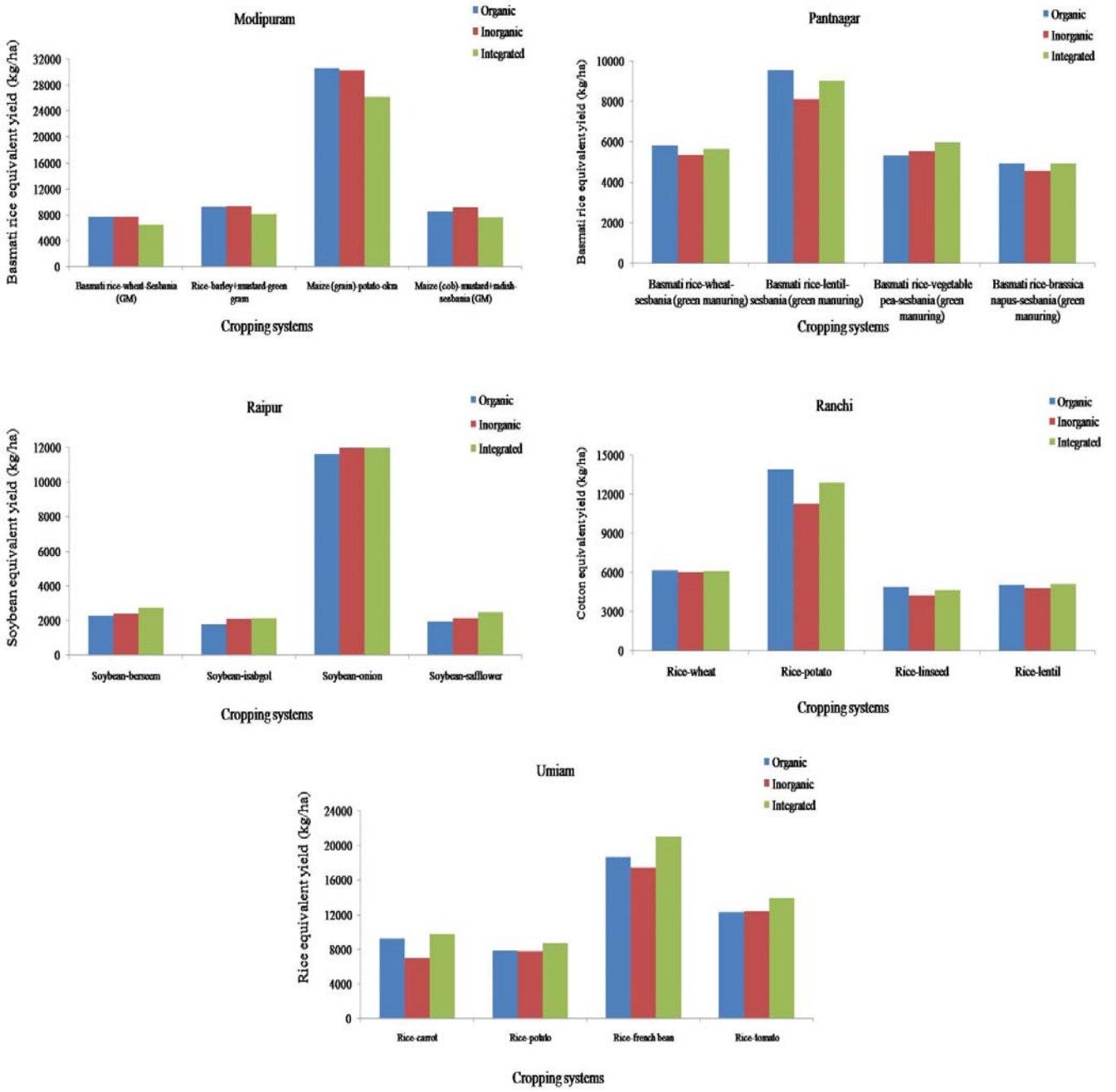


Fig. 1. Performance of various systems under different production systems based on system equivalent yield

21.8% under organic and integrated package compared to inorganic respectively. The yield drop with organic was found to be 13.5% over integrated package in turmeric. Black pepper registered higher yield under integrated (975 kg ha^{-1}) followed by organic (775 kg ha^{-1}) and inorganic (438 kg ha^{-1}).

Coimbatore: All the crops evaluated performed better under integrated package except chilli and brinjal which recorded higher yield under inorganic package. The additional yield obtained with inorganic package was found to be 558 and 3445 kg ha^{-1} compared to organic package respectively. The yield difference

Performance of cotton crop under organic condition at Coimbatore

Table 2. Influence of organic, inorganic and integrated packages on straw yield (kg/ha) of crops

Cropping systems/package	Organic			Inorganic			IM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Bajaura									
Cauliflower-pea-tomato	6270			5930			8650		
French bean-cauliflower-french bean	950	5430		430	7320		760	9760	
Cauliflower-pea-cauliflower	6050			6230			10270		
Maize-garlic	7820			8650			10200		
Coimbatore									
Cotton-maize-green manure		4956			5318			5774	
Chillies-sunflower-green manure		3984			3817			4090	
Brinjal-sunflower-green manure		3319			3457			3863	
Dharwad									
Maize-chickpea		1204			1070			1291	
Cotton+pea									
Groundnut-sorghum		5706			3959			5512	
Potato-chickpea		1402			1123			1387	
Soybean-wheat		2301			2007			1855	
Jabalpur									
Basmati rice-D. wheat-GM	6419	6034		6812	7236		5824	6991	
Basmati rice-chickpea-sesamum	5473	1785		5571	2093		5076	1877	
Basmati rice-berseem	5770	35621		5174	37811		5866	36299	
Basmati rice-veg.pea-sorghum	5573			5670			5582		
Karjat									
Rice-groundnut	4145	3186		4769	4335		4227	3824	
Rice-maize (sweet corn for cob)	3010	4409		3347	7149		2825	6400	
Rice-mustard	3032	887		3828	1627		2934	1129	
Rice-dolichos bean (for green pod vegetable)	3254	3875		4189	4394		4069	4159	
						Kharif		***Rabi***	
						SEm±	CD	SEm±	CD
Input						67.9	199	161	468
Cropping						78.5	229	185	540
Cropping X Input							NS		NS
Input X Cropping						137	NS	320	NS
Ludhiana I									
Cotton-gram(D)	11860			9360			10340		
Maize(PP)-gram(K)	10280			7800			9630		

Cropping systems/package	Organic			Inorganic			IM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Basmati rice-wheat-summer moong	8090			6690			7110		
Turmeric-onion	7070			2420			5660		
Maize-potato-summer moong	10740			7290			9380		
Modipuram									
Basmati rice-wheat-*sesbania* (GM)	6610	6450		4830	6110		5960	6900	
Rice-barley+mustard-GG	6950	4088 (1420)	2673	5790	3969 (1310)	2344	6540	4099 (1480)	2563
Maize cob-potato-okra	6710	3865		6370	3286		7140	4142	
Maize -mustard+radish-*sesbania* (GM)	11330	2691		10330	2385		11760	2783	
Pantnagar									
Basmati rice-wheat-*sesbania* (green manure)	5178	5031		5124	3726		5476	4784	
Basmati rice-lentil-*sesbania* (green manure)	5630	3266		5473	4857		5590	0.00	
Basmati rice-vegetable pea-*sesbania* (green manure)	5850	4691		4831	6166		5023	0.00	
Basmati rice-*Brassica napus*-*sesbania* (green manure)	5581	5041		5225	3669		4801	0.00	

	Kharif		*Rabi*	
	SEm±	CD	SEm±	CD
Input	110	NS	193	759
Cropping	62.8	187	125	370
Cropping X Input	109	323	216	641
Input X Cropping	145	511	269	932

Raipur									
Soybean-berseem	2371			2208			2799		
Soybean-isabgol	2342			2181			2766		
Soybean-onion	2165			1981			2493		
Soybean-safflower	2229			2167			2664		

	Kharif	
	SEm±	CD
Input	37.0	128
Cropping	49.0	142
Cropping X Input	84.9	NS
Input X Cropping	82.0	NS

Ranchi									
Rice-wheat	5990	3140		5470	3780		5610	3530	
Rice-potato	6250	3642		5550	2786		5790	3365	

Cropping systems/package	Organic			Inorganic			IM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Rice-linseed	5650	1530		5210	1435		5580	1487	
Rice-lentil	5480	1863		5100	2068		5310	2109	
Umiam									
Rice-carrot									
Rice-potato		5161			4641			5322	
Rice-frenchbean		1631			1487			1594	
Rice-tomato		1367			1212			1431	
								Rabi	
								SEm±	CD
Input								63.6	NS
Cropping								73.6	218
Cropping X Input								127	NS
Input X Cropping								127	NS
( ) Figures in parenthesis are straw yield of inter crops									

between integrated and organic package was found to be 274 and 1894 kg ha^{-1}. The drop in yield under organic package over integrated was found to be 17.2, 18.1, 16.8 and 12.7% for sunflower, maize, brinjal and cotton respectively. All the systems recorded higher cotton equivalent yield under integrated package even after applying premium price of organic produce. Among the systems, cotton-maize-greengram was found to be better (19260 kg ha^{-1}).

Dharwad: All the crops evaluated in five systems recorded higher yield with organic package. The yield increase over inorganic was found to be 36.9, 42.8, 46.5, 42, 27.2, 21.7, 51.9 and 24.7% for maize, chickpea, pea, groundnut, sorghum, potato, soybean and wheat respectively. Integrated package was the next best for all the crops. Straw yield also exhibited similar trend. All the systems recorded higher maize equivalent yield with organic package. Among the systems ground-sorghum and cotton+pea registered higher maize equivalent yield (2896 and 2340 kg ha^{-1} respectively) than other systems.

Jabalpur: Basmati rice, chickpea, sesamum, berseem, vegetable pea and sorghum recorded higher yield under inorganic package. The yield reduction observed in basmati rice with organic and integrated package was found to be 10.5 and 5.3% while, the reduction was much higher for wheat (18.2 and 8.6% respectively). The yield reduction of 12.4, 8.6, 26.4, 16, and 8.4% was found in vegetable pea, chickpea, sesamum, berseem and sorghum with organic package compared to inorganic. Straw yield of basmati rice and wheat have also exhibited similar trend. In term of basmati rice equivalent yield, all the systems recorded higher yield under inorganic package. Among the systems, basmati rice-vegetable pea-sorghum and basmati rice-wheat-greengram recorded higher equivalent yield of 7074 and 6656 kg ha^{-1} respectively than other systems.

Karjat: Rice during *kharif* registered significantly higher yield under inorganic followed by integrated package. The mean yield drop observed with organic and integrated package was found to be 25.3 and 14.9% respectively over inorganic. During *rabi*, it was observed that all the crops (groundnut, maize for cob, mustard and dolichos bean) have recorded significantly higher yield under inorganic package. The yield drop of groundnut, maize, mustard and dolichous bean was found to be 8.9, 45.1, 19 and 10.5%

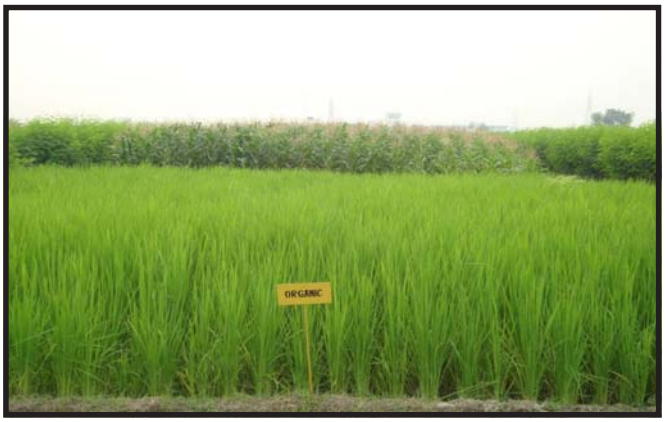
respectively with organic over inorganic package. Straw yield also recorded similar trend. All the systems registered higher rice equivalent under organic package and among the systems, rice-groundnut and rice-delichous bean (for green pod) was found to be better than other systems.

Ludhiana: Two set of experiments were conducted by including various combinations of crops in the system mode. In the first experiment, all the crops except gram, wheat and summer moong recorded higher yield under organic package. Gram, wheat and summer moong registered higher yield under integrated package. More than 100% increase in yield under organic over inorganic was observed in cotton and turmeric during *kharif*. Basmati rice recorded only 3.3% increase whereas maize recorded 46.7%. In *rabi*, the results revealed that an increase in yield of onion and potato by 28.9 and 40% under organic over inorganic package while gram yield drop was found to be 10%. Similarly, in summer moong, it was found that 7.1% drop in yield under organic package. Straw yield also exhibited similar trend. In the second set of experiment, the different management package did not significantly influence on the yield of crops during *kharif* and summer seasons implying suitability of organic management package especially for sorghum, maize, pearlmillet and cowpea. In *rabi*, berseem recorded higher yield under organic package (65483 kg ha^{-1}) while oats performed better under inorganic package (48500 $kgha^{-1}$). The yield drop in oats due to organic package was found to be 9.7%. In term of basmati rice equivalent yield, turmeric-onion (7781 kg ha^{-1}) and basmati rice-wheat summer moong (5814 kg ha^{-1}) was found to be better than other systems. Maize-potato summer moong, turmeric-onion and cotton-gram was found to be better performance with organic package.

Monitoring of NPOF experiment at Ludhiana by Project Director and National PI

Performance of wheat + chickpea system under organic management at Ludhiana

Modipuram: The response of different crops in the systems varied for the type of input packages adopted. Among the various crops in the systems, basmati rice, maize for cob and greengram recorded higher yield under organic system while maize for grain, potato, okra, barley, mustard and radish have recorded



Basmati rice under organic management at Modipuram

Maize under organic management at Modipuram

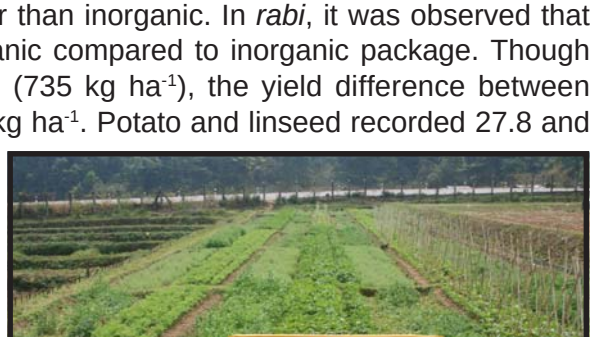
higher yield under integrated package. Wheat registered increase in yield to the tune of 15.0% with organic package while, the increase was found to be 21% under integrated. In case of basmati rice, it was observed that 20.3% higher yield under organic system compared to inorganic package, whereas in rice, the yield was increased 10.4 and 8.3% under organic and integrated package, respectively. Straw yield also exhibited the similar trend. Among the various systems, maize-potato-okra recorded higher basmati rice equivalent yield of 29037 kg ha-1. Organic and inorganic package resulted in on par basmati rice equivalent yield in all the systems except maize (cob)-mustard+raddish-sesbania GM.

Pantnagar: Significantly higher mean yield of basmati rice during *kharif* was observed with organic package as it recorded higher mean grain yield of 3714 kg ha^{-1} followed by integrated package 3499 kg ha^{-1}. The yield increase under organic was 18.3% over inorganic package. Among *rabi* crops, wheat recorded numerically higher yield under integrated package (4398 kg ha^{-1}) but, the same was at par with inorganic (4363 kg ha^{-1}). *Brassica napus* recorded higher yield (1992 kg ha^{-1}) under integrated followed by inorganic package. Vegetable pea and lentil produced better performance (6272 and 1702 kg ha^{-1}) under organic followed by integrated (5864 and 1697 kg ha^{-1}). The straw yield of both *kharif* and *rabi* crops have resulted in similar trend. In term of basmati rice equivalent yield, all the systems recorded higher yield under organic except basmati rice-vagetable pea-sesbania system. Among the systems, basmati rice-lentil sesbania (GM) recorded higher basmati rice equivalent yield (8898 kg ha^{-1})

Organic basmati rice (PB-1) under NPOF at Pantnagar

Raipur: Mean yield of soybean in *kharif* was found to be higher under integrated package (1223 kg ha^{-1}) followed by organic (1081 kg ha^{-1}) and inorganic (1064 kg ha^{-1}). Among the other crops evaluated, berseem registered higher yield under organic package, isabgol and onion registered higher yield under inorganic package, while safflower performed better under integrated package. The drop in yield of onion with organic package was found to be 2381 kg ha^{-1} compared to integrated package. All the nutrient management packages registered significant yield difference in *kharif* and non-significant difference in *rabi* seasons. Straw yield of soybean and sunflower also revealed the same trend. In term of soybean equivalent yield, soybean-berseem was found to be better, while inorganic package was found to be better for all systems except soybean-onion which recorded higher yield under in organic package.

Ranchi: Rice recorded higher mean grain yield of 4028 kg ha^{-1} during *kharif* under organic package which is 6.7% higher than integrated package and 15.8% higher than inorganic. In *rabi*, it was observed that wheat recorded around 460 kg ha^{-1} lesser yield with organic compared to inorganic package. Though lentil recorded numerically higher yield under integrated (735 kg ha^{-1}), the yield difference between integrated and organic package was found to be only 86 kg ha^{-1}. Potato and linseed recorded 27.8 and 6% increase in yield under organic over inorganic package. Similar trend was also obtained for straw yield of all the crops. Rice-potato system was found to be better in term of rice equivalent yield (12707 kg ha^{-1}) and all the systems performed better with organic package due to the higher premium price received for organic practice.



Organic farming experiments in Raised and sunken beds at Umiam

Umiam: Rice grown during *kharif* recorded numerically higher mean grain yield of 3373 kg ha^{-1} with inorganic package followed by integrated 3259 kg ha^{-1}. All the vegetables like carrot, potato, frenchbean and tomato grown during *rabi* performed better under integrated

package. Yield obtained with organic was at par with integrated package. Among the vegetable crops, carrot potato, frenchbean and tomato have recorded 69.9, 19.4, 24.8 and 15.4% higher yield with integrated over inorganic package. Residue yield of vegetables have also given same trend. Among the systems, rice-frenchbean systems recorded higher rice equivalent yield (19092 kg ha-1) while rice-carrot system recorded higher yield under organic package. All other systems recorded higher rice equivalent yield under integrated package.

Soil physical and available nutrient status (Table 3-5 and Fig. 2)

Except Jabalpur, Ranchi and Umiam all the centres have reported soil parameters

Bajaura: Organic carbon, soil available N, P, K and all the micronutrients were estimated. An increase of more than two times in organic carbon was observed with organic and integrated package over inorganic. Variation of only 0.07% was observed among different vegetable based systems. Availability of residual N, P, K was higher with inorganic (220, 94.7, 185 kg ha^{-1} respectively) irrespective of cropping systems. Cauliflower-pea-tomato system recorded lower soil available N (190 kg ha^{-1}), P (79.3 kg ha^{-1}) and K (169 kg ha^{-1}) among the various cropping systems. All micro nutrients were higher with organic (28.0, 12.3, 9.40 and 75.0 ppm of Mn, Zn, Cu and Fe respectively) package irrespective of cropping systems. Mn and Fe availability was found higher at the end of cauliflower-pea-cauliflower system. Zn recorded higher in frenchbean-cauliflower-frenchbean system while Cu were higher under maize-garlic system.

Bhopal: Physical and chemical characteristics of soil in terms of electrical conductivity and pH were estimated and no significant variation was found either by nutrient management practices or cropping systems. Electrical conductivity was higher with organic package (0.24 ds/m) compared to inorganic (0.20 ds/m). Marginal improvement in available N (5.1%) and residual P more than 2 times was observed with organic over inorganic package. The residual soil available N (258 kg ha^{-1}) and P (79 kg ha^{-1}) was found to be better in soybean-chickpea system while K was found to be higher in soybean-wheat system (709 kg ha^{-1}).

Calicut: Soil organic carbon, available N, P and K along with micronutrient such as Mn, Zn, Cu and Fe were estimated for turmeric, ginger and black pepper. Irrespective of crops, significant improvement was observed in pH and organic carbon with organic package (9.2 and 17.4%) compared to inorganic input use. Black pepper recorded significantly higher soil organic carbon content (2.31%) than ginger (1.61%) and turmeric (1.26%). Significant difference in available N, P and K was observed among various types of input packages. Availability of residual N, P and K was found to be higher with integrated package 193.0, 29.3 and 243.0 kg ha^{-1} respectively. Black pepper recorded significantly higher residual soil N and P while K was in turmeric. Except Mn, all the other micronutrients such as Zn, Cu Fe were higher under integrated package. Among the crops, ginger recorded higher availability of Cu (15.4 ppm) and Fe (50.1 ppm) while turmeric and black pepper recorded higher Mn (16.4 ppm) and Zn (2.34 ppm) respectively.

Coimbatore: Residual organic carbon, available soil N, P and K was estimated for all the three cropping systems under three management practice. Irrespective of the cropping systems, organic and integrated package resulted in 7.8 and 10.9% improvement in organic carbon compared to inorganic package. Cotton-maize-green manure system recorded higher organic carbon (0.70%) compared to all other systems. As expected, the residual available NPK was found to be higher with organic package (242, 20.7, 662 kg NPK ha^{-1}). Chillies-sunflower-green manure recorded higher available N and P (249 and 20.6 kg ha^{-1} respectively) while Cotton-maize-green manure systems left 678 kg ha^{-1} of soil available K at the end of cropping cycle.

Table 3. Influence of organic, inorganic and integrated package on soil bulk density, electrical conductivity, pH and organic carbon at the end of cropping cycle

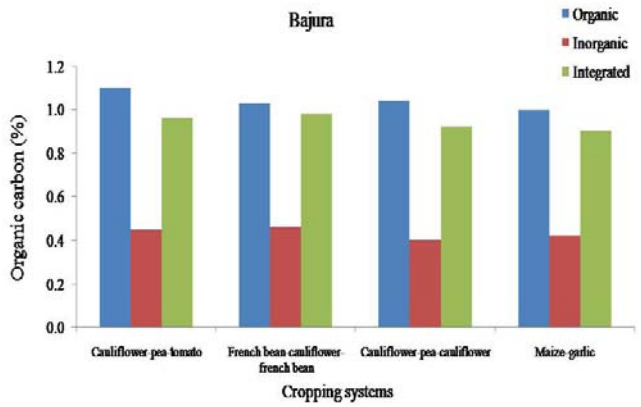
Cropping systems/package	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Bajaura																
Cauliflower-pea-tomato									5.30	5.50	5.40	5.40	1.10	0.45	0.96	0.84
French bean-cauliflower-french bean									5.40	5.60	5.40	5.47	1.03	0.46	0.98	0.82
Cauliflower-pea-cauliflower									5.30	5.60	5.40	5.43	1.04	0.40	0.92	0.79
Maize-garlic									5.40	5.60	5.30	5.43	1.00	0.42	0.90	0.77
Mean									5.35	5.58	5.38		1.04	0.43	0.94	
Bhopal																
Soybean-wheat					0.21	0.27	0.22	0.23	8.03	7.93	8.00	7.99				
Soybean-mustard					0.23	0.27	0.36	0.29	7.77	7.73	7.77	7.76				
Soybean-chickpea					0.30	0.25	0.27	0.27	7.70	7.73	7.70	7.71				
Soybean-linseed					0.24	0.20	.022	0.15	7.93	8.03	8.03	8.00				
Mean					0.25	0.25	0.22		7.86	7.86	7.88					
CD (P=0.05)						SEm±	CD			SEm±	CD					
Package						0.02	NS			0.03	NS					
Cropping						0.02	NS			0.03	0.08					
Cropping X Package						0.04	NS			0.04	NS					
Package X Cropping						0.04	NS			0.05	NS					
Calicut																
Ginger									5.23	4.77	5.18	5.06	1.51	1.69	1.64	1.61
Turmeric									5.57	4.51	4.88	4.99	1.40	1.12	1.25	1.26
Black Pepper									6.27	6.35	6.15	6.29	2.76	2.01	2.15	2.31
Mean									5.69	5.21	5.40		1.89	1.61	1.68	
CD (P=0.05)										SEm±	CD			SEm±	CD	
Package										0.04	0.10			0.04	0.10	
Cropping										0.02	0.07			0.04	0.10	

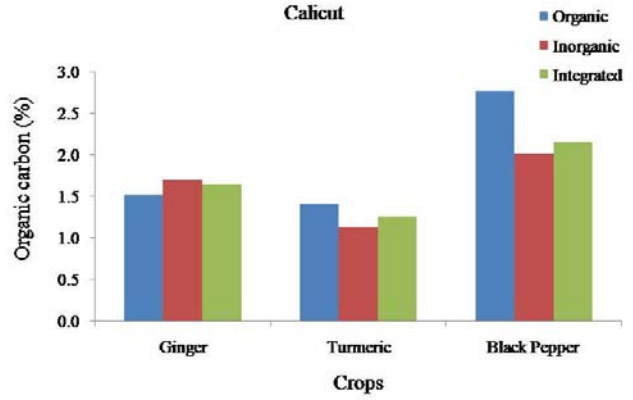
Cropping systems/package	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Cropping X Package										0.04	0.11			0.06	0.17	
Package X Cropping										0.04	0.13			0.06	0.17	
Coimbatore																
Cotton-maize -green manure													0.71	0.65	0.74	0.70
Chillies-sunflower-green manure													0.71	0.63	0.70	0.68
Brinjal-sunflower-green manure													0.66	0.64	0.68	0.66
Mean													0.69	0.64	0.71	
Dharwad																
Maize-chickpea	1.21	1.33	1.24	1.26	0.17	0.21	0.17	0.18	7.24	7.39	7.23	7.29	0.63	0.51	0.57	0.57
Cotton+pea	1.20	1.32	1.23	1.25	0.18	0.20	0.19	0.19	7.25	7.41	7.25	7.30	0.63	0.51	0.56	0.57
Groundnut-sorghum	1.20	1.31	1.24	1.25	0.18	0.21	0.19	0.19	7.21	7.35	7.29	7.28	0.65	0.50	0.60	0.58
Potato-chickpea	1.20	1.31	1.23	1.25	0.20	0.21	0.18	0.20	7.16	7.29	7.19	7.21	0.65	0.50	0.60	0.58
Soybean-wheat	1.19	1.29	1.22	1.23	0.19	0.19	0.20	0.19	7.23	7.37	7.29	7.30	0.64	0.51	0.56	0.57
Mean	1.20	1.31	1.23		0.18	0.20	0.19		7.22	7.36	7.25		0.64	0.51	0.58	
Karjat																
Rice-groundnut					0.42	0.45	0.47	0.45	6.77	6.75	6.71	6.74	1.53	1.29	1.34	1.39
Rice-maize (sweet corn for cob)					0.45	0.45	0.47	0.46	6.73	6.69	6.68	6.70	1.40	1.08	1.26	1.25
Rice-mustard					0.41	0.46	0.45	0.44	6.72	6.73	6.70	6.72	1.51	1.14	1.29	1.31
Rice-dolichos bean (for green pod vegetable)					0.46	0.00	0.43	0.30	6.71	6.70	6.73	6.71	1.40	1.14	1.29	1.28
Mean					0.44	0.34	0.46		6.73	6.72	6.71		1.46	1.16	1.30	
CD (P=0.05)						SEm±	CD			SEm±	CD			SEm±	CD	
Package						0.01	0.03			0.03	NS			0.02	0.07	
Cropping						0.01	0.04			0.03	NS			0.03	0.08	
Cropping X Package						0.02	0.07			0.04	NS				NS	
Package X Cropping						0.02	0.07			0.04	NS			0.05	NS	

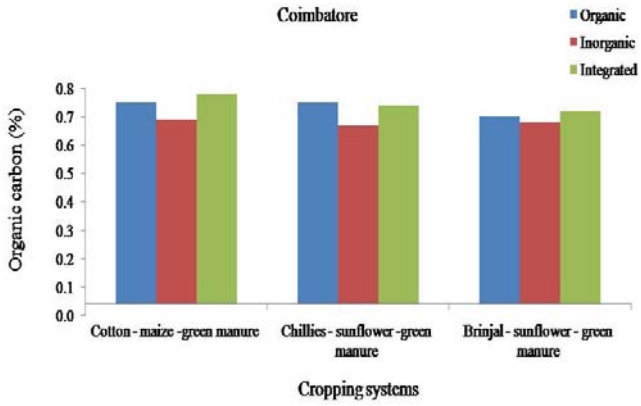
Cropping systems/package	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Ludhiana II																
Sorghum-berseem					0.29	0.28	0.26	0.28	7.47	7.50	7.43	7.47	0.56	0.46	0.55	0.52
Maize-berseem-bajra					0.27	0.26	0.28	0.27	7.50	7.53	7.55	7.53	0.57	0.45	0.54	0.52
Maize-berseem-maize+cowpea					0.33	0.31	0.28	0.31	7.54	7.64	7.51	7.56	0.59	0.46	0.57	0.54
Sorghum+guar-oats-cowpea					0.30	0.32	0.28	0.30	7.58	7.43	7.52	7.51	0.60	0.54	0.57	0.57
Mean					0.30	0.29	0.28		7.52	7.53	7.50		0.58	0.48	0.56	
CD (P=0.05)										SEm±	CD			SEm±	CD	
Package										0.01	NS			0.01	0.03	
Cropping										0.02	0.06			0.01	0.03	
Cropping X Package										0.04	0.10			0.02	NS	
Package X Cropping										0.04	1.10			0.02	NS	
Modipuram																
Basmati rice-wheat-sesbania GM					0.17	0.14	0.16	0.16	7.80	7.98	7.89	7.89	0.68	0.38	0.57	0.54
Rice-barley+mustard-GG					0.10	0.07	0.08	0.08	7.80	7.96	7.88	7.88	0.48	0.29	0.38	0.38
Maize cob-potato-Okra					0.17	0.15	0.17	0.16	7.75	7.93	7.74	7.81	0.74	0.37	0.69	0.60
Maize -mustard+radish-sesbania GM					0.20	0.15	0.18	0.18	7.78	7.96	7.81	7.85	0.67	0.42	0.70	0.60
Mean					0.16	0.13	0.15		7.78	7.96	7.83		0.64	0.37	0.59	
Pantnagar																
Basmati rice-wheat-Sesbania (green manuring)													0.96	0.82	0.94	0.91 0.93
Basmati rice-lentil-sesbania (green manuring)													1.01	0.82	0.97	0.92
Basmati rice-vegetable pea-sesbania (green manuring)													0.98	0.84	0.93	0.90
Basmati rice-brassica napus-sesbania (green manuring)													0.95	0.85	0.91	
Mean													0.98	0.83	0.94	

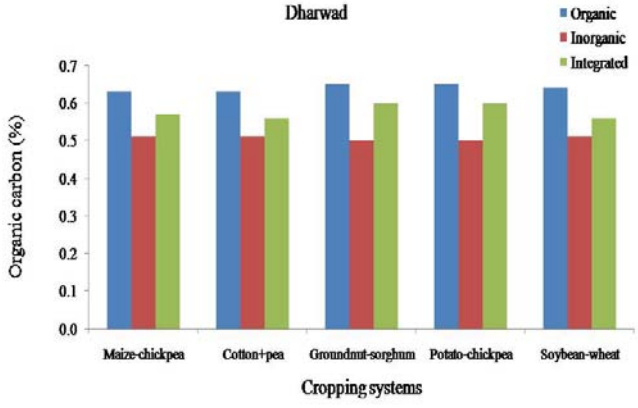
Cropping systems/package	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
CD (P=0.05)														SEm±	CD	
Package														0.01	0.03	
Cropping														0.01	NS	
Cropping X Package														0.01	NS	
Package X Cropping														0.01	NS	
Raipur																
Soybean-berseem	1.29	1.32	1.28	1.30									0.71	0.62	0.64	0.66
Soybean-isabgol	1.29	1.32	1.28	1.30									0.70	0.64	0.68	0.67
Soybean-onion	1.29	1.35	1.30	1.31									0.69	0.64	0.66	0.66
Soybean-safflower	1.32	1.36	1.33	1.34									0.70	0.63	0.67	0.67
Mean	1.30	1.34	1.30										.70	0.63	0.66	
CD (P=0.05)		SEm±	CD											SEm±	CD	
Package		0.01	0.02											0.01	0.03	
Cropping		0.01	0.02											0.01	NS	
Cropping X Package		0.01	NS											0.01	NS	
Package X Cropping		0.01	NS											0.01	NS	

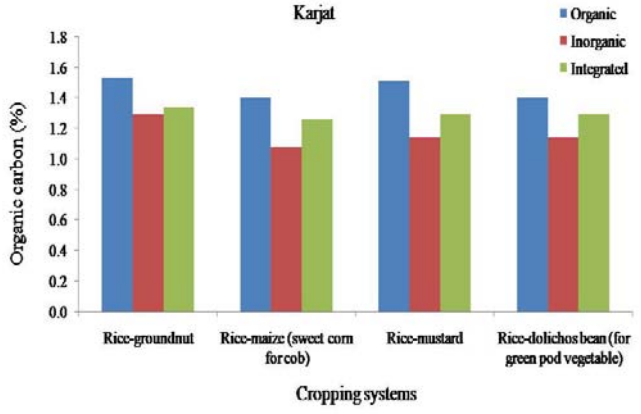
Org = Organic, Inorg = Inorganic, IM = Integrated

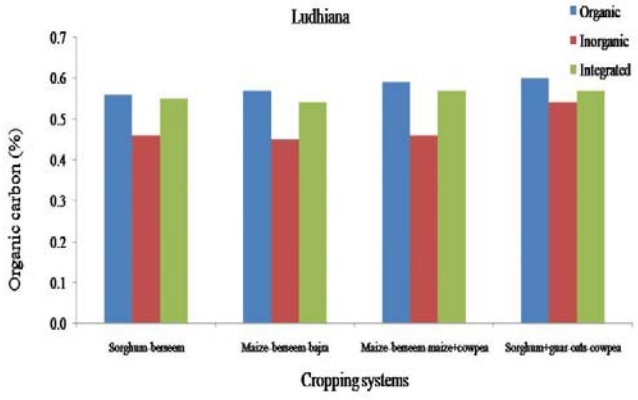

Bajura
Organic
Inorganic
Integrated
Organic carbon (%)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Cauliflower pea-tomato
French bean cauliflower-french bean
Cauliflower pea-cauliflower
Maize-garlic
Cropping systems

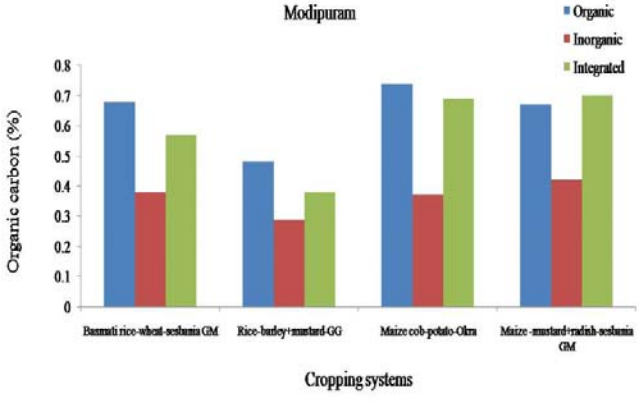

Calicut
Organic
Inorganic
Integrated
Organic carbon (%)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Ginger
Turmeric
Black Pepper
Crops


Coimbatore
Organic
Inorganic
Integrated
Organic carbon (%)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Cotton - maize -green manure
Chillies - sunflower -green manure
Brinjal - sunflower - green manure
Cropping systems


Dharwad
Organic
Inorganic
Integrated
Organic carbon (%)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Maize-chickpea
Cotton+pea
Groundnut-sorghum
Potato-chickpea
Soybean-wheat
Cropping systems


Karjat
Organic
Inorganic
Integrated
Organic carbon (%)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Rice-groundnut
Rice-maize (sweet corn for cob)
Rice-mustard
Rice-dolichos bean (for green pod vegetable)
Cropping systems


Ludhiana
Organic
Inorganic
Integrated
Organic carbon (%)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Sorghum berseem
Maize berseem bajra
Maize berseem maize+cowpea
Sorghum+guar oats cowpea
Cropping systems


Modipuram
Organic
Inorganic
Integrated
Organic carbon (%)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Basmati rice-wheat-sesbania GM
Rice-barley+mustard-GG
Maize cob-potato-Okra
Maize -mustard+radish-sesbania GM
Cropping systems

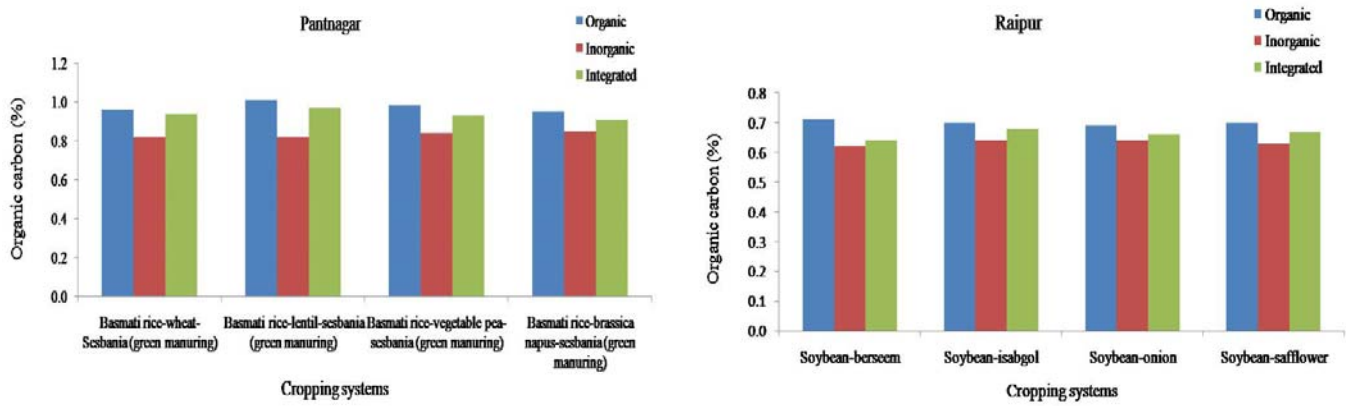


Fig. 2. Influence of management practices and cropping systems on organic carbon content during 2011-12

Dharwad: Lower bulk density (1.20 g/cc), EC (0.18 ds/m) and pH (7.22) were recorded under organic package compared to inorganic and integrated. No significant variation in these parameters was observed among different cropping systems. A significantly higher increase (25.5%) in organic carbon content was observed with organic package followed by integrated (13.7%) compared to inorganic. Variation in organic carbon among various cropping systems was found to be only 0.01%. The improvement in residual available N (9.3%) P (35.9%) K (47.9%) was found to be higher with organic package over inorganic. Cotton + pea recorded higher residual N of 278 kg ha^{-1} while P was higher in groundnut-sorghum. Available K was found to be higher with potato-chickpea system. The variation in residual N, P, and K among different cropping systems was found to be 10.0, 1.3 and 24.0 kg ha^{-1} respectively. Higher residual availability of Mn, Zn, Cu and Fe were observed under organic package compared to inorganic and integrated. Not much variation in availability of micronutrient was observed among different cropping systems.

Karjat: Significant variation in EC and OC of soil was observed in different cropping as well as input package. Significantly higher EC was observed in integrated package followed by organic packages compared to inorganic. Soil organic carbon was higher under organic (1.46%) followed by integrated (1.30%) and inorganic (1.16%) packages. Both rice-groundnut and rice-mustard owing to their higher drop of dry matter to the soil recorded higher organic carbon (1.39 and 1.31% respectively) compared to other systems. Significant variation in soil available N and P was observed among different input packages as well as in different cropping systems. Organic packages registered significantly higher residual N and P (252 and 28.2 kg ha^{-1} respectively). Rice-groundnut and rice-dolichos bean (for green pod vegetable) recorded significantly higher available N (256 and 254 kg ha^{-1} respectively) and P (28.3 and 27.7 kg ha^{-1} respectively) compared to other systems.

Ludhiana: Soil EC, pH, OC, available N, P and K was estimated for second set of experiment. Though there was not much variation in EC and pH was observed, soil organic carbon was found to increase by

Organic turmeric crop at Ludhiana

Inorganic Organic

Comparative growth of cotton at 30 days after sowing at Ludhiana

Table 4. Influence of organic, inorganic and integrated package on soil available nitrogen, phosphorus and potassium at the end of cropping cycle

Cropping/Input system	N (kg ha^{-1})				P (kg ha^{-1})				K (kg ha^{-1})			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Bajaura												
Cauliflower-pea-tomato	175	205	191	190	63.5	95.0	79.4	79.3	155	180	173	169
French bean-cauliflower-french bean	160	221	207	196	74.7	98.5	86.6	86.6	166	187	177	176
Cauliflower-pea-cauliflower	207	220	206	211	75.6	94.5	84.2	84.8	167	187	175	176
Maize-garlic	189	234	209	211	72.1	90.7	83.1	82.0	158	184	175	173
Mean	183	220	203		71.5	94.7	83.3		161.5	185	175	
Bhopal												
Soybean-wheat	280	228	226	245	111	36.9	78.9	76	705	717	704	709
Soybean-mustard	238	236	243	239	100	36.0	81.5	73	680	697	685	687
Soybean-chickpea	251	261	263	258	106	37.4	92.4	79	725	635	683	681
Soybean-linseed	222	217	205	215	58.4	29.9	67.0	52	632	723	689	681
Mean	248	236	234		94	35	80		686	693	690	
CD (P=0.05)		SEm±	CD			SEm±	CD			SEm±	CD	
Package		3.13	NS			3.80	14.9			15.8	NS	
Cropping		3.68	10.9			5.70	16.9			17.6	NS	
Cropping X Package		6.36	18.9			9.90	NS			30.6	NS	
Package X Cropping		6.34	20.3			9.34	NS			30.8	NS	
Calicut												
Ginger	126	124	131	127	6.38	20.0	10.9	12.4	149	198	200	182
Turmeric	136	118	132	129	1.42	28.2	43.2	24.3	237	284	252	258
Black pepper	264	269	317	283	35.8	29.7	33.7	33.1	221	228	278	242
Mean	175	170	193		14.5	26.0	29.3		202	237	243	
CD (P=0.05)		SEm±	CD			SEm±	CD			SEm±	CD	
Package		3.04	9.23			0.59	1.77			5.57	16.6	
Cropping		2.82	8.06			0.89	2.55			7.46	21.4	
Cropping X Package		4.89	14.0			1.55	4.42			12.7	36.4	
Package X Cropping		5.02	14.7			1.39	4.02			11.7	34.1	
Coimbatore												
Cotton-maize-green manure	247	242	230	240	19.8	18.2	17.6	18.5	680	672	682	678
Chillies-sunflower-green manure	252	246	248	249	21.4	20.6	19.7	20.6	668	642	638	649
Brinjal-sunflower-green manure	228	212	209	216	21.0	19.8	18.2	19.7	639	616	624	626
Mean	242	233	229		20.7	19.5	18.5		662	643	648	
Dharwad												
Maize-chickpea	269	267	286	274	32.5	25.2	28.8	28.8	392	267	356	338
Cotton+pea	292	256	286	278	33.2	22.7	27.9	27.9	363	256	331	317
Groundnut-sorghum	282	267	280	276	34.2	24.1	29.4	29.2	373	267	360	333

Cropping/Input system	N (kg ha^{-1})				P (kg ha^{-1})				K (kg ha^{-1})			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Potato-chickpea	282	252	270	268	33.7	24.9	28.7	29.1	403	252	369	341
Soybean-wheat	290	254	277	274	32.8	25.6	28.1	28.8	379	254	346	326
Mean	283	259	280		33.3	24.5	28.6		382	259	352	
Karjat												
Rice-groundnut	263	251	254	256	29.0	27.8	28.1	28.3	344	329	340	338
Rice-maize (sweet corn for cob)	230	217	222	223	27.8	25.1	26.6	26.5	355	345	347	349
Rice-mustard	247	217	234	233	28.1	26.9	26.9	27.3	346	328	342	339
Rice-dolichos bean (For green pod vegetable)	268	243	251	254	27.8	27.2	28.1	27.7	367	354	356	359
Mean	252	232	240		28.2	26.8	27.4		353	339	346	
CD (P=0.05)		SEm±	CD			SEm±	CD			SEm±	CD	
Package		2.98	8.69			0.28	0.82			4.23	NS	
Cropping		3.44	10.0			0.33	0.94			4.89	NS	
Cropping X Package			NS				NS				NS	
Package X Cropping		5.95	NS			0.56	NS			8.49	NS	
Ludhiana II												
Sorghum-berseem	271	260	266	266	60.1	58.7	59.9	59.6	172	167	170	170
Maize-berseem-bajra	285	277	281	281	61.3	57.2	60.2	59.6	164	159	156	160
Maize-berseem-maize+cowpea	300	285	287	291	67.2	57.9	63.5	62.9	169	163	160	164
Sorghum+guar-oats-cowpea	278	271	265	271	60.2	56.0	58.5	58.2	158	152	165	158
Mean	284	273	275		62.2	57.5	60.5		166	160	163	
CD (P=0.05)		SEm±	CD			SEm±	CD			SEm±	CD	
Package		1.44	4.96			0.52	1.79			1.10	3.81	
Cropping		1.76	5.11			1.41	NS			1.41	4.03	
Cropping X Package		3.06	NS			2.41	NS			2.40	7.00	
Package X Cropping		3.01	NS			2.15	NS			2.36	7.13	
Modipuram												
Basmati rice-wheat-sesbania GM	238	144	193	192	21.8	14.0	16.8	17.5	255	169	247	224
Rice-barley+mustard-GG	179	158	171	169	17.3	7.38	9.52	11.4	212	129	158	166
Maize cob-potato-okra	236	174	198	203	19.9	18.4	20.0	19.4	215	136	209	187
Maize-mustard+radish-sesbania GM	148	125	137	137	24.0	17.1	23.4	22.0	257	221	239	239
Mean	200	150	175		20.8	14.2	17.4		235	164	213	
Pantnagar												
Basmati rice-wheat-sesbania (green manuring)	336	380	327	348	28.4	35.7	35.6	33.2	269	291	284	281
Basmati rice-lentil-sesbania (green manure)	352	390	382	375	38.5	33.2	38.2	36.6	291	260	255	369

Cropping/Input system	N (kg ha^{-1})				P (kg ha^{-1})				K (kg ha^{-1})			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Basmati rice-vegetable pea-sesbania (green manure)	357	384	387	376	38.7	32.4	30.8	34.0	270	284	269	274
Basmati rice-brassica napus-sesbania (green manure)	349	330	353	344	29.3	35.9	34.3	33.2	250	265	250	255
Mean	349	371	262		33.7	34.3	34.7		270	275	265	
CD (P=0.05)		SEm±	CD			SEm±	CD			SEm±	CD	
Package		3.05	12.0			0.92	NS			3.28	NS	
Cropping		4.59	13.6			0.95	NS			3.06	9.10	
Cropping X Package		7.92	23.6			1.65	4.92			5.30	15.8	
Package X Cropping		7.57	23.6			1.70	5.54			5.65	18.6	
Raipur												
Soybean-berseem	252	269	265	262	12.9	14.6	13.9	13.8	248	255	255	253
Soybean-isabgol	248	269	256	258	12.3	13.0	15.0	13.4	251	261	258	257
Soybean-onion	261	278	274	271	14.3	17.7	14.5	15.5	250	281	270	267
Soybean-safflower	252	278	260	263	15.5	16.3	15.7	15.8	246	281	281	269
Mean	253	274	264		13.8	15.4	14.8		249	270	266	
CD (P=0.05)		SEm±	CD			Sem±	CD			SEm±	CD	
Package		3.40	11.8			0.28	0.98			3.39	11.7	
Cropping		5.39	NS			0.49	1.41			4.24	12.3	
Cropping X Package		9.34	NS			0.85	NS			7.36	NS	
Package X Cropping		8.77	NS			0.79	NS			7.21	NS	
Ranchi												
Rice-wheat	273	240	260	258	55.6	57.5	53.0	55.4	215	159	178	184
Rice-potato	292	251	268	270	59.3	60.3	54.0	57.9	230	162	190	194
Rice-linseed	288	238	256	261	54.1	55.3	53.0	54.1	225	154	180	186
Rice-lentil	289	241	266	265	49.6	54.3	52.0	52.0	218	150	176	181
Mean	286	243	263		54.7	56.9	53.0		222	156	181	

Table 5. Influence of organic, inorganic and integrated package on soil micronutrients at the end of cropping cycle

Cropping system/Package	Mn (ppm)				Zn (ppm)				Cu (ppm)				Fe (ppm)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Bajaura																
Cauliflower-pea-tomato	27.3	11.2	23.0	20.5	11.5	0.80	7.80	6.70	8.50	0.82	6.20	5.17	79.4	26.5	48.0	51.3
French bean-cauliflower-french bean	25.5	10.2	22.9	19.5	15.0	0.84	10.2	8.68	9.00	0.90	7.30	5.73	72.2	21.2	55.6	49.7
Cauliflower-pea-cauliflower	30.0	9.30	26.6	22.0	11.8	0.97	10.4	7.72	10.0	0.80	8.50	6.43	81.3	22.5	56.0	53.3
Maize-garlic	29.1	11.0	24.9	21.7	10.8	0.78	10.0	7.19	10.1	0.80	9.80	6.90	66.9	20.4	56.7	48.0
Mean	28.0	10.4	24.4		12.3	0.85	9.60		9.40	0.83	7.95		75.0	22.7	54.1	
Calicut																
Ginger	4.14	9.13	7.80	7.02	1.28	0.94	1.35	1.19	15.5	14.5	16.1	15.4	51.3	50.5	48.5	50.1
Turmeric	12.1	17.5	19.7	16.4	1.26	1.34	1.34	1.31	1.90	2.57	2.46	2.31	48.5	49.7	51.3	49.8
Blackpepper	13.0	19.2	10.5	14.2	2.41	2.30	2.30	2.34	7.96	6.83	8.23	7.67	30.3	26.7	31.8	29.6
Mean	9.75	15.3	12.7		1.65	1.53	1.66		8.45	7.97	8.93		43.4	42.3	43.9	
Dharwad																
Maize-chickpea	11.3	8.73	11.2	10.4	0.94	0.69	0.79	0.81	1.67	1.26	1.53	1.49	8.96	7.96	9.15	8.69
Cotton+pea	12.1	9.18	11.0	10.8/	0.82	0.71	0.75	0.76	1.61	1.31	1.49	1.47	9.17	7.65	8.43	8.42
Groundnut-sorghum	11.6	9.07	11.2	10.6	0.92	0.78	0.88	0.86	1.42	1.34	1.57	1.44	9.12	7.59	8.63	8.45
Potato-chickpea	12.4	9.19	10.7	10.8	1.03	0.79	0.84	0.89	1.72	1.39	1.69	1.60	8.61	8.01	8.31	8.31
Soybean-wheat	11.7	10.1	10.8	10.9	0.89	0.83	0.91	0.88	1.63	1.37	1.44	1.48	9.08	7.82	8.06	8.32
Mean	11.8	9.25	11.0		0.92	0.76	0.83		1.61	1.33	1.54		8.99	7.81	8.52	
Pantnagar																
Basmati rice-wheat-sesbania (green manure)	11.1	8.83	8.05	9.33	0.69	0.66	0.59	0.65	1.38	1.01	1.03	1.14	28.7	20.0	23.6	24.1
Basmati rice–lentil–sesbania (green manure)	11.7	7.89	7.89	9.16	0.73	0.60	0.64	0.66	1.59	1.17	1.27	1.34	26.3	22.1	24.0	24.1
Basmati rice-vegetable pea-sesbania (green manure)	11.8	6.36	7.79	8.65	0.52	0.61	0.64	0.59	1.57	0.95	1.40	1.31	27.0	20.0	23.3	23.4
Basmati rice-brassica napus-sesbania (green manure)	9.31	6.21	8.57	8.03	0.75	0.66	0.68	0.70	1.48	0.68	0.75	0.97	25.0	23.6	23.2	24.0
Mean	11.0	7.32	8.08		0.67	0.63	0.64		1.51	0.95	1.11		27.0	21.4	23.5	
CD (P=0.05)		SEm±	CD			SEm±	CD			SEm±	CD			SEm±	CD	
Package		0.42	1.67			0.01	NS			0.03	0.12			0.34	1.34	
Cropping		0.25	0.75			0.02	0.07			0.05	0.14			0.57	NS	
Cropping X Package		0.44	1.30			0.04	NS			0.08	0.25			1.00	2.95	
Package X Cropping		0.57	2.01			0.04	NS			0.08	0.24			0.93	2.87	

22.8% under organic compared to inorganic package. Sorghum+guar-oats-cowpea registered higher OC of 0.57% compared to other systems. Available N, P and K was observed to be higher with organic input system.. Among the cropping systems, maize-berseem-maize+cowpea recorded significantly higher residual N (291 kg ha^{-1}) and P (62.9 kg ha^{-1}) while K was significantly higher under sorghum-berseem (170kg ha^{-1}) system.

Modipuram: Soil EC, PH, OC, available N, P and K were estimated during the year. The result reveals that not much variation in EC and PH among various management practice and cropping systems. However, the soil quality under inorganic package deteriorated as it is evidenced through reduction in organic carbon by 73% under inorganic over organic package. Among the different cropping systems, maize for cob-potato-okra and maize-mustard+radish-sesbania (greenmanure) systems recorded higher organic carbon (0.60%). At the end of cropping cycle, it was observed that, the available N, P and K were higher with organic package followed by integrated. The residual soil P and K was higher in maize-mustard+radish-greengram (22.0 and 239 kg ha^{-1}) system while N was higher in maize cob-potato-okra system (203 kg ha^{-1}).

Evaluation of nutrient inputs for Basmati rice at Modipuram

Evaluation of maize + cowpea system under organic management at Modipuram

Pantnagar: Soil OC was found to be 16.9 and 13.2% higher with organic and integrated over inorganic package. Among the various cropping systems, basmati rice-lentil-sesbania (green manure) system resulted in higher OC (0.93%) followed by basmati rice-vegetable pea-sesbania (green manure) 0.92%. Available N, at the end of cropping cycle was significantly influenced by both input and cropping system packages. Drop in residual N was observed to the level of 5.9% with organic over inorganic while P and K were observed statistically non-significant. Significantly higher available N was recorded with basmati rice-vegetable pea–sesbania (green manure) system (376 kg ha^{-1}). Basmati rice-lentil-sesbania (green manure) recorded higher residual K (369 kg ha^{-1}) compared to other systems. Available P did not differ significantly among the system. Available Mn, Cu and Fe were significantly influenced by different input packages. Residual Mn, and Cu was found to increase by > 50% with organic over inorganic package while in Fe, the increase was observed to be 26.2% only. Among the various systems, Basmati rice-lentil-sesbania (green manure) registered significantly higher residual availability of Cu in soil while Basmati rice-wheat-

***Sesbania* green manuring in organic field at Pantnagar**

sesbania (green manure) recorded higher Mn. Basmati rice-brassica napus-sesbania (green manure) recorded higher Zn. Availability of Fe did not differ significantly among the cropping systems.

Raipur: Soil bulk density, organic carbon, available N, P and K were estimated at the end of cropping cycle. The soil bulk density was observed significantly lower with organic (1.30 g/cc) over inorganic (1.34 g/cc). Considerably higher bulk density of 1.34 g/cc was observed with soybean-safflower system. Around 11.1% higher organic carbon was observed under organic than inorganic package. No significant variation in residual organic carbon was observed among different cropping system. Significantly lower available N, P and K was observed under organic package compared to inorganic irrespective of cropping systems. Though available N did not differ significantly among systems, soybean-safflower systems resulted in higher residual P (15.7 kg ha^{-1}) and K (269 kg ha^{-1}). The reverse trend of lower.

Ranchi: Available N, P and K were estimated at the end of cropping cycle. The available N and K were higher with organic package followed by integrated while P was higher under inorganic package. Rice-potato system recorded higher residual soil N, P and K (270, 57.9 and 194 kg ha^{-1}).

Soil microbial count (Table 6)

Soil microbial count was estimated at Dharwad only. The increase in fungi and actinomycetes was found to be 32.4% and >100% with organic over inorganic package while higher bacteria's population was recorded with integrated (8.1%). Considerably higher count of fungi (92.3x10^4 CFU/g) and actinomycetes (68.3x10^4CFU/g) was observed with potato-chickpea systems while ground nut-soybean recorded higher bacteria count (11x10^4 CFU/g).

Table 6. Influence of methods of organic, inorganic and integrated on soil microbial count (x10^4 CFU/g) at the end of cropping cycle

Cropping system/ package	Fungi				Bacteria				Actinomycetes			
	Org	Inorg	Integ	Mean	Org	Inorg	Integ	Mean	Org	Inorg	Integ	Mean
Dharwad												
Maize-chickpea	8.0	5.0	11.0	8.0	12.0	6.0	8.0	8.7	46.0	18.0	16.0	26.7
Cotton+pea	7.0	8.0	11.0	8.7	8.0	8.0	6.0	7.3	53.0	5.0	52.0	36.7
Groundnut-sorghum	7.0	5.0	4.0	5.3	9.0	5.0	19.0	11.0	73.0	45.0	47.0	55.0
Potato-chickpea	23.0	10.0	4.0	12.3	4.0	8.0	3.0	5.0	86.0	70.0	49.0	68.3
Soybean-wheat	4.0	9.0	6.0	6.3	6.0	10.0	4.0	6.7	73.0	24.0	31.0	42.7
Mean	9.8	7.4	7.2		7.8	7.4	8.0		66.2	32.4	39.0	

Economics (Table 7)

Bajaura: Gross return was significantly higher (60.7%) with integrated followed by organic (43.2%) over inorganic package. Due to the lower cost of cultivation under these treatments, the increase in net returns was 132 and 177% higher with organic and integrated over inorganic package. Higher B: C ratio of 1.79 was recorded with integrated system. All the systems registered higher B: C ratio with integrated package and among the systems, maize-garlic recorded higher B: C ratio of 3.60.

Coimbatore: An increase in cost of cultivation due to organic and integrated package was observed (20.6 and 8.0% respectively). Further, the gross return was less by 15.2% with organic over inorganic packages. Consequence of this reduced net return (34.4 and 4.6%) was observed with organic and integrated package respectively. Among the systems, brinjal-sunflower-green manure recorded higher net return of Rs. 1,00,546 ha^{-1} but higher BC ratio of 1.80was recorded with cotton-maize-green manure system. All the system performed better with inorganic in terms of economics.

Table 7. Influence of organic, inorganic and integrated package on economics of different crops and cropping system

Cropping system/package	Gross returns (Rs. ha^{-1})				Cost of cultivation (Rs. ha^{-1})				Net returns (Rs. ha^{-1})				B:C ratio			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Bajaura																
Cauliflower-pea-tomato	268188	149170	290470	235943	142608	147977	145285	145290	125580	1193	145185	90653	0.88	0.01	1.00	0.63
French bean-cauliflower-french bean	276194	214595	281450	257413	146993	154826	154092	151970	129201	59769	127358	105443	0.87	0.39	0.83	0.70
Cauliflower-pea-cauliflower	240138	116930	280100	212389	137591	145061	143841	142164	102547	-28131	136259	70225	0.75	-0.19	0.95	0.50
Maize-garlic	395228	343088	471760	403359	86090	89292	87691	87691	309138	253796	384069	315668	3.59	2.84	4.38	3.60
Mean	294937	205946	330945		128321	134289	132727		166617	71657	198218		1.52	0.76	1.79	
Coimbatore																
Cotton-maize -green manure	106184	114383	124580	115049	46259	37158	41366	41594	59925	77225	83214	73455	1.30	2.08	2.01	1.80
Chillies-sunflower-green manure	93804	104340	105882	101342	55870	46953	50563	51129	37934	57387	55319	50213	0.68	1.22	1.09	1.00
Brinjal-sunflower-green manure	135630	177130	164470	159077	64409	53984	57200	58531	71221	123146	107270	100546	1.11	2.28	1.88	1.75
Mean	111873	131951	131644		55513	46032	49710		56360	85919	81934		1.03	1.86	1.66	
Dharwad																
Maize-chickpea	69299	53872	61519	61563	30517	20908	24366	25264	38782	32964	37154	36300	2.29	2.49	2.52	2.43
Cotton+pea	108116	67523	101563	92401	30425	26939	29182	28849	77691	40584	72381	63552	4.06	2.78	3.83	3.56
Groundnut-sorghum	137584	99086	128203	121624	30021	27537	28460	28673	107563	71549	99743	92952	4.12	3.28	4.06	3.82
Potato-chickpea	83063	71646	68643	74451	46077	36448	40321	40949	36986	27341	28322	30883	2.13	2.00	2.02	2.05
Soybean-wheat	80455	55276	65898	67210	29994	20918	27901	26271	50461	34358	37997	40939	2.43	2.44	2.19	2.35
Mean	95703	69481	85165		33407	26550	30046		62297	41359	55119		3.01	2.60	2.92	
Jabalpur																
Basmati rice-D.wheat-green manure	157185	135446	124498	139043	62729	65910	58544	62394	94456	69536	65954	76649	2.51	2.06	2.13	2.23
Basmati rice-chickpea-seasmum	125703	113384	107080	115389	61816	63018	58728	61187	63887	50366	48352	54202	2.03	1.80	1.82	1.88
Basmati rice-berseem	145145	138583	131349	138359	63699	63941	60234	62625	81446	74642	71115	75734	2.28	2.17	2.18	2.21
Basmati rice-veg.pea-sorghum	156105	146391	138465	146987	65096	65679	64062	64946	91009	80712	74404	82042	2.40	2.23	2.16	2.26
Mean	146035	133451	125348		63335	64637	60392		82700	68814	64956		2.31	2.07	2.07	
Modipuram																
Basmati rice-wheat-*sesbania* (GM)	141208	100493	121375	121025	60108	29494	44651	44751	81100	70999	76724	76274	1.35	2.41	1.72	1.82
Rice-barley+mustard-green gram	149774	109839	125133	128249	72255	36364	54085	54235	77519	73475	71047	74014	1.07	2.02	1.31	1.47

Cropping system/package	Gross returns (Rs. ha^{-1})				Cost of cultivation (Rs. ha^{-1})				Net returns (Rs. ha^{-1})				B:C ratio			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Maize -potato-okra	419205	293404	338982	350530	119962	71492	95503	95652	299243	221911	243479	254878	2.49	3.10	2.55	2.72
Maize cob-mustard+radish-Sesbania GM	129781	95664	115251	113565	42540	22907	32574	32674	87241	72757	82677	80892	2.05	3.18	2.54	2.59
Mean	209992	149850	175185		73716	40064	56703		136276	109786	118482		1.74	2.68	2.03	
Pantnagar																
Basmati rice-wheat-sesbania (green manure)	162736	122248	130745	138576	58368	50194	53365	53976	104368	72054	77380	84600	2.79	2.43	2.45	2.56
Basmati rice-lentil-sesbania (green manure)	253612	173100	192634	206449	52175	45306	44096	47192	201437	127794	148538	159256	4.86	3.82	4.37	4.35
Basmati rice-vegetable pea-sesbania (green manure)	155576	106563	115605	125915	53655	49016	58758	53810	101921	57547	56847	72105	2.90	2.17	1.97	2.35
Basmati rice-brassica napus-sesbania (green manure)	139733	100649	107949	116110	54875	49924	47495	50765	84858	50725	60454	65346	2.55	2.02	2.27	2.28
Mean	177914	125640	136733		54768	48610	50929		123146	77030	85805		3.27	2.61	2.76	
Raipur																
Soybean-berseem	76510	56955	64344	65936	39782	34181	35545	36503	36728	22774	28799	29434	1.01	0.70	0.83	0.85
Soybean-isabgol	65320	57173	57705	60066	45499	35627	37231	39452	19821	21546	20474	20614	0.44	0.62	0.55	0.54
Soybean-onion	128008	121067	120008	123028	60271	49920	53250	54480	67737	71147	66758	68547	0.95	1.18	1.06	1.06
Soybean-safflower	74345	59747	69613	67902	48180	36858	39173	41404	26165	22889	30440	26498	0.53	0.62	0.76	0.64
Mean	86046	73736	77918		48433	39147	41300		37613	34589	36618		0.73	0.78	0.80	
Ranchi																
Rice - Wheat	117031	63949	67494	82825	58090	34964	46527	46527	58941	57911	38371	51741	1.15	1.79	1.12	1.35
Rice - Potato	224725	146340	166500	179188	86630	63781	75205	75205	138095	82559	91295	103983	1.77	1.81	1.46	1.68
Rice - Linseed	87922	76717	67061	77233	40181	25057	32619	32619	63978	46208	48911	53032	0.94	1.24	0.84	1.01
Rice - Lentil	99096	76017	79677	84930	38251	26098	32174	32174	60846	49919	47503	52756	1.51	1.84	1.49	1.61
Mean	132194	90756	95183		55788	37475	46631		80465	59149	56520		1.34	1.67	1.23	

Dharwad: Organic input package resulted in 37.7% increase in gross returns over inorganic while integrated recorded increase to the level of 22.6%. The same trend was also reflected in cost of cultivation as organic package resulted in 25.8% increased cost while integrated recorded 13.2%. Considerably higher (50.6%) net return with organic was recorded whereas integrated recorded 33.3% increase over inorganic. B: C ratio was found to be higher with organic input (3.01). Among the cropping systems, groundnut-sorghum recorded higher B: C ratio of 3.82. The same system and cotton+pea recorded higher B: C ratio with organic package while for maize-chickpea, integrated was found to be more effective. Cotton+pea and ground-sorghum systems registered higher B:C ratio of 4.06 and 4.12 respectively with organic package.

Jabalpur: Organic nutrient input recorded 9.4% increase in gross returns, 2% reduction in cost of cultivation and 20.2% increase in net returns. The B: C ratio was also higher (2.31) compared to inorganic and integrated packages. Among the cropping systems, basmati rice-vegetable pea-sorghum registered higher gross return (Rs. 1,46,987 ha^{-1}), net returns (Rs. 82042 ha^{-1}) and B: C ratio (2.26). Invariably, all the system recorded higher net returns and B: C ratio with organic management.

Modipuram: Organic and integrated package increased the gross returns by 40.1% and 16.9% over inorganic irrespective of cropping systems. Though the cost of cultivation was higher under organic (84%) and integrated (41.5%), considerably higher net returns was recorded with organic (24.1%) and integrated (8%) over inorganic mainly due to premium price. Among the different systems, maize for cob-potato-okra recorded higher gross returns (Rs. 3,50,530 ha^{-1}), net returns (Rs. 2,54,878 ha^{-1}) and B: C ratio (2.72). Higher B: C ratio of 2.68 was observed under inorganic management due to lower cost of cultivation.

Pantnagar: Increase in gross returns with organic and integrated was found to be 41.6 and 8.8% over inorganic package. Cost of cultivation, net return and B: C ratio also followed the same trend with organic package recording Rs. 54786 ha^{-1}, Rs. 123146 ha^{-1} and 3.27 followed by integrated Rs. 50929 ha^{-1}, Rs. 85805 ha^{-1} and 2.76 respectively. Among the systems, basmati rice-lentil-sesbania (green manure) resulted in higher B: C ratio of 4.35. All the systems recorded higher BC ratio under organic package.

Raipur: The cost of cultivation with organic and integrated package was found to increase by 23.7 and 5.5% over inorganic. Net returns increased only 8.7% with organic and 5.9% with integrated package. Though higher gross return of 16.7% and 5.7% was observed with organic and integrated, owing to higher cost of cultivation, marginal difference was observed in B: C ratio between integrated and inorganic package (0.78). Soybean-onion system recorded higher gross returns of Rs. 1,23,028 ha^{-1}, cost of cultivation (Rs. 54, 480 ha^{-1}), net returns (Rs. 68547 ha^{-1})and B: C ratio (1.06). B: C ratio of soybean-berseem was found to be higher (1.01) with organic while soybean-onian recorded higher (1.18) under inorganic package.

Ranchi: Organic and integrated package recorded increase in gross returns by 45.7 and 4.9% respectively over inorganic. The cost of cultivation also found to be 48.9 and 24.4% higher with these packages respectively. Owing to higher gross returns, an increase in net return by 36% was recorded with organic while under integrated, net returns dropped by 4.4%. Inorganic package recorded higher B: C ratio of 1.67 followed by organic (1.34). Among the systems, rice-potato recorded higher B: C ratio (1.68) while rice-linseed recorded lowest (1.01).

Nutrient uptake (Table 8 to 12)

Six centres estimated uptake of nutrient for all the crops evaluated under different management practices.

Bajaura: Crops like cauliflower, pea, french bean and maize have recorded higher N uptake under integrated whereas, tomato and garlic have took higher N under organic package. Higher P uptake of pea (0.66%), tomato (0.22%), french bean (0.38%), cauliflower (0.42%) and garlic (0.39%) was observed with organic package. K uptake was also found to be better under organic package for almost all the crops grown in the system during *kharif* and *rabi* while in summer, integrated package recorded higher

K. Fe uptake was higher either under organic or integrated package. Among the different crops, higher uptake of 445 g ha^{-1} was observed with cauliflower. Cu and Mn uptake also followed the similar trend for various vegetable crops grown in the sequence while Zn was recorded higher with french bean.

Dharwad: N, P and K uptake in all the crops were found to be higher under organic package except maize. Crops like Groundnut (207 kg ha^{-1}), potato (134 kg ha^{-1}), soybean (257 kg ha^{-1}) and chickpea (102 kg ha^{-1}) have recorded higher N uptake under organic management. P and K also followed the similar trend for various crops grown in the sequence. Maize crop uptake was found to be better under inorganic management.

Ludhiana: In the second set of experiment in involving fodder crops, uptake of nutrients were assessed during *kharif* only. The uptake of N increased by 34.4% in sorghum, 17.1% in maize and 31.3% in sorghum+gaur under organic over inorganic package. The result reveals that uptake of P was found to be better under organic for sorghum (27.3 kg ha^{-1}) and sorghum+guar (38.7 $kgha^{-1}$). K uptake was also observed in the same trend with sorghum+gaur recording higher uptake of 110 kg ha^{-1} K under organic package.

Organic Basmati rice crop at Ludhiana

Organic cotton crop at Ludhiana

Pantnagar:. Higher N uptake in basmati rice was observed with integrated (77.2 kg ha^{-1}) followed by organic (75.2 kg ha^{-1}) over organic (70.6 kg ha^{-1}) package. N uptake of basmati rice was significantly influenced by cropping system. Around 23% higher P uptake with organic package compared to inorganic was observed for basmati rice. K uptake by basmati rice was significantly higher (69.1 kg ha^{-1}) with organic package.

Raipur: Significant difference in N uptake during *kharif* due to various management packages was observed. Among the different crops, uptake was higher in soybean under integrated (96.3 $kgha^{-1}$) followed by berseem (82.4 kg ha^{-1}). P uptake was highly influenced by management practice especially for soybean. Integrated recorded higher uptake of P (17.9 kg ha^{-1}) followed by inorganic (14.6 kg ha^{-1}). Similar trend was observed for K uptake also. Although K uptake rate remained non significant during *rabi.* Soybean in *kharif* recorded higher K uptake (53.2 kg ha-1) under integrated package.

Ranchi: Rice recorded N uptake of 103.5 kg ha^{-1} with organic followed by integrated (95.7 kg ha^{-1}) and inorganic (87.2 kg ha^{-1}). N uptake of potato and was found to be higher (63.4 kg ha^{-1}) with organic while wheat was higher with inorganic. P uptake of rice was also higher under organic package (21.0 kg ha^{-1}) followed by integrated (18.2 kg ha^{-1}). Potato recorded higher P uptake (47.2 kg ha^{-1}) with organic. Like N and P, K uptake also registered similar trend in rice with organic (72.4 kg ha^{-1}) package recorded higher uptake followed by integrated (66.9 kg ha^{-1}). Higher K uptake in wheat, lentil and linseed was observed with inorganic while K uptake of potato was found to better under organic (211.2 kg ha^{-1}).

Table 8. Influence of organic, inorganic and integrated on N uptake (kg ha^{-1}) of crops

Cropping systems/ package	Organic			Inorganic			Integrated		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura									
Cauliflower-pea-tomato	0.75	1.68	0.78	0.74	1.62	0.75	0.80	1.90	0.74
French bean-cauliflower-french bean	1.56	0.88	1.25	1.42	0.64	1.29	1.66	0.75	1.35
Cauliflower-pea-cauliflower	0.85	1.65	0.80	0.80	1.58	0.77	0.88	1.94	0.86
Maize-garlic	0.60	0.65		0.55	0.56		0.62	0.58	
Dharwad									
Maize-chickpea	206.0	78.0		234.0	58.8		217.0	73.8	
Cotton+Pea	24.5	83.1		21.9	61.7		19.7	74.4	
Groundnut-Sorghum	207.0	92.3		178.0	66.2		192.0	65.3	
Potato-chickpea	134.0	102.0		127.0	90.4		116	106.0	
Soybean-wheat	257.0	72.5		203.0	43.9		236.0	57.1	
Ludhiana II									
Sorghum-berseem	105.5			78.5			95.8		
Maize-berseem-bajra	66.1			56.5			65.3		
Maize-berseem-maize+cowpea	67.5			57.9			66.8		
Sorghum+guar-oats-cowpea	123.6			94.1			112.5		
	Kharif								
CD (P=0.05)	SEm±	CD							
Input	2.84	9.81							
Cropping	3.57	10.4							
Cropping X Input	6.19	NS							
Input X Cropping	6.06	NS							
Pantnagar									
Basmati rice-wheat-sesbania (green manure)	68.6			72.3			76.9		
Basmati rice-lentil-sesbania (green manure)	79.1			76.1			89.9		
Basmati rice-vegetable pea-sesbania (green manure)	74.1			66.6			69.2		
Basmati rice-Brassica napus-sesbania (green manure)	79.1			67.3			72.7		
	Kharif								
CD (P=0.05)	SEm±	CD							
Input	1.56	NS							

Cropping systems/ package	Organic			Inorganic			Integrated		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Cropping	1.20	6.05							
Cropping X Input	2.07	6.16							
Input X Cropping	2.36	7.99							
Raipur									
Soybean-berseem	86.6	81.2		86.3	77.6		102.4	82.4	
Soybean-isabgol	85.9	6.11		83.5	8.63		95.9	7.46	
Soybean-onion	80.3	23.2		79.6	30.0		92.8	28.0	
Soybean-safflower	81.8	38.5		81.1	41.5		94.3	47.2	
	Kharif		*Rabi*						
CD (P=0.05)	SEm±	CD	SEm±	CD					
Input	1.32	4.54	1.29	NS					
Cropping	1.36	3.93	1.89	5.49					
Cropping X Input	2.35	NS	3.27	NS					
Input X Cropping	2.42	NS	3.12	NS					
Ranchi									
Rice - wheat	105.4	50.1		88.6	64.4		96.8	58.0	
Rice - potato	113.1	63.4		94.4	52.8		102.5	62.7	
Rice - linseed	101.6	44.8		83.8	43.6		93.6	44.6	
Rice - lentil	93.8	37.6		82.0	44.0		90.0	43.3	

Table 9. Influence of inorganic, inorganic and integrated on P uptake (kg ha^{-1}) of crops

Cropping systems/ package	Organic			Inorganic			Integrated		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura									
Cauliflower-pea-tomato	0.38	0.66	0.22	0.35	0.42	0.18	0.38	0.57	0.20
French bean-cauliflower-french bean	0.38	0.40	0.33	0.32	0.28	0.30	0.34	0.36	0.32
Cauliflower-pea-cauliflower	0.40	0.58	0.50	0.32	0.45	0.40	0.35	0.55	0.48
Maize-garlic	0.30	0.39		0.23	0.30		0.28	0.35	
Dharwad									
Maize-chickpea	26.3	23.4		28.5	18.7		24.1	21.2	
Cotton+pea	2.90	10.2		2.10	9.10		2.40	9.30	
Groundnut-sorghum	20.1	19.1		17.7	11.6		19.1	17.3	
Potato-chickpea	18.4	22.8		21.8	19.5		16.3	21.9	
Soybean-wheat	20.8	25.5		12.4	20.2		19.7	24.0	

Cropping systems/ package	Organic			Inorganic			Integrated		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Ludhiana II									
Sorghum-berseem	27.3			21.1			25.4		
Maize-berseem-bajra	21.0			24.2			24.8		
Maize-berseem-maize+cowpea	25.8			25.3			28.9		
Sorghum+guar-oats-cowpea	38.7			24.9			35.3		
				Kharif					
CD (P=0.05)				SEm±	CD				
Package				1.81	NS				
Cropping				2.08	6.04				
Cropping X Package				3.60	NS				
Package X Cropping				3.61	NS				
Pantnagar									
Basmati rice-wheat-sesbania (green manure)	14.3			10.9			12.2		
Basmati rice-lentil-sesbania (green manure)	13.0			11.0			13.0		
Basmati rice-vegetable pea-sesbania (green manure)	12.5			11.5			11.7		
Basmati rice-brassica napus-sesbania (green manure)	14.3			10.5			11.9		
						Kharif			
CD (P=0.05)						SEm±	CD		
Package						0.33	1.29		
Cropping						0.57	NS		
Cropping X Package						0.99	NS		
Package X Cropping						0.92	NS		
Raipur									
Soybean-berseem	14.0	11.5		15.1	11.0		19.0	11.5	
Soybean-isabgol	13.7	0.67		14.8	1.08		17.9	0.88	
Soybean-onion	13.2	7.61		13.6	11.4		17.1	9.05	
Soybean-safflower	13.2	9.92		15.0	10.7		17.8	12.4	
						Kharif		*Rabi*	
CD (P=0.05)						SEm±	CD	SEm±	CD
Package						0.35	1.20	0.42	NS

Cropping systems/ package	Organic			Inorganic			Integrated		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Cropping						0.30	0.89	0.74	2.13
Cropping X Package						0.53	NS	1.27	NS
Package X Cropping						0.58	NS	1.18	NS
Ranchi									
Rice - wheat	21.0	8.33		16.2	11.6		18.2	10.0	
Rice - potato	23.3	47.2		17.8	40.6		19.8	46.2	
Rice - linseed	20.1	2.56		15.5	2.76		17.9	2.63	
Rice - lentil	19.4	5.80		14.9	7.61		16.8	7.00	

Table 10. Influence of inorganic, inorganic and integrated on K uptake (kg ha^{-1}) of crops

Cropping systems/ package	Organic			Inorganic			Integrated		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura									
Cauliflower-pea-tomato	0.68	0.79	0.62	0.61	0.60	0.59	0.65	0.70	0.66
French bean-cauliflower-french bean	0.85	0.74	0.72	0.77	0.60	0.69	0.83	0.68	0.73
Cauliflower-pea-cauliflower	0.70	0.80	0.53	0.62	0.65	0.48	0.67	0.70	0.56
Maize-garlic	0.70	0.65		0.62	0.58		0.66	0.60	
Dharwad									
Maize-chickpea	158	97.4		179	71.1		168	75.1	
Cotton+pea	20.3	91.2		12.9	60.4		19.5	82.9	
Groundnut-sorghum	71.6	72.6		56.2	48.4		58.5	61.3	
Potato-chickpea	115	116		90.2	91.9		104	102	
Soybean-wheat	113	69.3		98.1	30.5		106	35.6	
Ludhiana II									
Sorghum-berseem	95.9			73.9			90.5		
Maize-berseem-bajra	64.1			56.1			61.4		
Maize-berseem-maize+cowpea	60.7			60.1			63.0		
Sorghum+guar-oats-cowpea	110			86.0			106		
				Kharif					
CD (P=0.05)				SEm±	CD				
Input				3.76	NS				
Cropping				3.57	10.4				
Cropping X Input				6.18	NS				
Input X Cropping				6.53	NS				

Cropping systems/ package	Organic			Inorganic			Integrated		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Pantnagar									
Basmati rice-wheat-sesbania (green manure)	73.7			54.8			75.8		
Basmati rice-lentil-sesbania (green manure)	70.3			55.3			66.3		
Basmati rice-vegetable pea-sesbania (green manure)	66.3			58.9			62.3		
Basmati rice-brassica napus-sesbania (green manure)	65.9			63.5			60.9		
						Kharif			
CD (P=0.05)						SEm±	CD		
Input						2.02	7.95		
Cropping						2.10	NS		
Cropping X Input						3.64	NS		
Input X Cropping						3.75	NS		
Raipur									
Soybean-berseem	44.6	83.5		44.2	79.1		57.8	84.9	
Soybean-isabgol	43.8	2.26		43.8	3.02		53.6	2.60	
Soybean-onion	41.3	11.4		40.3	15.9		48.8	14.3	
Soybean-safflower	41.7	11.6		43.5	12.3		52.6	14.0	
						Kharif		***Rabi***	
CD (P=0.05)						SEm±	CD	SEm±	CD
Input						0.59	2.04	1.12	NS
Cropping						0.88	2.54	1.81	5.25
Cropping X Input						1.51	NS	2.93	NS
Input X Cropping						1.44	NS	3.13	NS
Ranchi									
Rice-wheat	73.8	30.2		64.0	37.7		67.5	33.9	
Rice-potato	79.3	211		66.3	165.6		71.0	197.6	
Rice-linseed	68.9	21.7		60.5	24.8		66.3	21.1	
Rice-lentil	67.4	21.9		59.8	26.7		62.6	25.5	

Quality of organic produces (Table 12)

Only protein content was estimated for all the crops in *kharif* and *rabi* at Dharwad. The result revealed that though numerically higher protein content was observed under inorganic package, but it was on par with organic and integrated. Among the crops, groundnut recorded higher protein (19.3%) under inorganic package while chickpea recorded higher protein with integrated (20.4%).

Table 11. Influence of inorganic, inorganic and integrated on Fe, Cu, Mn and Zn uptake (g ha^{-1}) of crops at Bajura

Cropping systems/ package	Organic			Inorganic			Integrated		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Fe									
Cauliflower-pea-tomato	422.5	388.6	272.5	355.2	352.4	222.5	406.4	370.8	235.0
French bean-cauliflower-french bean	409.8	413.5	418.0	283.0	352.2	375.0	356.8	388.4	390.4
Cauliflower-pea-cauliflower	445.4	386.5	260.0	310.3	363.4	215.5	413.1	375.2	226.7
Maize-garlic	405.6	298.0		284.5	270.5		375.0	283.2	
Cu									
Cauliflower-pea-tomato	35.6	25.4	27.0	10.0	20.2	10.2	31.2	24.5	22.0
French bean-cauliflower-french bean	26.3	28.1	18.0	12.8	12.5	10.0	25.0	25.3	17.4
Cauliflower-pea-cauliflower	28.0	28.9	20.4	10.4	10.7	9.0	26.6	22.0	22.2
Maize-garlic	26.1	29.4		12.5	12.5		26.0	24.1	
Mn									
Cauliflower-pea-tomato	88.2	65.0	62.7	50.5	50.6	42.5	84.8	60.5	60.3
French bean-cauliflower-french bean	69.2	72.3	63.2	36.2	45.1	32.5	58.7	66.5	47.8
Cauliflower-pea-cauliflower	78.5	62.3	60.0	50.2	51.0	32.9	72.7	58.2	48.2
Maize-garlic	42.6	75.0		28.5	57.8		35.3	66.7	
Zn									
Cauliflower-pea-tomato	38.2	35.5	38.5	10.6	24.8	24.0	25.4	32.0	32.7
French bean-cauliflower-french bean	52.5	30.4	45.2	18.5	12.5	28.5	38.2	25.5	35.1
Cauliflower-pea-cauliflower	40.2	36.2	40.5	11.3	20.0	20.7	31.7	31.5	33.6
Maize-garlic	35.6	38.8		10.0	20.3		30.5	32.6	

Table 12. Influence of organic, inorganic and integrated package on Protein (%) content at Dharwad

Cropping systems/ package	Organic		Inorganic		INM		Mean	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
Maize-chickpea	9.6	20.6	13.2	20.3	10.4	21.5	11.1	20.8
Cotton+pea	3.1	7.1	3.0	6.4	2.5	7.0	2.9	6.8
Groundnut-sorghum	18.7	8.4	20.7	9.0	18.5	6.4	19.3	7.9
Potato-chickpea	8.7	18.5	9.5	20.2	8.7	20.4	9.0	19.7
Soybean-wheat	13.3	11.3	12.9	10.0	12.6	10.9	12.9	10.7
Mean	10.7	13.2	11.9	13.2	10.5	13.2		

7.2 Evaluation of source of nutrient for organic package in different cropping system

Title of the experiment: Management of soil fertility using organic inputs in prominent cropping systems.

Objectives:

- To study the impact of various on and off farm produces of organic sources on nutrient supplying capacity, soil health and crop yield.
- To optimize the use of organic resources for improving their efficiency and quality of produce.
- Economic analysis of various nutrient management options in cropping systems.

Treatment: There are no common treatments for all the centres as cropping system and source for nutrients are varying from location to locations. The details of treatments are given in Table 13 along with experimental results.

Year of start: 2004-05 with few centres modifying cropping system during 2007-08 and 2008-09.

Locations: All the 13 centres in different ecosystem as mentioned in section 7.1 have conducted the experiments.

Results

Grain and straw yield (Table 13)

Bajaura: Two systems namely coriander-pea-tomato and cauliflower-pea-cauliflower were evaluated with different organic sources. During *kharif* application of FYM fb biodynamic fb panchgavya recorded higher yield of coriander (5463 kg ha^{-1}) and cauliflower (11150 kg ha^{-1}). Significantly lower yield was observed with FYM fb biodynamics and rock phosphate enriched FYM + VC (1:1) in coriander and cauliflower respectively. Though, the higher yield of pea was observed with FYM fb BD alone, its increase over FYM fb BD fb Panchagvya was 96 %. Tomato recorded higher yield under rock phosphate enriched FYM + VC (1:1) application and the increase over FYM fb BD alone was found to be 25%.

Bhopal: The yield increase due to biodynamic and panchgavya practice over organic manure alone was found to be significant in soybean-wheat and maize-chickpea systems. However, combined application of OM+PG + BD registered higher yield in all crops and the yield increase over organic manure alone was found to be 17, 411, 393 and 273 kg ha^{-1} in soybean, wheat, maize and chickpea respectively. Application of biodynamic packages alone recorded only marginal increase in yield of all the crops over control.

Calicut: Six treatments comprising of five different combinations of nutrient sources along with absolute control were evaluated in ginger and turmeric crops. In case of ginger, significantly higher rhizome yield of 7100 kg ha^{-1} was observed with FYM+PG+RP which is 69.1% higher than absolute control. The next best combination FYM+biodynamic packages+Panchgavya+RP) recorded 6925 kg ha^{-1}. Significantly higher rhizome yield of turmeric was observed with FYM+NC+2VC+PG+BD+RP (12150 kg ha^{-1}) followed by FYM+BD+PG+RP (11800 kg ha^{-1}) and FYM+BD +RP (11550 kg ha^{-1}).

Monitoring of experiment by Project Director at Calicut

Blackpepper under organic management at Calicut

Coimbatore: Two systems namely cotton-maize-green manure and chillies-sunflower-green manure were evaluated with five different combinations of nutrient sources. In both the systems, it was observed that application of nutrient through FYM+NEOC @ ½ N each+ panchgavya was found to give higher yield of cotton (1501 kg ha^{-1}), maize (3569 $kgha^{-1}$), chillies (4841 kg ha^{-1}) and sunflower (1369 kg ha^{-1}) which was on par with FYM + NEOC @ ½ N each alone for all the crops. The yield reduction due to application of either biodynamic packages alone or biodynamic with panchagavya was found to be 16 to 40% in various crops compared to combined application of organic inputs (FYM + NEOC) with panchgavya alone. Lowest yield in all the crops were observed with application of either biodynamic packages or panchagavya alone.

Dharwad: Three systems namely groundnut-sorghum, maize-chickpea and chilli + onion were tested with six different combinations of organic inputs along with control. In all the cropping systems, performance of EC + VC + GLM + biodynamic spray @ 12g ha^{-1} with panchagavya spray was found to be better, but it is on par with EC + VC + GLM + panchagavya spray or EC + VC + GLM+ biodynamic spray @ 12g ha^{-1} in most of the crops. Spray of panchagavya alone recorded lower yield in all the crops compared to EC+ VC + GLM. The yield increase in EC + VC + GLM + biodynamic + Panchgavya spray was found to be 50.7, 38.5, 69.3 and 42.9% in groundnut, sorghum, maize and chickpea respectively over control. In case of chilli, EC+ VC + GLM + biodynamic spray @ 12g ha^{-1} registered higher yield of 741 kg ha^{-1} while in onion higher bulb yield was obtained with EC + VC + GLM + biodynamic (741kg ha^{-1}) compared to other treatments. Straw yield of all the crops have also followed the similar trend.

Jabalpur: Two cropping systems namely basmati rice- duram wheat-green manure and basmati rice-berseem were evaluated with five different combinations of nutrient sources. In both the cropping systems, application of nutrients through VC + FYM + NEOC @ 1/3 N each + Panchgavya recorded higher grain yield (3743, 3700 and 232 kg of basmati rice, wheat and berseem seed ha^{-1}) followed by VC + FYM + NEOC @ 1/3 N each. Biodynamic and panchgavya packages recorded lower yield than that of combination of organic nutrient inputs. Among the systems, grain yield of basmati rice obtained with basmati rice-berseem was found to be higher (3325 kg ha^{-1}) compared to basmati rice-duram wheat-green manure (3280 kg ha^{-1}). Though significant difference in straw yield was noticed among the different nutrient sources, VC + FYM + NEOF @ 1/3 N each recorded higher straw yield in basmati rice compared to biodynamic packages.

Karjat: Rice-red pumpkin and rice-cucumber systems have recorded higher yield with application of FYM + rice straw + glyricidia leaves @ 1/3rd each of N during *kharif* and FYM + neem cake + vermicompost @ 1/3 each of N during *rabi* along with spray of Panchgavya (3565, 13094 kg ha^{-1} of rice-red pumpkin and 3735, 11649 kg ha^{-1} of rice-cucumber respectively). It was at par with application of nutrients through

Table 13. Influence of source of nutrients on grain and straw yield of crops

Cropping system	Source of nutrient	Grain Yield (kg/ha)			Straw Yield (kg/ha)		
		Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura							
Coriander-pea-tomato	Rock phosphate enriched FYM + VC (1:1)	5067	3307	5784			
	FYM fb BD	4228	3827	4637			
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya	4802	4427	4282			
	FYM fb BD fb Panchagvya	5463	4123	2600			
	Control	696	1215	1256			
	Control with Panchagavya	817	1552	1411			
	Mean	3512	3075	3328			
Cauliflower-pea-cauliflower	Rock phosphate enriched FYM + VC (1:1)	8724	4210	7774			
	FYM fb BD	10037	4904	6424			
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya	10535	3611	5562			
	FYM fb BD fb Panchagvya	11150	2509	5913			
	Control	1363	1137	1447			
	Control with Panchagavya	1788	1536	1841			
	Mean	7266	2985	4827			
		Kharif (GY)		***Rabi (GY)***		***Summer (GY)***	
	CD (P=0.05)	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	157	949	39	235	54	331
	Source	123	364	121	358	141	415
	Cropping X Source	175	514	172	506	199	587
	Source X Cropping	223	999	162	505	190	608
Bhopal							
Soybean-wheat	OM	359	2607				
	BD	310	2389				
	OM+PG	374	2864				
	OM+BD	371	2824				
	OM+PG+BD	376	3018				
	Control	302	2009				
	Mean	349	2619				
Maize-chickpea	OM	3912	1669				
	BD	2775	1603				
	OM+PG	4298	1928				
	OM+BD	4206	1717				
	OM+PG+BD	4305	1942				

Cropping system	Source of nutrient	Grain Yield (kg/ha)			Straw Yield (kg/ha)		
		Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
	Control	2486	1597				
	Mean	3663	1743				
		Kharif (GY)	***Rabi (GY)***				
	CD (P=0.05)	SEm± CD	SEm± CD				
	Cropping	36.7 163.9	68.9 15.4				
	Source	37.9 109.5	277.9 96.2				
	Cropping X Source	89.8 185.4	37.7 NS				
	Source X Cropping	61.2 211.4	125.1 NS				
Calicut							
Ginger	FYM+BD+PG+RP	6925					
	FYM+PG+RP	7100					
	FYM+BD+RP	3800					
	FYM+NC+2VC+PG+BD+RP	3350					
	FYM+NC+2VC+RP	3800					
	Absolute control	4200					
	Mean	4863					
Turmeric	FYM+BD+PG+RP	11800					
	FYM+PG+RP	11800					
	FYM+BD+RP	11550					
	FYM+NC+2VC+PG+BD+RP	12150					
	FYM+NC+2VC+RP	9750					
	Absolute control	11100					
	Mean	11358					
		Kharif					
	CD (P=0.05)	SEm± CD					
	Cropping	255 1146					
	Source	434 1251					
	Cropping X Source	614 1769					
	Source X Cropping	616 1944					
Coimbatore							
Cotton-maize-green manure	FYM + NEOC* (1/2+1/2)	1448	3422			5766	
	Panchagavya alone	886	2506			5348	
	FYM+NEOC*(1/2+1/2)+ Panchagavya	1501	3569			6285	
	Biodynamic Practices	958	2895			5269	
	BiodynamicPractices+ Panchagavya	1085	3090			5692	

Cropping system	Source of nutrient	Grain Yield (kg/ha)			Straw Yield (kg/ha)		
		Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
	Mean	1176	3096			5672	
Chillies-sunflower-green manure	FYM + NEOC* (1/2+1/2)	4806	1262			2814	
	Panchagavya alone	3777	1025			2295	
	FYM+NEOC*(1/2+1/2)+ Panchagavya	4841	1369			3034	
	Biodynamic Practices	3580	1130			2508	
	BiodynamicPractices+ Panchagavya	4059	1229			2721	
	Mean	4213	1203			2674	
		Kharif (GY)	***Rabi (GY)***				
	CD (P=0.05)	SEm± CD	SEm± CD			SEm± CD	
	Cropping	5.2 31.3	71.6 434			24.0 145	
	Source	123.4 369	96.5 289			144.7 432	
	Cropping X Source	174.5 NS	136.9 NS			204.3 NS	
	Source X Cropping	156.0 NS	141.8 NS			184.4 NS	
Dharwad							
Groundnut-sorghum	EC+VC+GLM	3618	1820		3305	11843	
	Panchagavya spray	3001	1420		2783	10990	
	EC+VC+GLM + Panchagavya spray	3980	1883		3479	10700	
	EC+VC+GLM+ Biodynamic spray @5g/ac	3926	1700		3504	11013	
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	4299	1914		3678	10802	
	FYM+VC+GLM	3573	1759		3127	11344	
	Control	2853	1382		2521	9700	
	Mean	3607	1697		3200	10913	
Maize-chickpea	EC+VC+GLM	5236	1337		6218	1172	
	Panchagavya spray	4360	1145		4938	1062	
	EC+VC+GLM + Panchagavya spray	5781	1366		6723	1263	
	EC+VC+GLM+ Biodynamic spray @5g/ac	5631	1253		6285	1131	
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	6015	1380		6487	1144	
	FYM+VC+GLM	5067	1130		5544	1120	
	Control	3552	966		4298	931	
	Mean	5092	1225		5785	1118	

Cropping system	Source of nutrient	Grain Yield (kg/ha)			Straw Yield (kg/ha)		
		Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Chilli+onion	EC+VC+GLM	649					
	Panchagavya spray	435					
	EC+VC+GLM + Panchagavya spray	707					
	EC+VC+GLM+ Biodynamic spray @5g/ac	702					
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	741					
	FYM+VC+GLM	579					
	Control	264					
	Mean	582					
		Kharif (GY)		***Rabi (GY)***		***Kharif (SY)***	***Rabi (GSY)***
	CD (P=0.05)	SEm± CD		SEm± CD		SEm± CD	SEm± CD
	Cropping	119.1 467		33.5 204		139.0 845	114.9 696
	Source	120.6 346		56.0 163		167.4 486	183.7 535
	Cropping X Source	209.2 599		79.4 NS		236.2 NS	266.7 932
	Source X Cropping	227.7 717		80.9 NS		259.6 NS	259.6 756
Jabalpur							
Basmati rice - D.wheat-green manure	VC+FYM+NEOF @1/3 N each	3601		3403		6307	5941
	Panchgavya alone	3034		2545		6251	5619
	VC+FYM+NEOF@1/3N each +Panchgavya	3669		3700		6396	6811
	Biodynamic practices	2802		2496		6189	5749
	Biodynamic practices+ Panchgavya	3294		2725		6282	6047
	Mean	3280		2974		6285	6033
Basmati rice - berseem	VC+FYM+NEOF @1/3 N each	3625		235		3520	31033
	Panchgavya alone	3050		226		6350	29944
	VC+FYM+NEOF @1/3N each +Panchgavya	3786		232		6573	31925
	Biodynamic practices	2894		218		6297	29814
	Biodynamic practices+ Panchgavya	3269		229		6449	30083
	Mean	3325		228		5838	30560
		Kharif (GY)		***Rabi (GY)***		***Kharif (SY)***	***Rabi (GSY)***
	CD (P=0.05)	SEm± CD		SEm± CD		SEm± CD	SEm± CD
	Cropping	152.5 NS		1.0 5.89		0.13 0.76	867 5258

Cropping system	Source of nutrient	Grain Yield (kg/ha)			Straw Yield (kg/ha)		
		Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
	Source	67.2 201	1.9 5.56		0.12 0.35	816 NS	
	Cropping X Source	95.0 NS	2.5 7.87		0.17 0.50	1154 NS	
	Source X Cropping	174.5 NS	2.6 8.75		0.19 0.83	1348 NS	
Karjat							
Rice- red pumpkin	Kh. FYM + rice straw + glyricidia leaves @1/3rd N each Rb. FYM +NC + VC - @1/3rd N each	3478	12561		4042	4367	
	Panchagavya alone	2734	6096		3226	3548	
	Kh. FYM + rice straw + glyricidia leaves @1/3rd N each Rb. FYM +NC +VC - @1/3rd N each + Panchagavya	3565	13094		4207	4528	
	Biodynamic practices	2698	5502		3164	3692	
	Panchagavya + Biodynamic practices	2946	6269		3490	3862	
	Mean	3084	8704		3626	3999	
Rice- cucumber	Kh. FYM + rice straw + glyricidia leaves @1/3rd N each Rb. FYM +NC +VC - @1/3rd N each	3565	11357		4313	2212	
	Panchagavya alone	2851	4143		3434	2042	
	Kh. FYM + rice straw + glyricidia leaves @1/3rd N each Rb. FYM +NC +VC - @1/3rd N each + Panchagavya	3735	11649		4447	2328	
	Biodynamic practices	2778	4033		3421	1700	
	Panchagavya + Biodynamic practices	3076	4439		3660	2170	
	Mean	3201	7124		3855	2090	
		Kharif (GY)	***Rabi (GY)***		***Kharif (SY)***	***Rabi (GSY)***	
	CD (P=0.05)	SEm± CD	SEm± CD		SEm± CD	SEm± CD	
	Cropping	29 NS	104 630		43 NS	131 795	
	Source	80 239	321 961		94 282	226 NS	
	Cropping X Source	113 NS	455 NS		133 NS	318 NS	
	Source X Cropping	105 NS	420 NS		127 NS	313 NS	
Ludhiana							
Maize-wheat+ gram-summer-moong	B.rice Other crops						
	GM FYM	5860	3173		11500	4160	
	GM+PG FYM+PG	5710	3100		11653	3917	
	GM+BD BD	3610	2013		7500	2743	

Cropping system	Source of nutrient		Grain Yield (kg/ha)			Straw Yield (kg/ha)		
			Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
	GM+BD+FYM	FYM+BD	5803	3300		11613	3927	
	GM+PG+BD	FYM+PG+BD	5877	3280		11297	4060	
	Control	Control	1270	993		3093	3250	
	Mean		4988	2643		9443	3676	
Basmati rice- wheat-green manure	GM	FYM	3640	3533		5397	4417	
	GM+PG	FYM+PG	3623	3580		5523	4387	
	GM+BD	BD	3627	1900		5197	3257	
	GM+BD+FYM	FYM+BD	3728	3402		5697	4597	
	GM+PG+BD	FYM+PG+BD	3753	3540		5370	4433	
	Control	Control	2433	1467		3487	2050	
	Mean		3467	1467		5112	3857	
			Kharif (GY)		***Rabi (GY)***		***Kharif (SY)***		***Rabi (GSY)***	
	CD P=0.05)		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping		44.8	272	43.1	262	1325	NS	32	NS
	Source		121.3	357	154.6	455	814	2395	179	526
	Cropping X Source		171.6	505	219.1	NS	1152	3387	253	744
	Source X Cropping		163.1	518	204.3	NS	1691	8217	233	700
Pantnagar										
Basmati rice-chickpea-sesbania (green manure)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)		4649	1731		5951				
	Biodynamic (BD)		3644	1244		4913				
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+Panchgavya		4637	1966		5807				
	FYM+VC+NC+EC 1/4+1/4+1/4+1/4)+BD		4637	1778		5644				
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+Panchgavya		4829	2003		5651				
	T6=Control		3882	1098		5024				
	Mean		4380	1637		5499				
Basmati rice-vegetable pea-maize+moong (moong residues incorporation)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4+1/4)		3968	8724	8107	5213	4901			
	Biodynamic (BD)		2893	5887	5833	3791	3518			
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+Panchgavya		4241	7729	8300	5184	5470			
	FYM+VC+NC+EC 1/4+1/4+1/4+1/4)+BD		4091	7809	8357	5372	5382			

Cropping system	Source of nutrient	Grain Yield (kg/ha)			Straw Yield (kg/ha)		
		Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
	FYM+VC+NC+EC (1/4+1/4+ 1/4+1/4)+BD+Panchgavya	4281	8955	8520	5381	5566	
	T6=Control	2821	4816	4930	3780	3236	
	Mean	3716	7320	8107	4787	4679	
		Kharif	***Rabi***	***Summer***	***Kharif***	***Rabi***	
	CD (P=0.05)	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	
	Cropping	80 488.6	148.6 904.4		138.8 844.8		
	Source	98 288.2	125.3 369.6	202.9 639.3	136.6 403.1	322 1015	
	Cropping X Source	138 NS	177.2 522.8		193.2 NS		
	Source X Cropping	150 NS	219.7 963.3		224.5 NS		
Raipur							
Rice-chickpea	EC+CDM+NEOC @ 1/3 N each	3813	1271		5746	3050	
	Bio dynamic practice	2263	796		3653	1896	
	EC+CDM+NEOC@1/3N each+Panchagavya	4156	1146		5861	2573	
	EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice	3825	1052		6021	2458	
	Biodynamicpractice+ EC+ CDM+NEOC@1/3Neach+ Panchagavya	4256	1375		6195	3031	
	Mean						
Rice-mustard+ lentil (alternate row)	EC+CDM+NEOC @ 1/3 N each	3704	840		5405	2813	
	Bio dynamic practice	2119	650		3191	2131	
	EC+CDM+NEOC@1/3N each+Panchagavya	3862	873		5477	2687	
	EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice	3802	865		5765	2636	
	Biodynamicpractice+ EC+ CDM+NEOC@1/3Neach+ Panchagavya	4154	940		5975	2804	
	Mean						
		Kharif (GY)	***Rabi (GY)***		***Kharif (SY)***	***Rabi (GSY)***	
	CD (P=0.05)	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	
	Cropping	61.9 NS	22.3 136		107 NS	36 NS	
	Source	61.8 185	44.7 134		72 216	95 285	
	Cropping X Source	87.7 NS	63.1 NS		102 NS	134 NS	
	Source X Cropping	99.7 NS	60.7 NS		141 NS	125 NS	

Cropping system	Source of nutrient	Grain Yield (kg/ha)			Straw Yield (kg/ha)		
		Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Ranchi							
Rice-wheat	50% VC+50% KC	3763	1923		5540	3304	
	BD Preparation (CPP, BD500 & 501)	2150	1033		3443	1907	
	VC + K.C+Panchagavaya	3867	2070		5803	3451	
	VC + K.C+ BD Prepartion	4003	2203		6003	3601	
	:VC + K.C+ BD Prepartion+ Panchagavya	4203	2332		6307	3742	
	Mean						
Rice-potato	50% VC+50% KC	3890	16400	5833	2853		
	BD Preparation (CPP, BD500 & 501)	2217	6867		3507	1267	
	VC + K.C+Panchagavaya	3953	16600		6090	2921	
	VC + K.C+ BD Prepartion	4090	16733		6297	3030	
	VC + K.C+ BD Prepartion + Panchagavya	4270	16967		6577	3201	
	Mean						
		Kharif *(GY)*		***Rabi*** *(GY)*	***Kharif*** *(SY)*		***Rabi*** *(GSY)*
	CD (P=0.05)	SEm± CD		SEm± CD	SEm± CD		SEm± CD
	Cropping	205 NS		225 969	247 NS		120 517
	Source	246 521		370 784	336 713		253 535
	Cropping X Source	348 NS		523 1108	476 NS		357 NS
	Source X Cropping	372 NS		519 1314	492 NS		341 NS
Umium 2A							
Maize+soybean (GM)-toria	FYM+VC	3575	363		8260		
	Panchagavya(PG)	810	91.3		2139		
	FYM+VC+PG	3677	467		8517		
	Biodynamic Formulation (BD-501)	915	111		2416		
	BD -501 +PG	1063	220		2535		
	Control	441	11.3		1398		
	Mean						
Maize (green cob)+soybean	FYM+VC	651	1165		5848	832	
(GM)-frenchbean (green pod)	Panchagavya(PG) FYM+VC+PG	167 713	480 1240		1661 6116	197 943	
	Biodynamic Formulation (BD-501)	174	488		1420	211	
	BD -501 +PG	197	496		1903	218	

Cropping system	Source of nutrient	Grain Yield (kg/ha)			Straw Yield (kg/ha)		
		Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
	Control	109	97.8		631	103	
	Mean	335	661		2930	832	
		Kharif (GY)	***Rabi (GY)***		***Kharif (SY)***	***Rabi (GSY)***	
	CD (P=0.05)	SEm± CD	SEm± CD		SEm± CD	SEm± CD	
	Cropping	35 211	8.6 52.2		170.4 1038	51.6 162.6	
	Source	93 273	18.5 54.7		149.9 443		
	Cropping X Source	131 385	26.2 84.0		212.1 626		
	Source X Cropping	124 397	25.4 77.3		258.1 1114		
Umium 2B							
Maize+soybean-tomato	FYM	5306	16212		10895	2049	
	VC	4838	14886		9468	1696	
	FYM+VC	5513	15607		11053	1919	
	Control	2137	2393		4804	819	
	Mean	4449	12275		9055	1621	
Maize+soybean-potato	FYM	5468	16708		10662	2373	
	VC	5287	17038		9495	2532	
	FYM+VC	5571	16794		11121	2403	
	Control	2259	4214		4689	900	
	Mean	4646	13689		8992	2052	
Maize+soybean-frenchbean	FYM	5642	17047		11065	4457	
	VC	5484	16182		9659	4038	
	FYM+VC	5687	18075		11438	4691	
	Control	2377	5359		5261	1531	
	Mean	4798	14166		9356	3679	
		Kharif (GY)	***Rabi (GY)***		***Kharif (SY)***	***Rabi (GSY)***	
	CD (P=0.05)	SEm± CD	SEm± CD		SEm± CD	SEm± CD	
	Cropping	167.9 NS	370.4 1454		375.6 NS	118.3 464.4	
	Source	206.0 612.1	298.7 888		332.8 988.7	66.9 198.7	
	Cropping X Source	356.8 NS	517.4 NS		576.4 NS	115.8 344.1	
	Source X Cropping	351.6 NS	581.4 NS		624.7 NS	155.1 547.0	

FYM, rice straw and glyricidia leaves during *kharif* and FYM + neem cake and vermicompost during *rabi*. Application of either panchgavya alone or Biodynamic packages or its combination registered significantly lower yield in all the crops. The reduction in yield was found to be 17.5, 52.1 and 61.9% in rice, red pumpkin and cucumber with combination of Panchgavya + biodynamic packages compared to organic sources + panchgavya.

Ludhiana: Two systems namely maize-wheat+gram-summer moong and basmati rice-wheat-green manure was evaluated with different organic sources and biodynamic packages. Application of FYM + panchgavya + biodynamic packages recorded higher grain yield of maize (5877 kg ha^{-1}), while in wheat FYM + BD recorded higher yield (3300 kg ha^{-1}). In case of basmati rice, except control, all the organic sources *viz*., green manure alone or its combination with FYM, biodynamic packages or panchagavya recorded statistically at par yield. Wheat yield was significantly lower in biodynamic packages (1900 kg ha^{-1}) alone and control (1467 kg ha^{-1}) compared to application of FYM alone or with biodynamic and Panchgavya packages. The yield increase due to biodynamic and panchgavya packages were not significant compared to FYM alone.

Visit of departmental team of PAU to NPOF experiments at Ludhiana

Pantnagar: Application of FYM + VC + NC + EC @ ¼ N each + BD + Panchgavya recorded an increase in yield to the tune of 180 kg ha^{-1} in basmati rice compared to application of FYM + VC + NC + EC alone. However in case of chickpea, it was observed that all the treatments except biodynamic packages alone or control was at par. Significantly higher yield of 8955 kg ha^{-1} in vegetable pea was recorded with FYM + VC +NC + EC @ ¼ N each + BD+Panchagavya compared to other treatments. Residue yield of the crops also responded similarly as that of economic yield.

Raipur: Two systems namely rice-chickpea and rice-mustard + lentil (alternate row) were evaluated with five combinations of nutrient sources. Though application of biodynamic package + EC + CDM + NEOC @ 1/3 N each + panchagavya recorded higher yield of rice (4256 kg ha^{-1}) and chickpea (1375 kg ha^{-1}), it was at par with application of + EC + CDM + NEOC @ 1/3 N each + panchagavya and EC + CDM + NEOC @ 1/3 N each alone in both the crops of rice-chickpea system. Similar trend was also observed with rice-mustard + lentil (alternate row system). Biodynamic practice + EC + CDM + NEOC @ 1/3 N each +panchagavya recorded higher yield of 940 kg ha^{-1}. Lowest yield in all the crops was observed under biodynamic package alone.

Ranchi: Two systems namely rice-wheat and rice-potato were evaluated for its response to organic inputs in the form of vermicompost, biodynamic preparation, cow pat pit and panchgavya in various combinations. All the crops recorded higher yield with vermicompost + KC + biodynamic peparration + panchagavya (4270, 2332 and 16967 kg ha^{-1} in rice, wheat and potato respectively) which was at par with without panchagavya in the same treatment. Lowest yield was obtained in all the crops under biodynamic preparation (CPP, BD 500 and 501) alone. The yield increase due to application of panchagavya and biodynamic preparation over and above, the vermicompost + KC @ ½ N each was found to be very minimum in rice and wheat (2.20 and 7.60 % with panchagavya and 5.7 and 14.6% with biodynamic preparations in rice and wheat respectively). However, the contribution of panchagavya and biodynamic preparation over and above VC + KC was found to be numerically higher value in potato. The residues yield of all the crops have also recorded similar trend as that of economic yield.

Umiam: The experiments were conducted with different combinations of cropping systems and organic inputs. In the first experiment, two systems namely maize + soybean (green manure)–toria and maize (green cob) + soybean (green manure)–frenchbean (green pod) were evaluated with biodynamic and panchgavya packages apart from vermicompost and FYM. Application of FYM + VC + panchagavya recorded numerically higher yield in maize for grain and green cobs (3677 and 713 kg ha^{-1} respectively and frenchbean (1240 kg ha^{-1}) but the same was on par with application of FYM + VC alone. Application of biodynamic preparation or panchagavya alone or its combination resulted in significantly lower yield in all the crops evaluated. In the other experiment, tomato, potato and frenchbean were evaluated as succeeding crop after maize + soybean with FYM and vermicompost. The response of maize was found to be better with application of FYM + VC @ ½ N each as it recorded significantly higher grain yield compared to VC alone. In case of vegetable crops, differential response was observed. Though, higher yield of tomato was observed with FYM alone, its increase over FYM+ VC was only 4 %. Potato recorded higher yield under vermicompost application and the increase over FYM alone was found to be 2 %. In case of frenchbean, combined application of FYM + VC resulted in 6% increase in yield over FYM alone. The yield of residues also performed in similar manner.

Carrot produced under organic management practice at Umiam

Potato under organic management in raised and sunken bed at Umiam

Physical and chemical properties along with microbial count in soil (Table 14, 15)

Bajaura: Soil pH did not vary among various nutrient sources. Soil organic carbon was found to be higher with application of rock phosphate enriched FYM + VC (1:1) in coriander-pea-tomato (0.86%) and Cauliflower-pea-cauliflower (0.85%) system. The increase of OC in coriander-pea-tomato was found to be 72% over control. Higher available N, P and K was also observed under rock phosphate enriched FYM + VC (1:1) in the same system. In both the systems, residual availability of Mn, Zn, Cu and Fe was found to be significantly higher with rock phosphate enriched FYM+VC @ ½ N each compared to application of same with panchagavya or biodynamic preparation and FYM. On an average the increase in availability of micronutrients was found to be more than 50% in both the systems compared to control.

Bhopal: Soil pH, EC, OC, available N, P and K were estimated and results reveals that different sources of nutrients did not significantly influenced the EC, organic carbon, available N, P and K. However soybean-wheat system, application of organic manures alone recorded higher organic carbon (1.15%). Soybean-wheat system recorded significantly higher available N in the soil (266 kg ha^{-1}) with the application of organic manure+panchagavya along with biodynamic package. Among the two systems also, no significant change in EC, P and available K was observed.

Table 14. Influence of source of nutrients on soil physical and chemical properties of soils at the end of cropping cycle

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Bajaura								
Coriander-pea-tomato	Rock phosphate enriched FYM + VC (1:1)		5.33		0.86	190	68.1	187
	FYM fb BD		5.43		0.85	180	65.8	183
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya		5.30		0.84	170	64.5	178
	FYM fb BD fb Panchagvya		5.37		0.85	178	65.1	184
	Control		5.23		0.50	119	32.4	138
	Control with Panchagavya		5.20		0.51	120	35.2	139
	Mean		5.31		0.74	160	55.2	168
Cauliflower-pea-cauliflower	Rock phosphate enriched FYM + VC (1:1)		5.37		0.85	185	69.2	196
	FYM fb BD		5.37		0.84	179	65.9	194
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya		5.33		0.83	171	65.2	177
	FYM fb BD fb Panchagvya		5.33		0.83	179	66.7	176
	Control		5.27		0.49	111	32.7	132
	Control with Panchagavya		5.13		0.48	114	34.9	135
	Mean		5.30		0.72	157	55.8	168
	CD (P=0.05)		SEm± CD		SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping		0.026 NS		0.01 NS	1.13 NS	0.40 NS	1.10 NS
	Source		0.023 0.069		0.01 0.03	1.70 3.49	0.86 1.79	1.20 3.08
	Cropping X Source		0.033 NS		0.02 NS	2.36 4.93	1.21 NS	2.09 4.36
	Source X Cropping		0.040 NS		0.02 NS	2.44 6.24	1.18 NS	2.20 5.80
Bhopal								
Soybean-wheat	OM		8.13	0.22	1.15	236	153	791
BD		8.17	0.21	0.73	201	67.3	816	
	OM+PG		8.10	0.21	0.79	207	97.7	845
	OM+BD		8.10	0.21	1.08	253	119	837

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
	OM+PG+BD		8.10	0.23	1.11	266	146	875
	Control		8.10	0.26	1.09	236	152	819
	Mean		8.12	0.22	0.99	233	123	831
Maize-chickpea	OM		8.13	0.25	0.87	220	109	816
	BD		8.20	0.20	0.57	178	49.3	787
	OM+PG		7.93	0.26	1.03	236	142	764
	OM+BD		8.03	0.22	0.74	213	59.7	760
	OM+PG+BD		8.10	0.19	0.73	192	57.3	791
	Control		8.00	0.25	0.64	178	35.7	729
	Mean		8.07	0.23	0.76	203	75.5	775
	CD (P-0.05)		SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping		0.014 0.083	0.002 NS	0.02 0.08	5.55 23.9	11.6 NS	18.7 NS
	Source		0.029 0.085	0.014 NS	0.13 NS	20.6 NS	25.5 NS	47.2 NS
	Cropping X Source		0.041 NS	0.019 NS	0.18 NS	29.1 NS	36.1 NS	66.7 NS
	Source X Cropping		0.040 NS	0.018 NS	0.17 NS	27.2 NS	34.9 NS	63.7 NS
Calicut								
Ginger	FYM+BD+PG+RP		5.40		1.77	128	6.00	1.23
	FYM+PG+RP		5.53		1.47	129	6.00	125
	FYM+BD+RP		5.23		1.43	133	3.50	147
	FYM+NC+2VC+PG+BD+RP		5.52		1.67	130	7.83	166
	FYM+NC+2VC+RP		5.27		2.07	130	11.7	139
	Absolute control		5.37		1.21	121	4.17	138
	Mean		5.39		1.60	129	6.53	119
Turmeric	FYM+BD+PG+RP		5.28		1.17	121	6.33	187
	FYM+PG+RP		5.49		1.17	122	4.50	174
	FYM+BD+RP		5.69		1.16	124	7.03	239
	FYM+NC+2VC+PG+BD+RP		5.67		1.12	124	4.67	226
	FYM+NC+2VC+RP		5.56		1.10	124	5.00	156

Cropping system	Source of nutrient	BD (g/cc)	pH		EC (dS/m)	OC (%)		N (kg ha^{-1})		P (kg ha^{-1})		K (kg ha^{-1})	
	Absolute control		5.57			1.17		103		3.17		139	
	Mean		5.54			1.15		120		5.12		187	
	CD (P-0.05)		SEm±	CD		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping		0.05	NS		0.04	0.11	0.71	2.26	0.57	NS	5.59	17.8
	Source		0.10	NS		0.07	0.15	2.06	4.20	0.80	1.64	12.2	24.9
	Cropping X Source		0.14	NS		0.10	0.21	2.91	NS	1.13	2.31	17.2	35.2
	Source X Cropping		0.13	NS		0.10	0.22	2.75	NS	1.18	2.73	16.7	36.2
Coimbatore													
Cotton-maize-green manure	FYM+NEOC (1/2+1/2)					0.74		249		20.8		748	
	Panchagavya alone					0.68		221		20.0		721	
	FYM+NEOC(1/2+1/2)+ Panchagavya					0.74		236		19.6		758	
	Biodynamic Practices					0.66		234		19.2		712	
	Biodynamic practices+ Panchagavya					0.69		232		19.0		728	
	Mean					0.70		234		19.7		733	
Chillies-sunflower-green manure	FYM + NEOC (1/2+1/2)					0.70		248		20.8		644	
	Panchagavya alone					0.66		225		18.0		632	
	FYM+NEOC (1/2+1/2)+ Panchagavya					0.70		244		21.0		648	
	Biodynamic Practices					0.64		212		18.0		622	
	BiodynamicPractices+ Panchagavya					0.63		218		16.9		613	
	Mean					0.67		229		18.9		632	
	CD (P-0.05)					SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	CD (P=0.05)					SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping					0.00	0.02	3.87	NS	0.66	NS	0.64	2.77
	Source					0.01	0.02	4.47	9.48	0.58	1.22	4.01	8.50

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
	Cropping X Source				0.02 NS	6.32 13.4	0.82 1.73	5.67 12.0
	Source X Cropping				0.01 NS	6.85 19.3	0.98 3.06	5.11 11.0
Dharwad								
Groundnut-sorghum	EC+VC+GLM	1.21	7.20	0.21	0.65	280	32.7	379
	Panchagavya spray	1.21	7.25	0.20	0.63	267	31.8	367
	EC+VC+GLM + Panchagavya spray	1.18	7.17	0.19	0.69	284	33.6	382
	EC+VC+GLM+ Biodynamic spray @5g/ac	1.20	7.22	0.19	0.62	262	31.6	361
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	1.21	7.21	0.20	0.63	268	31.8	365
	FYM+VC+GLM	1.20	7.29	0.21	0.65	271	30.1	369
	Control	1.30	7.36	0.15	0.57	254	24.8	323
	Mean	1.22	7.24	0.19	0.63	269	31.0	364
Maize-chickpea	EC+VC+GLM	1.19	7.19	0.19	0.66	286	32.7	379
	Panchagavya spray	1.20	7.24	0.20	0.64	271	31.4	364
	EC+VC+GLM + Panchagavya spray	1.19	7.18	0.21	0.69	287	31.6	379
	EC+VC+GLM+ Biodynamic spray @5g/ac	1.21	7.27	0.19	0.62	269	30.8	362
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	1.20	7.29	0.17	0.65	272	32.7	366
	FYM+VC+GLM	1.20	7.38	0.21	0.64	281	31.9	368
	Control	1.32	7.32	0.14	0.49	253	23.4	324
	Mean	1.22	7.27	0.19	0.63	274	31.0	363
Chilli+onion	EC+VC+GLM	1.20	7.23	0.19	0.68	279	32.6	379
	Panchagavya spray	1.20	7.26	0.19	0.62	265	30.9	363

Cropping system	Source of nutrient	BD (g/cc)		pH		EC (dS/m)		OC (%)		N (kg ha^{-1})		P (kg ha^{-1})		K (kg ha^{-1})	
	EC+VC+GLM + Panchagavya spray	1.21		7.24		0.22		0.69		281		32.7		379	
	EC+VC+GLM+ Biodynamic spray @5g/ac	1.22		7.23		0.18		0.60		262		29.8		363	
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	1.21		7.29		0.21		0.63		270		30.2		368	
	FYM+VC+GLM	1.22		7.25		0.22		0.64		270		31.4		370	
	Control	1.32		7.42		0.17		0.49		246		21.9		337	
	Mean	1.23		7.27		0.20		0.62		268		30.0		366	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	0.01	NS	0.041	NS	0.005	NS	0.01	NS	2.51	NS	0.44	NS	3.27	NS
	Source	0.02	0.04	0.033	0.096	0.008	0.022	0.01	0.03	2.99	6.06	0.56	1.14	4.47	9.07
	Cropping X Source	0.03	NS	0.058	NS	0.013	NS	0.02	NS	5.18	NS	0.98	NS	7.74	NS
	Source X Cropping	0.03	NS	0.068	NS	0.013	NS	0.02	NS	5.41	NS	1.01	NS	7.88	NS
Karjat															
Rice- red pumpkin	Kh. FYM + rice straw + glyricidia leaves /plot @1/3rd N each Rb. FYM +NC +VC plot-1 - @1/3rd N each			6.77		0.41		1.40		263		18.4		366	
	Panchagavya alone			6.71		0.38		1.33		238		17.5		345	
	Kh. FYM + rice straw + glyricidia leaves /plot @1/3rd N each Rb. FYM +NC +VC plot-1 - @1/3rd N each + Panchagavya			6.80		0.40		1.45		272		19.7		370	
	Biodynamic practices			6.67		0.35		1.29		234		17.2		344	
	Panchagavya + Biodynamic practices			6.73		0.40		1.33		238		17.8		349	
	Mean			6.74		0.39									

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Rice- cucumber	Kh. FYM + rice straw + glyricidia leaves /plot @1/3rd N each Rb. FYM +NC +VC plot-1 - @1/3rd N each		6.81	0.41	1.43	268	23.7	390
	Panchagavya alone		6.72	0.39	1.32	238	22.2	358
	Kh. FYM + rice straw + glyricidia leaves /plot @1/3rd N each Rb. FYM+ NC +VC plot-1 - @1/3rd N each + Panchagavya		6.82	0.43	1.45	276	25.0	396
	Biodynamic practices		6.69	0.39	1.34	238	22.2	359
	Panchagavya + Biodynamic practices		6.75	0.38	1.37	251	23.1	362
	Mean		6.76	0.40				
	CD (P-0.05)		SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping		0.016 NS	0.007 NS	0.02 NS	7.66 NS	0.17 0.75	4.24 18.3
	Source		0.029 0.09	0.016 NS	0.03 0.07	10.0 21.3	0.39 0.83	2.11 4.48
	Cropping X Source		0.041 NS	0.022 NS	0.05 NS	14.2 NS	0.55 NS	2.99 6.33
	Source X Cropping		0.040 NS	0.021 NS	0.05 NS	14.9 NS	0.52 NS	5.01 18.5
Ludhiana								
Maize-wheat+gram-summer moong	Basmati Rice	Other crops						
	GM	FYM	7.56	0.25	0.62	346	65.5	189
	GM+PG	FYM+PG	7.53	0.25	0.61	353	63.3	182
	GM+BD	BD	7.55	0.25	0.54	332	55.6	163
	GM+BD+FYM	FYM+BD	7.58	0.22	0.61	358	61.4	180
	GM+PG+BD	FYM+PG+BD	7.60	0.25	0.61	345	65.1	184
	Control	Control	7.57	0.21	0.39	255	39.8	101
	Mean		7.56	0.24				

Cropping system	Source of nutrient		BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Basmati rice-wheat-green manure	GM	FYM		7.50	0.28	0.61	339	67.8	186
	GM+PG	FYM+PG		7.65	0.28	0.64	330	62.0	184
	GM+BD	BD		7.70	0.29	0.59	308	49.4	162
	GM+BD+FYM	FYM+BD		7.62	0.30	0.60	331	62.6	182
	GM+PG+BD	FYM+PG+BD		7.60	0.29	0.61	344	62.0	175
	Control	Control		7.80	0.26	0.43	198	43.1	85.2
	Mean			7.64	0.28				
	CD (P-0.05)			SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping								
	Source								
	Cropping X Source								
	Source X Cropping								
Pantnagar									
Basmati rice-chickpea – sesbania (green manure)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4+1/4)					0.99	341.0	30.9	285.7
	Biodynamic (BD)					0.93	320.3	23.7	257.7
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4+1/4)+ Panchgavya					1.01	362.0	28.6	271.7
	FYM+VC+NC+EC 1/4+1/4+1/4+1/4+1/4)+BD					1.02	346.0	28.8	274.3
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4+1/4)+BD+ Panchgavya					1.04	359.7	32.8	265.3
	T6=Control					0.91	312.7	23.8	235.0
	Mean					0.98	340.3	28.1	264.9
Basmati rice – Vegetable pea– maize+moong (moong residues incorporation)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4+1/4)					0.97	303.3	29.4	217.0

Cropping system	Source of nutrient	BD (g/cc)		pH		EC (dS/m)		OC (%)		N (kg ha^{-1})		P (kg ha^{-1})		K (kg ha^{-1})	
	Biodynamic (BD)							0.95		281.3		25.7		213.3	
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ Panchgavya							0.97		349.7		31.7		208.0	
	FYM+VC+NC+EC 1/4+1/4+1/4+1/4)+BD							1.03		345.3		33.1		215.7	
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+ Panchgavya					1.04		358.7		35.2		218.3			
	T6=Control							0.90		273.0		25.2		196.0	
	Mean							0.98		318.6		30.0		211.4	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	
	Cropping							0.006	NS	5.0	30.7	0.40	2.43	6.60	40.16
	Source							0.012	0.037	8.8	25.9	0.95	2.81	4.72	13.93
	Cropping X Source							0.018	NS	12.4	NS	1.35	NS	6.68	NS
	Source X Cropping							0.017	NS	12.4	NS	1.29	NS	8.98	NS
Raipur															
Rice-chickpea	EC+CDM+NEOC @ 1/3 N each	1.24		7.40		0.27		0.65		216		12.4		281	
	Bio dynamic practice	1.27		7.46		0.34		0.58		186		10.4		259	
	EC+CDM+NEOC@1/3N each+Panchagavya	1.24		7.31		0.25		0.64		206		12.9		279	
	EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice	1.22		7.35		0.28		0.64		213		12.1		282	
	Biodynamicpractice+ EC+CDM+NEOC@1/3N each+Panchagavya	1.21		7.29		0.22		0.66		221		13.6		307	
	Mean			7.36		0.27									
Rice- mustard+ lentil (alternate row)	EC+CDM+NEOC @ 1/3 N each	1.23		7.38		0.28		0.60		207		11.9		267	
	Bio dynamic practice	1.31		7.44		0.34		0.56		189		9.40		245	

Cropping system	Source of nutrient	BD (g/cc)		pH		EC (dS/m)		OC (%)		N (kg ha^{-1})		P (kg ha^{-1})		K (kg ha^{-1})	
	EC+CDM+NEOC @1/3Neach+Panchagavya	1.23		7.28		0.27		0.60		203		12.1		265	
	EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice	1.23		7.35		0.27		0.63		203		11.5		265	
	Biodynamicpractice+ EC+ CDM+NEOC@1/3Neach+ Panchagavya	1.23		7.39		0.29		0.62		215		12.4		279	
	Mean			7.37		0.29									
	CD (P-0.05)	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	0.01	NS	0.02	NS	0.003	0.020	0.01	0.02	5.15	NS	0.41	NS	3.94	17.0
	Source	0.01	0.03	0.05	NS	0.010	0.029	0.02	0.03	7.02	14.9	0.61	1.30	4.60	9.74
	Cropping X Source	0.02	NS	0.07	NS	0.014	NS	0.02	NS	9.93	NS	0.87	NS	6.50	NS
	Source X Cropping	0.02	NS	0.06	NS	0.013	NS	0.02	NS	10.3	NS	0.87	NS	7.02	NS
Ranchi															
Rice-wheat	50% VC+50% KC									258		39		152	
	BD Preparation (CPP,BD500 & 501)									221		29		128	
	VC + K.C+Panchagavaya									261		39		153	
	VC + K.C+ BD Prepartion									262		42		155	
	VC+ K.C+ BD Prepartion + Panchagavya									264		45		156	
	Mean									253		39		149	
Rice-potato	50% VC+50% KC									253		40		146	
	BD Preparation (CPP,BD500 & 501)									216		28		127	
	VC + K.C+Panchagavaya									255		42		149	
	VC + K.C+ BD Prepartion									255		46		151	
	VC+ K.C+ BD Prepartion + Panchagavya									258		46		155	
	Mean									247		40		146	

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Umium 2A								
Maize + soybean (GM) - toria	FYM+VC	1.14	5.10		2.24	231	21.8	228
	Panchagavya(PG)	1.21	4.99		1.60	197	15.7	191
	FYM+VC+PG	1.12	5.16		2.34	235	22.9	237
	Biodynamic Formulation (BD-501)	1.23	5.01		1.68	199	16.4	198
	BD -501 +PG	1.21	4.97		1.75	203	16.6	204
	Control	1.26	4.89		1.49	174	12.6	187
	Mean							
Maize (green cob) + soybean (GM) – French bean (Green pod)	FYM+VC	1.15	5.12		2.29	237	23.0	229
	Panchagavya(PG)	1.24	4.97		1.64	206	14.5	194
	FYM+VC+PG	1.14	5.18		2.34	242	25.2	237
	Biodynamic Formulation (BD-501)	1.22	4.96		2.08	206	15.2	208
	BD -501 +PG	1.26	4.97		2.04	214	14.3	211
	Control	1.28	4.87		1.72	196	12.6	187
	Mean							
	CD (P-0.05)	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	0.01 NS	0.03 NS		0.03 0.11	0.90 3.87	0.72 NS	4.62 NS
	Source	0.02 0.05	0.05 0.11		0.07 0.15	5.24 10.9	1.57 3.28	4.12 8.60
	Cropping X Source	0.03 NS	0.07 NS		0.10 NS	7.41 NS	2.22 NS	5.83 NS
	Source X Cropping	0.03 NS	0.07 NS		0.10 NS	6.83 NS	2.15 NS	7.05 NS
Umium 2B								
Maize+soybean-tomato	FYM	1.19	5.13		2.25	241.7	26.6	243.2
	VC	1.16	5.13		2.18	233.1	25.7	239.3
	FYM+VC	1.13	5.13		2.28	244.0	28.5	244.0

Cropping system	Source of nutrient	BD (g/cc)		pH		EC (dS/m)	OC (%)		N (kg ha^{-1})		P (kg ha^{-1})		K (kg ha^{-1})	
	Control	1.17		4.97			1.89		193.2		20.9		217.3	
	Mean	1.16		5.09			2.15		228.0		25.4		236.0	
Maize+soybean-potato	FYM	1.17		5.11			2.23		239.2		26.0		245.8	
	VC	1.14		5.11			2.21		232.9		26.9		239.1	
	FYM+VC	1.16		5.12			2.29		239.6		29.9		248.5	
	Control	1.24		4.94			1.86		195.9		18.9		214.1	
	Mean	1.18		5.07			2.15		226.9		25.4		236.8	
Maize+soybean-frenchbean	FYM	1.17		5.15			2.31		243.4		31.4		246.5	
	VC	1.19		5.11			2.24		237.0		28.0		241.7	
	FYM+VC	1.20		5.16			2.32		246.5		30.3		251.0	
	Control	1.24		4.94			1.85		196.5		19.8		217.6	
	Mean	1.20		5.09			2.18		230.9		27.4		239.2	
		SEm±	CD	SEm±	CD		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	0.012	NS	0.018	NS		0.03	NS	5.4	NS	2.88	NS	1.99	NS
	Source	0.013	0.039	0.033	0.098		0.06	0.17	7.0	20.9	2.26	6.70	2.08	6.18
	Cropping X Source	0.023	NS	0.057	NS		0.10	NS	12.2	NS	3.91	NS	3.60	NS
	Source X Cropping	0.023	NS	0.053	NS		0.09	NS	11.9	NS	4.44	NS	3.70	NS

Table 15. Influence of source of nutrients on soil micro nutrients (ppm) and microbial count (x 10^4 CFU/g) at the end of cropping cycle

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Fungi	Bacteria	Actinomycetes
Bajaura								
Coriander-pea-tomato	Rock phosphate enriched FYM + VC (1:1)	46.6	3.63	2.83	85.5			
	FYM fb BD	45.6	3.17	2.78	75.7			
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya	45.0	3.03	2.76	73.7			
	FYM fb BD fb Panchagvya	45.9	3.23	2.78	77.4			
	Control	21.6	0.68	0.64	44.8			
	Control with Panchagavya	24.9	0.71	0.67	45.9			
	Mean	38.3	2.41	2.08	67.2			
Cauliflower-pea-cauliflower	Rock phosphate enriched FYM + VC (1:1)	47.5	3.27	2.80	84.2			
	FYM fb BD	45.6	3.10	2.76	75.8			
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya	45.4	3.00	2.72	71.6			
	FYM fb BD fb Panchagvya	46.6	3.10	2.79	77.2			
	Control	20.1	0.44	0.64	41.6			
	Control with Panchagavya	25.3	0.48	0.66	45.0			
	Mean	38.4	2.23	2.06	65.9			
	CD (P=0.05)	SEm± CD	SEm± CD	SEm± CD	SEm± CD			
	Cropping	0.24 NS	0.06 NS	0.02 NS	0.38 NS			
	Method	0.52 1.08	0.07 0.14	0.02 0.03	0.77 1.60			
	Cropping X Method	0.73 NS	0.10 NS	0.02 NS	1.08 NS			
	Method X Cropping	0.71 NS	0.10 NS	0.03 NS	1.06 NS			
Calicut								
Ginger	FYM+BD+PG+RP	5.73	1.17	9.80	50.7			
	FYM+PG+RP	7.63	1.40	15.0	50.0			
	FYM+BD+RP	3.87	0.77	14.3	51.3			

Cropping system	Source of nutrient	Mn		Zn		Cu		Fe		Fungi	Bacteria	Actinomycetes
	FYM+NC+2VC+PG+BD+RP	4.37		1.27		14.8		51.3				
	FYM+NC+2VC+RP	3.80		0.97		15.1		51.7				
	Absolute control	3.73		0.73		12.9		54.3				
	Mean	4.86		1.05		13.7		51.6				
Turmeric	FYM+BD+PG+RP	9.29		1.22		2.03		47.0				
	FYM+PG+RP	7.33		1.27		2.30		49.0				
	FYM+BD+RP	6.77		1.36		6.35		47.0				
	FYM+NC+2VC+PG+BD+RP	10.3		1.81		3.76		49.3				
	FYM+NC+2VC+RP	7.84		1.20		3.42		47.0				
	Absolute control	7.70		1.39		2.39		47.7				
	Mean	8.21		1.38		3.38		47.8				
	CD (P=0.05)	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD			
	Cropping	0.73	2.34	0.04	0.13	0.38	1.21	0.63	1.99			
	Method	0.93	NS	0.10	0.20	0.53	1.09	0.90	NS			
	Cropping X Method	1.31	NS	0.14	0.29	0.75	1.54	1.27	NS			
	Method X Cropping	1.41	NS	0.14	0.29	0.79	1.82	1.32	NS			
Coimbatore												
Cotton - maize - green manure	FYM + NEOC* (1/2+1/2)									21.0	117	36.5
	Panchagavya alone									18.8	101	32.0
	FYM+NEOC*(1/2+1/2)+ Panchagavya									21.4	121	38.6
	Biodynamic Practices									18.2	105	31.5
	BiodynamicPractices+ Panchagavya									21.0	106	32.8
	Mean									20.1	110	34.3
Chillies - Sunflower - Green manure	FYM + NEOC* (1/2+1/2)									21.9	117	35.6
	Panchagavya alone									19.8	98.6	33.5

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Fungi	Bacteria	Actinomycetes
	FYM+NEOC*(1/2+1/2)+ Panchagavya					22.4	118	39.3
	Biodynamic Practices					19.5	98.4	33.0
	BiodynamicPractices+ Panchagavya					22.2	101	35.0
	Mean					21.2	107	35.3
	CD (P=0.05)					SEm± CD	SEm± CD	SEm± CD
	Cropping					0.17 0.75	2.68 NS	0.76 NS
	Method					0.63 1.35	2.95 6.24	1.14 2.42
	Cropping X Method					0.90 NS	4.15 NS	1.61 NS
	Method X Cropping					0.82 NS	4.59 NS	1.63 NS
Dharwad								
Groundnut-sorghum	EC+VC+GLM	13.6	1.03	1.43	10.2	3.00	3.00	9.00
	Panchagavya spray	11.6	1.05	1.39	9.15	3.00	7.00	8.00
	EC+VC+GLM + Panchagavya spray	14.6	1.07	1.45	10.3	6.00	7.00	11.0
	EC+VC+GLM+ Biodynamic spray @5g/ac	10.7	0.99	1.41	8.94	2.00	11.0	7.00
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	13.0	1.02	1.26	8.46	2.00	7.00	16.0
	FYM+VC+GLM	13.1	1.05	1.36	8.19	2.00	8.00	10.0
	Control	8.51	0.97	099	7.85	3.00	15.0	8.00
	Mean	12.2	1.03	15.3	9.01	3.00	8.29	9.86
Maize-chickpea	EC+VC+GLM	13.5	1.02	1.36	9.92	3.00	14.0	17.0
	Panchagavya spray	11.4	1.04	1.19	9.45	9.00	12.0	29.0
	EC+VC+GLM + Panchagavya spray	14.7	0.99	1.24	10.8	2.00	9.00	3.00
	EC+VC+GLM+ Biodynamic spray @5g/ac	11.4	0.96	1.12	9.23	4.00	10.0	11.0

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Fungi	Bacteria	Actinomycetes
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	12.5	0.95	1.15	9.12	2.00	7.00	5.00
	FYM+VC+GLM	12.1	0.97	1.11	9.98	4.00	11.0	16.0
	Control	9.64	0.87	0.98	7.52	4.00	12.0	13.0
	Mean	12.2	0.97	1.16	9.43	4.00	10.7	13.4
Chilli+onion	EC+VC+GLM	12.4	0.99	1.42	9.32	2.00	15.0	6.00
	Panchagavya spray	10.7	0.96	1.39	9.37	3.00	7.00	6.00
	EC+VC+GLM + Panchagavya spray	13.8	1.06	1.53	9.41	2.00	2.00	12.0
	EC+VC+GLM+ Biodynamic spray @5g/ac	10.3	0.99	1.46	8.96	2.00	5.00	12.0
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	11.0	1.01	1.24	8.82	2.00	2.00	8.00
	FYM+VC+GLM	12.3	0.93	1.32	8.91	3.00	1.00	9.00
	Control	8.02	0.85	0.98	7.75	2.00	5.00	5.00
	Mean	11.2	0.97	1.33	8.93	2.29	5.29	8.29
	CD (P=0.05)	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	0.44 NS	0.05 NS	0.02 0.06	0.34 NS			
	Method	0.72 1.46	0.04 0.08	0.05 0.10	0.39 0.79			
	Cropping X Method	1.25 NS	0.07 NS	0.09 NS	0.67 NS			
	Method X Cropping	1.23 NS	0.08 NS	0.09 NS	0.71 NS			

Calicut: Soil pH, OC, available N, P, K, Mn, Zn, Cu and Fe were estimated at the end of the cropping period of ginger and turmeric. No significant change was observed for pH of both the crops due to application of various organic input packages. FYM + NC + VC + RP recorded higher OC in ginger, (2.07%) and turmeric (1.17%). Soil available N was found to be higher in the FYM + BD + RP treatment for ginger and turmeric while, available P was found to be higher in FYM + NC + +2VC + RP treatment for ginger, while in turmeric, it was better in FYM + BD + RP. Higher residual K was recorded with FYM + BD + RP (239 kg ha^{-1}) in turmeric. Among the two crops, organic carbon content was found to be higher in ginger (1.60%) compared to turmeric (1.15%). In ginger, application of different input packages did not contribute for improvement in soil available micronutrients such as Mn, and Fe as it is evident that control recorded higher availability of Fe at the end of cropping period. However, in case of turmeric, FYM + BD + RP registered higher Cu (6.35 ppm) while Mn, Zn, and Fe was higher under FYM + NC + 2VC + PG + BD + RP (10.3, 1.81 and 49.3 ppm respectively).The improvement over control was found to be 33.8, 30.2 and 166% for Mn, Zu and Cu respectively with the combined application of all the inputs over control.

Coimbatore: Organic carbon, available N, P, K and microbial count of fungi, bacteria and actinomycetes were analysed at the end of the cropping cycle. In cotton-maize-green manure system, application of FYM + NEOC @ ½ N each recorded higher OC (0.74%), available N (249 kg ha^{-1}), P (20.8 kg ha^{-1}) while K (758 kg ha^{-1}) was found to be better in FYM + NEOC @ ½ N each + panchagavya. In case of chillies-sunflower-green manure system, FYM + NEOC @ ½ N each was found better for organic carbon and available N (0.70%, 248, kg ha^{-1}) however FYM + NEOC @ ½ N each + panchagavya recorded better for available P and K (21.0 and 648 kg ha^{-1}). Among the two systems, cotton-maize-green manure recorded slightly better residual organic carbon and available soil nutrients. Fungi, bacteria and actinomycetes count was higher in FYM + NEOC @ ½ N each + panchagavya in both the systems. Application of panchagavya or biodynamic packages alone does not increase the microbial population compared to addition of the same with FYM + NEOC.

Dharwad: All the physical and chemical properties of soil along with microbial count was estimated at the end of cropping cycle. Higher bulk density was observed with either panchagavya spray or biodynamic spray @ 12 g ha^{-1} in all the cropping systems. Soil pH and EC did not vary much due to application of different sources of nutrients. Groundnut-sorghum, maize-chickpea and chilli+onion systems recorded higher organic carbon, available N, P and K with application of EC + VC + GLM + panchagavya spray compared to other packages. Among the panchagavya and biodynamic package, combining panchagavya with organic inputs such as EC + VC + GLM was found to be more effective in terms of soil health. Among the three systems, maize-chickpea recorded better residual organic carbon and nutrients. All the micronutrients estimated were also exhibited similar trend as that of macro nutrients by recording higher residual availability with EC + VC + GLM @ 1/3 N each + panchagavya spray. However, irrespective of the cropping systems, microbial count such as fungi, bacteria and actinomycetes was higher in all the treatments which received biodynamic spray. Among the cropping systems, fungi, bacteria and actionmycetes were higher in maize-chickpea (4, 10.7 and 13.4 $x10^4$ CFU/g of soil).

Karjat: Soil pH, EC, OC, available N, P and K were estimated and results reveals that different sources of nutrients did significantly influence the soil pH, organic carbon, available N, P and K. however, in both rice-red pumpkin and rice-cucumber systems, application of FYM + rice straw + glyricidia leaves @ 1/3 N each during *kharif* and FYM + NC + VC @ 1/3 N each during *rabi* with pachagavya during both the seasons recorded higher organic carbon (1.45% in each), N (272 and 276 kg ha^{-1} respectively), residual soil P (19.7 and 25.0 kg ha^{-1} respectively) and K (370 and 396 kg ha^{-1} respectively). Among the two systems also, no significant change in pH, EC, OC and available N was observed.

Ludhiana: Soil pH did not vary significantly with different nutrient sources while EC, organic carbon, soil available N, P and K was highly influenced. In maize-wheat + gram-moong (s), application of FYM + BD recorded 56% increase in organic carbon and 40.4% increase in available N. Application of FYM alone recorded higher availability of residual soil P (64.6%) and K (87%) over control. In basmati rice-wheat-green manure system, an increase of 49% was observed in organic carbon with application of GM+PG to rice and FYM + PG to other crops while, availability of N in soil was higher with GM+PG+BD in the system compared to control. Significantly higher residual P (57.3% increase) and K (118% increase) was observed with application of GM alone to basmati rice and FYM alone to other crops in the same system.

Organic chickpea crop at Ludhiana

Pantnagar: Marginal increase of 5 to 6% in organic carbon was observed with FYM + VC + NC + EC @ ¼ N each + panchagavya+biodynamic spray in basmati rice-chickpea-*sesbania* (green manure) and in basmati rice-vegetable pea-maize+moong (residues incorporation) system. Available N, P and K was also found to be higher under the same treatments in both the systems.

Raipur: Bulk density and EC of soil was found to be higher with biodynamic package in both rice-chickpea and rice-mustard+lentil (alternate row) systems (1.27 and 1.31 g cc^{-1}). No significant variation among different input packages and cropping system was observed in soil pH. However, organic carbon was found to be higher under biodynamic+EC + CDM + NEOC @ 1/3 N each + panchagavya in rice-chickpea (0.66%) and EC + CDM + NEOC@ 1/3 N each + biodynamic package in rice-mustard + lentil (0.63%) system. Soil available N, P, K was not significantly influenced by different input packages in cropping systems. EC + CDM + NEOC@ 1/3 N each with use of biodynamic and panchagavya package registered higher availability of residual N, P and K in soil for both the systems.

Ranchi: Higher availability of N, P and K in soil was observed with the application of VC+KC with use of biodynamic and panchagavya package in both rice-wheat and rice-potato system.

Umiam: Bulk density and soil pH was significantly influenced by application of nutrient sources along with panchagavya and biodynamic preparation. In both the systems (maize + soybean (GM)–toria and maize (green cob)+soybean (GM)-french bean (green pod)), application of FYM+VC+PG recorded higher organic carbon (2.34% each) and higher available nutrients after the harvest of crops. N, P and K was also found to be higher in the same treatment in both system. Panchagavya spray and biodynamic application did increase the OC and nutrients compared to control, but the increase was lower than the combined application of nutrient inputs with panchagavya and biodynamic packages. In the another experiment, FYM + VC @ ½ N each was found to be better for increasing higher OC and nutrients over control in all the systems. The increase in OC was found to be 25% over control in the system involving frenchbean.

General view of organic farming experimental block at Umiam

Nutrient uptake (Table 16-18)

Bajaura: Both coriander-pea-tomato and cauliflower-pea-cauliflower system recorded higher NPK concentration in plants with rock phosphate enriched FYM + VC @ ½ N each as nutrient sources. Application of panchagavya or biodynamic preparation also improved the concentration of NPK in all the crops compared to control. No significant improvement in panchagavya alone was observed with respect to uptake of all the nutrients compared to control. Fe, Mn, Zn and Cu concentration in plants of tomato, coriander, pea and cauliflower in the respective system have also been found higher with rock phosphate enriched FYM + VC @ ½ N each compared to other sources. The increase Fe concentration was found to be 51.1, 52, 11.3 and 24.6% in tomato, coriander, pea and cauliflower respectively.

Dharwad: NPK uptake was found to be significantly higher with application of EC+VC+GLM with panchagavya spray in all three systems. Uptake of all the nutrients compared to control in plants of groundnut, sorghum, maize and chickpea in the respective system have also been found higher with EC+VC+GLM with panchagavya spray. The increase in N uptake over panchagavya and biodynamic packages alone was found to be 74, 12.6, 47.4 and 14.2% groundnut, sorghum, maize and chickpea respectively. Chilli+onian system also registered higher N, P and K uptake with the same package.

Ludhiana: Estimation of NPK uptake in basmati rice indicates, an increase of 48.3% in N and 67% in P uptake was observed with GM+ PG to basmati rice and FYM + PG to other crops, while GM + PG+BD to basmati rice and FYM + PG + BD to other crops recorded higher uptake.

Organic moong crop at Ludhiana

Pantnagar: In both the systems NPK uptake of basmati rice was found to be significantly higher with FYM + VC + NC + EC @ ¼ N each + biodynamic preparation + panchagavya application (92, 17.7 and 94.5 kg ha^{-1} of N, P and K uptake respectively) compared to FYM + VC + NC + EC alone (77.3, 14.2 and 79.2 kg ha^{-1} of NPK uptake respectively). In vegetable pea, application of FYM, VC, NC and EC as nutrient sources along with biodynamic preparation and panchagavya recorded higher N and P uptake (129.4and 25.0 kg ha^{-1}) while K uptake (46.2 kg ha^{-1}) was found to be higher under organic sources along with biodynamic preparation compared to combining the same with either panchagavya or biodynamic preparation. Micronutrient Fe and Zn was also higher with the application of FYM, VC, NC and EC as nutrient sources along with biodynamic preparation (35.3 and 0.94 ppm) in basmati rice.

Raipur: Uptake of NPK was significantly influenced by nutrient sources in rice-chickpea and rice-mustard+lentil systems. Application of EC + CDM + NEOC @ 1/3 N each + biodynamic spray + panchagavya registered significantly higher N, P and K uptake in all the crops in both the systems (77.1, 16.6 and 121 kg ha^{-1} in rice, 66.2, 18.3 and 29.0 kg ha^{-1} in chickpea and 40.7, 7.11 and 44.7 kg ha^{-1} in mustard). Application of biodynamic and panchagavya packages contributed significantly in nutrient uptake compared to application of nutrients sources EC+ CDM + NEOC.

Ranchi: N, P and K uptake were estimated and results reveals that in both the systems uptake of NPK was found to be higher by nutrient sources of VC + KC + biodynamic preparation + panchagavya 109.1, 18.2 and 75.3 kg ha^{-1} in rice, 54.2, 9.8 and 43.0 kg ha^{-1} in wheat and 126.6, 36.2 and 158.2 kg ha^{-1} in potato.

Table 16. Influence of source of nutrients on NPK uptake of different crops

Cropping systems	Treatments	N				P				K			
		Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean
Bajaura													
Coriander-pea-tomato	Rock phosphate enriched FYM + VC (1:1)	0.80	1.68	1.30	1.26	0.37	0.60	0.42	0.46	0.58	0.79	1.28	0.88
	FYM *fb* BD	0.74	1.52	1.29	1.18	0.35	0.57	0.37	0.43	0.54	0.71	1.22	0.82
	Rock phosphate enriched FYM + VC (1:1) *fb* Panchagvya	0.72	1.53	1.30	1.18	0.34	0.51	0.44	0.43	0.55	0.68	1.25	0.83
	FYM *fb* BD *fb* Panchagvya	0.72	1.52	1.25	1.16	0.33	0.52	0.34	0.40	0.53	0.69	1.24	0.82
	Control	0.62	1.15	0.89	0.89	0.28	0.32	0.30	0.30	0.46	0.56	0.98	0.67
	Control with Panchagavya	0.64	1.21	0.93	0.93	0.29	0.34	0.30	0.31	0.49	0.58	0.98	0.68
	Mean	0.71	1.44	1.16		0.33	0.48	0.36		0.53	0.67	1.16	
Cauliflower-pea-cauliflower	Rock phosphate enriched FYM + VC (1:1)	1.67	1.63	1.24	1.51	0.45	0.62	0.53	0.53	0.66	0.80	1.16	0.87
	FYM *fb* BD	1.60	1.53	1.20	1.44	0.41	0.51	0.48	0.47	0.65	0.73	1.09	0.82
	Rock phosphate enriched FYM + VC (1:1) *fb* Panchagvya	1.64	1.43	1.22	1.43	0.39	0.54	0.53	0.49	0.65	0.71	1.11	0.82
	FYM *fb* BD *fb* Panchagvya	1.61	1.50	1.23	1.45	0.40	0.48	0.54	0.47	0.63	0.71	1.12	0.82
	Control	1.49	1.15	0.87	1.17	0.33	0.32	0.35	0.33	0.55	0.58	0.87	0.67
	Control with Panchagavya	1.53	1.13	0.86	1.17	0.33	0.33	0.39	0.35	0.55	0.60	0.90	0.68
	Mean	1.59	1.40	1.10		0.39	0.47	0.47		0.61	0.69	1.04	
	CD (P=0.05)	SEm CD	SEm CD	SEm CD		SEm CD	SEm CD	SEm CD		SEm CD	SEm CD	SEm CD	
	Cropping	0.00 0.01	0.01 0.02	0.02 NS		0.01 0.05	0.01 NS	0.01 0.04		0.003 0.017	0.01 NS	0.01 0.06	
	Source	0.01 0.02	0.02 0.04	0.02 0.04		0.01 0.02	0.02 0.03	0.02 0.03		0.006 0.016	0.02 0.03	0.02 0.03	
	Cropping X Source	0.01 NS	0.03 NS	0.03 NS		0.02 NS	0.02 NS	0.02 0.05		0.008 0.023	0.02 NS	0.02 NS	
	Source X Cropping	0.01 NS	0.03 NS	0.03 NS		0.02 NS	0.02 NS	0.02 0.05		0.008 0.026	0.02 NS	0.02 NS	

Cropping systems	Treatments	N			P			K		
		Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
Dharwad										
Groundnut-sorghum	EC+VC+GLM	173	130.5		39.7	29.6		140	114.3	
	Panchagavya spray	130	120.8		25.6	21.3		122	72.5	
	EC+VC+GLM + Panchagavya spray	227	136.0		48.2	37.1		197	123.5	
	EC+VC+GLM+ Biodynamic spray @5g/ac	153	116.7		26.0	20.5		110	70.9	
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	167	119.4		31.1	21.1		137	74.3	
	FYM+VC+GLM	150	116.9		34.3	25.8		109	102.9	
	Control	120	103.7		21.5	13.7		76.4	58.4	
	Mean	160	120.6		32.3	24.2		127	88.1	
Maize-chickpea	EC+VC+GLM	224	127.6		47.1	17.5		178	62.3	
	Panchagavya spray	171	115.1		37.3	15.6		140	49.3	
	EC+VC+GLM + Panchagavya spray	252	131.4		55.4	20.9		189	65.1	
	EC+VC+GLM+ Biodynamic spray @5g/ac	171	100.1		39.9	16.2		135	48.5	
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	196	110.3		41.2	15.9		147	50.4	
	FYM+VC+GLM	219	109.5		43.8	15.2		150	52.9	
	Control	131	74.6		27.5	9.7		115	31.6	
	Mean	195	109.8		41.7	15.9		151	51.4	
Chilli+onion	EC+VC+GLM	30.2			7.60			25.6		
	Panchagavya spray	26.1			5.90			22.1		
	EC+VC+GLM + Panchagavya spray	32.4			8.40			26.9		

Cropping systems	Treatments		N			P			K		
			Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
	EC+VC+GLM+ Biodynamic spray @5g/ac		25.2			5.10			21.1		
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray		27.3			6.20			20.5		
	FYM+VC+GLM		28.6			6.40			21.6		
	Control		20.4			4.30			15.6		
	Mean		27.8			6.27			21.9		
			SEm	CD	SEm CD	SEm	CD	SEm CD	SEm	CD	SEm CD
	Cropping		8.44	23.4	0.29 1.77	0.75	2.10	0.99 6.02	2.79	7.75	2.09 12.7
	Source		7.28	14.8	3.36 9.80	1.67	3.38	1.63 4.77	4.44	9.00	3.52 10.3
	Cropping X Source		12.6	25.6	4.75 NS	2.89	5.86	2.31 NS	7.69	15.6	4.97 14.5
	Source X Cropping		14.4	32.9	4.41 NS	2.78	5.79	2.36 NS	7.65	16.3	5.05 17.5
Ludhiana											
Maize-wheat+ gram-summer moong	Basmati Rice	Other crops									
	GM	FYM	175			66.5			138		
	GM+PG	FYM+PG	186			68.5			116		
	GM+BD	BD	111			46.0			78.8		
	GM+BD+ FYM	FYM+BD	179			60.6			125		
	GM+PG+ BD	FYM+PG+ BD	184			68.3			128		
	Control	Control	43.4			17.7			28.3		
	Mean										
Basmati rice- wheat- green manure	GM	FYM	79.7			13.2			88.3		
	GM+PG	FYM+PG	87.2			14.2			103		
	GM+BD	BD	80.3			13.3			95.0		
	GM+BD+ FYM	FYM+BD	84.0			14.0			101		

Cropping systems	Treatments		N			P			K		
			Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
	GM+PG+ BD	FYM+PG+ BD	86.6			15.2			105		
	Control	Control	58.8			9.10			69.7		
	Mean										
	CD (P=0.05)		SEm	CD		SEm	CD		SEm	CD	
	Cropping		10.6	45.7		9.06	39.0		15.0	NS	
	Source		8.78	18.3		5.18	10.8		10.6	22.0	
	Cropping X Source		12.4	25.9		7.32	15.3		15.0	31.2	
	Source X Cropping		15.5	48.5		11.3	39.6		20.3	67.1	
Pantnagar											
Basmati rice-chickpea-sesbania (green manure)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)		78.8			14.5			84.3		
	Biodynamic (BD)		70.5			10.8			69.2		
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ Panchgavya		81.5			17.0			95.9		
	FYM+VC+NC+EC 1/4+1/4+1/4+1/4)+BD		90.6			16.9			85.9		
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ BD+Panchgavya		97.8			17.6			101.3		
	T6=Control		65.9			14.4			63.6		
	Mean		80.9			15.2			83.4		
Basmati rice-vegetable pea-maize+moong (moong residues incorporation)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)		75.8	127.4		13.8	16.8		74.0	43.1	
	Biodynamic (BD)		52.3	65.4		9.9	12.6		52.9	27.3	
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ Panchgavya		83.0	115.2		17.7	20.7		85.3	42.3	

Cropping systems	Treatments	N			P			K		
		Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
	FYM+VC+NC+EC 1/4+1/4+1/4+1/4)+BD	79.1	125.9		16.3	20.7		86.1	46.2	
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ BD+Panchgavya	86.2	129.4		14.1	25.0		89.5	38.9	
	T6=Control	65.9	77.2		10.2	13.8		50.0	26.8	
	Mean	73.7	106.7		13.7	18.3		73.0	37.5	
	CD (P=0.05)	SEm CD	SEm CD		SEm CD	SEm CD		SEm CD	SEm CD	
	Cropping	0.14 0.83			0.46 2.80			1.60 9.75		
	Source	1.89 5.57	6.6 20.8		0.75 2.22	1.80 5.67		2.26 6.67	2.30 7.24	
	Cropping X Source	2.67 7.87			1.07 NS			3.20 NS		
	Source X Cropping	2.44 7.22			1.08 NS			3.33 NS		
Raipur										
Rice-chickpea	EC+CDM+NEOC @ 1/3 N each	68.7	60.8		14.9	16.9		113	28.1	
	Bio dynamic practice	39.5	37.2		8.17	9.87		68.3	16.7	
	EC+CDM+NEOC @1/3Neach+ Panchagavya	75.6	54.7		17.0	15.3		118	24.6	
	EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice	69.4	50.0		15.7	14.9		120	23.4	
	Biodynamicpractice+ EC+CDM+NEOC @1/3Neach+ Panchagavya	80.9	66.2		17.3	18.3		122	29.0	
	Mean									
Rice-mustard+ lentil (alternate row)	EC+CDM+NEOC @ 1/3 N each	64.1	35.2		14.6	6.66		106	40.3	
	Bio dynamic practice	34.3	24.9		7.94	4.47		58.9	29.5	
	EC+CDM+NEOC @1/3Neach+ Panchagavya	37.4	35.5		14.8	6.74		109	40.0	

Cropping systems	Treatments	N			P			K		
		Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
	EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice	37.7	38.2		15.6	6.82		114	41.1	
	Biodynamicpractice+ EC+CDM+NEOC @1/3Neach+ Panchagavya	73.2	40.7		15.9	7.11		120	44.7	
	Mean									
	Cd (P=0.05)	SEm CD	SEm CD		SEm CD	SEm CD		SEm CD	SEm CD	
	Cropping	3.13 NS	1.00 4.32		0.79 NS	0.76 3.28		3.37 NS	1.49 6.39	
	Source	2.31 4.89	2.59 5.49		0.69 1.46	0.66 1.39		3.17 6.71	2.31 4.90	
	Cropping X Source	3.26 NS	3.66 7.76		0.98 NS	0.93 1.96		4.48 NS	3.27 NS	
	Source X Cropping	4.28 NS	3.42 7.90		1.18 NS	1.13 3.52		5.23 NS	3.28 NS	
Ranchi										
Rice-wheat	50% VC+50% KC	93.40	47.0		16.10	8.50		65.1	38.3	
	BD Preparation (CPP,BD500 & 501)	52.40	23.1		7.50	3.93		37.7	22.2	
	VC + K.C+ Panchagavaya	97.70	49.3		16.40	8.65		66.9	39.5	
	VC + K.C+ BD Prepartion	101.30	51.9		18.10	9.02		69.2	40.4	
	:VC + K.C+ BD Prepartion + Panchagavya	107.30	54.2		19.00	9.81		74.0	43.0	
	Mean									
Rice-potato	50% VC+50% KC	98.90	121.9		16.10	33.96		67.8	150.8	
	BD Preparation (CPP,BD500 & 501)	55.30	49.0		8.70	13.37		38.5	61.5	
	VC + K.C+ Panchagavaya	101.80	123.1		17.20	35.25		70.7	154.0	
	VC + K.C+ BD Prepartion	105.80	124.7		18.20	35.51		73.9	155.4	
	VC + K.C+ BD Prepartion + Panchagavya	110.90	126.6		17.40	36.15		76.5	158.2	
	Mean									

Table 17. Influence of source of nutrients on Fe & Mn uptake of different crops at various locations

Cropping systems	Source of nutrient	Fe				Mn			
		Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean
Bajaura									
Coriander-pea-tomato	Rock phosphate enriched FYM + VC (1:1)	544	276	399	406	83	79	139	101
	FYM fb BD	538	272	390	400	82	75	141	99
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya	542	273	381	399	81	73	139	98
	FYM fb BD fb Panchagvya	535	271	379	395	83	72	139	98
	Control	358	248	264	290	55	61	88	68
	Control with Panchagavya	362	248	265	292	57	60	91	69
	Mean	480	265	346		74	70	123	
Cauliflower-pea-cauliflower	Rock phosphate enriched FYM + VC (1:1)	436	277	348	354	77	81	143	100
	FYM fb BD	436	271	340	349	74	77	140	97
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya	431	274	341	349	75	72	138	95
	FYM fb BD fb Panchagvya	430	275	336	347	73	73	138	95
	Control	350	245	226	274	45	60	83	63
	Control with Panchagavya	352	249	228	276	48	62	85	65
	Mean	406	265	303		65	71	121	
	CD (P=0.05)	SEm± CD	SEm± CD	SEm± CD		SEm± CD	SEm± CD	SEm± CD	
	Cropping	0.25 1.10	0.43 NS	1.23 5.41		0.19 0.81	0.55 NS	0.28 1.20	
	Source	1.41 2.93	1.83 3.82	2.48 5.12		1.22 2.54	1.10 2.30	2.68 5.60	
	Cropping X Source	1.99 4.14	2.59 NS	3.51 7.32		1.72 NS	1.56 NS	3.80 NS	
	Source X Cropping	1.83 4.00	2.40 NS	3.44 8.20		1.58 NS	1.53 NS	3.48 NS	

Cropping systems	Source of nutrient	Fe			Mn		
		Kharif	Rabi	Summer	Kharif	Rabi	Summer
Pantnagar							
Basmati rice–chickpea–sesbania (green manure)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)				32.8		5.88
	Biodynamic (BD)				30.1		4.87
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ Panchgavya				32.6		5.09
	FYM+VC+NC+EC 1/4+1/4+1/4+1/4)+BD				34.0		5.28
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+ Panchgavya				32.4		4.95
	T6=Control				29.4		4.45
	Mean				31.9		5.09
Basmati rice – vegetable pea – maize+moong (moong residues incorporation)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)				32.1		7.57
	Biodynamic (BD)				33.4		4.53
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ Panchgavya				32.8		5.43
	FYM+VC+NC+EC 1/4+1/4+1/4+1/4)+BD				36.5		5.44
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+ Panchgavya				34.3		5.30
	T6=Control				32.6		5.29
	Mean				33.6		5.59
					SEm±	CD	SEm± CD
	Cropping				0.40	2.44	0.01 0.04
	Source				0.56	1.67	0.10 0.31
	Cropping X Source				0.80	NS	0.15 0.43
	Source X Cropping				0.83	NS	0.13 0.40

Table 18. Influence of source of nutrients on Zn & Cu uptake of different crops at various locations

Cropping systems	Source of nutrient	Fe				Mn			
		Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean
Bajaura									
Coriander-pea-tomato	Rock phosphate enriched FYM + VC (1:1)	32.9	37.0	73.7	47.9	29.8	25.4	44.7	33.3
	FYM fb BD	31.6	31.7	71.3	44.9	25.2	23.4	38.0	28.9
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya	32.8	32.8	67.0	44.2	24.9	24.0	42.3	30.4
	FYM fb BD fb Panchagvya	29.4	32.4	69.7	43.8	23.3	23.9	38.0	28.4
	Control	17.4	24.9	43.0	28.4	14.4	15.7	29.0	19.7
	Control with Panchagavya	17.2	21.0	46.3	28.2	13.9	14.6	29.7	19.4
	Mean	26.9	30.0	61.8		21.9	21.2	37.0	
Cauliflower-pea-cauliflower	Rock phosphate enriched FYM + VC (1:1)	35.0	41.3	77.0	51.1	31.9	29.9	44.3	35.4
	FYM fb BD	31.0	37.2	73.7	47.3	26.5	24.5	38.0	29.7
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya	33.2	36.5	73.0	47.6	26.2	26.7	41.7	31.5
	FYM fb BD fb Panchagvya	28.6	34.0	73.0	45.2	23.4	24.7	39.3	29.1
	Control	15.8	23.8	43.7	27.8	13.1	19.1	27.0	19.7
	Control with Panchagavya	16.9	22.2	47.7	28.9	13.6	18.2	28.7	20.2
	Mean	26.8	32.5	64.7		22.5	23.9	36.5	
	CD (P=0.05)	SEm± CD	SEm± CD	SEm± CD		SEm± CD	SEm± CD	SEm± CD	
	Cropping	0.42 NS	0.41 1.76	0.63 2.71		0.12 0.50	0.30 1.28	0.70 NS	
	Source	1.18 2.47	1.63 3.40	1.58 3.29		1.11 2.32	0.71 1.47	1.39 2.90	
	Cropping X Source	1.67 NS	2.30 NS	2.23 NS		1.57 NS	0.10 NS	1.97 NS	
	Source X Cropping	1.58 NS	2.14 NS	2.13 NS		1.44 NS	0.96 NS	1.92 NS	
Pantnagar									
Basmati rice – chickpea – sesbania (green manure)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)	0.71				1.12			

Cropping systems	Source of nutrient	Fe			Mn		
		Kharif	Rabi	Summer	Kharif	Rabi	Summer
	Biodynamic (BD)	0.72			0.88		
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+Panchgavya	0.79			1.14		
	FYM+VC+NC+EC 1/4+1/4+1/4+1/4)+BD	0.90			1.07		
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+ Panchgavya	0.83			1.02		
	T6=Control	0.77			1.04		
	Mean	0.79			1.05		
Basmati rice – vegetable pea – maize+ moong (moong residues incorporation)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)	1.15			0.89		
	Biodynamic (BD)	0.81			0.71		
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ Panchgavya	0.91			0.81		
	FYM+VC+NC+EC 1/4+1/4+1/4+1/4)+BD	0.87			0.69		
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ BD+Panchgavya	0.97			1.00		
	T6=Control	0.67			0.83		
	Mean	0.90			0.82		
	CD (P=0.05)	SEm±	CD		SEm±	CD	
	Cropping	0.03	0.18		0.016	0.097	
	Source	0.03	0.07		0.020	0.060	
	Cropping X Source	0.04	0.11		0.029	0.085	
	Source X Cropping	0.04	0.19		0.031	0.117	

Quality parameters (Table 19)

Protein content of ground nut, maize and chilli was estimated for all the crops in *kharif* at Dharwad. Significant variation among different organic input packages and cropping system was observed. Protein content was found to be higher with EC+VC+GLM with panchagavya spray in ground nut (21.8%) and maize (13.1%) while in chilli, FYM+VC+GLM performed better (9.27%). The increase in protein was 74.4% in the groundnut and 24.8 in maize over control.

Table 19. Influence of source of nutrients on quality parameters of different crops at Dharwad in kharif

Cropping systems	Source of nutrients	Protein	
Groundnut-sorghum	EC+VC+GLM	19.1	
	Panchagavya spray	18.1	
	EC+VC+GLM + Panchagavya spray	21.8	
	EC+VC+GLM+ Biodynamic spray @5g/ac	18.3	
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	14.4	
	FYM+VC+GLM	19.1	
	Control	12.5	
Maize-chickpea	EC+VC+GLM	10.9	
	Panchagavya spray	10.2	
	EC+VC+GLM + Panchagavya spray	13.1	
	EC+VC+GLM+ Biodynamic spray @5g/ac	8.20	
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	9.00	
	FYM+VC+GLM	11.6	
	Control	10.5	
Chilli+onion	EC+VC+GLM	8.47	
	Panchagavya spray	8.43	
	EC+VC+GLM + Panchagavya spray	8.83	
	EC+VC+GLM+ Biodynamic spray @5g/ac	7.23	
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	7.33	
	FYM+VC+GLM	9.27	
	Control	9.23	
	CD (P=0.05)	SEm±	CD
	Cropping	0.62	1.73
	Source	0.70	1.43
	Cropping X Source	1.22	2.47
	Source X Cropping	1.29	2.84

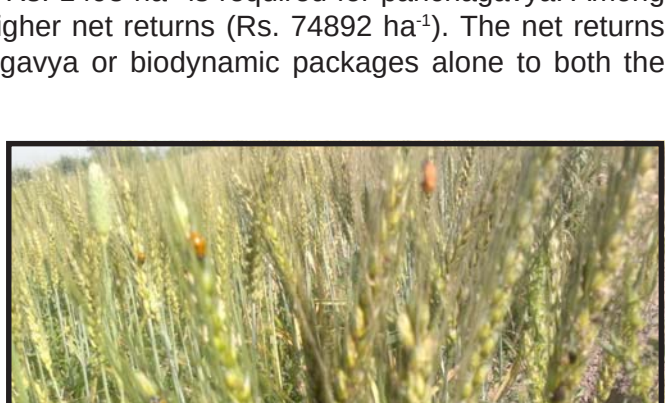
Economics of nutrient sources and cropping systems (Table 20)

Bajaura: Application of rock phosphate enriched FYM + vermicompost @ 1:1 ratio to coriander-tomato-pea system recorded higher gross returns of Rs. 2,02,304 ha^{-1} which is 294% higher than control (panchagavya alone). Net returns (Rs. 1,28,235 ha^{-1}) and B: C ratio (1.73) was also higher in the same treatment thought cost of cultivation was 96% higher compared to panchagavya alone. Application of FYM followed by biodynamic spray in cauliflower-pea-cauliflower system recorded higher net returns (Rs. 1,95,117 ha^{-1}) and B: C ratio (2.71). Among the cropping system around 160% increase in net returns and 61% increase in B:C ratio of cauliflower-pea-cauliflower was observed over tomato-coriander-pea system.

Coimbatore: Application of FYM+ NEOC @ ½ N each with panchagavya to cotton-maize-green manure and chilli-sunflower-green manure recorded higher net returns (Rs. 45,421 ha^{-1} and Rs. 44,917 ha^{-1} in both the systems respectively) though this treatment recorded 6.2% higher cost than FYM + NEOC@ ½ N each alone. Among the two systems, chilli-sunflower-green manure recorded 7.6% higher net returns than other systems. Application of panchagavya package alone recorded lower net returns among all the treatments.

Dharwad: Application of EC + VC+ GLM + biodynamic spray @ 12 g ha^{-1}+ panchagavya spray resulted in higher gross and net returns with B:C ratio due to lower cost of cultivation in groundnut-sorghum, maize-chickpea and chilli +onion system. The increase in net returns over control was found to be 56 and 76% in groundnut-sorghum and maize-chickpea systems respectively due to combined application of panchagavya and biodynamic spray along with other organic inputs such as EC, VC and GLM. Among the three cropping systems, groundnut-sorghum registered 130 and 70.5% higher net returns over maize-chickpea and chilli+ onion systems.

Jabalpur: Among the various sources of nutrients, application of VC+ FYM+ NEOF @ 1/3 N each + panchagavya was found to give higher net returns (Rs. 95,678 and 85,008 ha^{-1}) and B: C ratio (2.42 and 2.25) in basmati rice-wheat-green manure and basmati rice-berseem systems. Though, marginal increase in cost of cultivation due to panchagavya was observed in this treatment, due to increase in yield net returns and B: C ratio was better. Additional cost of Rs. 1493 ha^{-1} is required for panchagavya. Among the two systems, basmati rice-berseem recorded higher net returns (Rs. 74892 ha^{-1}). The net returns and B: C ratio was lower in application of panchagavya or biodynamic packages alone to both the systems.



Lady bird beetles in organic wheat at Ludhiana

Ludhiana: Application of green manure to basmati rice and FYM to other crops in the maize-wheat+gram-summer moong and basmati-wheat-green manure system was found to be better in terms of gross returns, net returns and B: C ratio compared to application of panchagavya and biodynamic packages along with green manure and FYM. The increase in net returns was found to be 8.1 and 2.4% over control in these systems respectively. Although gross returns of basmati rice-wheat-green manure system was higher in GM +PG +BD for basmati rice and FYM +PG +BD for other crops, it was closely followed by GM+ FYM +biodynamic combination. Among the systems, basmati rice-wheat-green manure recorded 7.5 and 21.3% higher net returns and B: C ratio than maize-wheat+ gram-summer moong.

Pantnagar: Application of biodynamic package and panchagavya along with FYM +VC +NC +EC @ ¼ N each registered 11.0 and 12.0% higher gross returns in basmati rice-chickpea-sesbania (green

Table 20. Influence of source of nutrients on economics of different cropping systems

Cropping system	Source of nutrient	Gross returns (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
Bajaura					
Coriander-pea-tomato	Rock phosphate enriched FYM + VC (1:1)	202304	74069	128235	1.73
	FYM *fb* BD	179793	71421	108371	1.52
	Rock phosphate enriched FYM + VC (1:1) *fb* Panchagvya	192902	80772	112129	1.39
	FYM *fb* BD *fb* Panchagvya	179646	78124	101522	1.30
	Control	43065	31075	11990	0.39
	Control with Panchagavya	51343	37778	13565	0.36
	Mean	141509	62207	79302	1.12
Cauliflower-pea-cauliflower	Rock phosphate enriched FYM + VC (1:1)	258854	76699	182156	2.37
	FYM *fb* BD	267063	71946	195117	2.71
	Rock phosphate enriched FYM + VC (1:1) *fb* Panchagvya	246354	83402	162953	1.95
	FYM *fb* BD *fb* Panchagvya	244638	78649	165989	2.11
	Control	49346	27825	21521	0.77
	Control with Panchagavya	64563	34528	30035	0.87
	Mean	188470	62175	126295	1.80
Coimbatore					
Cotton-maize-green manure	FYM + NEOC (1/2+1/2)	95562	50451	45111	0.89
	Panchagavya alone	63006	35478	27528	0.78
	FYM+NEOC*(1/2+1/2)+ Panchagavya	99299	53878	45421	0.84
	Biodynamic Practices	70165	38628	31537	0.82
	BiodynamicPractices+ Panchagavya	77390	40653	36737	0.90
	Mean	81084	43818	37267	0.85
Chillies-sunflower-green manure	FYM + NEOC (1/2+1/2)	95532	51322	44210	0.86
	Panchagavya alone	76074	40425	35649	0.88
	FYM+NEOC*(1/2+1/2)+ Panchagavya	99162	54245	44917	0.83
	Biodynamic Practices	76860	40696	36164	0.89
	BiodynamicPractices+ Panchagavya	85578	45658	39920	0.87
	Mean	86641	46469	40172	0.87

Cropping system	Source of nutrient	Gross returns (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
Dharwad					
Groundnut-sorghum	EC+VC+GLM	150394	29777	120617	4.05
	Panchagavya spray	122670	28706	93964	3.27
	EC+VC+GLM + Panchagavya spray	162696	31315	131381	4.20
	EC+VC+GLM+ Biodynamic spray @5g/ac	156862	27620	129242	4.68
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	172973	28606	144367	5.05
	FYM+VC+GLM	147665	30088	117578	3.91
	Control	117386	24818	92568	3.73
	Mean	147235	28704	118531	4.13
Maize-chickpea	EC+VC+GLM	84558	31625	52933	1.67
	Panchagavya spray	74469	28375	46094	1.62
	EC+VC+GLM + Panchagavya spray	90290	33430	56860	1.70
	EC+VC+GLM+ Biodynamic spray @5g/ac	85753	28498	57255	2.01
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	92771	29400	63371	2.16
	FYM+VC+GLM	79425	32028	47398	1.48
	Control	62307	26244	36063	1.37
	Mean	81368	29943	51425	1.72
Chilli+onion	EC+VC+GLM	98749	20838	77912	3.74
	Panchagavya spray	69255	20724	48531	2.34
	EC+VC+GLM + Panchagavya spray	107296	20848	86448	4.15
	EC+VC+GLM+ Biodynamic spray @5g/ac	106936	20116	86820	4.32
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	108336	20836	87500	4.20
	FYM+VC+GLM	88315	22237	66077	2.97
	Control	48504	15286	33218	2.17
	Mean	89627	20126	69501	3.41
Jabalpur					
Basmati rice-D. wheat-green manure	VC+FYM+NEOF @1/3 N each	155265	65096	90169	1.39

Cropping system	Source of nutrient		Gross returns (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
	Panchgavya alone		124400	62584	61816	0.99
	VC+FYM+NEOF@1/3N each +Panchgavya		162875	67197	95678	1.42
	Biodynamic practices		117775	61685	56090	0.91
	Biodynamic practices + Panchgavya		134280	63995	70285	1.10
	Mean		138919	64111	74808	1.16
Basmati rice-berseem	VC+FYM+NEOF @1/3 N each		148565	66734	81831	1.23
	Panchgavya alone		132407	63636	68771	1.08
	VC+FYM+NEOF @1/3 N each +Panchgavya		153235	68227	85008	1.25
	Biodynamic practices		127702	62719	64983	1.04
	Biodynamic practices + Panchgavya		138200	64332	73868	1.15
	Mean		140022	65130	74892	1.15
Ludhiana						
Maize-wheat+ gram-summer moong	Basmati rice	Other crops				
	GM	FYM	177730	63400	114330	1.80
	GM+PG	FYM+PG	172817	66525	106292	1.60
	GM+BD	BD	120188	59270	60918	1.03
	GM+BD+FYM	FYM+BD	175415	66400	109015	1.64
	GM+PG+BD	FYM+PG+BD	175260	69525	105735	1.52
	Control	Control	68883	56270	12613	0.22
	Mean		148382	63565	84817	1.30
Basmati rice-wheat-green manure	GM	FYM	156603	46975	109628	2.33
	GM+PG	FYM+PG	156825	52375	104450	1.99
	GM+BD	BD	129513	52875	76638	1.45
	GM+BD+FYM	FYM+BD	157593	53412	104181	1.95
	GM+PG+BD	FYM+PG+BD	159532	52475	107057	2.04
	Control	Control	89285	44075	45210	1.03
	Mean		141559	50365	91194	1.80
Pantnagar						
Basmati rice-Chickpea-*Sesbania* (green manure)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)		236369	53652	182717	3.40
	Biodynamic (BD)		178067	53415	124652	2.34

Cropping system	Source of nutrient	Gross returns (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+Panchgavya	251278	54142	197136	3.64
	FYM+VC+NC+EC 1/4+1/4+1/4+1/4)+BD	239000	54152	184848	3.41
	FYM+VC+NC+EC (1/4+1/4+ 1/4+1/4)+BD+Panchgavya	262076	54152	207924	3.84
	T6=Control	174821	48161	126660	2.63
	Mean	223602	52946	170656	3.21
Basmati rice-vegetable pea-maize+moong (moong residues incorporation)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)	186732	82653	104079	1.26
	Biodynamic (BD)	96543	80901	15642	0.19
	FYM+VC+NC+EC (1/4+1/4+ 1/4+1/4)+Panchgavya	193243	81887	111356	1.36
	FYM+VC+NC+EC 1/4+1/4+1/4+1/4)+BD	183304	82590	100714	1.22
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+ Panchgavya	209055	83728	125327	1.50
	T6=Control	97810	71307	26503	0.37
	Mean	161114	80511	80603	0.98
Ranchi					
Rice-wheat	50% VC+50% KC	110695	55939	54756	0.98
	BD Preparation (CPP, BD500 & 501)	62988	28923	34065	1.18
	VC + K.C+Panchagavaya	115654	58139	57515	0.99
	VC + K.C+ BD Prepartion	120757	58539	62218	1.06
	VC + K.C+ BD Prepartion + Panchagavya	126968	62539	64429	1.03
	Mean	107412	52816	54597	1.05
Rice-potato	50% VC+50% KC	195933	84236	111697	1.33
	BD Preparation (CPP, BD500 & 501)	93517	53918	39598	0.73
	VC + K.C+Panchagavaya	199025	88236	110789	1.26
	VC + K.C+ BD Prepartion	202592	86836	115755	1.33
	VC + K.C+ BD Prepartion + Panchagavya	207742	90836	116905	1.29
	Mean	179762	80812	98949	1.19

manure) and basmati rice-vegetable pea-maize+moong (residues in corporation) systems respectively compared to FYM +VC +NC +EC alone. In the first system, B:C ratio was higher (3.84) in FYM +VC +NC +EC @ ¼ N each+biodynamic package and panchagavya spray owing to higher gross return (Rs. 2,62,076 ha^{-1}) but lower cost of cultivation (Rs. 54152 ha^{-1}) which was closely followed in biodynamic spray alone with FYM+VC+NC+EC@1/4 N each (Rs. 2,39,000 ha^{-1} 54152 ha^{-1} and 3.41 of gross return, cost of cultivation and B:C ratio respectively). However, in the later system, FYM +VC +NC +EC either with panchagavya alone or panchagavya + biodynamic package recorded the higher B: C ratio (2.36 and 2.50) compared to control and biodynamic package alone. Basmati rice-chickpea-*sesbania* (green manure) was found to be better by 39, 112 and 62% in terms of gross, net returns and B: C ratio respectively compared to basmati rice-vegetable pea-maize + moong (moong residues incorporation).

Ranchi: The gross and net returns (Rs. 1,26,968 and 64,429 ha^{-1} respectively) were higher with VC+ KC + BD preparation + panchagavya in rice-wheat system. However, higher B: C ratio of 1.34 was recorded with BD preparation (CPP, BD 500 &501) alone owing to its lower cost of cultivation (Rs. 28923 ha^{-1}). In rice-potato system, though VC + KC +BD preparation + panchagavya recorded higher gross returns of Rs 2,07,742 ha^{-1} net returns and B: C ratio was better in VC + KC +BD preparation (Rs. 1,16,905 ha^{-1} and 1.48 respectively) even though cost of cultivation was lower in application of BD preparation alone. Among the systems, rice-potato recorded 67.4, 81 and 26% higher gross, net returns and B: C ratio, though cost of cultivation was 53% more compared to rice-wheat system.

7.3 Evaluation of Pest and disease management package for organic farming

Title of the experiment: Pest and disease management in cropping system under organic farming.

Objective: To study the effect of organic and integrated pest management strategies on pest population, natural enemy complex, microbial population, yield and economics.

Year of start: Varied from centre to centre. Experiment was started in 2004-05 at Coimbatore, Raipur, Karjat, Ludhiana and Bajaura, 2005-06 at Jabalpur, Calicut and Dharwad and in 2007-08 at Modipuram and Umiam.

Treatments: There are no common treatments for all the centres, but they varied from location to location. The number of cropping system tested varied from 1 to 2. The details of treatments are given in Table 21-25 along with experimental results. The first summer ploughing and green manures were evaluated only at Modipuram. The centre wise data on yield, pest and disease infestation, soil properties and economics are presented in table 21-25 and results are given below.

Results

Bajaura (Table 22, 24 and 25)

Cauliflower-pea-tomato system was tested under different pest and disease management packages involving leaf extracts, natural products and bio control agents like *Bacillus thuringiensis* under different combinations. Infestation of pest and diseases like fruit borer, fruit rot and other factors were assessed in tomato apart from recording yield loss due to these factors in different treatments. Yield of all the crops in the system have also been recorded. Infestation of fruit borer and fruit rot in tomato was lower in application of Lipel (*Bacillus thuringiensis* sub sp. kurstaki) @ 1 kg ha^{-1}. Incidence of other factors (pests and diseases) was lower in *Metarhizium anisopliae* @ 2g per litre of water + Tween -80 (0.05%) as emulsifier applied. The same trend was observed in yield loss in tomato also. Lower yield loss due to fruit borer was observed with application of Lipel (*Bacillus thuringiensis* sub sp. kurstaki) @ 1.0 kg ha^{-1} (1.63%). The yield loss due to fruit rot ranged from 21.9 to 28.7% in various treatments and no significant variation was observed among the different treatments. Lower yield loss of 15.8% was observed with other pest and diseases factors under *Metarhizium anisopliae* @ 2g per litre of water+Tween -80 (0.05%) as emulsifier. Though fruit borer and fruit rot of tomato was lower with Lipel (*Bacillus thuringiensis* sub sp. kurstaki) @ 1 kg ha^{-1}, yield loss due to other factors of pest and diseases was more (18.2%) as a consequence of higher incidence (16%) of other pest & disease. Significant difference in yield of pea was observed among the different treatments as the yield difference between best performing treatment Margersom (*Azedarachtin* 1%) @ 1 ml/l 8944 kg ha^{-1}) and least performing treatment of Lipel (*Bacillus thuringiensis* sub sp. kurstaki) @ 1 kg/ha in *Kharif*, and Darek (*M. azedarach* (2.5% ALE) + Karvi (*Roylea cinerea*) @ 2.5% ALE + cow urine (3%) (7641 kg ha^{-1}) in *rabi* was only 1303 kg ha^{-1}. Compared to control, higher tomato yield of 10597 kg ha^{-1} was realized with application of Lipel (*Bacillus thuringiensis* sub sp. kurstaki) @ 1 kg/ha in *Kharif* and Darek (*M. azedarach* (2.5% ALE) + karvi (*Roylea cinerea*) @ 2.5% ALE + cow urine (3%) as this particular treatment recorded lower incidence of all (fruit borer: 1.63%, other factors 18.2%) and yield loss due to fruit borer, fruit rot and other factors were also less. Bhang (*Cannabis sativa*) 10% ALE+cow urine (3%)+Tween -80 (0.05%) as emulsifier in *kharif* and kaner (*Nerium sp*.) (5%)+ cow urine (3%) in *rabi* also recorded better tomato yield of 10448 kg ha^{-1} compared to other combinations of pest and diseases management packages. Higher gross return of Rs. 1,67,700 ha^{-1} was recorded with application of margosom (*Azodarachtin* 1%) @ 1 ml/l during *rabi* which is 28.4 higher than gross returns obtained from absolute control. Performance of mixture of derisom (2% EC) @ 2 ml/l and Ha NPV (*Helicide*) @ 0.5ml/l during *khrif* and Darek (*Meliaazedarach*) @ 5% ASE + cow urine

(3%) was also found to better as it also recorded increase in gross returns to the tune of 22% over untreated check (control).

Calicut (Table 22 and 24)

Rhizome rot infestation in ginger and yield of ginger and turmeric were recorded with six treatments comprising of IISR 6, 8, 13, 51, 151 and Pb_{21}+P_1AR_6 cultures, ginger endophytic bacteria and rhizobacteria combinations were tested along with absolute control. Rhizome rot infestation in ginger was lower with ginger endophytic bacteria (GEB) 18 and IISR 6, 51,853, Pb21 and P1AR6 cultures and ginger rhizobacteria (GRB 58) compared to absolute control.

Experimental crop of Turmeric at Calicut

The reduction in infestation was observed to be 68.2, 64.6 and 59.2% respectively. Significantly higher rhizome yield of ginger and turmeric was observed with ginger endophytic bacteria GEB 17 (7250 and 8150 kg ha^{-1} respectively) which was at par with GRB 58 application in ginger. Owing to higher infestation of rhizome rot in ginger with GRB 57 application, lower yield of 3200 kg ha^{-1} was recorded which is 24% lower than absolute control. However, in turmeric absolute control recorded the lower yield (4600 kg ha^{-1}).

Modipuram (Table 21, 24 25)

Four management packages *viz.*, summer ploughing treated and untreated, green manure treated and untreated were evaluated in basmati rice-chickpea and basmati rice-mustard systems. The results reveal that summer ploughing and green manure treated plots recorded higher grain yield of basmati rice (3450 and 3860 kg ha^{-1}respectively) chick pea (963 and 1297 kg ha^{-1}) and mustard (772 and 977 kg ha^{-1}) compared to untreated plots of summers ploughing and green manure. Net returns of basmati rice-chickpea system was higher in green manure untreated (Rs. 53,117 ha^{-1}) followed by summer ploughing treated (Rs. 52,607 ha^{-1}). The green manure treated plots recorded lower net returns in both systems.

In the second set of treatments, six treatments comprising of organic inputs such as FYM, vermicompost along with biodynamic preparation and panchagavya spray was evaluated besides control in basmati rice-wheat and maize+ cowpea-wheat +mustard system. The results reveals that application of FYM+vermicompost with biodynamic preparation and panchagavya recorded higher increase of (21%) yield in basmati rice over control followed by addition of BD preparation with FYM and vermicompost (20%). In the maize+ cowpea-wheat +mustard system application of BD preparation+ FYM +Vermicompost +panchagavya recorded 12 and 15% increase in yield of maize and wheat respectively over FYM +Vermicompost alone indicating the usefulness of biodynamic and panchagavya preparations. Straw yield of all the crops have also followed the similar trend. Economics analysis of various treatments indicates FYM + vermicompost + biodynamic preparation + panchagavya and FYM+ vermicompost+biodynamic preparation recorded net return of Rs 1,56,801 and 1,53,214 ha^{-1} respectively in basmati rice-wheat system, however, higher net return and B:C ratio was observed with BD preparation alone. In maize+ cowpea-wheat +mustard system, application of BD preparation alone or FYM+vermicompost+ BD recorded higher net returns (Rs 98,639 and 88,529 ha^{-1} respectively) even though FYM+ Vermicompost + BD + Panchagavya combination recorded higher gross returns (Rs. 1,61853 ha^{-1}) excluding the control. The cost of cultivation was higher under this combination (Rs. 71,900 ha^{-1}) compared to BD alone (Rs. 29,050 ha^{-1}) and control (Rs. 25,050 ha^{-1}).

Umiam (Table 23 and 24)

Various pest and disease management packages were studied in maize+ soybean-tomato system and observations on incidence of monolepta, mylloceros, epilechna, leaf folder and soybean rust was

Table 21. Influence of pest and disease management practices under organic farming on grain and straw yield (kg ha^{-1}) at Modipuram

Cropping system	Pest and disease management	Grain Yield		Straw Yield		Net returns
		Kharif	Rabi	Kharif	Rabi	(Rs. ha^{-1})
Basmati rice -mustard	Summer ploughing-untreated	3390	646	4680	2367	35209
	Summer ploughing-treated	3420	772	4923	3057	35982
	Green manure-treated	3640	977	5460	3393	32534
	Green manure-untreated	3570	764	5220	2840	36956
Basmati rice- chick pea	Summer ploughing-untreated	3330	767	4780	2973	46206
	Summer ploughing-treated	3450	963	5180	3517	52607
	Green manure-treated	3860	1297	5560	3823	43995
	Green manure-untreated	3620	937	5480	3413	53117

Table 22. Influence of pest and disease management practices under organic farming on disease infestation and yield loss

Treatments	Infestation (%)			Yield loss (%)		
	Fruit borer	Fruit rot	Other factors	Fruit borer	Fruit rot	Other factors
Bajaura (Tomato)						
Mixture of Derisom (2% EC) @ 2ml/l and Ha NPV (Helicide) @ 0.5 ml/l	3.39	30.4	17.7	2.98	28.7	20.5
Bhang (*Cannabis sativa*)10% ALE + Cow urine (3%)+ tween -80 (0.05%) as emulsifier	2.42	24.1	17.4	2.38	23.3	19.1
Karvi (*Roylea cinerea*) @ 10% ALE + Cow Urine (3%)+ tween -80 (0.05%) as emulsifier	2.57	26.7	16.9	2.74	25.7	16.8
Metarhizium anisopliae @ 2g/l of water + tween -80 (0.05%) as emulsifier	2.64	25.2	16.0	2.24	23.7	15.8
Nomurea rileyi (Nolep) @ 2 g/l of water + tween -80 (0.05%) as emulsifier	4.29	25.4	20.1	3.83	26.2	19.2
Margosom (Azedarachtin 1.0% EC) @ 1ml/l	2.03	27.2	17.1	1.65	24.0	17.8
Lipel (*Bacillus thuringiensis sub sp. kurstaki*) @ 1 kg ha^{-1}	1.97	23.4	18.3	1.63	21.9	18.2
Control (untreated check)	13.9	25.4	17.7	13.7	24.5	19.3
Calicut (Ginger)	**Rhizome rot in ginger**					
Absolute control	42.4					
IISR 6, 8, 13, 51, 151 and Pb_{21}+P_1AR_6	15.0					
Ginger endophyticbacteria(GEB) 17	28.5					
Ginger endophyticbacteria(GEB) 18	13.5					
Ginger rhizobacteria(GRB) 57	26.8					
Ginger rhizobacteria(GRB) 58	17.3					

Table 23. Influence of pest and disease management practices under organic farming on insect and disease infestation (%) in Maize + soybean-tomato system at Umiam

Treatment	Kharif (Maize + soybean)										Rabi (Tomato)		
	Early stage				Late stage								
	Monolepta	mylloceros	epilechna	leaf folder	Monolepta	mylloceros	epilechna	leaf folder	Tursicum late blight	Soybean rust %	Fruit borer	% damage	Early blight
Control	0.70	2.27	0.47	0.47	0.20	0.47	0.13	0.67	56.3	37.1	1.47	15.9	47.6
Neem oil @3ml/l	0.47	2.33	0.23	0.47	0.17	0.33	0.13	0.33	42.0	32.2	1.41	12.9	34.3
Anonin 3 ml/l	0.47	2.00	0.27	0.47	0.33	0.47	0.17	0.47	52.6	36.1	1.25	13.5	51.1
Derisom@3ml/l	0.60	1.40	0.27	0.40	0.27	0.53	0.10	0.27	54.5	33.4	1.30	13.0	47.8
Panchagavya 3 %	0.40	1.40	0.33	0.47	0.20	0.47	0.13	0.47	40.3	32.1	1.33	11.4	32.5
Panchagavya. 3 %+ lantana 10 %+ V.wash 10 %	0.40	1.60	0.20	0.40	0.17	0.33	0.13	0.40	42.8	29.7	1.13	10.2	32.3
Trichoderma 5g/l	0.47	2.00	0.33	0.60	0.13	0.47	0.13	0.40	51.1	35.0	1.27	12.9	47.8
Botanicals	0.47	1.87	0.30	0.60	0.13	0.37	0.10	0.33	53.1	35.8	2.27	17.8	46.6
Derisom+panchgabaya	0.53	1.40	0.37	0.53	0.17	0.50	0.10	0.27	47.3	33.5	1.17	10.6	37.4
Derisom (3ml/l)+ Panchagavya 10 %+ cow urine 3 %	0.47	0.93	0.23	0.40	0.10	0.40	0.13	0.33	47.3	33.0	1.13	11.9	35.5

Table 24. Influence of weed, pest and disease management practices under organic farming on grain yield & straw yield (kg ha^{-1})

Cropping system	Pest and disease management practice	Yield			Straw yield
		Crop 1	Crop 2	Crop 3	
Bajaura					
Cauliflower- peas- tomato	*Kharif :* Mixture of Derisom (2% EC) @ 2ml/l and Ha NPV (Helicide) @ 0.5 ml/L *Rabi:* Darek (*Melia azedarach*) @ 5% ASE + Cow urine (3.0%)		8501	9141	
	Kharif: Bhang (Cannabis sativa)10% ALE + Cow Urine (3%)+ Tween -80 (0.05%) as emulsifier , *Rabi:* Kaner (Nerium sp.) (5%) + Cow urine (3.0%)		8285	10448	
	Kharif: Karvi (*Roylea cinerea*) @ 10% ALE + Cow Urine (3%)+ tween -80 (0.05%) as emulsifier Rabi: Karvi (*Roylea cinerea*) @ 5%+ Cow urine (3.0%)		8203	9348	
	Kharif: Metarhizium anisopliae @ 2g/l of water + tween -80 (0.05%) as emulsifier *Rabi:* Darek (M. azedarach) (5% ALE) + Cow urine (3%)		7984	10360	
	Kharif: Nomurea rileyi (Nolep) @ 2 g/l of water + tween -80 (0.05%) as emulsifier *Rabi:* Darek (*M. azedarach*) @ 2.5% ASE + Kaner (*Nerium sp.*) @ 2.5% ALE + Cow urine (3%)		7888	10072	
	Kharif: Margosom (Azedarachtin 1% EC) @ 1ml/l *Rabi:* Karvi (*Roylea cinerea*) @ 2.5% ALE + Kaner (Nerium sp.) @ 2.5% ALE + Cow urine (3%)		7682	9527	
	Kharif: Lipel (*Bacillus thuringiensis* sub sp. kurstaki) @ 1 kg/ha, *Rabi:* Darek (*M. azedarach* (2.5% ALE) + Karvi (Roylea cinerea) @ 2.5% ALE + Cow urine (3%)		7641	10597	
	Kharif: Control (untreated check), Rabi: Margosom (Azedarachtin 1%) @ 0.5ml/ L		8039	9743	
	Rabi: Margosom (Azedarachtin 1%) @ 0.75 ml/ l		8697		
	Rabi: Margosom (Azedarachtin 1%) @ 1.0 ml/ l		8944		
	Rabi: Control (untreated check)		6968		
	SEm±		272	518	
	CD (P=0.05)		801	NS	
Calicut					
Ginger	Absolute control	4200			
	IISR 6, 51, 853, Pb21 and P1AR6	4250			
	Ginger endophyticbacteria(GEB) 17	7250			

Cropping system	Pest and disease management practice	Yield			Straw yield	
		Crop 1	Crop 2	Crop 3		
	Ginger endophyticbacteria(GEB) 18	4700				
	Ginger rhizobacteria(GRB) 57	3200				
	Ginger rhizobacteria(GRB) 58	7025				
Turmeric	Absolute control	4600				
	IISR 6, 51, 853, Pb21 and P1AR6	5350				
	Ginger endophyticbacteria(GEB) 17	8150				
	Ginger endophyticbacteria(GEB) 18	6700				
	Ginger rhizobacteria(GRB) 57	5300				
	Ginger rhizobacteria(GRB) 58	7875				
	CD (P=0.05)	SEm±	CD			
	Crop	272	865			
	Source	471	961			
	Crop x source	666	NS			
	Source x crop	666	NS			
Karjat						
Mango yield	150 kg FYM + 20 kg Glyricidia leaves as a basal dose tree-1	3380	Check unit			
	300 kg FYM + 20 kg Glyricidia leaves as a basal dose tree-1	7500				
	155 kg Glyricidia leaves tree-1	4400				
	290 kg Glyricidia leaves tree-1	1000				
	50 kg Vermicompost + 20 kg Glyricidia leaves as a basal dose tree^{-1}	6920				
	100 kg Vermicompost + 20 kg Glyricidia leaves as a basal dose tree^{-1}	1080				
	Control	1880				
	SEm±	624				
	CD (P=0.05)	NS				
Modipuram						
Basmati rice-wheat	FYM+vermi compost	3960	3943		7040	6257
	BD preparation	3870	3133		6350	6113

Cropping system	Pest and disease management practice	Yield			Straw yield	
		Crop 1	Crop 2	Crop 3		
	FYM+vermi compost+panchgavya	4240	4087		6660	6480
	FYM+vermi compost+bd preparation	4420	4277		7260	6510
	BD preparation+FYM+vermicompost+ panchgavya	4453	4537		7510	6697
	Control	3680	2960		6300	5467
Maize+cowpea-wheat+ mustard	FYM+vermi compost	4580	3383		6737	5090
	BD preparation	4470	2747		6670	4550
	FYM+vermi compost+panchgavya	5020	3490		6780	5063
	FYM+vermi compost+BD preparation	4960	3680		7090	5467
	BD preparation+FYM+vermicompost+ panchgavya	5260	3793		7917	5567
	Control	3960	2423		6293	4773
	CD (P=0.05)	SEm± CD	SEm± CD		SEm± CD	SEm± CD
	CS	22.7 97.5	194 NS		53.4 NS	16.5 71.0
	Source	127 265	148 308		186 389	253 527
	CS x source	180 NS	209 NS		264 NS	357 NS
	Source x Cs	166 NS	272 NS		247 NS	326 NS
Umiam		Maize	Soybean	Tomato		
Maize+soybean- tomato	Control	3350	6567	16070		
	Neem oil @3ml/l	3657	7207	17412		
	Anonin 3 ml/l	3475	7337	17703		
	Derisom@3ml/l	3555	7240	17230		
	Panchagavya 3 %	3305	7583	17190		
	Panchagavya 3 %+lantana 10 %+V.wash 10 %	3680	7972	18338		
	Trichoderma 5g/l	3145	6940	17527		
	Botanicals	3440	6975	16598		
	Derisom+ Panchagavya	3520	7095	18222		
	Derisom (3ml/l)+ Panchagavya 10 %+cow urine 3 %	3640	7210	18242		
	SEm±	279	848	831		
	CD (P=0.05)	NS	NS	NS		

Table 25. Influence of pest and disease management practices under organic farming on economics of cropping systems

Cropping system	Pest and disease management (Treatment details in Table 16)	Gross returns (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
Bajura					
cauliflower - peas-tomato	*Kharif* : Mixture of Derisom (2% EC) @ 2ml/L and Ha NPV (Helicide) @ 0.5 ml/L *Rabi*: Darek (Melia azedarach) @ 5% ASE + Cow Urine (3.0%)	159394			
	Kharif: Bhang (Cannabis sativa)10% ALE + Cow Urine (3%)+ Tween -80 (0.05%) as emulsifier, *Rabi*: Kaner (Nerium sp.) (5%)+ Cow Urine (3.0%)	155344			
	Kharif: Karvi (Roylea cinerea) @ 10% ALE + Cow Urine (3%)+ Tween -80 (0.05%) as emulsifier *Rabi*: Karvi (Roylea cinerea) @ 5%+ Cow Urine (3.0%)	153806			
	Kharif: Metarhizium anisopliae @ 2g per litre of water + Tween -80 (0.05%) as emulsifier *Rabi*: Darek (M. azedarach) (5% ALE) + Cow Urine (3%)	149700			
	Kharif : Nomurea rileyi (Nolep) @ 2 gm per litre of water + Tween -80 (0.05%) as emulsifier *Rabi*: Darek (M. azedarach) @ 2.5% ASE + Kaner (Nerium sp.) @ 2.5% ALE + Cow Urine (3%)	147900			
	Kharif : Margosom (Azedarachtin 1.0% EC) @ 1ml/L *Rabi*: Karvi (Roylea cinerea) @ 2.5% ALE + Kaner (Nerium sp.) @ 2.5% ALE + Cow Urine (3%)	144038			
	Kharif : Lipel (Bacillus thuringiensis sub sp. kurstaki) @ 1.0 kg/ha, *Rabi*: Darek (M. azedarach (2.5% ALE) + Karvi (Roylea cinerea) @ 2.5% ALE + Cow Urine (3%)	143269			
	Kharif: Control (untreated check), *Rabi*: Margosom (Azedarachtin 1%) @ 0.5ml/ L	150731			
	Rabi: Margosom (Azedarachtin 1%) @ 0.75 ml/ L	163069			
	Rabi: Margosom (Azedarachtin 1%) @ 1.0 ml/ L	167,700			
	Rabi: Control (untreated check)	130650			
Modipuram					
Basmati rice-wheat	FYM+Vermi Compost	140958	60108	80851	1.39
	BD Preparation	127071	28980	98091	3.40
	FYM+Vermi Compost+Panchgavya	147537	66108	81429	1.26
	FYM+Vermi Compost+BD Preparation	153214	64108	89107	1.44
	BD Preparation+FYM+Vermicompost+ Panchgavya	156801	70108	86693	1.26
	Control	119829	24980	94849	3.83
Maize+cowpea-Wheat+mustard	FYM+Vermi Compost	140361	61900	78461	2.51
	BD Preparation	127689	29050	98639	3.61
	FYM+Vermi Compost+Panchgavya	149793	67900	81893	2.82
	Fym+Vermi Compost+BD Preparation	154429	65900	88529	3.02
	BD Preparation+Fym+Vermicompost+Panchgavya	161853	71900	89953	3.16
	Control	115131	25050	90081	3.52

observed in two stages in maize +soybean while fruit borer and early blight incidence in tomato was observed in one stage. Yield of all the crops were also recorded. Application of derisom (3 ml/l) + panchagavya @ 10% and cow urine 3% recorded lower incidence of monolapta (0.47%), mylloceros (0.93%) and leaf folder (0.40%) in early stage of maize while epilechna incidence (0.20%) was found to be reduced through application of panchagavya @ 3%+ lantana 10% +vermi wash 10%. Soybean rust was found to be controlled to the level of 29.7% with the application of panchagavya @ 3% + lantana @ 10% + vermiwash @ 10%. In tomato, fruit borer incidence can be reduced to the level of 1.13% with application of either panchagavya @ 3% + lantana 10% + vermin wash 10% or derisom (3 ml/l) + panchagavya @ 10% and cow urine 3%. Similarly, application of panchagavya @ 3% or panchagavya @ 3%+ lantana @ 10% + vermiwash @ 10% recorded 32.5 and 32.3% less incidence of early blight compared to control (untreated check). Though application of panchagavya @ 3%+ lantana @ 10% + vermi wash @ 10% recorded higher maize grain yield of 3680 kg $ha^{-1,}$ it is not significantly different with other treatments. Trichoderma 5 g/l recorded lower yield of 3145 kg ha^{-1} of maize. Although application of panchagavya @ 3% + lantana @ 10% + vermi wash @ 10% recorded 14.1% higher tomato yield (18338kg ha^{-1}) than control (16070 kg ha^{-1}), it is on par with derisom (3 ml/l) + panchagavya @ 10% and cow urine 3% and derisom+panchagavya.

7.4 Weed management under organic farming

Title of the experiment: Weed management in cropping systems under organic farming

Objectives: To study on the effect of weed management practice on weed dynamics, crop nutrient uptake, nutrient removal by weeds, yield and economics under organic farming.

Year of start: 2004-05, treatments are modified during 2009-08.

Treatments: There are no common treatments for all the centres, but they varied from location to location. The number of cropping systems tested at each location ranges from 1 to 3. The details of treatments are given in Table 26-32 along with experimental results.

Locations: The experiment was conducted at 9 centres namely Coimbatore, Dharwad, Jabal pur, Karjat, Ludhiana, Pantnagar, Raipur, Ranchi and Umiam.

Results

Coimbatore (Table 28, 29, 31 and 32)

Five treatments comprising of un-weeded check, two hand weeding, spray of aqueous leaf extract at 3-4 leaf stage of weeds, hand weeding + aqueous leaf extract spray and weed free check was evaluated in rice-blackgram-green manure system and observations on yield, soil properties, microbial count and economics were taken. In both rice and blackgram, weed free condition recorded higher yield (4213 and 863 kg ha^{-1} respectively) followed by combination of two hand weeding + spray of aqueous leaf extract at 3-4 leaf stage of weeds which recorded 88 and 163% increase yield of rice and blackgram over unweeded control. Spray of aqueous leaf extract alone was not effective in controlling of weeds in both the crops as it recorded the reduction in yield to the tune of 39.9 and 49.9% in rice and blackgram compared to weed free check. Straw yield of rice also exhibited the similar trend. Soil analysis indicated higher organic carbon with weed free check and two hand weeding + spray of aqueous leaf extract combination (0.64% in each). Residual availability of soil N, P and K also followed the similar trend. Compared to unweeded check, hand weeding, hand weeding + leaf extract spray, leaf extract spray alone and weed free check recorded 10.5, 19.8, 12.3 and 22.2% higher fungal population. Though bacteria and actinomycetes population was not significantly influenced by weed management packages, numerically higher bacteria was observed under aqueous leaf extract spray while actinomycetes was higher under weed free check. Higher gross and net returns of Rs. 99,593 and 67,473 ha^{-1} was observed under weed free check in rice-blackgram-green manure system. The next best treatment for weed management in terms of economics was found to be two hand weeding + spray of aqueous leaf extract at 3-4 leaf stage of weeds to both the crops in the system. A reduction of 35.3% in net returns was observed under spray of aqueous leaf extract alone compared to two hand weeding package. Unweeded check recorded 67.3% reduction in net returns over weed free condition.

Dharwad (Table 28 and 32)

Weed management packages under organic farming in groundnut was evaluated with 14 treatments comprising of aqueous leaf spray of cassia, parthenium, *Prosopis juliflora* in each condition of pre and post emergence of weeds along with hand weeding, hand hoeing, sorghum stubble mulch, wheat straw mulch, weed free and weedy check. The result indicates, weed free recorded higher pod yield of 3041 kg ha^{-1}. The next best treatment was One hand weeding at 20 DAS+Two hand hoeing at 20 and 40 DAS+aqueous spray of cassia at 25% as pre-emergent application which was at par with one hand weeding at 20DAS+two hand hoeing at 20 and 40 DAS+Aqueous spray of parthenium at 25%as pre-emergent application. Among the aqueous sprays, spray of cassia and *prosopis juliflora* as post emergent was found to be more effective than pre or post emergence application of parthenium. Post emergence spray of aqueous leaf extract was found to be better than pre emergence application. On an average, 1

Table 26. Influence of weed management practices under organic farming on weed count (no's/m²) of crops at various locations

Cropping system/ weed management practices	Kharif		Rabi	
	Grasses	Sedges	Total	BLW's
Jabalpur				
Basmati rice-wheat				
Unweeded-control			18.1	9.55
Two hand weeding/mechanical weeding			10.0	5.70
Spray of 3-4 leaf stage of weed			10.1	8.40
Two hand weeding/mechanical weeding+Spray of 3-4 leaf stage of weed			8.18	4.70
Weed free			2.30	1.45
			SEm± CD	SEm± CD
			0.05 0.11	0.16 0.65
Pantnagar				
Basmati rice-wheat-sesbania				
Kh. Weedy check Rb. Weedy check			9.67	30.7
Kh. Use of conoweeder Rb. One HW at 25-30 DAS			3.67	13.7
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS			0.67	10.0
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS			1.33	16.0
Basmati rice-lentil-sesbania				
Kh. Weedy check Rb. Weedy check			10.0	32.0
Kh. Use of conoweeder Rb. One HW at 25-30 DAS			6.33	18.0
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS			1.33	7.33
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS			2.33	24.0
Basmati rice-Brassica napus-sesbania				
Kh. Weedy check Rb. Weedy check			8.67	48.0
Kh. Use of conoweeder Rb. One HW at 25-30 DAS			2.67	15.3
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS			0.67	9.00
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS			1.33	18.7
CD (P=0.05)			SEm± CD	SEm± CD
Cropping			0.89 NS	1.27 3.54
Source			1.05 2.20	5.30 11.1
Cropping X Source			1.81 NS	9.17 NS
Source X Cropping			1.80 NS	8.05 NS
Raipur (Rice-mustard)				
Weedy check			21.0	435
Kh. Use of cono weeder with square planting Rb.Stale seed bed			6.73	174
1 HW at 25-30 DAT			14.0	206
2 HW at 25-30 and 45-50 DAT			8.70	64.3
Aquious spray at 15-20 DAT + 1 HW at 40-50 DAT			15.0	228
			SEm± CD	SEm± CD
			1.34 4.38	18.3 59.6

Table 27. Influence of weed management practices under organic farming on weed total dryweight (g/m²) of crops at various locations

Cropping system/ weed management practices	Kharif		Rabi	
	Total		Total	
Ludhiana				
Rice-wheat				
Kh. HW @25-30 DAT Rb.HW @25-30 DAS	9.04		754	
Kh.2 HW @25-30 and 45-50 DAT Rb.2 HW @30-35 and 45-50 DAS	9.56		882	
Kh. ES@15-30DAT+HW@40-45DAT Rb. ES@15-30DAS+HW@40-45DAS	10.7		714	
Kh. Sq planting+paddy weeder Rb.Bed sowing+2HW@30-35&45-50DAS	9.06		867	
Kh. High density+hw@25-30DAT Rb.High seed rate (25%)+15cm spacing	8.12		624	
Control	16.2		559	
	SEm±	CD	SEm±	CD
	1.11	2.35	65.4	139
Pantnagar				
Basmati rice-wheat-sesbania				
Kh. Weedy check Rb. Weedy check			346	
Kh. Use of conoweeder Rb. One HW at 25-30 DAS			71.0	
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS			18.7	
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS			54.0	
Basmati rice-lentil-sesbania				
Kh. Weedy check Rb. Weedy check			504	
Kh. Use of conoweeder Rb. One HW at 25-30 DAS			80.7	
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS			28.0	
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS			74.3	
Basmati rice-Brassica napus-sesbania				
Kh. Weedy check Rb. Weedy check			624	
Kh. Use of conoweeder Rb. One HW at 25-30 DAS			114	
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS			43.0	
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS			101	
CD (P=0.05)			SEm±	CD
Cropping			32.1	NS
Source			65.4	137
Cropping X Source			113	NS
Source X Cropping			103	NS

Cropping system/ weed management practices	Kharif		Rabi	
	Total		Total	
Raipur (Rice-mustard)				
Weedy check	19.5		582	
Kh. Use of cono weeder with square planting Rb.Stale seed bed	7.16		232	
1 HW at 25-30 DAT	8.81		291	
2 HW at 25-30 and 45-50 DAT	7.34		60.8	
Aquious spray at 15-20 DAT + 1 HW at 40-50 DAT	10.7		276	
	SEm±	CD	SEm±	CD
	1.14	3.71	19.1	62.4
Ranchi				
Rice – wheat				
Unweeded Control	57.1		42.6	
Two hand hoeing 25 & 40 DAT/ DAS	8.38		10.4	
Aqueous leaf extract at 3-4 leaf stage of weeds.	51.9		40.0	
Two hand hoeing 25 & 40 DAT/ DAS + Aqueous leaf extract at 3-4 leaf stage of weeds	8.17		9.50	
Weed free (manual).	0.44		6.73	
One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds	28.2		28.2	
Rice – linseed				
Unweeded Control	54.7		41.9	
Two hand hoeing 25 & 40 DAT/ DAS	7.48		10.5	
Aqueous leaf extract at 3-4 leaf stage of weeds.	50.1		38.3	
Two hand hoeing 25 & 40 DAT/ DAS + Aqueous leaf extract at 3-4 leaf stage of weeds	6.17		6.90	
Weed free (manual).	0.33		5.80	
One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds	27.1		26.2	
CD (P=0.05)	SEm±	CD	SEm±	CD
Cropping	1.45	NS	2.19	NS
Source	2.14	4.46	2.00	4.16
Cropping X Source	3.03	NS	2.83	NS
Source X Cropping	3.12	NS	3.38	NS

Table 28. Influence of weed management practices under organic farming on grain/straw yield (kg/ha) of crops at various locations

Cropping system/ weed management practices	(GY)		(SY)		(GY)		(SY)		(GY)		(SY)	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
Coimbatore (Rice-Blackgram-GM)												
Un-weeded control	2053	310	2862									
Two hand weeding	3708	795	4950									
Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree	2591	435	3360									
Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree	3850	816	5220									
Weed free	4213	863	5887									
	SEm±	CD	SEm±	CD	SEm±	CD						
	86.8	283.2	45.7	148.9	95.4	311.0						
Dharwad (Groundnut)												
Aqueous spray of cassia at 25%as pre-emergent application	2230											
Aqueous spray of cassia at 25%as post-emergent application	2403											
Aqueous spray of parthenium at 25%as pre-emergent application	2259											
Aqueous spray of parthenium at 25% as post-emergent application	2325											
Aqueous spray of Prosopis juliflora at 25%as pre-emergent application	2320											
Aqueous spray of Prosopis juliflora at 25%as post-emergent application	2340											
One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS	2701											
One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS+ Aqueous spray of cassia at 25%as pre-emergent application	2822											
One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS+ Aqueous spray of parthenium at 25% as pre-emergent application	2811											

Cropping system/ weed management practices	(GY)		(SY)		(GY)		(SY)		(GY)		(SY)	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS+ Aqueous spray of Prosopis juliflora at 25%as pre-emergent application	2650											
Sorghum stubble mulch	2669											
Wheat straw mulch	2779											
Weed free	3041											
Weedy check	1993											
Jabalpur (Rice-Wheat)	*Kharif*	*Rabi*	*Kharif*	*Rabi*								
Unweeded control	1827	1384	3576	2337								
Two hand weeding /mechanical weeding	3786	3433	7746	6422								
Spray of 3-4 leaf stage of weeds	2669	2116	5309	4007								
Two hand weeding /mechanical weeding + Spray of 3-4 leaf stage of weeds	3805	3889	8095	7289								
Weed free	4584	4351	10217	8076								
	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD				
	146	319	90.7	198	497	1084	237	516				
Ludhiana	Rice-Wheat (GY)				Rice-Wheat (SY)							
Kh. HW @25-30 DAT Rb.HW @25-30 DAS	3242	3080	4824	4002								
Kh.2 HW @25-30 and 45-50 DAT Rb.2 HW @30-35 and 45-50 DAS	3254	3372	4888	4208								
Kh. ES@15-30DAT+HW@40-45DAT Rb. ES@15-30DAS+HW@40-45DAS	3106	3086	4996	4316								
Kh. Sq planting+paddy weeder Rb.Bed sowing+2HW@30-35&45-50DAS	3154	3450	4876	4752								
Kh.High density+hw@25-30DAT Rb.High seed rate (25%)+15cm spacing	3208	2326	5002	3352								
Control	3098	2186	5112	3030								
	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD				
	195	NS	218	462	315	NS	319	676				

Cropping system/ weed management practices	(GY)		(SY)		(GY)		(SY)		(GY)		(SY)	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
Pantnagar	**Basmati rice – wheat-*Sesbania* (green manuring) (GY)**		**Basmati rice – wheat-*Sesbania* (green manuring) (SY)**		**Basmati rice – lentil-*Sesbania* (green manuring) (GY)**		**Basmati rice – lentil-*Sesbania* (green manuring) (SY)**		**Basmati rice – *Brassica napus*-*Sesbania* (green manuring) (GY)**		**Basmati rice – *Brassica napus*-*Sesbania* (green manuring) (SY)**	
Kh. Weedy check Rb Weedy check	2235	2485	3596	3725	2584	305	3747	651	2302	589	3524	1567
Kh. Use of conoweeder Rb. One HW at 25-30 DAS	4385	3014	5453	4784	4578	650	5485	1282	4452	827	5403	1646
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS	3614	4372	4422	4652	3278	932	4566	1855	3411	1595	4414	2370
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS	4207	3963	5173	5194	4393	727	5322	1418	4248	1214	5082	2489
	Kh.	Rb.	Kh.	Rb.								
CD (P=0.05)	SEm± CD	SEm± CD	SEm± CD	SEm± CD								
Cropping	39.7 NS	79.2 220	87.3 NS	246 684								
Source	104 219	85.1 179	155 326	133 279								
Cropping X Source	180 NS	147 310	269 NS	230 484								
Source X Cropping	161 NS	150 344	249 NS	317 795								
Raipur	Rice-Mustard (GY)		Rice-Mustard (SY)									
Weedy check	2639	359	6453	1186								
Kh. Use of cono weeder with square planting Rb.Stale seed bed	3568	640	7388	1957								
1 HW at 25-30 DAT	3146	706	7011	2202								
2 HW at 25-30 and 45-50 DAT	3329	786	6997	2403								
Aquious spray at 15-20 DAT + 1 HW at 40-50 DAT	3044	654	6861	2067								
	SEm± CD	SEm± CD	SEm± CD	SEm± CD								
	180.2587.8	21.3 69.5	170.3555.3	31.9 104.1								
Ranchi	**Rice – Wheat (GY)**		**Rice – Wheat (SY)**		**Rice – Linseed (GY)**		**Rice – Linseed (SY)**					
Unweeded Control	2198	1091	3403	1992	2137	392	3313	850				
Two hand hoeing 25 & 40 DAT/ DAS	3633	1818	5160	2899	3573	745	4857	1229				

Cropping system/ weed management practices	(GY)		(SY)		(GY)		(SY)		(GY)		(SY)	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
Aqueous leaf extract at 3-4 leaf stage of weeds.	2627	1182	4143	2083	2504	410	3977	958				
Two hand hoeing 25 & 40 DAT/ DAS + Aqueous leaf extract at 3-4 leaf stage of weeds	3847	1939	5243	3145	3725	787	5117	1333				
Weed free (manual).	4031	2060	5673	3401	3969	838	5943	1615				
One hand weeding / hoeing (25 DAT /DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds	3481	1606	4760	2708	3328	607	4697	1143				
	Kh.		Rb.		Kh.		Rb.					
CD (P=0.05)	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD				
Cropping	150	NS	96.0	413	162	NS	186	801				
Source	243	507	92.3	193	400	835	177	368				
Cropping X Source	344	NS	131	NS	566	NS	250	NS				
Source X Cropping	348	NS	153	NS	541	NS	294	NS				
Umiam	**maize (green cob) – mustard (GY)**				**Maize (green cob)– mustard (SY)**							
Mechanical weeding (20 DAS) + HW once (60 DAS)	3212	500	6995	944								
Mulching with fresh Eupatorium/ Ambrossia @ 10t/ha (After earthing up)	3756	639	9507	1167								
Aqueous leaf extract spray of lantana& pine spp. at 3-4 leaf stage of weed	3462	528	9205	917								
HW twice (20 & 40 DAS)	2996	472	6576	861								
aqueous leaf extract spray of lantana & pine + hand weeding twice	3327	556	8546	1083								
Soybean green manure incorporation in situ (1:1) + HW once	3161	444	8118	806								
Weed free check	3145	458	6459	880								
Weedy check	2894	383	5657	752								
	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD				
	11	33	64.4		35	10	11					
	1.4	7.9			7.8	85.4	4.1					

Table 29. Influence of weed management practices under organic farming on soil physical and chemical properties at the end of cropping cycle (BD: g/cc, EC: dS/m, OC: %, N, P, K: kg/ha)

Cropping system/ weed management practices*	BD	pH	EC	OC	N	P	K	BD	pH	EC	OC	N	P	K	BD	pH	EC	OC	N	P	K
Coimbatore **Rice-Blackgram-GM**																					
Unweeded control				0.57	185	22.5	468														
Two hand weeding				0.62	225	26.4	551														
Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree				0.60	190	23.0	480														
Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree				0.64	245	27.8	560														
Weed free				0.64	251	29.4	601														
	S Em ±	CD	S Em ±	CD	S Em ±	CD	S Em ±	CD	S Em ±	CD	S Em ±	CD	S Em ±	CD	S Em ±	CD					
				0.001	0.004	6.6	21.6	14	46	13.1	42.8										
Pantnagar	Basmati rice – wheat-*Sesbania* (green manuring							Basmati rice – lentil-*Sesbania* (green manuring)							Basmati rice – *Brassica napus*-*Sesbania* (green manuring)						
Kh. Weedy check Rb. Weedy check				0.97	344	30.5	226				0.95	365	32.7	225				0.96	369	33.8	232
Kh. Use of conoweeder Rb. One HW at 25-30 DAS				0.91	332	33.8	230				0.95	363	29.9	213				0.91	346	35.4	217
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS				0.91	347	32.9	223				0.95	381	34.3	232				0.98	363	30.7	225
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS				0.82	343	29.2	219				0.94	355	34.3	240				0.83	368	31.9	230

Cropping system/ weed management practices*	BD	pH	EC	OC	N	P	K	BD	pH	EC	OC	N	P	K	BD	pH	EC	OC	N	P	K
CD (P=0.05)	S Em ± CD	S Em ± CD	S Em ± CD	S Em ± CD	S Em ± CD	S Em ± CD	S Em ± CD														
Cropping	0.01	0.04	7.02	19.5	1.17	NS	7.42														
Source	0.01	0.02	10.9	NS	1.24	NS	8.22														
Cropping X Source	0.02	0.04	19.0	NS	2.15	4.51	14.2														
Source X Cropping	0.02	0.05	17.9	NS	2.20	5.04	14.4														
Raipur	**(Rice-mustard)**																				
Weedy check	1.44	7.54	0.21	0.45	204	10.1	276														
Kh. Use of cono weeder with square planting **Rb.**Stale seed bed	1.42	7.52	0.20	0.44	227	10.8	287														
1 HW at 25-30 DAT	1.37	7.56	0.21	0.46	229	12.2	298														
2 HW at 25-30 and 45-50 DAT	1.36	7.52	0.19	0.46	236	13.9	306														
Aquious spray at 15-20 DAT + 1 HW at 40-50 DAT	1.41	7.53	0.22	0.46	221	11.3	283														
	S Em ± CD	S Em ± CD	S Em ± CD	S Em ± CD	S Em ± CD	S Em ± CD	S Em ± CD														
	0.02	0.05	0.01	0.01	8.6	1.6	7.7														
Ranchi					**Rice-wheat**							**Rice-linseed**									
Unweeded Control					234	33.3	192					228	33.0	194							
Two hand hoeing 25 & 40 DAT/ DAS					242	39.3	203					241	37.7	200							
Aqueous leaf extract at 3-4 leaf stage of weeds.					239	34.3	193					234	34.0	195							

Cropping system/ weed management practices*	BD	pH	EC	OC	N	P	K	BD	pH	EC	OC	N	P	K	BD	pH	EC	OC	N	P	K
Two hand hoeing 25 & 40 DAT/ DAS + Aqueous leaf extract at 3-4 leaf stage of weeds					245	40.3	206					244	38.0	203							
Weed free (manual).					255	41.3	213					246	39.3	205							
One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds					233	37.0	200					233	35.0	198							
Umiam	**maize (green cob) - mustard**																				
Mechanical weeding (20 DAS) + HW once (60 DAS)	1.27	5.53		2.43	276	18.2	278														
Mulching with fresh Eupatorium/ Ambrossia @ 10t/ha (After earthing up)	1.18	5.62		3.18	270	24.6	281														
Aqueous leaf extract spray of lantana&pine spp. at 3-4 leaf stage of weed	1.24	5.10		2.52	238	32.2	265														
HW twice (20 & 40 DAS)	1.24	5.33		2.39	251	20.4	263														
aqueous leaf extract spray of lantana & pine + hand weeding twice	1.21	5.51		2.39	263	20.3	267														
Soybean green manure incorporation in situ (1:1) + HW once	1.20	5.46		2.63	257	19.4	279														
Weed free check	1.30	5.58		2.21	276	19.4	271														
Weedy check	1.25	5.12		2.18	235	23.4	244														
	S Em ±	CD	S Em ±	CD	S Em ±	CD	S Em ±	CD	S Em ±	CD	S Em ±	CD	S Em ±	CD							
	0.03	NS	0.16		0.09	0.27	6.0	18.2	2.2	6.8	4.7	14.2									

Table 30. Influence of weed management practices under organic farming on NPK uptake by crops at various locations

Cropping system/ weed management practices	NPK uptake by crop (kg/ha)								
	Kharif			Rabi			Summer		
	N	P	K	N	P	K	N	P	K
Pantnagar Basmati rice – wheat-s*esbania* (green manuring)									
Kh. Weedy check Rb. Weedy check	43.4	10.4	32.6	59.2	10.6	69.3			
Kh. Use of conoweeder Rb. One HW at 25-30 DAS	75.7	19.2	47.7	68.5	18.6	84.9			
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS	64.6	15.4	53.8	77.2	19.9	93.6			
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS	72.6	17.8	48.6	74.7	18.1	105			
Basmati rice – lentil-s*esbania* (green manuring)									
Kh. Weedy check Rb. Weedy check	50.9	12.9	36.7	21.1	2.74	12.0			
Kh. Use of conoweeder Rb. One HW at 25-30 DAS	76.8	18.7	50.7	40.9	3.56	21.4			
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS	65.4	14.6	46.0	54.7	4.41	31.5			
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS	77.5	19.1	44.8	48.9	4.14	25.2			
Basmati rice – *Brassica napus*-s*esbania* (green manuring)									
Kh. Weedy check Rb. Weedy check	47.5	12.0	35.3	19.5	3.07	23.2			
Kh. Use of conoweeder Rb. One HW at 25-30 DAS	77.8	18.5	49.3	17.4	4.07	27.1			
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS	58.9	15.6	44.4	32.1	7.34	43.4			
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS	68.4	18.1	46.0	21.8	11.58	42.8			

Cropping system/ weed management practices	NPK uptake by crop (kg/ha)								
	Kharif			Rabi			Summer		
	N	P	K	N	P	K	N	P	K
Ranchi I									
Rice-wheat									
Unweeded Control	52.6	10.1	39.3	25.4	6.1	27.5	-	-	-
Two hand hoeing 25 & 40 DAT/ DAS	86.5	13.1	59.9	43.7	10.2	40.2	-	-	-
Aqueous leaf extract at 3-4 leaf stage of weeds.	64.3	10.8	45.3	28.0	6.6	29.2	-	-	-
Two hand hoeing 25 & 40 DAT/ DAS +Aqueous leaf extract at 3-4 leaf stage of weeds.	95.6	17.6	62.2	46.6	11.2	42.2	-	-	-
Weed free (manual).	102.2	18.6	67.1	49.7	11.7	44.7	-	-	-
One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds.	78.1	13.3	53.5	39.4	9.2	36.6	-	-	-
Rice-linseed									
Unweeded Control	52.4	9.4	37.3	11.5	5.3	27.6			
Two hand hoeing 25 & 40 DAT/ DAS	85.6	14.0	58.6	21.3	9.1	40.6			
Aqueous leaf extract at 3-4 leaf stage of weeds.	58.9	11.6	44.9	12.9	5.5	28.3			
Two hand hoeing 25 & 40 DAT/ DAS +Aqueous leaf extract at 3-4 leaf stage of weeds.	92.2	16.6	61.7	22.4	9.2	42.2			
Weed free (manual).	103.2	17.0	66.6	25.4	10.2	46.1			
One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds.	79.0	13.1	53.1	18.3	7.6	34.4			

Table 31. Influence of weed management practices under organic farming on soil microbial population (x10^4 CFU/g) at the cropping cycle at Coimbatore

Cropping system/ weed management practices (Treatment details in Table 21)	Fungi	Bacteria	Actinomycetes
Coimbatore			
Unweeded control	16.2	96.0	26.3
Two hand weeding	17.9	98.9	24.9
Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree	18.2	107	29.4
Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree	19.4	102	28.0
Weed free	19.8	105	29.9

spray of aqueous leaf extracts alone recorded reduction in yield to the tune of 23.9% over weed free condition while the increase over weedy check was found to be 16% indicating usefulness of aqueous leaf extract which can be combined with hand weeding packages. Gross, net return and BC ratio was higher with hand weeding+hand hoeing+cassia spray as pre emergent application.

Jabalpur (Table 26, 28 and 32)

Weed management packages viz., two hand/mechanical weeding, spray at 3-4 leaf stage of weeds and its combination along with weed free and unweeded control were experimented in rice-wheat system. The results reveals that weed free recorded higher grain yield of rice (4584 kg ha^{-1}) and wheat (4351 kg ha^{-1}) followed by combination of two hand weeding + spray at 3-4 leaf stage of weeds which recorded 108 and 181% higher grain yield of rice and wheat respectively compared to unwedded check. Straw yield of both the crops also exhibited the similar trend. Higher gross (Rs 201620 ha^{-1}), net (Rs. 139075 ha^{-1}) return and B: C ratio (3.22) was recorded with weed free condition in rice-wheat system even though high cost of cultivation (Rs. 62545 ha^{-1}) was noticed in weed free condition. The next best treatment in terms of gross, net returns and B: C ratio was two hand/mechanical weeding +spray at 3-4 leaf stage of weeds (Rs. 1,72,905, 1,16,916 ha^{-1} and 3.09 respectively).

Ludhiana (Table 27 and 28)

Five management packages along with unweeded control was evaluated in basmati rice-wheat system. Observations on total dry weight of weeds, grain and straw yield were recorded. High density planting + hand weeding at 25-30 DAT recorded maximum reduction of total dry weight of weeds (8.1 gm^{-2}) which was on par with hand weeding at 25-30 DAT, hand weeding at 25-30 and 45-50 DAT and square planting + weeder in rice. Two hand weeding @ 25-30 and 45-50 DAT in rice recorded higher yield of 3254 kg ha^{-1} and it was not significantly different with other practices. In case of wheat, bed sowing + two hand weeding at 30-35 and 45-50 DAS recorded higher yield (3450 kg ha-1) which is 48.3 and 57.8% increase over high seed rate (25%) + 15 cm spacing and unweeded check respectively. Other practice such as hand weeding at 25-30 DAS and ES @ 15-30 DAS + HW @ 40-45 DAS recorded yield on par (3080 and 3086 kg ha^{-1}). The straw yield of rice and wheat also followed the similar trend as that of grain yield.

Pantnagar (Table 26, 27, 28, 29, 30 and 32)

Three weed management packages namely use of conoweeder during *kharif* and one hand weeding at 25-30 DAS in *rabi*, one hand weeding during *kharif* and two hand weeding at 25-30 and 45-50 DAS in *rabi*, two hand weeding at 25 and 45-50 DAT during *kharif* and stale seed bed + 1 hand weeding at 30-35 DAS *rabi* along with weedy check were evaluated in three cropping systems namely basmati rice-

Table 32. Influence of weed management practices under organic farming on economics (Rs/ha) of cropping systems at various locations

Cropping system/ weed management practices (Treatment details in Table 21)	Gross returns	Cost of cultivation	Net returns	B:C ratio	Gross returns	Cost of cultivation	Net returns	B:C ratio	Gross returns	Cost of cultivation	Net returns	B : C ratio
Coimbatore	**Rice-Blackgram-GM**											
Unweeded control	42998	20950	22048									
Two hand weeding	89196	29500	59696									
Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree	56202	22700	33502									
Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree	92220	29480	62740									
Weed free	99593	32120	67473									
Dharwad	**Groundnut**											
Aqueous spray of cassia at 25%as pre-emergent application	66894		47094	3.38								
Aqueous spray of cassia at 25%as post-emergent application	72077		52877	3.75								
Aqueous spray of parthenium at 25%as pre-emergent application	67758		47358	3.32								
Aqueous spray of parthenium at 25%as post-emergent application	69739		49099	3.38								
Aqueous spray of Prosopis juliflora at 25%as pre-emergent application	69614		48974	3.37								
Aqueous spray of Prosopis juliflora at 25%as post-emergent application	70188		49188	3.34								
One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS	81019		58819	3.65								

Cropping system/ weed management practices (Treatment details in Table 21)	Gross returns	Cost of cultivation	Net returns	B:C ratio	Gross returns	Cost of cultivation	Net returns	B:C ratio	Gross returns	Cost of cultivation	Net returns	B : C ratio
One hand weeding at 20DAS+ Two hand hoeing at 20 and 40 DAS+Aqueous spray of cassia at 25%as pre-emergent application	84647		62807	3.88								
One hand weeding at 20DAS+ Two hand hoeing at 20 and 40 DAS+Aqueous spray of parthenium at 25%as pre-emergent application	84338		62018	3.78								
One hand weeding at 20DAS+ Two hand hoeing at 20 and 40 DAS+Aqueous spray of Prosopis juliflora at 25%as pre-emergent application	79372		57172	3.58								
Sorghum stubble mulch	83063		60863	3.74								
Wheat straw mulch	83357		61157	3.75								
Weed free	91237		68437	4.00								
Weedy check	59797		38797	2.85								
Jabalpur	**Rice - Wheat**				-				-			
Unweeded control	73375	40190	33185	1.83								
Two hand weeding / mechanical weeding	163310	55150	108160	2.96								
Spray of 3-4 leaf stage of weeds	109065	50446	58619	2.16								
Two hand weeding / mechanical weeding + Spray of 3-4 leaf stage of weeds	172905	55989	116916	3.09								
Weed free	201620	62545	139075	3.22								
Pantnagar	Basmati rice – wheat-*Sesbania* (green manuring)				Basmati rice – lentil-*Sesbania* (green manuring)				Basmati rice – *Brassica napus*-*Sesbania* (green manuring)			
Kh. Weedy check Rb. Weedy check		59652	44374	1.74		56779	38224	1.67		56329	19571	1.35

Cropping system/ weed management practices (Treatment details in Table 21)	Gross returns	Cost of cultivation	Net returns	B:C ratio	Gross returns	Cost of cultivation	Net returns	B:C ratio	Gross returns	Cost of cultivation	Net returns	B : C ratio
Kh. Use of conoweeder Rb. One HW at 25-30 DAS		63525	102582	2.61		60652	122015	3.01		60202	76554	2.27
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS		65107	95994	2.47		62234	104470	2.68		61784	54707	1.88
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS		67689	107559	2.59		61816	116868	2.89		64366	70831	2.10
Raipur		**Rice-mustard**										
Weedy check		44715	17579									
Kh. Use of cono weeder with square planting Rb.Stale seed bed		48615	40165									
1 HW at 25-30 DAT		50715	33470									
2 HW at 25-30 and 45-50 DAT		53715	36392									
Aquious spray at 15-20 DAT + 1 HW at 40-50 DAT		51915	28508									
Ranchi		**Rice - Wheat**				**Rice - Linseed**						
Unweeded Control	64763	53041	11722		47324	44246	3078					
Two hand hoeing 25 & 40 DAT/ DAS	104881	56995	47886		78890	47805	31085					
Aqueous leaf extract at 3-4 leaf stage of weeds.	74728	53441	21287		54799	44646	10153					
Two hand hoeing 25 & 40 DAT/ DAS +Aqueous leaf extract at 3-4 leaf stage of weeds.	110958	57395	53562		82566	48205	34361					
Weed free (manual).	117478	57787	59692		89266	48596	40670					
One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds.	97681	56077	41604		72419	47019	25401					

wheat-*sesbania* (green manure), basmati rice-lentil-*sesbania* (green manure) and basmati rice-*brassica napus*-sesbania (green manure). Observations on weed count, total dry weight, grain, straw yield, soil properties, NPK uptake by crops along with economics were taken. Total grasses and sedges count during *kharif* and broad leaved weeds count during *rabi* was found to be significantly lower in all the three systems with one hand weeding at 25-30 DAT during *kharif* and 2 hand weeding at 25-30 and 45-50 DAS during *rabi*. Across the cropping systems, the reduction of total grasses & sedges and broad leaved weeds was found to be 90.6 and 77.2 % respectively due to 1 hand weeding during *kharif* and 2 hands weeding during *rabi*. Among the three cropping systems, basmati rice-wheat-sesbania recorded lower grasses, sedges and broad leaved weeds compared to other systems. The reduction in total dry weight of weeds during *rabi* was significantly higher in one hand weeding at 25-30 DAT during *kharif* and two hand weeding at 25-30 and 45-50 DAS during *rabi*. The reduction over weedy check was found to be 95, 94.4 and 93.1% in basmatirice-wheat-sesbania, basmatirice-lentil-sesbania and basmati rice-*brassicanapus*-sesbania respectively. More than 50% reduction was also observed in conoweeder + hand weeding and hand weeding + stale seed bed techniques.

Significantly higher grain yield of basmati rice in all the three systems during *kharif* was recorded with use of conoweeder during *kharif* and one hand weeding at 25-30 DAS during *rabi* which registered on an average 88.4% increase in yield over weedy check. This was closely followed by two hands weeding at 25 & 45-50 DAT in *kharif* and stale seed bed + one hand weeding at 30-35 DAS during *rabi*. The yield of wheat and lentil during *rabi* was found to be significantly higher with one hand weeding at 25-30DAT in *kharif* and two hand weeding at 25-30 and 45-50 DAS in *rabi*. The increase over weedy check was found to be 75.9, 205.6% and 170.8 respectively for wheat, lentil and *Brassica napus*. Weedy check registered significantly lower yield in all the three systems. Straw yield of all the crops in the three systems resulted in similar trend as that of grain yield. No significant variation in available soil N, P and K was observed in all the three systems with various weed management packages. Among the three systems residual organic carbon was found to be higher with basmati rice-lentil-sesbania (green manure) system. Uptake of N was numerically higher in one hand weeding at 25-30 DAT in kharif and Two HW at 25-30& 45-50 DAS in *rabi* in basmati rice while it was higher in Weedy check for *brassicanapus*. Economic analysis indicates, in all the systems, use of conoweeder during *kharif* and one hand weeding at 25-30 DAS during *rabi* recorded higher gross, net returns and B: C raio in all the three systems. This was closely followed by one hand weeding during *kharif* and stale seed bed + 1 hand weeding during *rabi*. Among the three systems, basmati rice-wheat-sesbania (green manure) recorded higher net return of Rs 58248 ha^{-1} with B: C ratio of 1.95. In general use of conoweeder, stale seed bed and hand weeding are found to be suitable weed management technique under organic farming conditions.

Raipur (Table 26, 27, 28, 29 and 32)

Weed management packages comprising of cono weeder with square planting in rice, state seed bed in mustard, aqueous spray and hand weeding along with weedy check was evaluated under rice-mustard system and observations on weed count grain and straw yield along with soil fertility status were recorded. Maximum reduction in total weed count was observed with use of conoweeder with square planting in rice while in mustard it was found with 2 hand weeding at 25-30 and 45-50 DAT (Reduction of 68% in rice and 85% in mustard compared to weedy check). Aqueous spray at 15-20 DAT + 1HW at 40-50 DAT recorded 28.6 and 47.6%reduction in rice and mustard respectively. Use of conoweeder with square planting in rice contributed for 68% reduction while stale seed bed to mustard resulted in 60% reduction in total weed count. Dry weight of weed also exhibited similar trend as that of weed count. Use of conoweeder with square planting recorded significantly higher yield of rice (3568 kg ha^{-1}) while in mustard it was higher under 2 hand weeding at 25-30 and 45-50 DAT (786 kg ha^{-1}). Aqueous spray and one hand weeding recorded 14.7 and 16.8% reduction in yield compared to best performing treatment of conoweeder with square planting and 2 hand weeding to rice and mustard respectively. Straw yield also exhibited similar trend as that of grain yield. Post harvest analysis of soil indicates no significant variation in bulk density, pH, EC and available N, P and K. Use of conoweeder with square planting recorded lower organic

carbon of 0.44% while 2 hand wedding and aqueous spray+1 hand weeding package recorded higher organic carbon content (0.46% in both the treatments). Higher net return of rice-mustard system Rs. 40165 ha^{-1} was recorded with conoweeder+square planting in rice and stale bed in mustard.

Ranchi (Table 27, 28, 29, 30 and 32)

Four weed management packages involving hand hoeing, use of aqueous leaf extract and hand weeding were evaluate along with weed free and unweeded control in rice-wheat and rice-linseed system. Observations on weed dry weight, grain, straw yield, NPK uptake and economics were taken. Two hand hoeing at 25 and 40 DAS/DAT with use of aqueous leaf extract registered significantly lower weed dry weight in both the system. (On an average reduction of 87.2% in rice, 77.7% in wheat and 83.5% in linseed compared to unweeded control). It was at par with two hand hoeing 25 and 40 DAS/DAT. In all the crops in the systems, weed free recorded higher grain yield followed by two hand hoeing at 25 and 40 DAT/DAS with aqueous leaf extract spray at 3-4 leaf stage. Spray of aqueous leaf extract alone recorded reduction in yield to the tune of 34.8% in rice, 42.6% in wheat and 51.1% in linseed. Keeping the field free from weeds gave yield advantage of 83.4% in rice, 88.8% in wheat and 114% in linseed over unweeded control. Similar trend was observed for straw yield of all the crops. Keeping the field free from weeds through hand weeding recorded higher NPK uptake in all the crops, this was closely followed by two hand hoeing + aqueous leaf extract spray at 3-4 leaf stage of weeds. In both rice-wheat and rice-linseed system, weed free recorded higher net return of Rs 59692 and 34361 ha^{-1} and B: C ratio of 2.03 and 1.84 respectively followed by two hand weeding and aqueous leaf extract spray (Net return of Rs 53562 and 48205 ha^{-1} respectively in rice-wheat and rice-linseed). Unweeded control and spray of aqueous leaf extract resulted in lower net returns and B:C ratio indicating loss, over investment.

Umiam (Table 28 and 29)

Six weed control treatments involving mechanical weeding (20 DAS) + hand weeding once (60 DAS), mulching with fresh Eupatorium/Ambrosia @ 10 t ha^{-1} (after earthing up), aqueous leaf extract spray of lantana and pine spp. at 3-4 leaf stage of weed, hand weeding twice at 20 and 40 DAS, aqueous leaf extract spray of lantana and pine+2 hand weeding and soybean green manure incorporation insitu (1:1) + one hand weeding was evaluated along with weed free and weedy checks in maize (green cob)- mustard system. Observations on grain, straw yield and post harvest soil parameters were taken. In both maize (green cobs) and mustard, mulching with fresh eupatorium ambrosia @ 10 t ha^{-1} (after earthing up) recorded higher yield followed by aqueous leaf extract spray of lantana and pine spp. at 3-4 leaf stage of weed. The increase in yield under mulching with fresh Eupatorium/Ambrosia was found to be 19.4 and 29.8% in maize and 39.5 and 66.8% in mustard over weed free and weedy checks respectively. Two hand weeding along with aqueous leaf extract spray of lantana and pine and mechanical weeding + one hand weeding to both the crops was more effective than two hand weeding (20 and 40 DAS) alone. In situ incorporation of soybean green manure and hand weeding recorded lower yield compared to mulching or aqueous leaf extract spray. Straw yield also exhibited the similar trend. Post harvest analysis of soil sample indicates, bulk density was lower in mulching with Eupatorium/Ambrosia (1.18 g/cc). Soil was in acidic condition and no significant variation in pH was observed. Organic carbon content of soil ranged from 2.21 to 3.18% in various treatments and mulching with fresh Eupatorium/Ambrosia @ 10 t ha^{-1} recorded the higher organic carbon followed by insitu incorporation of soybean as green manure + one hand weeding (2.63%). Residual available N (276 kg ha^{-1}) was higher with mechanical weeding (20DAS) + hand weeding once (60 DAS) and weed free check which was followed by mulching with fresh Eupatorium/Ambrosia @ 10 t ha^{-1} (270 kg ha^{-1}). Available P in soil was higher with aqueous leaf extract spray of lantana and pine spp. at 3-4 leaf stage while K was higher in mulching with fresh Eupatorium/ Ambrosia @ 10 t ha^{-1}.

8. PUBLICATION AND HUMAN RESOURCE DEVELOPMENT

8.1 List of Publications

Research Papers

Subbarao, A., Singh AB and K. Ramesh (2011) Nutrient management strategies for organic package of practices. *In*: Proceedings of International Conference on Organic Bihar. June 22-24, 2011 p. 23-35.

Upadhyay, V B., Vikas Jain, S. K. Vishwakarma and A.K.Kumhar (2011) .Production potential, soil health, water productivity and economics of rice (Oryza sativa)–based cropping systems under different nutrient sources. *Indian Journal of Agronomy.* 56 (4): 311-316.

Book Chapters

Singh AB and Subba Rao A (2011). Efficient Methods of Organic Wastes Recycling for Sustainable Agriculture. In: Recycling Organic wastes Soil Health and Productivity. Published by Agrotech publishing Academy Udaipur, pp 1-344.

Subba Rao, Ramesh P, Sammi Reddy K, Singh AB and Ramesh K (2011) Soil fertility Management and Soil Quality Under organic Farming. In: Recycling Organic wastes Soil Health and Productivity. Published by Agro-tech Publishing Academy Udaipur, pp 1-344.

Singh AB (2011). Chemical and Biochemical quality assessment of compost prepared from organic wastes. In: Efficient Utilization of Farm Wastes for Sustainable Agriculture. Published by Agro-tech publishing Academy Udaipur, pp 1-328.

Presentation in Symposium/ Conferences

Singh AB, Ramesh K and Subba Rao A (2011). Nutrient Management Options in Organic Farming. In: State Level Seminar on "*Soil Health, Sustainability and Food Security*" at Dr Balsaheb Sawant Konkan Krishi Vidyapeeth, Dapoli Distt. Ratnagiri (M. S), held during January 21-22, 2011.

Ramesh K, AB Singh, S Ramana, Brijlal Lakaria, Dasrath Singh and Kuldeep S Solanki (2011). Chickpea responses to organic farming under conserved soil moisture. 76th ISSS convention held during 16-19, Nov 2011 at UAS, Dharward. P.14

Ramesh K, AB Singh, S. Ramana and NR Panwar (2011). Soybean yields in soybean based cropping systems under organic, inorganic and integrated nutrient management systems. National symposium cum brain storming workshop on Organic agriculture, 19-20 Apr 2011, CSKHPKV, Palampur, HP p. 48

Singh AB, K.Ramesh, S. Ramana, NR Panwar and A Subba Rao (2011) Improving Soybean quality under Organic Farming in soybean based cropping systems. Paper presented at National symposium cum brain storming workshop on Organic agriculture, 19-20 Apr 2011, CSKHPKV, Palampur, HP p. 47

Brij Lal Lakaria, K. Ramesh, A.B. Singh, J.K .Thakur and S. Ramana (2012). Phosphorus and potassium dynamics in soybean based cropping systems under different nutrient management options in a vertisol.

A. K. Jha, Upadhyay, V. B. and **Vishwakarma, S. K**. (2011). Diversification through selection vegetable crops for maximizing the productivity and soil health indifferent rice based cropping system under the organic farming. Paper presented in "*National Symposium on Vegetable Biodiversity*" organized byIndian Society of Vegetable Science, Varansi held at Jawaharlal Nehru Krishi VishwaVidyalaya, Jabalpur (M.P.) on 4-5 April 2011

Pamphlets

Singh AB, Ramana S, Brij Lal Lakaria, Ramesh K and Thakur JK (2012). Soybean ke Jaivik Kheti. Published by IISS, Bhopal.

Singh AB, Ramana S, Ramesh P, Panwar NR, Brij Lal Lakaria, Ramesh K and Thakur JK (2012). Isabgol ke Jaivik Kheti. Published by IISS, Bhopal.

Singh AB, Ramana S, Brij Lal Lakaria, Ramesh K and Thakur JK, Ramesh P and Panwar NR (2012). Durum wheat ke Jaivik Kheti. Published by IISS, Bhopal.

Singh AB (2012). Vermicopmosting (Hindi & English). Published by Indian Institute of Soil Science Bhopal

A.B. Singh, N.R. Panwar, P. Ramesh, S. Ramanna, K. Ramesh and J.K. Thakur (2012). Chana ki jaivik kheti, Published by Indian Institute of Soil Science Bhopal.

A.B. Singh, N.R. Panwar, P. Ramesh, S. Ramanna, K. Ramesh and J.K. Thakur (2012). Sarson ki jaivik kheti, Published by Indian Institute of Soil Science Bhopal.

8.2 Human Resource Development

1. M.sc /Ph.D. thesis generated from the project

S.No.	Name & Year	Thesis title	Degree
Jabalpur			
1.	Ms. Such Gangwar	Agronomic evaluation of biodynamic product and panchgavya for organic calculation of important cropping system	Ph D
2.	Ms Megha Dubey	Studies on comparative efficiency of organic, chemical and integrated nutrient management practices on soil health and crop productivity under various cropping system	Ph.D

2. Participation of Scientists in Seminars/workshops

S.No.	Title of the Programme	Name of the Scientists
Bajaura		
1.	International Conference on Preparing Agriculture for Climate Change organized by Crop Improvement Society of India on February 6-8, 2011 at PAU Ludhiana, India	Dr. D.K. Parmar
2.	National Symposium cum Brainstorming Workshop on Organic Agriculture Organised by Organic Agricultural Society of India, Palampur; ICAR, New Delhi; National Centre of Organic Farming, Gaziabad (UP) and CSKHPKV, Palampur on April 19-20, 2011 at CSKHPKV, Palampur	Dr. J.K. Sharma Dr. D.R. Thakur Dr. D.K. Parmar Dr. (Mrs.) Brij Bala

3. Human Resource Development in organic farming (Farmers) at Bhopal

Name of the Organization	Beneficiaries (No)	Coordinating Scientist	Duration of the training	Training imparted on
Purvi Champaran Distt. Bihar under ATMA Project	25	Dr A. B Singh	September, (16-21, 2011)	Organic farming and various technologies developed in the institute
Gaya Distt. Bihar under ATMA Project	25	Dr A. B Singh	26/09/2011 to 01/10/2011	Organic farming and various technologies developed in the institute
Saran Distt. Bihar under ATMA Project	25	Dr A. B Singh	October 10-15, 2011	Organic farming and various technologies developed in the institute
Darbhanga Distt. Bihar under ATMA Project	25	Dr A. B Singh	December 1-6, 2011	Organic farming and various technologies developed in the institute
Diara Development Project Patna, Bihar	25	Dr A. B Singh	December 26-30, 2011	Organic farming and various technologies developed in the institute
Supoul Distt. Bihar under ATMA Project	25	Dr A. B Singh	January 15-20, 2012	Organic farming and various technologies developed in the institute
Supoul Distt. Bihar under ATMA Project	25	Dr A. B Singh	February 02-07, 2012	Organic farming and various technologies developed in the institute
Raisen Distt. Madhya Pradesh ATMA Project	25	Dr A. B Singh	March 15-19, 2012	Organic farming and Soil health in the institute.
Banka Distt. Bihar under ATMA	25	Dr A. B Singh	June 2-7, 2012	Organic farming and Soil health in the institute

4. Human Resource Development in organic farming (Technical) for students at Bhopal

Name of college	Details of training programme	Coordinating Scientist	Duration	Topic
Govt. Geetanjali Girls college, Bhopal	12 students of B.Sc. IIIrd Semester.	Dr. A.B. Singh	10 days	Vermicomposting and Vermiculture technique
Govt. Geetanjali Girls college, Bhopal	13 students of B.Sc. vth Semester.	Dr. A.B. Singh	10 days	Vermicomposting and Vermiculture technique

9. APPENDIX

Details of crops and varieties used in experiment at various locations

Crop	Variety	Duration / days
Bajaura		
Tomato (Summer)	No.7711/Roma/Naveen/Heem Sona	Medium
French bean (Summer)	Falguni	Medium
Cauliflower (Summer)	Megha	Medium
French bean (*Kharif*)	Falguni	Medium
Cauliflower (*Kharif*)	Swati	Medium
French bean (*Kharif*)	Pole Type	Medium
Maize (*Kharif*)	Bajaura Makka	Medium
Pea (*Rabi*)	Azad P-1/GC-477/DPP-68	Medium
Cauliflower (*Rabi*)	Swati	Medium
Garlic (*Rabi*)	GHC-1	Long
Coriander (Kharif)	Hybrid 363	Medium
Bhopal		
Soybean	JS-335	
Duram wheat	HI-8498	
Mustard	Pusa Bold	
Chickpea	JG-130	
Linseed	JL-9	
Calicut		
Ginger	Varada, Rejatha and Mahima	Short
Turmeric	Alleppey Supreme,Prathibha	Short
Black pepper	Sreekara, Panniyur -1	Long
Coimbatore		
Green manure (Sun hemp)	CO 1	45
Cotton	MCU 12/Suraj	167/170
Maize	CO1	93
Chillies	K1	170
Sunflower	CO 4	92
Brinjal	CO 2	170
Sunflower	CO 4	92
Daincha (GM)	Local	63
Rice	White Ponni	141
Greengram	CO 6	64
Dharwad		
Groundnut	GPBD-4	105-110 days
Rabi sorghum	DSV-4	Medium
Soybean	JS-335	85-90 days
Durum wheat	DWR-2006	85-90 days
Potato	Kufri Jawahar	85-90 days
Chickpea	JG-11	85-90 days
Cotton	DHB-915	175-180 days
Pea	Arka komal	60 days
Maize	Arjun	110-115 days
Chilli+onion	Byadagi dabbi+Arka kalyani	Medium
Sugar Cane	CO86032	
Soybean	DSB-121	
	DSB-8	

Crop	Variety	Duration / days
	DSB-21	
	DSB-16	
	DSB-18	
	JS-335	85-90 days
Groundnut	Dh 4-3	
	Dh 86	
	Dh 2000-1	
	Dh 101	
	Mutant III	
	JL 24	
	TMV 2	
	TGLPS 3	
	GPBD 4	
	GPBD 5	105-110 days
Chickpea	JJ-11	Long
	BGD-103	
	A-1	-
	BG-1105	-
	BG-256	-
	ICCV-10	-
	KAK-2	-
	ICCV-2	-
French bean	Arka Komal	
Jabalpur		
Basmati rice	PB	127
Wheat	MPO-1106	140
Chickpea	JG-322	128
Berseem	JB-1/JB-5	174/160
Vegetable pea	Arkel	98
Sesame	TKG-55	123
Sorghum	MP Chari	51
Sun hemp	Local	47
Karjat		
Rice	*Karjat - 4*	Early
Groundnut	*SB-XI*	Early
Maize (Sweet corn)	*Sugar-75*	Early
Mustard	*Varuna*	Early
Dolichos bean(Green pod vegetable)	*Konkan Bhushan*	Early
Red pumpkin	*MPH 1*	Medium
Cucumber	*Himangi*	Medium
Green gram	*Vaishali*	
Mango	*Alphonso*	15 years old mango trees
Ludhiana		
Cotton	F-1861	
Chickpea	GPP-2/BG-1053	
Maize	Peral Popcorn/PMH-1/J-1006	
Basmati rice	PB-2	
Wheat	PBW-550	
Summer moong	SML-668	
Turmeric	Local	
Onion	Pb.Naroya	
Potato	Kufri Jyoti	
Bajra	PCB-164	Short
Cowpea	CL-367	Short
Sorghum	SL-44	Short
Guara	Guara-80	Short

Crop	Variety	Duration / days
Berseem	BL-10	Short
Oats	OL-9	Short
Modipuram		
Basmati rice	Basmati 370 / PB-2	/120
Rice	Saket-4	
Maize cob	Star-56	
Maize grain	Star-56	
Wheat	PBW-343	
Barley	Ajad	
Mustard	Pusa Bold	115
Radish	Ivory White	
Potato	Chipsona-3	
Okra	Arka Anamika	
Green gram	SML-668	
Chickpea	Avrodhi	160
Cowpea	Pusa barsati	
Pantnagar		
Sesbania	Ses pant - 1	
Rice	Pusa Basmati -1/ Pusa-1121	Medium
Wheat	PBW-343/ PBW-502	Medium
Lentil	Pant Lentil - 406	Medium
Vegetable pea	Arkel	Early
Brassica napus	GLS-1	Medium
Chick pea	Pant Kabuli Chana-1	
Maize	Gaurav	
Moong	Pant Moong-5	
Raipur		
Soybean	JS – 335	Medium
Berseem	JB-2	Medium
Isabgol	GI-2	Medium
Onion	Nasik red	Medium
Safflower	NARI-NH 1	Medium
Rice	Kasturi	Medium
Chickpea	Vaibhav	Medium
Mustard	Pusa bold	Medium
Lentil	JL-1	Medium
Ranchi		
Rice	Birsamati	125 - 135 (Medium)
Wheat	K- 9107	130
Potato	Kufri Ashoka	95
Linseed	Shekhar	140
Lentil	PL 406	115
Umiam		
Maize (green cob/seed)	DA61-A	80/110 days
Soybean	JS-80-21	40 days/142days
Frenchbean	Naga local	100 days/120days
Toria	M-27	127 days
Tomato	Avinash-2	140 days/105days
Potato	Kufri jyoti	110 days
Rice	IR-64/Lumpnah/Vivek dham/Sahsarang-1/Bhalum-1	140days/140days/ 135days/140days/125days
Carrot	New curoda	98days

10. ANNEXURE

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ACRONYMS

ALE : Aquous leaf extract

ASE : Aquous seed extract

B:C : Benefit:Cost

BD : Biodynamic

CC : Cost of cultivation

CDM : Cowdung manure

Cu : Copper

EC : Enriched compost

ECe : Electrical conductivity

fb : followed by

Fe : Iron

FYM : Farm yard manure

GLM : Green leaf manure

GM : Green manure

GR : Gross returns

IM : Integrated management

K : Potassium

KC : Karanj cake

Mn : Manganese

MOP : Muriate of potash

N : Nitrogen

NC : Neem coated

NEOC : Non edible oil cakes

NPV : Nuclear Polyhedrosis virus

NR : Net returns

OC : Organic carbon

P : Phosphorus

PG : Panchagavya

pH : Negative logarithum of hydrogen ion concentration

PPM : Parts per million

RP : Rock phosphate

SSP : Single super phosphate

VC : Vermicompost

Zn : Zinc

NOTES

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Visit by Shri Umesh Katti, Hon'ble Agriculture Minister of Govt. of Karnataka to NPOF experiments at Dharwad

Monitoring of NPOF experiment at Umiam by Dr. B. Gangwar, Project Director, PDFSR

भाकृअनुप
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