NETWORK PROJECT ON ORGANIC FARMING

Consolidated Report (2004 to 2011)

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

About PDFSR

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

Vision

- Sustainable management of farm resources in integrated manner for achieving household food, nutritional and livelihood improvement.

Mission

- Food, nutrition, livelihood and environment improvement of small and marginal farmers through integrated farming systems research approach.

Focus

- Characterization and dynamics of farming systems at macro and micro level
- Location-specific efficient farming system models
- Integrated organic farming systems
- Bio-intensive diversified complementary cropping systems using resource efficient land configurations
- System-based conservation agriculture
- Climate-resilient agriculture production systems
- Precision/ Hi-tech agriculture
- On-farm post-harvest processing and value addition
- Capacity building/ human resource development in IFS

All India Coordinated Research project on Integrated Farming Systems (AICRP on IFS) is an integral part of PDFSR with 31 on-station IFSR centres, 11 on-station CSR centres and 32 on-farm research centres spread across length and breadth of the country. The directorate is also leading a Network Project on Organic Farming (NPOF) with 13 centres from 2004.

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Compiled & Edited by : Dr. B. Gangwar, Project Director
: Dr. Kamta Prasad, Programme Facilitator, CU
: Dr. N. Ravisankar, Principal Scientist (Agronomy), CU

Data processing by : Dr. N. Ravisankar, Principal Scientist (Agronomy), CU
Mr. K. P. Singh, Technical Officer, CU
Dr. Brij Mohan, Technical Officer, CU

Hindi Translation by : Dr. Brij Mohan, Technical Officer, CU

Type set by : Mr. Brij Beer Singh, Personal Assistant

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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 consolidated report is based on experimental data generated during *kharif*, *rabi* and *summer* seasons from April 2004 to June 2010. The other details are relevant up to 31 March 2011.
- The report includes both processed and semi-processed data, generated in different experiments under NPOF and 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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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 work and generating data over the years (2004 to 2011). The sincere efforts put forth by **Dr. N. Ravisankar**, Principal Scientist deserves words of appreciation for drafting, editing and proof corrections 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. Brij Mohan**, Technical Officers for their cooperation in compilation of the data of six years and help in checking the proofs. I also express my happiness to **Mr. Brij Beer Singh**, Personal Assistant in typing the whole report in a shortest possible time.

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 scientific findings derived from the consolidated report will go in a long way in preparation of road map and policy guidelines for implementation of organic farming in India specially in the context of emerging food, nutritional and health concerns of the society.

(B. GANGWAR)
Project Director

CONTENTS

मुख्य उपलब्धियाँ

उत्पादन शुद्ध आय एवं जैविक कार्बन बढाने के लिए विगत छः वर्षो में विभिन्न केन्द्रों पर किये गये परिक्षणों की मुख्य उपलब्धियाँ निम्न हैं ।

1. विभिन्न फसलों / फसल प्रणालियों के लिए जैविक, रसायनिक एवं समेकित प्रबन्धन का पोषण हेतु मूल्याँकन

- भिण्डी, हल्दी, कपास, गाजर, काली मिर्च एवं लोबिया की उपज में रसायनिक के बजाय जैविक खेती अपनाने से 20 प्रतिशत की वृद्धि पायी गयी। इसी प्रकार प्याज, अदरक, फ्रैन्चबीन में 10–20 प्रतिशत की वृद्धि पायी गयी। जबकि, मूगँ, सूरजमुखी और लहसुन की उपज में 5–10 प्रतिशत की वृद्धि पायी गयी। लगभग 5 प्रतिशत की वृद्धि मक्का, सोयाबीन, बरसीम, बैंगन, मिर्च ,शिमला मिर्च, टमाटर, ज्वार एवं मटर मे भी विभिन्न स्थानों व मौसमों में उपज में वृद्धि पायी गयी।
- रसायनिक की तुलना में समेकित प्रबन्धन अपनाने सें हल्दी, अदरक, कपास और गाजर की उपज में 20 प्रतिशत की वृद्धि पायी गयी। जबकि, मक्का, आलू, मूली, मूगँ, प्याज, सूरजमूखी, बन्दगोभी, कालीमिर्च, लहसुन एवं लोबिया की उपज में यह वृद्धि 10–20 प्रतिशत रही। तथा अन्य फसलों की उपज में लगभग 10 प्रतिशत की वृद्धि पायी गयी।
- इसके विपरित कुछ फसलों में जैविक खेती अपनाने से उपज में कमी भी देखी गई यह कमी मूली व ईसबगोल की उपज में 20 प्रतिशत, गेहूँ, आलू, बन्दगोभी, फ्रैचबीन एवं मसूर में 10–20 प्रतिशत, सरसों, फूलगोभी एवं बेबीकार्न में 5–10 प्रतिशत तथा धान, चना एवं मूँगफली में 5 प्रतिशत पायी गई।
- रसायनिक प्रबन्धन की तुलना में जैविक प्रबन्धन अपनाने से शुद्ध आय में भी वृद्धि विभिन्न फसलक्रमों में विभिन्न केन्द्रों पर पायी गयी। जबलपुर मे, धान–गेहूँ, मिर्च–प्याज और अदरक–प्याज कोयम्बटूर में, मूँगफली–ज्वार धारवाड में, कपास–गेहूँ, मक्का–चना, मक्का–आलू–मूँग, धान–गेहूँ–मूँग, ज्वार–बरसीम, मक्का–बरसीम–बाजरा, मक्का–बरसीम–मक्का+लोबिया और ज्वार–ज्वार–जई–लोबिया लुधियाना में, फूलगोभी–मूली–टमाटर और बन्दगोभी–मूली–शिमला मिर्च बजौरा में, धान–गेहूँ–ढैंचा और धान–मटर (सब्जी)–ढैंचा पन्तनगर में और धान–गाजर में उमियम केन्द्र पर जैविक खेती से 20 प्रतिशत से अधिक शुद्ध आय मिली।
- जैविक खेती से बजौरा में, बन्दगोभी–मूली–शिमला मिर्च फसल प्रणाली की शुद्ध आय रसायनिक प्रबन्धन में अकार्बनिक प्रबन्धन की अपेक्षा 352.8 प्रतिशत ज्यादा थी, जबकि लुधियाना में कपास–गेहूँ व मक्का–आलू–मूँग से प्राप्त शुद्ध आय क्रमशः 153.3 और 96.7 प्रतिशत ज्यादा थी। कोयम्बटूर में, हल्दी + प्याज (सहफसली) खेती में भी जैविक खेती से प्राप्त शुद्व आय रासायनिक खेती की तुलना में 76 प्रतिशत ज्यादा थी।
- जैविक प्रबन्धन अपनाने से विभिन्न केन्द्रों पर विभिन्न फसलक्रमों से प्राप्त शुद्ध आय में अलग–अलग कमी पायी गयी। रसायनिक प्रबन्धन के बजाय जैविक प्रबन्धन अपनाने से कालीकट में, हल्दी से प्राप्त शुद्ध आय में 20 प्रतिशत अधिक की कमी पायी गयी। इसी प्रकार विभिन्न फसलक्रमों द्वारा तथा विभिन्न स्थानों पर जैसे धान–मूँगफली, चना–मक्का और धान–बीन कर्जट केन्द्र पर, धान–सरसों कर्जट व राँची में, सेम–फूलगोभी–सेम ने बजौरा में, धान–सरसों–ढैंचा पन्तनगर में, सोयाबीन–सरसों ने भोपाल व रायपुर केन्द्र पर, अदरक कालीकट में, धान–मसूर–ढैंचा पन्तनगर व धान–सेम उमियम स्थानों पर 10–20 प्रतिशत कम शुद्ध लाभ मिला। इसके अलावा, कोयम्बटूर में मक्का–कपास, उमियम में धान–टमाटर व बजौरा में मक्का–अदरक फसलक्रमों में जैविक प्रबन्धन अपनाने से शुद्ध लाभ में 10 प्रतिशत की कमी दर्ज की गयी।

- अधिकाशंतः ऐसे फसलक्रम जिन्होने रसायनिक प्रबन्धन की अपेक्षा समेकित प्रबन्धन अपनाया जैविक प्रबन्धन की तरह ही 20 प्रतिशत से अधिक शुद्ध लाभ अर्जित किया। इसके अतिरिक्त कालीकट केन्द्र पर हल्दी व अदरक फसलों जिन्होनें जैविक प्रबन्धन में 20 प्रतिशत से अधिक कम शुद्ध लाभ दिया ने समेकित प्रबन्धन में रसायनिक प्रबन्धन की अपेक्षा क्रमशः 54.8 और 27.7 प्रतिशत अधिक शुद्ध लाभ दिया। इसी प्रकार अन्य फसल चक्र जैसे धान–टमाटर और धान–सेम द्वारा उमियम में, मक्का–लहसुन और सेम–फूलगोभी–सेम बजौरा में, जैविक प्रबन्धन में रसायनिक प्रबन्धन की अपेक्षा कम शुद्ध लाभ मिला परन्तु समेकित प्रबन्धन में लगभग 10 प्रतिशत अधिक शुद्ध लाभ प्राप्त किया गया। इससे इन फसलक्रमों के लिए समेकित प्रबन्धन की सार्थकता प्रतीत होती है।
- कर्जट में, धान–मूँगफली एवं धान–मक्का फसल क्रम को छोडकर शेष सभी फसल क्रमों में जैविक प्रबन्धन अपनाने से मृदा में जैविक कार्बन की मात्रा में वृद्वि पायी गयी। भूमि में जैविक कार्बन में लगभग 20 प्रतिशत से अधिक वृद्धि विभिन्न फसलक्रमों जैसे धान–गेहूँ मोदीपुरम, जबलपुर और राँची केन्द्र पर, मक्का–सरसों–मूली–मूँग, धान–आलू–मूली, मक्का–आलू–भिण्डी, बेबीकार्न–आलू–मूँग, ज्वार (चारा)– मटर–भिण्डी, धान–जौं +सरसों–मूँग को मोदीपुरम केन्द्र पर जैविक प्रबन्धन अपनाने से पायी गयी। लुधियाना में फसल चक्र जैसे कपास–गेहूँ, धान–गेहूँ–मूँग, मक्का–आलू–मूँग, मक्का–चना, मक्का–गेहूँ–लोबिया (चारा) एवं हल्दी प्याज कोयम्बटूर में जैविक प्रबन्धन अपनाने पर जैविक कार्बन में वृद्वि पायी गयी। सभी फसलक्रमों में भूमि में जैविक कार्बन की मात्रा में लगभग 10 प्रतिशत की वृद्धि पायी गयी। कर्जट में, जैविक प्रबन्धन अपनाने से धान–मूँगफली और धान–मक्का, फसलक्रम में जैविक कार्बन की मात्रा में लगभग 3. 3 और 3.5 प्रतिशत की कमी पायी गयी।
- रसायनिक प्रबन्धन के बजाय समेकित प्रबन्धन अपनाने से भूमि में जैविक कार्बन की मात्रा में वृद्धि तो हुई परन्तु यह वृद्धि जैविक प्रबन्धन की अपेक्षा कम थी। कर्जट में धान–मक्का, धान–मूँगफली और धान–फ्रैन्चबीन एवं कालीकट में हल्दी और रायपुर व भोपाल में सोयाबीन–चना फसल चक्र अपनाने से जैविक कार्बन में क्रमशः 2.7, 1.1, 6.7, 4.3 एवं 1.8 प्रतिशत की कमी पायी गयी।

2. पौषक तत्व स्रोत के लिए विभिन्न जैविक स्रोतों का मूल्याँकन

- मोदीपुरम केन्द्र पर किये गये परीक्षण में पाया गया कि बासमती धान–गेहूँ और बासमती धान–आलू–प्याज फसलक्रमों की नत्रजन आवश्यकता को यदि 33 प्रतिशत उपजाऊ कम्पोस्ट + 33 प्रतिशत वर्मीकम्पोस्ट + 33 प्रतिशत अभोज्य चूरा के मिश्रण द्वारा दिया जाये तो नियन्त्रण की तुलना में उपज में 61 प्रतिशत शुद्ध आय में, 150 प्रतिशत उपज एवं जैविक कार्बन में 29.6 प्रतिशत की वृद्धि पायी गयी।
- बासमती धान–गेहूँ फसल क्रम में नत्रजन की आपूर्ति 50 प्रतिशत गोबर की खाद एवं 50 प्रतिशत नीम की खली द्वारा, एवं बरसीम में 33 प्रतिशत गोबर की खाद + 33 प्रतिशत नीम की खली एवं 33 प्रतिशत वर्मीकम्पोस्ट द्वारा करने पर जबलपुर में उपज एवं शुद्ध लाभ में वृद्धि पायी गयी। बासमती धान–गेहूँ एवं बासमति धान–बरसीम फसल क्रमों को नत्रजन की आपूर्ति हेतु प्रयुक्त गोबर की खाद (1/3), नीम की खली (1/3), व वर्मीकम्पोस्ट (1/3) द्वारा, भूमि में जैविक कार्बन की मात्रा में 5.80 प्रतिशत की वृद्धि पायी गयी। कोयम्बटूर में धान–उर्द–तिल और मक्का–सूरजमुखी फसलक्रमों में नत्रजन की आपूर्ति हेतु प्रयुक्त गोबर की खाद (50:) + अभोज्य नीम का चूरा (50:) द्वारा उपज में वृद्धि पायी गयी। तथा शुद्ध लाभ 247.4 प्रतिशत अधिक प्राप्त हुआ जबकि भूमि में जैविक कार्बन में 60 प्रतिशत की वृद्धि पायी गयी।
- रायपुर में धान–चना एवं धान–गेहूँ/सरसों. मसूर फसलक्रमों की नत्रजन आपूर्ति हेतु प्रयुक्त अभोज्य नीम की खली (1/3) + गाय के गोबर की खाद (1/3) एवं उपजाऊ कम्पोस्ट (1/3) द्वारा उपज में वृद्धि अंकित की गयी एवं शुद्ध लाभ 90.7 प्रतिशत एवं भूमि में जैविक कार्बन में 6.4 प्रतिशत की वृद्धि पायी गयी।

- कालीकट में हल्दी व अदरक फसल क्रम में अदरक के लिए प्रति हैक्टर 15 टन गोबर की खाद + 2 टन नीम की खली व 5 टन नारियल की जटा की कम्पोस्ट, एवं हल्दी के लिए प्रति हैक्टर 30 टन गोबर की खाद प्रयुक्त करने से, हल्दी व अदरक की उपज में क्रमशः 30.1 एवं 28.6 प्रतिशत की वृद्धि अंकित की गयी उपचार तदानुसार शुद्ध लाभ में वृद्धि पायी गयी जबकि भूमि में जैविक कार्बन की मात्रा में वृद्धि प्रति हैक्टर 30 टन गोबर की खाद द्वारा पायी गयी।
- धारवाड में मूँगफली –ज्वार, सोयाबीन–गेहूँ एवं मिर्च–कपास–कपास फसलक्रमों की नत्रजन की आपूर्ति हेतु उपजाऊ कम्पोस्ट + वर्मीकम्पोस्ट एवं हरी पत्तियों की खाद प्रत्येक द्वारा 3/8 भाग प्रतिस्थापित करने पर उपज एवं शुद्ध लाभ में वृद्धि पायी गयी जबकि भूमि में जैविक कार्बन की मात्रा में सर्वाधिक वृद्धि गोबर की खाद (3/4) + हरी पत्तियों की खाद (1/4) को प्रयुक्त करने से हुई।
- कर्जट में खरीफ मौसम में धान–शिमला मिर्च एवं धान–खीरा फसलक्रमों में आवश्यक नत्रजन की आपूर्ति हेतु गोबर की खाद (1/3) + धान की पुआल (1/3) + ग्लाईरीसीडिया की हरी पत्तियॉ (1/3) एवं रबी के मौसम में गोबर की खाद (1/3) + नीम की खली (1/3) + वर्मीकम्पोस्ट (1/3) द्वारा करने से उपज, शुद्ध लाभ एवं मृदा में जैविक कार्बन की मात्रा में वृद्धि पायी गयी।
- लुधियाना में खरीफ मौसम में मक्का–चना फसलक्रम में नत्रजन आवश्यकता की आपूर्ति हेतु हरी खाद द्वारा व गोबर की खाद का प्रयोग रबी मौसम में, तथा धान–गेहूँ फसलक्रम के लिए हरी खाद + गोबर की खाद + वर्मीकम्पोस्ट खरीफ मौसम व गोबर की खाद + वर्मी कम्पोस्ट व फसल अवशषों का प्रयोग रबी मौसम में करने से बेहतर उपज प्राप्त की गयी। हरी खाद व गोबर की खाद का अनुप्रयोग खरीफ व गोबर की खाद तथा फसल अवशेषों का प्रयोग रबी मौसम में करने से भूमि में जैविक कार्बन की वृद्धि पायी गयी।
- बजौरा केन्द्र पर फूलगोभी–मटर/मूली–टमाटर फसलक्रम में गोबर की खाद व वर्मीकम्पोस्ट का प्रयोग करने से उपज एवं शुद्व आय में वृद्धि अंकित की गयी। गोबर की खाद का प्रयोग अन्य कार्बनिक उपचारों की तुलना में भूमि में जैविक कार्बन बढाने में सार्थक सिद्व हुआ।
- भोपाल में गाय के गोबर की खाद + वर्मीकम्पोस्ट व मुर्गी की खाद द्वारा सोयाबीन–गेहूँ व सोयाबीन–सरसों फसलचक्रों में प्रयोग करने से उपज शुद्ध लाभ व भूमि में जैविक कार्बन की मात्रा में वृद्धि पायी गयी।
- पन्तनगर में, धान–गेहूँ, धान–चना और धान–हरी मटर फसल क्रमों की नत्रजन आवश्यकता की आपूर्ति गोबर की खाद (50%) और वर्मीकम्पोस्ट (50%) द्वारा करने पर अधिक उत्पादन प्राप्त किया गया। इसी उपचार द्वारा भूमि में जैविक कार्बन की मात्रा भी बेहतर पायी गयी। एक अन्य उपचार, जिसमें कि प्रत्येक से 25 प्रतिशत नत्रजन का प्रतिस्थापन उपजाऊ कम्पोस्ट, वर्मीकम्पोस्ट, अभोज्य खली और गोबर की खाद द्वारा किया गया में भी मृदा में बेहतर जैविक कार्बन पाया गया।
- रॉची में धान–गेहूँ, धान–मसूर/आलू फसलक्रमों में आवश्यक नत्रजन की आपूर्ति गोबर की खाद (33%) + नीम की खली (33%) + वर्मीकम्पोस्ट (33%) द्वारा करना अधिक फायदेमन्द पाया गया।
- उमियम में, धान + सोयाबीन–सरसों, धान + सोयाबीन–टमाटर, मक्का + सोयाबीन–मूँगफली, मक्का + सोयाबीन–सेम, सेम–टमाटर, मूली–आलू और सेम–गाजर फसलक्रमों में गोबर की खाद, वर्मीकम्पोस्ट व स्थानीय कम्पोस्ट के समेकित प्रयोग से अधिक उपज, शुद्ध लाभ एवं मृदा में अधिक जैविक कार्बन पाया गया।

3. कार्बनिक खेती में रोग एवं कीट प्रबन्ध

- मोदीपुरम केन्द्र पर धान–चना फसलक्रम में रोग एवं कीट नियन्त्रण हेतु ग्रीष्मकालीन जुताई फायदेमन्द पायी गयी जबकि हरी खाद का उपचार बासमती धान–सरसों फसल क्रम के लिए बेहतर पाया गया। रोग नियन्त्रण हेतु ट्राइकोड्रमा द्वारा मृदा एवं पर्णीय प्रयोग स्यूडोमोनास द्वारा बीज उपचार अधिक प्रभावी पाये गये।

- कोयम्बटूर केन्द्र पर धान–धान फसलक्रम में कीट एवं रोग निदान हेतु कर्षण, जैविक, वानस्पतिक, मशीनीकरण एवं व्यवहारिक विधियों को अपनाने से बेहतर उपज, शुद्ध लाभ एवं सूक्ष्म जीवाणु की संख्या में वृद्धि अंकित की गयी। कोयम्बटूर एवं रायपुर केन्द्रों पर नीम + महुआ की खली + ट्राइकोड्रमा + नीम के मिश्रण का छिड़काव एवं परसेज चिडिया का अनुप्रयोग बेहतर पाया गया।
- जबलपुर में, टिलरिंग एवं पेनीकल इनिसियेशन हेतु बासमती धान में स्यूडोमोनास फ्लोरिसेन्स द्वारा मृदा उपचार + नीम के घोल के द्वारा दो छिडकाव के साथ–साथ हरी खाद या ग्रीष्मकालीन जुताई द्वारा अधिक उपज पायी गयी जबकि गेहूँ में ट्राइकोड्रमा व स्यूडोमोनास फ्लोरिसेन्स (1:1) द्वारा बीज उपचार करने अधिक शुद्व लाभ प्राप्त हुआ।
- कालीकट में, आई.आई.एस.आर–6 + आई.आई.एस.आर–8 + आई.आई.एस.आर–13 + आई.आई.एस.आर–51 + आई. आई.एस.आर–151 ओर पी बी–21 + पी आई ए आर–6 के मिश्रण का जैविक कल्चर अदरक और हल्दी फसलों के लिए बेहतर साबित हुआ।
- धारवाड में बरटीसिलियम लीकायनी + इकोनीम + नीम के बीजों का घोल + वानस्पतिक का छिडकाव करने से मिर्च को रोग एवं कीट नियन्त्रण रखने में बेहतर पाये गये।
- कर्जट में वर्मीकम्पोस्ट 100 कि0 ग्रा0 तथा 20 कि0 गा0 ग्लारीसीडिया की पत्तियों का बेसल प्रयोग प्रति आम के पौधे में करने से अधिक फल उपज, शुद्ध लाभ एवं लाभ लागत अनुपात प्राप्त हुए।
- लुधियाना में धान के बीज का नीम की खली से उपचार करने के साथ–साथ ट्राइकोड्रमा हर्जियानम के दो छिडकाव करने से बेहतर उपज प्राप्त हुई। ट्राइकोड्रमा हर्जियानम द्वारा मृदा उपचार गेहूँ की फसल के लिए बेहतर पाया गया।
- भाँग की पत्तियों का जलीय घोल टमाटर के लिए बजौरा में अधिक फायदेमन्द पाया गया।
- मक्का तथा सोयाबीन फसलों हेतु करंजी 3 मिली/लीटर का छिडकाव करने से उमियम में अधिक उपज प्राप्त हुई।

4. जैविक खेती में खरपतवार नियन्त्रण

- कोयम्बटूर में, उर्द–ज्वार–तिल एवं सूरजमुखी–कपास–हरी खाद फसलचक्र में यांत्रिक एवं एक निराई हाथो द्वारा साथ–साथ करने से अधिक शुद्ध लाभ पाया गया।
- पन्तनगर में, बुआई के 20 व 40 दिनो में दो गुडाई हाथों द्वारा करने पर धान एवं मसूर के अर्न्तगत शुद्ध लाभ अधिक पाये गये एवं स्टेल सीड सैय्या + दो गुडाई हाथों द्वारा करने पर सरसों में बेहतर परिणाम पाये गयें।
- रॉची केन्द्र पर बासमती धान एवं गेहूँ फसल के अर्न्तगत चाहे श्रमिकों द्वारा या एक्यूएस पत्तियों के घोल का 3 से 4 छिडकाव करने पर खेत को खरपतवार रहित रखने से अधिक उपज प्राप्त की गयी।
- जबलपुर में, बासमती धान एवं गेहूँ में हाथों द्वारा निराई से अथवा दो निराइयां हाथों द्वारा और मशीनीकरण निराई के मिश्रण से खेतो को खरपतवार रहित रख कर अधिक शुद्ध लाभ प्राप्त किया गया।
- मक्का एवं सरसों फसलों के अन्तर्गत उमियम केन्द्र पर हरे यूपेटोरियम अथवा एम्ब्रोसिया का पलवार अथवा हरे यूपेटोरियम का पलवार एवं एक निराई हाथों द्वारा करने से बेहतर परिणाम प्राप्त हुए।

SALIENT FINDINGS

The increase in yield, net returns and organic carbon across the locations over six years were pooled (Appendix IV to VI) and the experiment wise salient findings are given below.

1. Evaluation of organic, inorganic and INM as nutrient input system for various crops/cropping systems

- Okra, turmeric, cotton, carrot, black pepper and cowpea have recorded more than 20% increase in yield under organic nutrient input system compared to inorganic system. The increase in yield of onion, ginger, dolichos bean are in the range of 10-20 % while greengram, sunflower and garlic recorded 5 to 10% increase in yield. An increase of up to 5% was observed in maize, soybean, berseem, brinjal, chilli, capsicum, tomato, sorghum and peas across the seasons and locations.

- Turmeric, ginger, cotton and carrot have recorded more than 20% increase in yield under Integrated Nutrient Management (INM) package compared to inorganic system. Maize, potato, radish, greengram, onion, sunflower, cauliflower, black pepper, garlic and cowpea registered an increase in yield to the tune of 10 to 20% over inorganic system. Other crops recorded up to 10% increase in yield with INM package.

- Yield reduction of > 20% was observed for radish and Isabgol with organic nutrient input system. Wheat, potato, cabbage, french bean and lentil have recorded reduction of 10 to 20% while in mustard, cauliflower, and baby corn, the reduction is only 5 to 10% . Rice, chickpea and groundnut recorded yield reduction of < 5% with organic nutrient input system over inorganic system. In the case of INM practice, only pea and lentil registered reduction in yield to the tune of < 5% over inorganic system.

- Rice-berseem at **Jabalpur**, chilli- onion and turmeric +onion at **Coimbatore**, groundnut-sorghum at **Dharwad**, cotton-wheat, maize-gram, , maize –potato- summer moong, rice-wheat- summer moong, sorghum - berseem, maize-berseem –bajra, maize-berseem – maize+cowpea and sorghum+ guar-oats-cowpea at **Ludhiana**, cauliflower-radish-tomato and cabbage-radish- capsicum at **Bajaura**, rice-wheat-*Sesbania* and rice-pea (vegetable)- *Sesbania* at **Pantnagar** and rice-carrot at **Umiam** recorded > 20% increase in net returns with organic nutrient input system compared to inorganic system.

- Cabbage-radish-capsicum system at **Bajaura** increased the net returns to as high as 352.8% compared to inorganic system. The increase in net return of cotton-wheat and maize-potato-summer moong at **Ludhiana** is also higher as it recorded an increase of 153.3 and 96.7% respectively. Turmeric +onion at **Coimbatore** recorded an increase of 76% in net returns with organic nutrient input system.

- Reduction in net return of > 20% was observed in turmeric at **Calicut**, rice- groundnut, rice- maize and rice- dolichos bean at **Karjat**, rice- mustard at **Karjat** and **Ranchi**, french bean – cauliflower – french bean at **Bajaura**, and rice- mustard-*Sesbania* at **Pantnagar**. Soybean-mustard at **Bhopal and Raipur**, ginger at **Calicut**, rice- lentil – *Sesbania* at **Pantnagar** and rice- french bean at **Umiam** had registered reduction of 10-20% in net returns with organic input system compared to inorganic system. The reduction in net return of maize- cotton at **Coimbatore**, rice- tomato at **Umiam** and maize-garlic at **Bajaura** was up to 10% only.

- Most of the systems which recorded >20% higher net returns with organic input system have also performed better under INM by recording > 20% increase over inorganic system. In addition, the crops like turmeric and ginger at **Calicut** which recorded reduction of > 20% net returns under organic system have recorded increase of net returns to the tune of 54.8 and 27.7% respectively with INM practice. Similarly, the cropping systems *viz*, rice- tomato and rice- French bean at **Umiam**, maize-

garlic and french bean –cauliflower- french bean at **Bajaura**, which also recorded reduction in net returns under organic system have recorded increase of > 10% net returns with INM practice indicating suitability of INM package for these systems than organic system.

- Organic carbon content of soils increased significantly in all the cropping systems with organic nutrient input systems except rice- groundnut and rice- maize systems at **Karjat**. An increase of > 20% organic carbon in soils was observed with many systems like rice-wheat at **Modipuram, Jabalpur and Ranchi**, maize- mustard- radish- green gram, rice- potato- radish, maize - potato- okra, baby corn- potato-greengram, sorghum (F)- pea-okra and rice – barley + mustard – green gram at **Modipuram**, cotton –wheat, rice-wheat- summer moong, maize- potato- moong (S), maize-gram, maize-wheat- cowpea (F) at **Ludhiana** and turmeric +onion at **Coimbatore** over a period six years. The increase in organic carbon content of soil was found to be up to 10% for all the other cropping systems experimented. Rice-groundnut and rice-maize at **Karjat** recorded reduction of 3.3 and 3.5% organic carbon respectively with organic nutrient input system.

- Application of nutrient through INM practice also registered increase in organic carbon over inorganic system but the increase is lesser than the organic nutrient input system. Rice- maize, rice- groundnut and rice-dolichos bean at **Karjat**, turmeric at **Calicut** and soybean-chickpea at **Raipur and Bhopal** have recorded reduction of 2.7, 1.1, 6.7, 4.3 and 1.8 % respectively.

2. Evaluation of various sources of organics for nutrient source

- Application of enriched compost + vermicompost + non edible oil cakes @ 1/3 each to meet the nitrogen requirement in basmati rice-wheat and basmati rice-potato-onion systems at **Modipuram** recorded 61% increase in yield, 156% increase in net returns and 29.6% increase in organic carbon over control.

- Farm yard manure + neem cake @ ½ each to meet the nitrogen requirement in basmati rice-wheat system and farm yard manure + neem cake + vermicompost @ 1/3 each to berseem registered higher grain yield and net returns at **Jabalpur**. The increase in organic carbon was higher (5.80%) with farm yard manure + neem cake + vermicompost @ 1/3 each in basmati rice-wheat and basmati rice-berseem systems.

- Application of farm yard manure + non edible oil cakes @ ½ each to meet the nitrogen requirement in rice- black gram – *Sesame* and maize – sunflower systems have recorded higher increase in yield, net returns (247.4%) and organic carbon content (60%) at **Coimbatore**.

- At **Raipur**, application of non edible oil cakes + cow dung manure + enriched compost @ 1/3 each to meet the nitrogen requirement in rice – chickpea and rice-wheat/mustard + lentil recorded an increase in yield, net returns (90.7%) and organic carbon (6.4%).

- Turmeric and ginger at **Calicut** registered increase in yield of 30.1% and 28.6% respectively with application of 15 t of farm yard manure + 2 t of neem cake + 5 t of coir compost to ginger and 30 t of farm yard manure ha^{-1} to turmeric. The net returns were also higher in the same source of nutrient application, while higher increase in organic carbon content of soil was observed with 30 t FYM ha^{-1} in both the crops.

- Incorporation of enriched compost + vermicompost + green leaf manure @ 3/8 each to meet the nitrogen requirement recorded higher yield and net returns in ground nut-sorghum, soybean –wheat and chilli-cotton-onion systems at **Dharwad**. However, higher increase in organic carbon content of soil was observed with farm yard manure (3/4) + green leaf manure (1/4) applications.

- Application of farm yard manure + paddy straw + *Gliricidia* green leaves @ 1/3 each to meet the nitrogen requirement during *kharif* and farm yard manure + neem cake + vermicompost @ 1/3 each to meet the nitrogen requirement during *rabi* in rice- capsicum and rice – cucumber at **Karjat** recorded higher yield, net returns and organic carbon content of soils.

- At **Ludhiana**, application of green manure during *kharif* and farm yard manure during *rabi* to meet the requirement of nitrogen in maize- gram and green manure + farm yard manure + vermicompost during *kharif* and farm yard manure + vermicompost + crop residue during *rabi* in rice-wheat system recorded better yield. However, organic carbon content in soil was higher with green manure + farm yard manure during *kharif* and farm yard manure + crop residue during *rabi* in both the systems.

- Application of reinforced farm yard manure + vermicompost recorded higher yield and net returns in cauliflower-pea/ radish – tomato system at **Bajaura**. Higher organic carbon content in soil was recorded with reinforced farm yard manure application than other nutrient sources.

- Cow dung manure + vermicompost +poultry manure application to soybean-wheat and soybean-mustard recorded higher yield, net returns and organic carbon at **Bhopal**.

- At **Pantnagar**, farm yard manure + vermicompost @ ½ each to meet the nitrogen requirement is found to record higher yield in rice-wheat, rice-chickpea and rice- vegetable pea systems. Organic carbon content of soil was also found to be better with farm yard manure + vermicompost @ ½ each or enriched compost + vermicompost + non edible oil cakes + farm yard manure @ ¼ each as nutrient source.

- At **Ranchi**, farm yard manure + neem cake + vermicompost @ 1/3 each to meet the nitrogen requirement was found to be better for rice-wheat, rice-lentil/ potato systems.

- Integrated application of farm yard manure + vermicompost + local compost recorded higher yield, net returns and organic carbon content of soil at **Umiam** in rice + soybean- mustard, rice + soybean – tomato, maize + soybean-groundnut, maize+ soybean- french bean, french bean – tomato, radish – potato and french bean – carrot systems.

3. Pest and disease management under organic farming

- At **Modipuram**, summer ploughing treatment was found to be better for controlling pest and disease in basmati rice-chickpea system while green manure treatment is better for basmati rice-mustard system. Soil and foliar application of *Trichoderma* and seed treatment of *Pseudomonas* was found to be effective for managing diseases.

- Combination of cultural, biological, botanical, physical, mechanical, and behavioural methods recorded better yield, net returns and microbial count in rice-rice system at **Coimbatore**. Application of neem + mahua cake + *Trichogramma* + neem spray + bird perches was better for rice –chickpea system at **Coimbatore and Raipur**.

- Soil application of *Pseudomonas fluorescence* + two spray of neem extract at tillering and panicle initiation stages along with green manuring or summer ploughing is found to be better for basmati rice at **Jabalpur**. In case of wheat, seed treatment with *Trichoderma* and *Pseudomonas florescence* in 1:1 ratio was found to be better.

- Microbial culture combination of IISR 6 + IISR 8 + IISR 13 + IISR 51 + IISR 151 and PB 21 + PIAR 6 was found to be better for ginger and turmeric at **Calicut**.

- *Verticillium lecani* + eco neem + neem seed kernal extract + botanicals is found to be better for chilli for managing the pest and diseases at **Dharwad**.

- Application of vermicompost @ 100 kg + 20 kg of *Gliricidia* leaves plant $^{-1}$ as basal dose to mango registered better fruit yield, net returns and B: C ratio at **Karjat**.

- Seed treatment with neem cake + 2 sprays of *Trichoderma harzianum* recorded better yield of rice. Soil application of *Trichoderna harzianum* was found to be better for wheat at **Ludhiana**.

- Spray of aqueous leaf extract of bhang (*Cannabis sativa*) was found to be better for tomato at **Bajaura**.

- Spray of Karanji @ 3 ml / lit recorded higher yield of maize and soybean at **Umiam**.

4. Weed management under organic farming

- Using of mechanical weeder + one hand weeding recorded higher net returns in black gram- sorghum-sesame and sunflower- cotton-green manure systems at **Coimbatore**.

- Two hand hoeing at 20 and 40 days after sowing was found to be better for rice and lentil while stale seed bed + 2 hand hoeing at 20 and 40 days after sowing was better for mustard at **Pantnagar**.

- Keeping the field weed free with manual method or spraying of aqueous leaf extract at 3-4 leaf stages of weeds with two hand hoeing was better for basmati rice and wheat at **Ranchi**.

- Keeping the field free from weeds through hand weeding or combination of two hand weeding along with mechanical weeding was found to be better for basmati rice and wheat at **Jabalpur**.

- Mulching with fresh eupatorium/ ambrosia alone or with one hand weeding was found to be better for maize and mustard crops at **Umiam**.

1. INTRODUCTION

The system of farming in the country based on the traditional knowledge and practices handed down from generation to generation could not produce enough to feed the increasing population. Thus dependence of India for food on the western developed nations and the politics of food aid practiced by them added to the determination to produce more by modernizing agriculture. The green revolution technologies (GRT's) fulfilled our aspirations by changing the image of India from a food importing to a food self sufficient as well as exporting nation. The ability of Indian agriculture to meet the demand for food in the country during the post independence had been a matter of pride for farmers, scientists and all the stake holders. Promotion of modern agriculture with GRT's was necessary during those period to fill the stomach of hard working fellow Indians as they have not enjoyed the benefit of modern tools such as computers, machineries etc. Over the period of time, development of industries and other sectors led to higher growth rate having the impact on the money available and spent on the health sectors. The growth of health sector from 1990's to 2010's has been at the level of 13% per annum and it is on the increasing trend. The growth rate of hospitals in the country is between 10 to 20 %. The reasons for phenomenally higher growth rate of health sector have been the effects of modern agriculture and it's after math effects. The achievement of food self-sufficiency and export was at the expense of ecology and environment and to the detriment of the well-being of the people. Modern agriculture system started showing increasingly unsustainability and once again the need for an appropriate method suitable to our requirements is being felt. The practice of organic farming, said to be the best known alternative to the conventional method, also originated in the west which suffered from the ill effects of chemical agriculture. The principles underlying our traditional agriculture are also part of the organic farming concepts.

Organic agriculture aims at the human welfare without any harm to the environment, which is the foundation of human life itself. Organic farming evolved on the basic theoretical expositions of Rodale in the United States, Lady Bal Four in England and Sir Albert Howard in India in the 1940' has progressed to cover about 23 mha of land all over the world. The relatively high success of organic farming in some countries are due to the high awareness of the health problems caused by the consumption of contaminated food products, the ill effects of environment degradation, appropriate support by the government and organizations like the European union and International Federation of Organic Agriculture Movements (IFOAM). In India, also, the necessity of having an alternative agriculture method which can function in a friendly ecosystem while sustaining and increasing the crop productivity is realized. Organic farming is recognized as the best known alternative to the modern inputs based agriculture. The progress of organic agriculture in India is though very slow but steady. India has the potential to become a major organic producing country given the international demand for our diversified farm products from different agro climatic regions, the size of the domestic market and above all the long tradition of environment friendly farming and living. Technological backstopping for organic production of various crops are necessary to meet the challenges of high nutrient and water driven modern high yielding varieties along with measures for managing the emerging weeds, pests and diseases through eco friendly inputs and methods.

United Sates Department of Agriculture (USDA) defines organic farming as a system that is designed and maintained to produce agricultural products by the use of methods and substances that maintain the integrity of organic agricultural products until they reach the consumer. This is accomplished by using substances, to fulfill any specific fluctuation with in the system so as to maintain long term soil biological activity, ensure effective peak management, recycle farm wastes to return nutrients to the land, provide alternative care for farm animals and handle the agricultural products without the use of extraneous synthetic additives or processing in accordance with the act and the regulation in this part. Organic farming involves management of the agro-ecosystem as autonomous based on the capacity of the soil in the given local climatic conditions.

Indian agriculture in a way may be regarded as organic because majority of its cultivated area is under rainfed cultivation and only about 38% of cultivated land is under irrigation, Infact, in rainfed areas, there is little or no use of fertilizers and other agriculture chemicals on account of risks associated, resources poor farmers and smaller land holdings.

In order to develop a comprehensive technological package of organic farming for different crops and cropping systems at various locations of the country, 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 nodal institute. In order to address, all issues such as comparison of organic, inorganic and integrated nutrient management practices, method and source of nutrient application, management of pest, diseases and weeds in various crops/ cropping systems, four experiments were planned and conducted at 13 centres covering length and breadth of the country (Fig. 1). The major objectives of the network project, consolidated results of various experiments and significant findings of the project are given in the subsequent sections of the report.

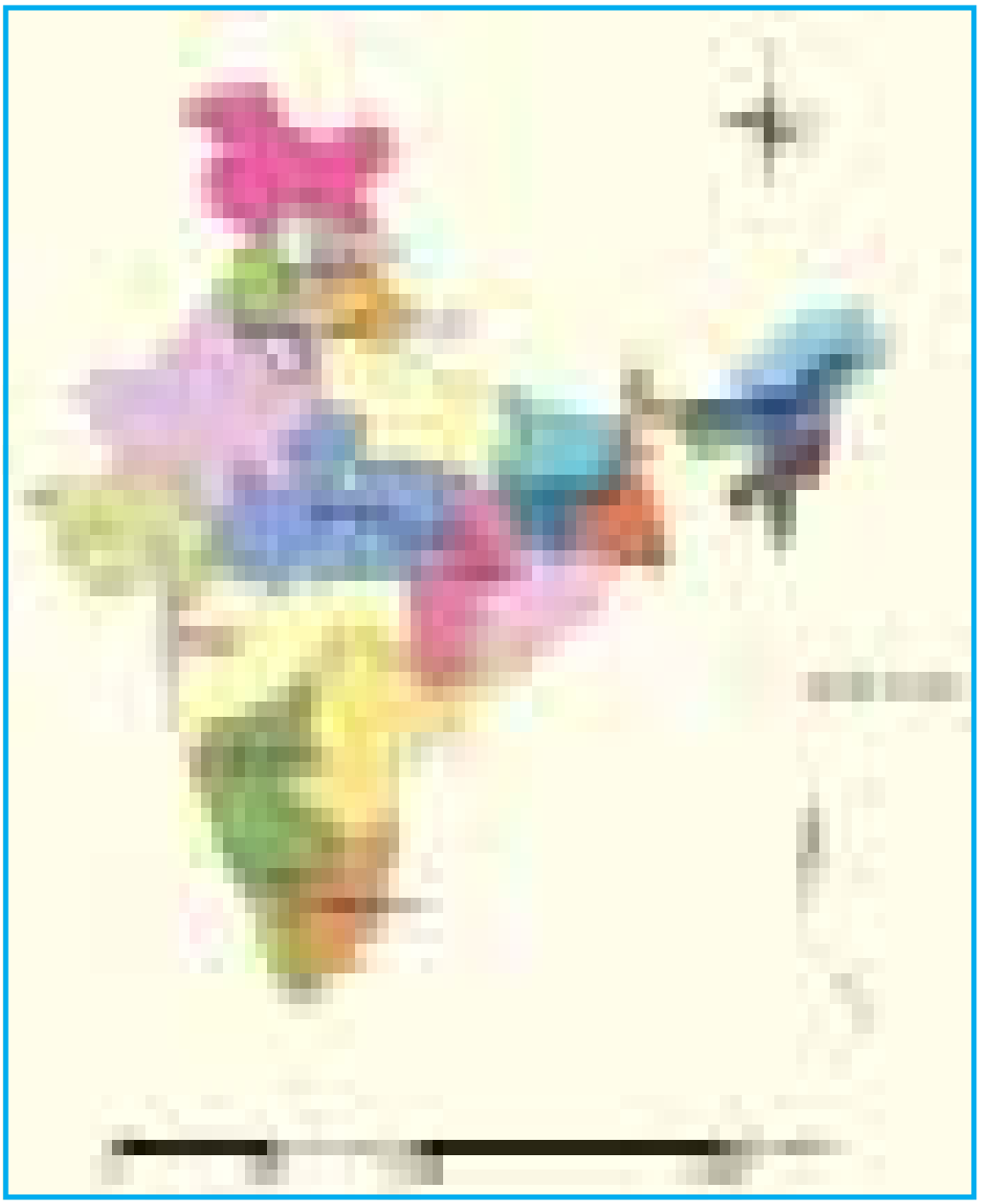


Fig. 1. Network project on organic farming

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), fruit trees (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) in location-specific cropping systems. During 2004 to 2010, following four experiments were undertaken at different centers:

I. Evaluation of different nutrient input system in various cropping systems on soil health and crop productivity

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. The varieties of crops used in experiment at various locations are given in Appendix I. General guidelines and standards for the production of organic production, as suggested under National Standards for Organic Production (NSOP), forms the basis for raising the experimental crops in the project. A compact block of land has been earmarked at each of the cooperating centres for experimental purposes, as far as possible. The plot identified was in general, free from hazards of erosion, sediments, chemical pollutants and contaminants. Shelterbelts have been developed by planting multi-purpose trees/shrubs 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 from 2004-05 to 2009-10 at 13 research centers of SAUs/ ICAR Institutes. Centre details 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 parameters and initial values of soil physical and chemical properties at various locations are presented below.

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

S. No.	Name of centre	Soil Type	Weather				Latitude (N)	Longi-tude (E)
			Rainfall (mm)	Tempera-ture (°C)		R.H (%)		
				Max.	Mini.			
1.	Modipuram	Alluvium soils Typic ustochrept	862.7	41.2	16.8	75-85	29^{0}4’	77^{0}46’
2.	Jabalpur	Vertisols, Chromusterts.	1100-1500	46.0	20.0	80-90	23°90’	79°90’
3.	Coimbatore	Udic, Rhodustalfs, fine loamy red and sandy soil	675	31.5	21.0	52-87	11°	77°
4.	Karjat	Haplustults udic-fluvents, red soil	3100	41.5	10.7	80-95	18°33’	77°03’
5.	Raipur	Ochraquals association, deep black soil	979	42.6	15.8	70-90	21°16’	81°36’
6.	Bhopal	Vertisols, clayey Montmorillonite/smectite type	1080	32.0	22.0	70-80	23°18’	77°24’
7.	Ranchi	Ultic Palesustalfs, very deep soils	1353	35.6	7.7	70-80	23°17’	85°19’
8.	Ludhiana	Ustochrepts-Ustic pramments association, alluvial, sandy & sandy loam	1426	39.6	5.4	60-98	30°56’	75°52’
9.	Calicut	Clay loam, ustic Humitropept	4121	31.8	22.0	67-88	11°34’	75°48’
10.	Pantnagar	Hapludolls, very deep alluvium coarse loomy soils	2382	37.4	7.9	75-85	29°08’	79°05’
11.	Bajura	Silty loam	1017	34.8	9.3	79-96	31^{0}8°	77°
12.	Dharwad	Vertic inceptisols	602	37.4	12.5	65-83	15°26’	75°07’
13.	Umiam	Clay loam	2000	29.4	21.2	70-80	25°41’	91°54’

Initial nutrient status of soil

S.No.	Centre	OC %	N (kg/ha)	P (kg/ha)	K (kg/ha)	S (ppm)	Fe (ppm)	Zn (ppm)
Experiment 1								
1.	Modipuram	0.59	-	-	-	-	-	-
2.	Jabalpur	0.70	264	12.6	282	-	-	-
3.	Coimbatore	-	-	-	-	-	-	-
4.	Karjat	1.10	234	30.0	350	-	-	1.72
5.	Raipur	6.4	237	13.0	274	-	-	-
6.	Bhopal	0.53	154	12.77	530	4.9	5.5	0.74
7.	Ranchi	0.44	320	48.0	270	-	59.8	1.22
8.	Ludhiana	0.34	278	36.3	134	-	-	-
9.	Calicut	2.4	220	24.6	264	-	72.0	3.80
10.	Pantnagar	0.65	238	16.7	156	29.3	30.2	0.84
11.	Bajaura	0.45	146	43.3	121	22.4	30.0	1.20
12.	Dharwad	0.50	-	-	-	-	-	-
13.	Umiam	1.32	186	10.4	165	-	-	-
Experiment 2								
1.	Modipuram	-	-	-	-	-	-	-
2.	Jabalpur	0.68	252	11.8	273	-	-	-
3.	Coimbatore	-	-	-	-	-	-	-
4.	Karjat	0.65	259	34.0	389	-	-	1.75
5.	Raipur	6.10	248	16.2	252	-	-	-
6.	Bhopal	-	-	-	-	-	-	-
7.	Ranchi	0.39	305	44.0	260	-	63.4	1.32
8.	Ludhiana	-	-	-	-	-	-	-
9.	Calicut	-	-	-	-	-	-	-
10.	Pantnagar	-	-	-	-	-	-	-
11.	Bajaura	0.30	126	31.0	110	17.9	44.1	0.80
12.	Dharwad	-	-	-	-	-	-	-
13.	Umiam	2.46	151	13.0	245	-	-	-
Experiment 3								
1.	Bajaura	0.30	155	47.2	127.4	17.9	40.1	1.60
Experiment 4								
1.	Raipur	6.6	220	16.2	260	-	-	-

5. MANPOWER

No regular posts, 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 scientists of related disciplines were also involved in the research programme by the respective institution. For technical support, two senior research fellows (as contractual staff) have been provided at each center.

6. BUDGET

A total budget of Rs. 518.4 lakh was released to 13 centers during 2004-05 to 2009-10. The centre wise allocation/utilization of funds are given below.

(Rs. in lakhs)

S. No.	Centre	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	Total
1.	Modipuram	14.00	14.96	3.20	5.95	6.02	8.98	53.11
2.	Jabalpur	8.55	9.42	2.85	4.95	5.43	6.16	37.36
3.	Coimbatore	8.55	9.42	3.05	4.95	5.43	6.16	37.56
4.	Raipur	8.55	9.42	2.50	4.95	5.28	6.16	36.86
5.	Calicut	8.55	9.42	3.15	4.95	5.43	6.16	37.66
6.	Dharwad	8.55	9.42	3.55	4.95	5.43	6.16	38.06
7.	Karjat	8.55	9.42	2.75	4.95	5.28	6.16	37.11
8.	Ludhiana	8.55	9.42	2.75	4.95	5.43	6.16	37.26
9.	Bajaura	8.55	9.42	3.75	4.95	5.28	6.16	38.11
10.	Bhopal	8.55	9.42	1.90	4.95	5.28	6.16	36.26
11.	Pantnagar	8.55	9.42	4.60	4.95	5.28	6.16	38.96
12.	Ranchi	8.55	9.42	1.75	4.95	5.43	6.16	36.26
13.	Umiam	8.55	9.42	2.60	10.00	15.00	8.26	53.83
	Total							**518.40**

7. RESEARCH RESULTS

7.1 Evaluation of organic, inorganic & INM input system

Title of the experiment: Evaluation of different nutrient input system in various cropping systems on soil health and crop productivity at different locations.

Objectives

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

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

Year of Start: The experiment was originally planned during 2004-05. However, the year of start varied with the centers depending upon the establishment of infrastructure for conducting the experiments. The center wise year of start of experiments are as follows.

Sl.No.	Centre	Year of start	No. of years experiments
1	Modipuram	2005-06	2
2	Jabalpur	2004-05	6
3	Coimbatore	2004-05	6
4	Raipur	2004-05	6
5	Calicut	2004-05	6
6	Dharwad	2004-05	5
7	Karjat	2004-05	5
8	Ludhiana	2004-05	6
9	Bajaura	2004-05	4
10	Bhopal	2004-05	6
11	Pantnagar	2004-05	6
12	Ranchi	2004-05	5
13	Umiam	2005-06	5

The cropping system adopted remained almost same for all the years in each center except Ludhiana where in the cropping system was changed during 2008-09 in one set of experiments as Ludhiana centre conducted two set of experiments for the experiment 1 at the same time.

Treatments: The experiment was conducted in split plot design with year as replications. Three input systems such as organic, inorganic and integrated nutrient management were assigned to main plots which were common to all the centers while the center specific cropping systems were assigned to sub plots. The number of cropping systems ranged from 3 (Calicut) to as high as 7 (Modipuram) in various centers. The details of treatments are given in Table 1 along with experimental results. The organic and INM treatments were formulated based on 100% recommended nitrogen dose of each systems.

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), Bajaura (Gujarat) Ludhiana (Punjab)
Semi Arid	Coimbatore (TN)
Sub humid	Modipuram (Uttar Pradesh) Raipur (Chattisgarh) Bhopal (M.P) Jabalpur (M.P.) Pantnagar (Uttarakhand) Ranchi (Jharkhand)
Humid	Umiam (Meghalaya)
Coastal	Calicut (Kerala) Karjat (Maharashtra)

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

Source of nutrient inputs and their NPK content at various locations

Nutrient Sources	NPK contents on dry weight basis (%)		
	N (%)	P (%)	K (%)
Raipur			
Enriched compost	0.40	0.60	0.80
Cow dung manure	0.50	0.50	0.75
Non Edible Oil Cakes (NEOC)	5.00	0.80	1.50
Rock phosphate	-	23.00	-
Calicut			
F.Y.M.	0.98	0.28	0.54
Neem cake	0.82	0.44	0.92
Ash	-	0.23	7.00
Vermicompost	0.79	0.20	0.58
Green leaf manure	2.62	0.09	0.62
Rajphos	-	18.5	-
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	2.74	0.50	1.15
Paddy straw	1.20	0.16	1.14
Ranchi			
F.Y.M.	0.50	0.30	0.50
Vermicompost	1.20	0.45	1.40
KC	4.00	1.00	1.00

Nutrient Sources	NPK contents on dry weight basis (%)		
	N (%)	P (%)	K (%)
Umiam			
F.Y.M.	1.01	0.56	1.00
Vermicompost	1.50	0.62	1.01
Rock phosphate	-	16.0	-
Tephrosia spp	3.31	0.44	1.46

Results

The pooled results (2004-2010) of experiment on cropping systems along with nutrient input system evaluated at various centres are presented in this chapter. The parameter wise consolidated result of each center for experiment 1 are presented and discussed.

Grain and Straw yield (Table 1, 2 and Appendix II)

Modipuram: The experiment was conducted for only 2 years and pooled data are presented. The yield of different crops under various input systems such as organic, inorganic and INM were not significantly different. However, inorganic and INM practices registered higher grain and straw yield of respective crops followed by organic input system. The decrease in yield under organic system was about 9% from inorganic and INM system for rice. The other crops such as wheat (15.9%), and potato (25.9%) also recorded similar trend. However, maize, mustard, okra and barley crops responded significantly to organic input system. The increase in yield was to the tune of 2.5%, 32.8%, 34.5% and 20.6% over inorganic input system and 10.9%, 10.3%, 15.1% and 9.7% over INM for maize, mustard, okra and barley respectively. The trend of other crops such as babycorn, fodder sorghum, greengram and radish are better in INM compared to organic and inorganic system.

General view of experimental plot of NPOF at Modipuram

Performance of mustard under organic system at Modipuram

Raipur: Pooled data of 6 years are presented. Though different input systems did not differ significantly for all the crops, INM registered numerically higher soybean yield during *kharif* over inorganic (1.5%) and organic (1.8%) systems. Similarly in *rabi* season, INM registered higher yield of wheat (18.2%) compared to organic system, while mustard registered 37.5% higher yield under inorganic system than organic system. However, inorganic was on par with INM for mustard. The straw yield of all the above crops also followed the similar trend.

Performance of maize at Raipur with inorganic input system

Jabalpur: The experiment was conducted for 6 years and pooled data of grain and straw yield are presented. During *kharif* . On an average, rice registered 5 and 12% higher grain yield under inorganic system compared to INM and organic system respectively. Similarly in *rabi* also inorganic system registered 2.3% and 23% higher wheat yield than INM and organic system respectively. Similar results were observed for potato, berseem and pea crops.

Turmeric + onion intercropping system under organic input system at Coimbatore

Coimbatore: Experiment was conducted for 6 years. Among the crops evaluated under different input system during *kharif,* all the crops except chilies and brinjal registered significantly higher yield under organic system compared to inorganic and INM. The yield increase in organic system was to the tune of 8.3% (maize), and 50. 6% (turmeric) compared to inorganic and 35.2% (turmeric) compared to INM. Chillies registered on par yield in all the systems while brinjal recorded 5.3% higher yield under INM over organic system and 11.4% over inorganic system. Cotton responded well to organic input system by recording 18.2% and 26.7% higher yield over INM and inorganic system respectively during *rabi* . There is no significant difference in yield of onion was observed among the different input systems, while sunflower recorded 10.8% and 19.0% higher yield under INM compared to organic and inorganic system respectively. Straw yield also followed the similar trend.

Calicut: Spice crops such as ginger, turmeric and black pepper were evaluated for six years. The response of ginger and turmeric was in the order of INM> organic > inorganic. The increase in yield under INM was 9.5% and 28.6% for ginger compared to organic and inorganic systems. Similarly it is 15.4% and 19.9% for turmeric. However, black pepper responded well to the organic system by recording 23.6% and 47.3% higher berry yield compared to INM and inorganic system respectively.

Dharwad: Pooled data of 5 years experiments on field and vegetable crops are presented. Among the different crops evaluated, groundnut and soybean registered higher yield under organic system while wheat, potato, chickpea, chilli and cotton recorded higher yield under INM practice. The increase in the yield of groundnut under organic system was to the tune of 13.7% compared to inorganic system while it is 16.8% for soybean. INM recorded 13.3% increase in wheat yield, 8.8% for chickpea, 38.2% for cotton, and 4.7% for maize compared to inorganic systems.

Karjat: The experiment was conducted for 5 years and rice crop was taken during *kharif* season while groundnut, maize, mustard and dolichos bean has been tested in *rabi* season under organic, inorganic and INM systems. Though no significant difference in rice yield was observed among the three input systems, organic system registered numerically higher grain yield followed by INM and organic systems. The increase in the yield under inorganic system to the tune of 6.4% and 1.6% compared to organic and INM systems was observed. During *rabi,* the response of groundnut, maize and mustard was in the order of inorganic > INM > organic while dolichus bean responded in reverse order by recording 9.8% and 17.9% increase in yield under organic system over INM and inorganic system respectively. Straw yield also followed the similar trend.

Ludhiana: Two set of experiments were conducted by including the different crops under organic, inorganic and INM input systems. In the first experiment, initial 4 years, 5 systems were evaluated and during 2008-09 and 2009-10, the cropping system was changed. The second set of experiments was conducted for 6 years. Pooled data of all the systems tested at the centre is presented. In the first set of experiments conducted for 4 years, except turmeric and maize, all the other crops such as rice, wheat, onion, groundnut, garlic and mentha recorded higher yield under integrated nutrient management practices compared to organic and inorganic systems. Turmeric recorded 20.4% higher yield under organic system compared to INM while the maize yield was on par in all the systems. The new system tested for two years in the first set of experiments reveals that cotton and maize responded well to organic system by recording 78.4% and 32.4% higher yield than inorganic system respectively. The other crops such as rice and potato recorded higher yield under INM practices while increase in wheat yield to the tune of 383 and 225 kg ha^{-1} was recorded under inorganic system compared to organic and INM practices respectively. The second set of experiment was conducted with organic system only in which sorghum, berseem and bajra responded well compared to other crops. Straw yield also followed the similar trend as that of economic yield in most of the crops.

Wheat crop under organic system at Ludhiana

Bajaura: Four different cropping systems were evaluated under three input systems for 4 years. The pooled results of 4 years reveals that cauliflower, radish, cabbage maize and garlic registered higher

Cauliflower harvested from organic input system at Bajaura

Cauliflower harvested from inorganic input system at Bajaura

yield under INM practice while tomato recorded better yield under organic system. In case of capsicum, not much variation has been observed among the three input systems. French bean yield was higher under organic system during *kharif* season while in *rabi*, it responded better under INM practice. The increase in the yield under INM practice was to the tune of 140.1%, 43.3%, and 87.6% 26%, 27.2% and 51.8% for cauliflower, radish, frenchbean, cabbage maize and garlic respectively over organic systems. Tomato recorded 10.9 and 24.1% higher yield under inorganic system compared to INM and organic input system respectively.

Bhopal: Four cropping systems were evaluated under three input systems for six years. The results reveals that the performance of soybean was better under INM Practice while wheat, mustard and chickpea performed better under inorganic system.

Pantnagar: Four cropping systems were evaluated for six years under three nutrient input systems. However, data of only *rabi* season are reported for all the systems. Inorganic system recorded higher yield of wheat, lentil, pea (vegetable) and mustard compared to other systems. The decrease in yield under organic system of these crops were 43.6 % , 17.3% , 11.5% and 39.5% respectively over inorganic system. The order of performance was inorganic > INM > organic for all the crops.

Ranchi: Experiment was conducted for 5 years and pooled analysis of results reveals that the difference in yield under three input systems are not significant. However, during *kharif*, INM Practice recorded numerically higher grain yield of rice than organic and inorganic system. On an average, the increase was 7.2% and 8% respectively. During *rabi* also though INM Practice recorded numerically higher economic yield of wheat, potato, mustard and lentil, it is not statistically significant. The decrease in yield of wheat, potato, mustard and lentil were 9.9%, 18%, 30.5% and 12.2% respectively under organic systems compared to INM Practice.

Umiam: Four cropping systems were evaluated for 5 years and the consolidated result indicates, during *kharif*, on an average, basmati rice under organic system recorded 9.1% and 15.7% increase in grain yield compared to inorganic and INM Practice respectively. Similarly during *rabi*, carrot, potato and french bean recorded higher yield under INM Practice while tomato registered 2.3% and 23.1 % higher yield under organic system over inorganic and INM practices respectively. The difference in yield between INM and organic system was 2.5% 10.5% and 5% for carrot, potato and french bean respectively during *rabi* season. Straw yield also registered similar trend as that of economic yield.

Potato with vermicompost application at Umiam

Table 1. Influence of methods of nutrient application on yield (kg/ha) of crops in cropping system at various locations (2004-05 to 2009-10)

Cropping / Input system	Organic			Inorganic			INM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
1. Modipuram (mean of 2 years)									
Rice-Wheat	2799	2999	-	2967	3549	-	3142	3514	-
Rice-Potato-Radish	3488	10757	3875	3850	14526	8958	3894	14216	6500

Cropping / Input system	Organic			Inorganic			INM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Babycorn-Potato-Greengram	1001	10333	592	1060	14375	624	1161	15916	664
Sorghum (F)-Pea-Okra	43170	3536	3055	40563	2661	2270		2690	2655
Rice –Barley + mustard-Greengram	4120	2920 (120)	790	4670	2420 (113)	680	4420	2590 (123)	720
Maize-Potato-Okra	9160	1250	6460	8480	10660	4320	10160	11010	4830
Maize-Mustard-Radish +Greengram*	4380	850	9580 (780*)	4270	640	8040 (690*)	4860	770	8750 (740*)
							Kharif		*Rabi*
							SEm±	CD	SEm±	CD
				Cropping			6300	28354	733	3302
				Input			920	NS	202	658
				Cropping X Input			6477	NS	804	3453
				Input X Cropping			1840	NS	404	1316
2. Jabalpur (mean of 6 years)										
Rice-Wheat	3636	2603	-	4000	3209	-	3855	3136	-	
Rice – potato -Okra	3348	15273	4961	3831	18401	5279	3544	18002	5116	
Rice – Berseem	3384	47744	251	3818	46759	251	3620	47004	251	
Rice-Pea-Sorghum F	3314	6726	24987	3693	7385	27911	3601	7005	26173	
							Kharif		*Rabi*	
							SEm±	CD	SEm±	CD
				Cropping			66	198	1636	4931
				Input			40	114	175	499
				Cropping X Input			92	NS	1661	4998
				Input X Cropping			80	NS	349	998
3.Coimbatore (mean of 6 years)										
Maize-Cotton	3915	1321		3612	1043		3945	1117		
Chilly-Onion	1702	2768		1702	2768		1701	2768		
Brinjal-Sunflower	3215	1173		3109	1092		3385	1300		
Turmeric+ Onion	4907(NR)	-		3258(NR)	-		3629(NR)	-		
							Kharif		*Rabi*	
							SEm±	CD	SEm±	CD
				Cropping			654	NS	422	NS
				Input			129	386	83	NS
				Cropping X Input			687	NS	438	NS
				Input X Cropping			258	NS	144	NS
4. Raipur (mean of 6 years)										
Soybean-Wheat	2045	7706		2118	9094		2142	9106		
Soybean-Berseem	2210	25218		2161	25600		2115	27347		
Soybean-Mustard	1902	2299		2018	3162		2059	3022		
Soybean-Chickpea	2212	972		2096	1045		2203	1093		

Cropping / Input system	Organic			Inorganic			INM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
							Kharif		*Rabi*	
							SEm±	CD	SEm±	CD
				Cropping			32.69	100	5574	NS
				Input			27.82	NS	350	1008
				Cropping X Input			55.98	NS	5603	NS
				Input X Cropping			55.65	NS	701	NS
5. Calicut (mean of 6 years)										
Ginger-Ginger-Ginger	18043	21190	24503	14702	15840	23727	18713	23543	27537	
Turmeric- Turmeric- Turmeric	22820	22850	26820	22102	18650	28960	28595	25410	29640	
Black pepper	1746	-	-	1185	-	-	1412	-	-	
							Kharif		*Rabi*	
							SEm±	CD	SEm±	CD
				Cropping			2551	15523	2874	NS
				Input			1374	NS	1757	NS
				Cropping X Input			3207	NS	3518	NS
				Input X Cropping			2379	NS	2485	NS
6. Dharwad (mean of 5 years)										
G.Nut -Sorghum	2721	1187	-	2393	1061	-	2607	1156	-	
Soybean- Wheat	1724	1101	-	1476	983	-	1654	1114	-	
Potato-Chickpea	3965	773	-	3715	724	-	4222	788	-	
Chilli + Cotton / Chilli + Cotton-Onion	447	561(5530)	-	416	508(4874)	-	445	613(6736)	-	
Maize-Chickpea	2498	1028	-	2540	972	-	2661	1057	-	
							Kharif		*Rabi*	
							SEm±	CD	SEm±	CD
				Cropping			52	991	94	290
				Input			322	151	17	49
				Cropping X Input			333	NS	98	NS
				Input X Cropping			105	NS	34	NS
7. Karjat (mean of 5 years)										
Rice-G.Nut	3193	2723		3372	3379		3271	3380		
Rice-Maize	3187	33149		3332	51338		3352	44736		
Rice-Mustard	3126	599		3307	740		3307	728		
Rice-Dolichos bean	3160	4419		3463	3748		3329	4023		
							Kharif		*Rabi*	
							SEm±	CD	SEm±	CD
				Cropping			41.86	NS	4580	14110
				Input			44.53	128	745	2144
				Cropping X Input			83.91	NS	4739	14536
				Input X Cropping			89.06	NS	1489	4289

Cropping / Input system	Organic			Inorganic			INM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
8. Ludhiana I (mean of 4 years)									
Rice-Wheat-GM	2950	4348	23500	3140	4330	23000	3368	4588	24000
Turmeric - Onion	30877	10918		14548	8553		25637	11315	
G.Nut.(S)- Garlic	2178	9203		2138	7620		2233	9278	
Maize-Wheat-Cowpea(F)	4883	4703	31127	4220	4670	23557	4808	4875	27430
Rice-Garlic+Mentha oil	5790	7427.5 (99)		6008	5542.5 (73)		6593	6772.5 (115)	
New system from 2008-09 (mean of 2 years)									
Cotton - Wheat	1600	2165		894	2425		1358	2060	
Maize-Gram	4505	1840		3780	2130		4585	1820	
Maize -Potato-Moong (S)	6560	15225	1240	4950	10025	1010	6100	18325	1230
Rice -Wheat-Moong (S)	3400	3295	1000	3175	3800	1070	3550	3715	1210
						Kharif		*Rabi*	
						SEm±	CD	SEm±	CD
				Cropping		682	2101	1145	3527
				Input		347	1001	183	527
				Cropping X Input		930	2783	1193	3656
				Input X Cropping		775	2238	409	1179
Ludhiana II (mean of 6 years)									
Sorghum - Berseem	31586	67288	-	-	-	-	-	-	-
Maize- Berseem- Bajra	26650	65770	35142	-	-	-	-	-	-
Maize-Berseem –Maize +Cowpea	20034	67374	29828	-	-	-	-	-	-
Sorghum +Guara-Oats-Cowpea	30606	48122	30190	-	-	-	-	-	-
9. Bajaura (mean of 4 years)									
Cauliflower-Radish-Tomato	13705	9428	21400	13640	10508	26680	15635	13514	24043
French bean-Cauliflower-French bean	6183	10143	8819	5865	12466	16289	5289	14093	17716
Cabbage-Radish-Capsicum	16179	8375	3945	19290	9239	3801	20390	13759	3827
Maize-Garlic	3142	6027	-	3316	8129	-	3997	9151	-
						Kharif		*Rabi*	
						SEm±	CD	SEm±	CD
				Cropping		2186	6993	1394	NS
				Input		589	NS	524	1528
				Cropping X Input		2389	NS	1635	NS
				Input X Cropping		1178	NS	1047	NS
10. Bhopal (mean of 6 years)									
Soybean- Wheat	1481	4337	-	1307	4377	-	1374	4719	
Soybean-Mustard	1451	1769	-	1294	1809	-	1349	1981	
Soybean-Chickpea	1397	2035	-	1250	2015	-	1343	2165	
Soybean-Isabgol	1379	1321	-	1254	1277	-	1335	1375	

Cropping / Input system	Organic			Inorganic			INM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
11. Pantnagar (mean of 6 years)									
Rice-Wheat-Sesbania (GM)	-	2126	-	-	3053	-	-	2739	-
Rice -Lentil-Sesbania (GM)	-	655	-	-	792	-	-	713	-
Rice -Pea (veg.)-Sesbania(GM)	-	3010	-	-	3402	-	-	3239	-
Rice -Mustard-Sesbania (GM)	-	574	-	-	949	-	-	847	-
								Rabi	
								SEm±	CD
						Cropping		161	495
						Input		46	132
						Cropping X Input		177	540
						Input X Cropping		92	264
12. Ranchi (mean of 5 years)									
Rice -Wheat	2532	2382	-	2587	2522	-	2726	2645	-
Rice -Potato	2603	16623	-	2558	18755	-	2626	20275	-
Rice -Mustard / Linseed	2784	416	-	2559	596	-	2850	599	-
Rice -Lentil	2524	764	-	2663	801	-	2994	870	-
							Kharif		*Rabi*
							SEm±	CD	SEm±	CD
						Cropping	86	NS	1222	3907
						Input	71	NS	214	624
						Cropping X Input	145	NS	1271	4037
						Input X Cropping	143	NS	428	1250
13. Umiam									
Rice - Carrot	3687	8657		3488	6938		3211	8873	
Rice - Potato	3639	12163		3216	11478		3110	13441	
Rice – French bean	3847	7090		3442	6921		3451	7448	
Rice - Tomato	3727	25550		3508	20748		3107	24985	
							SEm±	CD	SEm±	CD
						Cropping	105	NS	966	3342
						Input	79	236	330	988
						Cropping X Input	166	NS	1106	3705
						Input X Cropping	158	NS	659	1976

( ) Figures in parenthesis are yield of intercrop.

Table 2. Influence of methods of nutrient application on straw yield (kg/ha) of crops in cropping system at various locations (2004-05 to 2009-10)

Cropping / Input system	Organic			Inorganic			INM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
1. Modipuram (mean of 2 years)									
Rice-Wheat	5928	4181	-	5947	4894	-	6116	5180	-
Rice-Potato-Radish	3594	-	-	4860	-	-	4877	-	-
Babycorn -Potato- Green gram	18093	-	-	21211	-	-	20138	-	-
Rice –Barley +mustard – Green gram	4670	2420(113)	-	4670	2420(113)	680	4670	2420 (113)	680
Maize-Potato-Okra	8480	10660	4320	8480	10660	4320	8480	10660	4320
Maize-Mustard-Radish + Green gram	4270	640	8040 (690)	4270	640	8040 (690)	4270	640	8040 (690)
2. Jabalpur (mean of 6 years)									
Rice-Wheat	5917	6957	-	6656	8522	-	6536	8094	-
Rice – potato -Okra	5847	14279	-	6423	15448	-	6170	15181	-
Rice – Berseem	5955	39126	-	6545	38405	-	6246	12834	-
Rice-Pea-Sorghum F	5751	8884	-	5751	8884	-	6280	30845	-
								Kharif	
								SEm±	CD
						Cropping		80	NS
						Input		83	237
						Cropping X Input		157	NS
						Input X Cropping		166	NS
3. Raipur (mean of 6 years)									
Soybean-Wheat	3288	3235	-	-	3900	-	-	3960	-
Soybean-Berseem	3307	-	-	-	-	-	-	-	-
Soybean-Mustard	3053	2175	-	-	2440	-	-	2750	-
Soybean-Chickpea	3285	1405	-	-	1510	-	-	1610	-
4. Karjat (mean of 5 years)									
Rice-G.Nut	4041	4623	-	4363	4968	-	4297	4485	-
Rice-Maize	3946	3133	-	4141	4038	-	3774	4070	-
Rice-Mustard	4165	922	-	4326	1162	-	3985	1427	-
Rice-Dolichos bean	4003	4974	-	4203	4032	-	4031	4011	-
5. Ludhiana I (mean of 4 years)									
Rice-Wheat-GM	7160	6265	-	10488	5715	-	10195	6260	-
Turmeric - Onion	9256	3620	-	3714	3320	-	9394	4213	-
G.Nut.(S)- Garlic	6733	4328	-	5445	3268	-	6830	3993	-
Maize-Wheat-Cowpea(F)	10648	6730	-	7753	6628	-	9270	6640	-
Rice-Garlic+Mentha oil	13068	3463	-	15728	2568	-	17853	2960	-

Cropping / Input system	Organic			Inorganic			INM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
New system from 2008-09 (mean of 2 years)									
Cotton - Wheat	12795	4620	-	7270	3180	-	11300	3370	-
Maize-Gram	10290	3050	-	9980	3855	-	13400	3845	-
Maize -Potato-Moong (S)	11355	2175	-	9140	1425	-	11520	1575	-
Rice -Wheat-Moong (S)	11245	6570	-	8950	6185	-	12200	7280	-
								Rabi	
								SEm±	CD
						Cropping		712	2194
						Input		116	335
						Cropping X Input		743	NS
						Input X Cropping		259	NS
6. Bajaura (mean of 4 years)									
French bean-Cauliflower-French bean	1007	-	1869	1044	-	2909	878	-	2995
Cabbage-Radish-Capsicum	-	-	-	-	-	-	-	-	-
Maize-Garlic	7120	-	-	7900	-	-	9890	-	-
7. Bhopal (mean of 6 years)									
Soybean- Wheat	3160	5444	-	2929	5528	-	3213	5997	-
Soybean-Mustard	3024	6011	-	2910	6277	-	2973	6502	-
Soybean-Chickpea	3134	3138	-	2993	3012	-	3157	3294	-
Soybean-Isabgol	3260	4271	-	2789	3778	-	2965	4363	-
8. Pantnagar (mean of 6 years)									
Rice-Wheat-Sesbania (GM)	-	3781	-	-	4835	-	-	4344	-
Rice -Lentil-Sesbania (GM)	-	2469	-	-	2223	-	-	2202	-
Rice -Mustard-Sesbania (GM)	-	1763	-	-	2701	-	-	2432	-
9. Umiam									
Rice - Carrot	6359	-	-	6296	-	-	6214	-	-
Rice - Potato	6112	-	-	6159	-	-	6167	-	-
Rice – French bean	6224	1752	-	6320	1150	-	6334	1471	-
Rice - Tomato	5887	1850	-	6241	1660	-	6154	1930	-

( ) Figures in parenthesis are straw yield of intercrop.

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

Soil physical parameter (Bulk Density) chemical properties (EC, pH), available primary nutrient status (OC, N, P, K) and micro-nutrients (Mn, Zn, Cu, Fe) were also recorded at the end of each cropping system cycle for all the three input systems. Mean data of these parameter for all the years are presented in Table 3-5 and it is compared with the initial parameters (before start of experiment). The center wise result of soil physical, chemical and micronutrients are presented below.

Modipuram: Soil EC, pH, OC, N, P, K have been estimated for 2 years at the end of cropping cycle while micronutrients such as Mn, Zn, Cu and Fe are estimated for 1 year. The mean data of all the parameters are presented which reveals that soil was having normal EC with near neutral values of pH and application of different input systems such as organic, inorganic and INM did not affect these parameters significantly. The initial organic carbon content was 0.59% which increased to 0.91% under organic system and 0.73% under INM Practice. The inorganic system recorded 0. 54% organic carbon, which is lower than the initial value. Organic system of input resulted in 54.2 % increase in organic carbon while INM practice accounted for 23.7% increase in carbon pool. The inorganic system deteriorated the soil by reducing the organic carbon to the tune of 8.5%. The increase in organic carbon content was observed in almost all the cropping systems. The available N was highest (206 kg/ha) under inorganic system which was on par with INM practice (199 kg ha^{-1}). Organic system registered 11.6% lower available N compared to inorganic system. Available N did not differ significantly among various cropping system. Contrary to nitrogen, available P and K was higher under INM followed by organic system. The inorganic input system recorded 21.2 % and 9.1% lower available P compared to INM and organic system respectively. Though the data of micronutrients are not subjected to statistical analysis due to lack of sufficient years of data, the trend indicates higher Mn, Zn, Cu and Fe status under organic system followed by INM and inorganic system. Organic system registered 167%, 154% , 137% and 267% increase in Mn, Zn, Cu and Fe content of soil compared to inorganic system indicating the good scope of organic farming in enriching the micronutrient content of soil.

Maize crop grown with organic input system at Modipuram

Jabalpur: Physical parameters of soil in terms of bulk density, chemical parameters in terms of EC, pH and nutrient status in terms of OC, N, P, K and micronutrients in terms of Mn, Zn, Cu and Fe were estimated at the end of each cropping cycle for 6 years and mean data is presented. The different input system such as organic, inorganic and INM practices did not influence the bulk density significantly. EC remained normal and slight increase in pH was observed under all the cropping systems. The organic carbon content of soil increased to 0.76% under organic system from the initial level of 0.70% and 0.73% under INM Practice indicating 8.6% and 4.3% improvement in organic carbon content of soil respectively. Organic carbon remained same under inorganic system which might be due to shredding of residues of cropping system adopted. Among the cropping system, rice-wheat system registered higher organic carbon content of 0.77% compared to other systems. Similar to the organic carbon, available N,P and K also improved under organic system compared to initial level. The level of improvement was to the tune of 6.4%, 1.6% and 5.7% for NPK respectively. Among the systems rice-wheat and rice-pea-fodder sorghum registered higher available N of 276 and 277 kg ha^{-1} respectively compared to initial nitrogen of 264 kg ha^{-1}. Micronutrients such as Mn, Zn, Cu and Fe increased by 60%, 77%, 84% and 96% respectively, under organic system compared to inorganic system. Irrespective of the cropping system, inorganic system resulted in lower Mn of 12.3 PPM compared to INM (15.5 PPM) and organic system (19.75 PPM).

Coimbatore: Organic carbon content and micronutrient status of soil was estimated at the end of each cropping cycle for 3 years while available NPK content was estimated for six years . The mean data of all the parameters are presented. Organic system registered higher organic carbon content of 0.63% compared to INM (0.60%) and inorganic system (0.59%). The % improvement in organic carbon content was to the tune of 6.8% under organic system and 1.7% under INM practice compared to inorganic system. Among the different cropping system, turmeric + onion recorded maximum available nitrogen and phosphorus. Improvement of 3.4% in available N and 8.1 % in available P was observed under organic system compared to inorganic system. Considerable improvement in micronutrients has been observed under organic system. The % improvement was 8.9, 15.9, 12.7 and 5 respectively for Mn, Zn Cu and Fe over inorganic system. INM practice also had positive effect on micronutrient content of soil. Among the cropping systems, maize-cotton registered higher Mn content (17.6 PPM) while brinjal- sunflower system recorded higher Zn (8.50 PPM), Cu (2.56 PPM) and Fe (28.4 PPM).

Performance of maize under various input systems at Coimbatore

Growth of black pepper in organic input system at Calicut

Calicut : Ginger, turmeric and black pepper were evaluated under organic, inorganic and INM systems. Soil pH and organic carbon was measured at the end of cropping cycle for 4 and 6 years respectively. Similarly N, P, K, Mn, Cu and Fe was measured for 4 years while Zn was estimated for 6 years after each cropping cycle. The pooled mean of soil available nutrient status are presented. The soil remained under acidic condition with mean pH of 5.2 The initial organic carbon content of 2.4% has been reduced to 2.3%, 2.2% and 2.1% under organic, INM and inorganic systems respectively. Around 4.2% reduction in organic carbon content was observed under organic system. The reduction is much higher (12.5 %) with inorganic system. Ginger and turmeric registered lower organic carbon than black pepper owing to its nature of higher leaf litter fall. Available soil NPK was not influenced by either cropping or input system. The reduction in available nitrogen and phosphorus was to the tune of 35.5% and 67.9% respectively under organic system compared to initial level of nitrogen (220 kg ha $^{-1}$) and phosphorus (24.6 kg). Among the input systems organic and INM resulted in marginal improvement in available NPK of soil compared to inorganic systems. Though different input system did not differ significantly on account of micronutrients such as Mn, Zn, Cu and Fe, numerically higher content of Zn and Cu in the soil under organic and INM was observed compared to inorganic system. Around 52.9% improvement in soil Zn and 209% in soil Cu was observed under organic system compared to inorganic system. However, Zn level in soil was reduced by 32.1% under organic system compared to initial level in the soil (3.8 PPM). The % reduction was much higher (55.3%) with inorganic system. Similar to Zn, Fe content also reduced by 32.7% with organic system compared to initial level of 72 PPM. Among the crops, ginger registered higher available Mn of 10 PPM while turmeric recorded higher available Fe. Black pepper had higher Zn and Cu in the soil at the end of cropping cycle.

Raipur: Bulk density, organic carbon, soil available NPK were estimated for 6 years continuously at the end of each cropping cycle and the pooled data reveals no variation in bulk density, improvement in organic carbon (figure), available N, P and K in soil. The increase in organic carbon was to the tune of 5.3% / year under organic system and about 1.8% increase in organic carbon content was observed compared to inorganic system. The improvement in soil available N was to the tune of 6.3%, 9.7% and 10.9% under organic, inorganic and INM compared to initial level of nitrogen. The improvement in available 'P' was more pronounced in INM (17.8%) than organic farming (2.1%) compared to initial level of phosphorus in the soil. Available potassium also followed the similar trend.

A good crop of mustard at Raipur under organic input system

Dharwad: Bulk density, soil EC and pH was studied under different input systems for 4 years while organic carbon, available N, P, K and micronutrients such as Mn, Zn, Cu and Fe are estimated for 5 years and pooled data of each parameters are statistically analyzed and presented. Five cropping systems were evaluated under three input systems such as organic, inorganic and INM. Bulk density, soil EC, and pH was not significantly influenced either by cropping or input system. The soil pH was near neutral. The soil recorded 8% higher organic carbon than initial level under organic system and the same was 10% for INM Practice. The organic carbon remained same (0.50%) for inorganic system. Among the different cropping systems, potato-chickpea are found to increase the carbon content in the soil. Available N, P and K are found be higher under organic and INM compared to inorganic system. The increase in available N are found to be 14.1% and 9% under organic and INM respectively compared to inorganic system. The increase in available P was found to be 18.5 and 13.5% respectively. Though Mn and Cu did not differ significantly among different cropping and input system, organic farming practice had pronounced effect on Zn and Fe availability by recording 20.2% and 18.7% improvement in Zn and Fe of soil compared to inorganic practices. Cropping system had much lesser influence on the micronutrient availability in soil.

Karjat: Four cropping systems were evaluated with three input systems such as organic, inorganic and INM practices. Soil EC was recorded for 3 years while pH, organic carbon, available N, P, K were recorded for 4 years. All the data were pooled and analyzed statistically. The soil was having normal EC with near neutral pH. The initial organic carbon content was 1.10%, which raised to 1.12% under organic system at the end of cropping cycle. In few years, the improvement in organic carbon content was about 8.2%. Soil available nitrogen at the end of cropping period was decreased to the level of 3.7% with organic system and 3.0 % with INM compared to initial level or inorganic system as both had soil available N of 234 kg ha^{-1}. Irrespective of cropping or input system, available P decreased by 12.4% with organic, 74.1% with inorganic and 15.9% with INM. Available potassium also recorded similar trend.

Ludhiana: Two set of experiments were conducted. In the first set, bulk density was reported for 1 year, while soil EC, pH, organic carbon and available NPK were estimated for 4 years. The results revealed that not much significant variation in bulk density, EC and soil pH while organic carbon content improved significantly. Among the different input systems, the organic system recorded maximum increase of organic carbon (67.6%) followed by INM (52.9%) and inorganic (32.9%) system compared to initial level (0.34%).The difference between inorganic and organic system was also high (32.5%) paving way for improvement of organic carbon pool in the system. Among the different cropping systems, rice-garlic+mentha (oil) recorded the maximum organic carbon content of 0.58% followed by turmeric-onion (0.53%). Though the available soil N was lower under organic system compared to initial level (278 kg

ha $^{-1}$), it registered 13.8% improvement in available N than inorganic system. In case of available P and K, it is observed that 3.6% and 2.6% improvement under organic system than inorganic system where in the same level of nutrient was maintained or slight decrease in P and K content was observed.

In the second set of experiments, bulk density was measured for one year while other parameters such as EC, pH, organic carbon, N, P, K were measured for 5 years and pooled results are presented. Soil was near neutral having the pH of 7.31. Similar to the first set of experiments, the organic carbon content improvement was to the tune of 3.8% under organic system than inorganic system. Among the different cropping system, maize-berseem-bajra recorded higher content of organic carbon (0. 59%) followed by sorghum-berseem (0. 57%). Soil available N, P, K was not significantly influenced either by cropping or input system.

Bajaura: Four cropping systems involving high value crops such as cauliflower, cabbage, capsicum, radish and garlic were evaluated under three input systems namely organic, inorganic and INM practices and observations on organic carbon, available N, P, K and micronutrients such as Mn, Zn Cu and Fe were recorded for 6 years. The pooled results reveals that 35.6% improvement in soil organic carbon with organic system compared to initial level. In line with the organic carbon, soil available N content also increased by 70.5% with organic system and 93.2 % with INM compared to initial level of 146 kg N ha^{-1}. However, phosphorus and potassium content of soil declined. Around 21.5% decline in phosphorus was observed under organic system. Profound increase in soil Mn, Zn Cu and Fe was observed with organic system than inorganic practice. The increase was to the tune of 3 times for Mn, 2 times for Zn, 6 times for Cu and 2 times for Fe. Inorganic system had lower micronutrient level compared to INM.

Bhopal: Four cropping systems involving soybean were evaluated with three input systems. Bulk density was measured for 4 years while organic carbon, available NPK was estimated at the end of each cropping cycle for 6 years and pooled results reveals that while there was no significant difference in bulk density, the organic carbon increased from 0.53% to 0.62% with organic system. The increase is found to be 17%. Similar to organic carbon, available N and phosphorus also increased to the level of 16.9% and 75.8% with organic system respectively. Soybean-wheat system resulted in higher available nitrogen and phosphorus.

Pantnagar: Three input systems and four cropping systems were evaluated in which observations of bulk density was recorded for 3 years while organic carbon, available N, P, K were recorded for 6 years. Micronutrients such as Mn, Zn, Cu, Fe were estimated for 2 years. Pooled results of organic carbon indicates improvement of organic carbon by 32% with organic system and 292% with INM. Rice-lentil-sesbania and rice-peas-*sesbania* recorded higher organic carbon content of 0.85%. Estimation of available N indicates marginal improvement in soil with organic (2.5%) and INM practice (6.7%) compared to inorganic system. However, the effect on soil available 'P' was found to be 45.6%, 46.1% and 55.7% higher than original level with organic, inorganic and INM respectively. Among the cropping system, rice-mustard-*sesbania* had higher available nitrogen while rice-pea-*sesbania* had higher available phosphorus. There was improvement in Zn and Fe with organic system. The increase was found to be 9.5% for Zn and 1.3% for Fe. INM had also equally performed better while inorganic system registered lower level of these nutrients in the soil. As such, there was no significant difference in Mn and Cu are observed.

Ranchi: Four cropping systems with three input systems were evaluated and observations on pH, EC and NPK were taken for 4 years at the end of each cropping cycle and pooled results reveals that soil was in slightly acidic by having pH ranging from 5.7 – 5.9. The initial organic carbon content before initiation of experiments was found to be 0.44% which raised to 0.49% with organic system indicating 1.4% improvement in soil organic carbon/annum. Organic carbon content at the end of first year (2005-06) was only 0.45% with organic input system and it raised to 0.62% during 2009-10 under organic system while under INM, the increase was lesser. Inorganic system registered lower value of organic carbon than the initial level. No significant difference in organic system was observed among the various cropping

systems. In case of available nitrogen, 6.9% decrease was observed with inorganic system while slight improvement (1%) of available N was observed with organic system. More pronounced effect of organic system in improving soil available phosphorus by 25.2% from initial level was observed. The increase in available soil phosphorus was lesser under inorganic system and INM. No significant influence on soil available N and P was observed among various cropping systems.

Umiam: Four cropping systems involving rice and vegetables with three input system were evaluated and observations on bulk density, pH, organic carbon, available N and P were taken for 3 years while K was reported for 2 years. Micronutrients such as Mn, Zn Cu and Fe were estimated for only one year. The pooled results of the experiment reveals that no significant variation in bulk density and pH. However, organic carbon, available N, P, K and micronutrients had marginal improvement with organic system. The initial level of organic carbon was 1.32%, which rose to 3.30% with organic system indicating 1.5 times increase. Organic carbon did not very among different cropping systems. Around 21.5% improvement in available N was observed with organic system compared to initial level. The same was 19.8% for inorganic system and 22.5% for INM. Available phosphorus and potassium was higher with INM which resulted in 54.8% improvement in available P from the original level of 10.4 kg ha^{-1}. The increase was 29% in case of inorganic system and 37.5% with organic system. Available soil NPK was not affected significantly by various cropping systems. Marginal improvement in micronutrients such as Mn, Zn and Fe were observed with organic over inorganic input system.

A general view of experimental plot of NPOF at Umiam

Table 3. Influence of methods of nutrient application on soil bulk density, electrical conductivity, pH and organic carbon at the end of in different crops and cropping system at various locations (2004-05 to 2009-10)

Cropping/Input system	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
1.Modipuram (mean of 2 years)																
Rice-Wheat	-	-	-	-	0.32	0.24	0.27	0.28	7.59	7.69	7.83	7.70	0.80	0.53	0.70	0.68
Rice-Potato-Radish	-	-	-	-	0.22	0.22	0.22	0.22	7.67	7.45	7.61	7.58	0.71	0.51	0.68	0.63
Babycorn-Potato-Green gram	-	-	-	-	0.23	0.21	0.22	0.22	7.66	7.72	7.45	7.61	0.78	0.49	0.55	0.60
Sorghum (F)-Pea-Okra	-	-	-	-	0.19	0.22	0.20	0.20	7.80	7.81	7.75	7.78	0.88	0.51	0.71	0.70
Rice –Barley +mustard-Green gram	-	-	-	-	0.33	0.19	0.20	0.24	7.63	8.12	8.04	7.93	0.98	0.55	0.97	0.83
Maize-Potato-Okra	-	-	-	-	0.40	0.28	0.25	0.31	7.45	7.93	7.53	7.64	0.82	0.66	0.79	0.76
Maize-Mustard-Radish-Green gram	-	-	-	-	0.49	0.32	0.31	0.37	7.49	7.62	8.29	7.80	1.44	0.57	0.73	0.91
Mean	-	-	-	-	0.31	0.24	0.24		7.61	7.76	7.78		0.91	0.54	0.73	
						SEm±	CD			SEm±	CD			SEm±	CD	
Cropping						0.03	NS			0.06	NS			0.09	0.13	
Input						0.01	NS			0.08	NS			0.04	NS	
Cropping X Input						0.03	NS			0.14	NS			0.11	NS	
Input X Cropping						0.02	NS			0.16	NS			0.08	NS	
2.Jabalpur (mean of 6 years)																
Rice-Wheat	1.39	1.40	1.39	1.39	0.47	0.51	0.50	0.50	7.34	7.28	7.16	7.26	0.77	0.70	0.73	0.73
Rice – potato -Okra	1.38	1.39	1.39	1.39	0.49	0.50	0.50	0.50	7.06	7.12	7.22	7.13	0.75	0.70	0.71	0.72
Rice – Berseem	1.39	1.39	1.40	1.39	0.47	0.49	0.47	0.48	7.14	7.22	7.18	7.18	0.76	0.71	0.73	0.73
Rice-Pea-Sorghum F	1.38	1.39	1.40	1.39	0.51	0.48	0.50	0.50	7.34	7.24	7.24	7.27	0.76	0.70	0.74	0.74
Mean	1.38	1.39	1.39		0.49	0.50	0.49		7.22	7.22	7.20		0.76	0.70	0.73	
		SEm±	CD			SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		0.003	NS			0.003	0.009			0.023	0.070			0.003	0.010	
Input		0.004	NS			0.003	0.007			0.027	NS			0.003	0.009	
Cropping X Input		0.009	NS			0.005	0.016			0.051	NS			0.006	NS	
Input X Cropping		0.007	NS			0.005	0.015			0.055	NS			0.006	NS	

Cropping/Input system	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
3.Coimbatore (mean of 3 years)																
Maize-Cotton	-	-	-	-	-	-	-	-	-	-	-	-		0.59	0.61	0.62
Chilly-Onion	-	-	-	-	-	-	-	-	-	-	-	-	0.62	0.58	0.59	0.60
Brinjal-Sunflower	-	-	-	-	-	-	-	-	-	-	-	-	0.63	0.59	0.61	0.61
Turmeric+ Onion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	-	-	-	-	-	-	-	-	-	-	-	-	0.63	0.59	0.60	
														SEm±	CD	
Cropping														0.004	0.014	
Input														0.003	0.008	
Cropping X Input														0.005	NS	
Input X Cropping														0.005	NS	
4.Raipur (mean of 6 years)																
Soybean-Wheat	1.28	1.31	1.31	1.30	-	-	-	-	-	-	-	-	5.65	5.49	5.44	5.52
Soybean-Berseem	1.27	1.31	1.30	1.29	-	-	-	-	-	-	-	-	5.78	5.44	5.54	5.59
Soybean-Mustard	1.27	1.31	1.31	1.30	-	-	-	-	-	-	-	-	5.63	5.48	5.49	5.53
Soybean-Chickpea	1.27	1.31	1.31	1.29	-	-	-	-	-	-	-	-	5.76	5.67	5.57	5.67
Mean	1.27	1.31	1.31		-	-	-	-	-	-	-	-	5.70	5.52	5.51	
		SEm±	CD											SEm±	CD	
Cropping		0.007	NS											0.024	0.076	
Input		0.004	0.012											0.040	0.114	
Cropping X Input		0.009	NS											0.069	NS	
Input X Cropping		0.008	NS											0.079	NS	

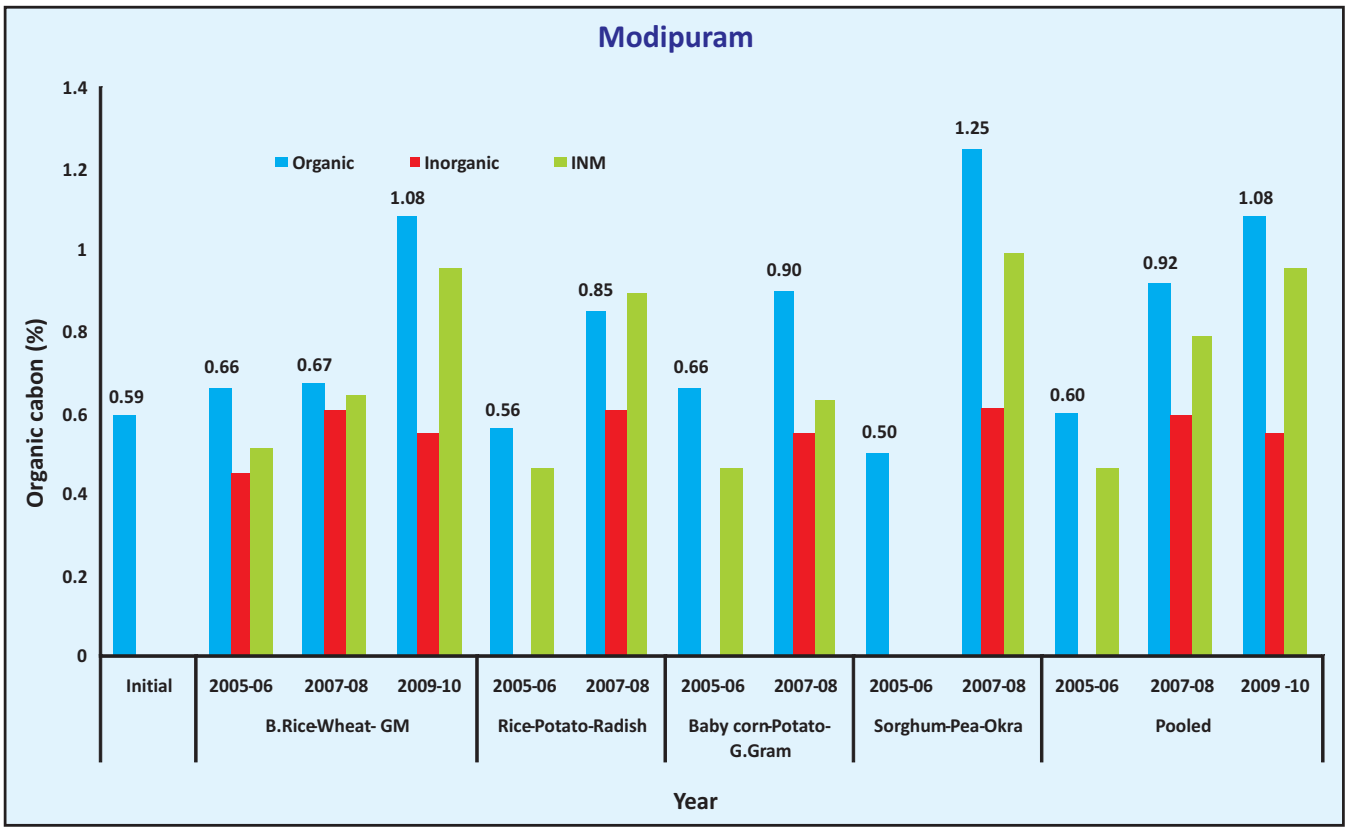
Cropping/Input system	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
5.Calicut										Mean of 4 years				Mean of 6 years		
Ginger	-	-	-	-	-	-	-	-	5.30	5.21	5.42	5.31	2.15	1.95	2.11	2.07
Turmeric	-	-	-	-	-	-	-	-	5.39	5.05	5.15	5.19	2.11	2.09	2.00	2.07
Black pepper	-	-	-	-	-	-	-	-	5.23	4.95	5.14	5.11	2.52	2.36	2.47	2.45
Mean	-	-	-	-	-	-	-	-	5.31	5.07	5.24		2.26	2.13	2.19	
										SEm±	CD			SEm±	CD	
Cropping										0.004	NS			0.075	NS	
Input										0.128	NS			0.048	NS	
Cropping X Input										0.148	NS			0.101	NS	
Input X Cropping										0.181	NS			0.082	NS	
6. Dharwad						Mean of 4 years								Mean of 5 years		
G.Nut -Sorghum	1.22	1.28	1.25	1.25	0.22	0.26	0.21	0.23	7.22	7.38	7.30	7.30	0.57	0.48	0.55	0.53
Soybean- Wheat	1.23	1.29	1.26	1.26	0.21	0.25	0.21	0.22	7.34	7.44	7.43	7.40	0.59	0.51	0.56	0.55
Potato-Chickpea	1.23	1.29	1.25	1.26	0.22	0.25	0.24	0.24	7.11	7.49	7.39	7.33	0.60	0.52	0.55	0.56
Chilli+Cotton /Chilli+Cotton-Onion	1.23	1.26	1.27	1.25	0.24	0.25	0.23	0.24	7.14	7.43	7.21	7.26	0.60	0.48	0.54	0.54
Maize-Chickpea	1.21	1.23	1.28	1.24	0.15	0.13	0.16	0.15	7.13	7.17	7.23	7.18	0.58	0.49	0.53	0.53
Mean	1.22	1.27	1.26		0.21	0.23	0.21		7.19	7.38	7.31		0.59	0.50	0.55	
		SEm±	CD			SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		0.009	NS			0.009	NS			0.029	0.088			0.009	NS	
Input		0.008	0.021			0.008	0.021			0.035	0.101			0.005	0.015	
Cropping X Input		0.016	NS			0.015	NS			0.064	NS			0.012	NS	
Input X Cropping		0.015	NS			0.015	NS			0.070	NS			0.010	NS	

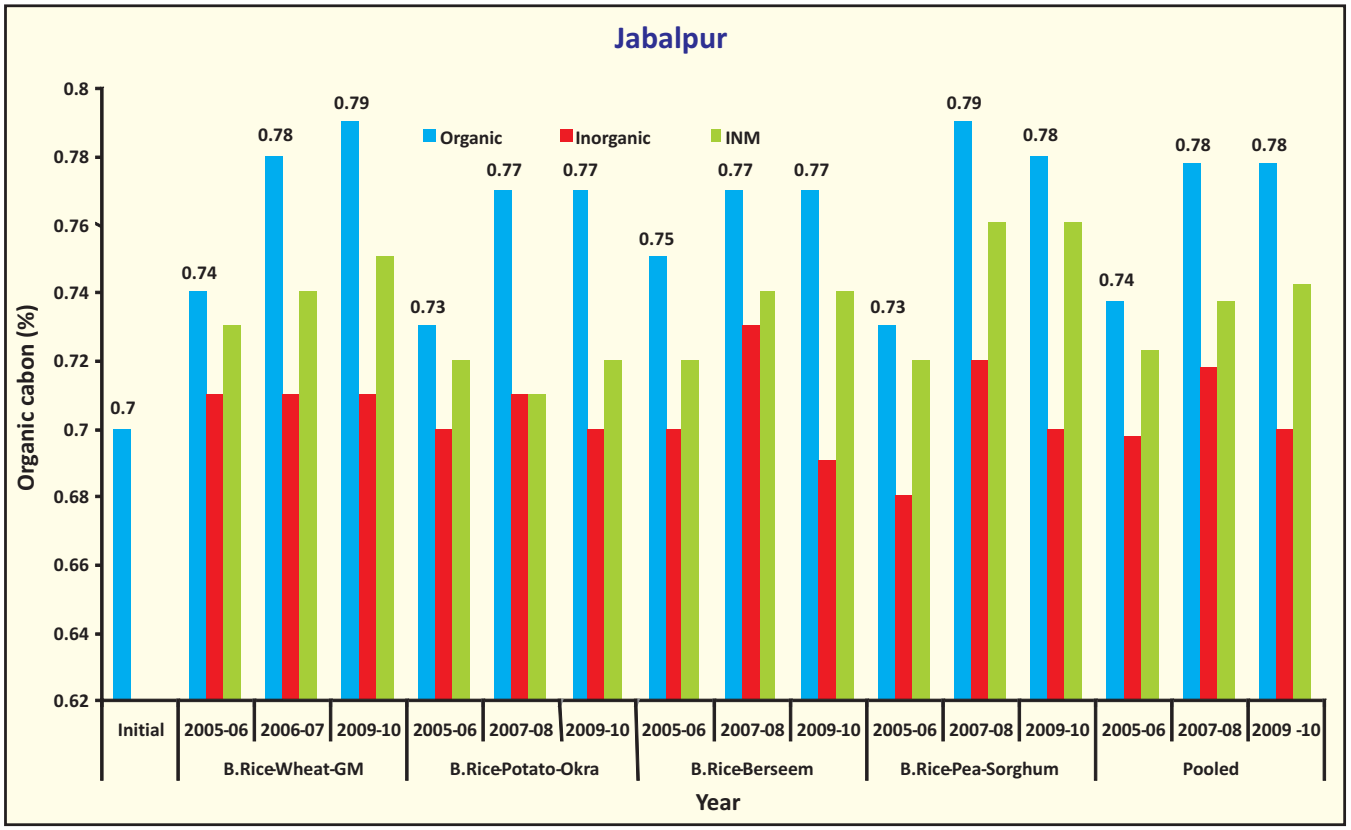
Cropping/Input system	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
7. Karjat		Mean of 3 years								Mean of 4 years						
Rice-G.Nut	-	-	-	-	0.37	0.37	0.39	0.38	6.76	6.87	6.81	6.81	0.88	0.91	0.90	0.90
Rice-Maize	-	-	-	-	0.37	0.37	0.39	0.37	6.74	6.86	6.82	6.81	1.09	1.13	1.10	1.11
Rice-Mustard	-	-	-	-	0.38	0.36	0.39	0.38	6.75	6.78	6.83	6.79	1.23	1.16	1.11	1.17
Rice-Dolichos bean	-	-	-	-	0.36	0.39	0.39	0.38	6.77	6.86	6.86	6.83	1.28	1.19	1.11	1.19
Mean	-	-	-	-	0.37	0.37	0.39		6.75	6.84	6.83		1.12	1.10	1.06	
						SEm±	CD			SEm±	CD			SEm±	CD	
Cropping						0.013	NS			0.042	NS			0.180	NS	
Input						0.007	NS			0.015	NS			0.036	NS	
Cropping X Input						0.017	NS			0.048	NS			0.189	NS	
Input X Cropping						0.014	NS			0.029	NS			0.072	NS	
8. Ludhiana I		Mean of 1 year								Mean of 4 years						
Rice-Wheat-GM	1.55	1.59	1.65	1.60	0.18	0.17	0.20	0.18	6.92	6.92	7.06	6.97	0.49	0.43	0.45	0.46
Turmeric - Onion	1.56	1.58	1.63	1.59	0.19	0.17	0.18	0.18	7.05	7.13	6.92	7.03	0.60	0.43	0.57	0.53
G.Nut.(S)- Garlic	1.52	1.52	1.62	1.55	0.17	0.17	0.18	0.17	7.10	7.11	7.03	7.08	0.53	0.37	0.50	0.47
Maize-Wheat-Cowpea(F)	1.52	1.52	1.62	1.55	0.16	0.15	0.19	0.17	6.89	6.75	6.95	6.86	0.55	0.40	0.50	0.48
Rice-Garlic+Mentha oil	1.53	1.54	1.64	1.57	0.17	0.14	0.16	0.16	6.95	6.82	6.90	6.89	0.66	0.50	0.58	0.58
Mean	1.54	1.55	1.63		0.17	0.16	0.18		6.98	6.95	6.97		0.57	0.43	0.52	
2008-09 (mean of 2 years)																
Cotton - Wheat	-	-	-	-	0.22	0.10	0.15	0.16	7.01	7.10	7.10	7.07	0.59	0.41	0.55	0.52
Maize-Gram	-	-	-	-	0.18	0.12	0.18	0.16	7.35	7.51	7.71	7.52	0.46	0.36	0.45	0.42
Maize -Potato-Moong (S)	-	-	-	-	0.19	0.13	0.20	0.17	7.29	7.43	7.65	7.46	0.58	0.32	0.51	0.47
Rice -Wheat-Moong (S)	-	-	-	-	0.18	0.21	0.16	0.18	7.36	7.41	7.32	7.36	0.60	0.33	0.58	0.50
Mean	-	-	-	-	0.19	0.14	0.17		7.25	7.36	7.45		0.56	0.36	0.52	
										SEm±	CD			SEm±	CD	
Cropping										0.046	0.140			0.040	NS	
Input										0.036	NS			0.021	0.061	
Cropping X Input										0.081	NS			0.056	NS	
Input X Cropping										0.082	NS			0.047	NS	

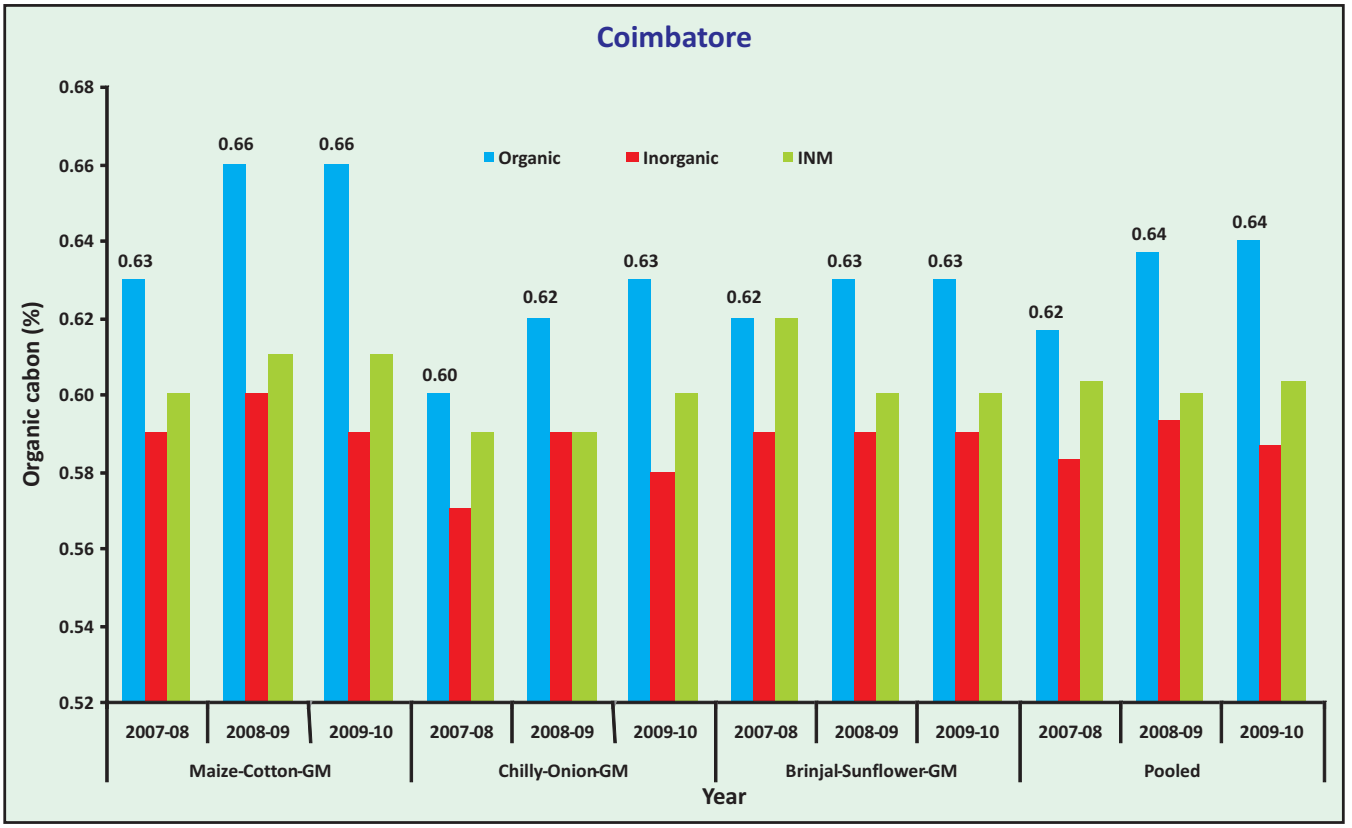
Cropping/Input system	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
Ludhiana II	Mean of 1 year								Mean of 5 years							
Sorghum - Berseem	1.54	1.56	1.54	1.55	0.20	0.20	0.19	0.20	7.31	7.35	7.33	7.33	0.58	0.56	0.57	0.57
Maize- Berseem- Bajra	1.57	1.58	1.56	1.57	0.20	0.21	0.20	0.20	7.28	7.30	7.29	7.29	0.59	0.58	0.60	0.59
Maize-Berseem-Maize + Cowpea	1.55	1.58	1.51	1.55	0.19	0.20	0.18	0.19	7.31	7.34	7.32	7.32	0.55	0.53	0.55	0.55
Sorghum +Guar-Oats-Cowpea	1.49	1.53	1.48	1.50	0.18	0.19	0.18	0.18	7.29	7.31	7.31	7.30	0.54	0.52	0.54	0.53
Mean	1.54	1.56	1.52		0.19	0.20	0.19		7.30	7.32	7.31		0.57	0.55	0.57	
						SEm±	CD			SEm±	CD			SEm±	CD	
Cropping						0.013	NS			0.016	NS			0.025	NS	
Input						0.004	0.011			0.007	0.020			0.004	0.012	
Cropping X Input						0.014	NS			0.020	NS			0.026	NS	
Input X Cropping						0.008	NS			0.015	NS			0.009	NS	
9. Bajaura (mean of 6 years)																
Cauliflower-Radish-Tomato	-	-	-	-	-	-	-	-	-	-	-	-	0.60	-	-	0.60
French bean-Cauliflower-French bean	-	-	-	-	-	-	-	-	-	-	-	-	0.62	-	-	0.62
Cabbage-Radish-Capsicum	-	-	-	-	-	-	-	-	-	-	-	-	0.61	-	-	0.61
Maize-Garlic	-	-	-	-	-	-	-	-	-	-	-	-	0.60	-	-	0.60
Mean	-	-	-	-	-	-	-	-	-	-	-	-	0.61	-	-	
10. Bhopal	Mean of 4 years												Mean of 6 years			
Soybean- Wheat	1.38	1.42	1.41	1.40	-	-	-	-	-	-	-	-	0.71	0.57	0.65	0.64
Soybean-Mustard	1.38	1.40	1.40	1.39	-	-	-	-	-	-	-	-	0.69	0.57	0.64	0.63
Soybean-Chickpea	1.39	1.42	1.40	1.41	-	-	-	-	-	-	-	-	0.64	0.55	0.61	0.60
Soybean-Isabgol	1.40	1.51	1.41	1.44	-	-	-	-	-	-	-	-	0.61	0.54	0.57	0.57
Mean	1.38	1.44	1.41		-	-	-	-	-	-	-	-	0.66	0.56	0.62	
11. Pantnagar	Mean of 3 years												Mean of 6 years			
Rice-Wheat-Sesbania (GM)	1.41	1.38	1.41	1.40	-	-	-	-	-	-	-	-	0.85	0.78	0.84	0.82
Rice -Lentil-Sesbania (GM)	1.37	1.55	1.37	1.43	-	-	-	-	-	-	-	-	0.88	0.82	0.87	0.85
Rice -Pea (veg.)-Sesbania(GM)	1.55	1.33	1.38	1.42	-	-	-	-	-	-	-	-	0.87	0.83	0.85	0.85
Rice -Mustard-Sesbania (GM)	1.46	1.37	1.39	1.41	-	-	-	-	-	-	-	-	0.84	0.79	0.82	0.82
Mean	1.45	1.41	1.39		-	-	-	-	-	-	-	-	0.86	0.80	0.84	
														SEm±	CD	
Cropping														0.013	NS	

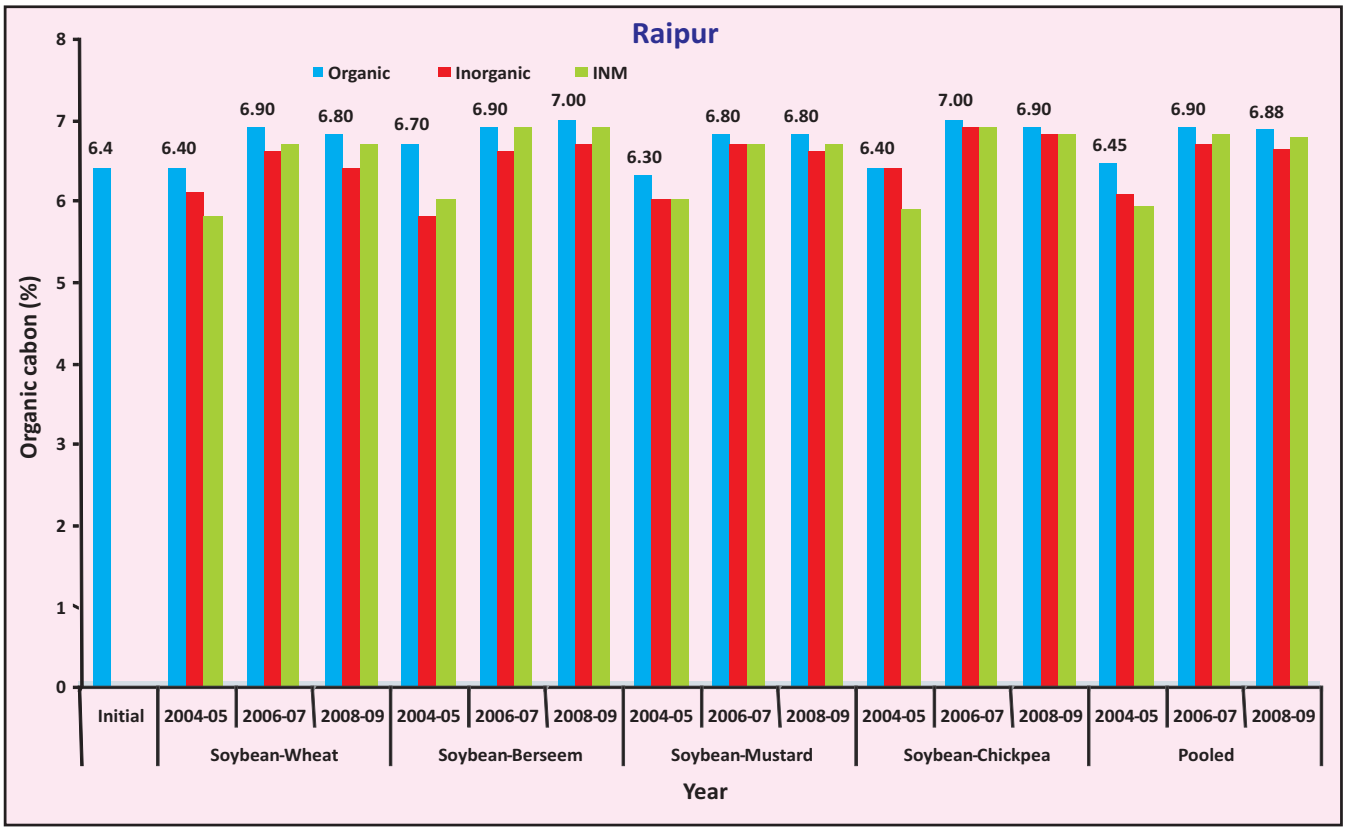
Cropping/Input system	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
Input														0.008	0.023	
Cropping X Input														0.018	NS	
Input X Cropping														0.016	NS	
12. Ranchi (mean of 4 years)																
Rice -Wheat	-	-	-	-	-	-	-	-	5.89	5.60	5.72	5.74	0.49	0.40	0.44	0.44
Rice -Potato	-	-	-	-	-	-	-	-	5.80	5.64	5.74	5.72	0.49	0.40	0.44	0.44
Rice -Mustard / Linseed	-	-	-	-	-	-	-	-	5.76	5.62	5.74	5.71	0.48	0.39	0.43	0.44
Rice -Lentil	-	-	-	-	-	-	-	-	5.79	5.64	5.74	5.72	0.50	0.41	0.44	0.45
Mean	-	-	-	-	-	-	-	-	5.81	5.63	5.73		0.49	0.40	0.44	
														SEm±	CD	
Cropping														0.005	NS	
Input														0.003	0.008	
Cropping X Input														0.007	NS	
Input X Cropping														0.005	NS	
13. Umiam (mean of 3 years)																
Rice - Carrot	1.14	1.17	1.14	1.15	-	-	-	-	5.20	5.13	5.17	5.17	3.26	3.22	3.29	3.25
Rice - Potato	1.14	1.16	1.15	1.15	-	-	-	-	5.10	5.03	5.12	5.09	3.28	3.22	3.34	3.28
Rice – French bean	1.14	1.16	1.15	1.15	-	-	-	-	5.19	5.12	5.21	5.17	3.36	3.27	3.35	3.33
Rice - Tomato	1.15	1.17	1.16	1.16	-	-	-	-	5.06	5.00	5.09	5.05	3.30	3.26	3.39	3.32
Mean	1.14	1.16	1.15		-	-	-	-	5.14	5.07	5.15		3.30	3.24	3.34	
		SEm±	CD							SEm±	CD			SEm±	CD	
Cropping		0.007	NS							0.074	NS			0.023	NS	
Input		0.006	0.017							0.022	0.065			0.027	NS	
Cropping X Input		0.012	NS							0.082	NS			0.050	NS	
Input X Cropping		0.011	NS							0.044	NS			0.055	NS	

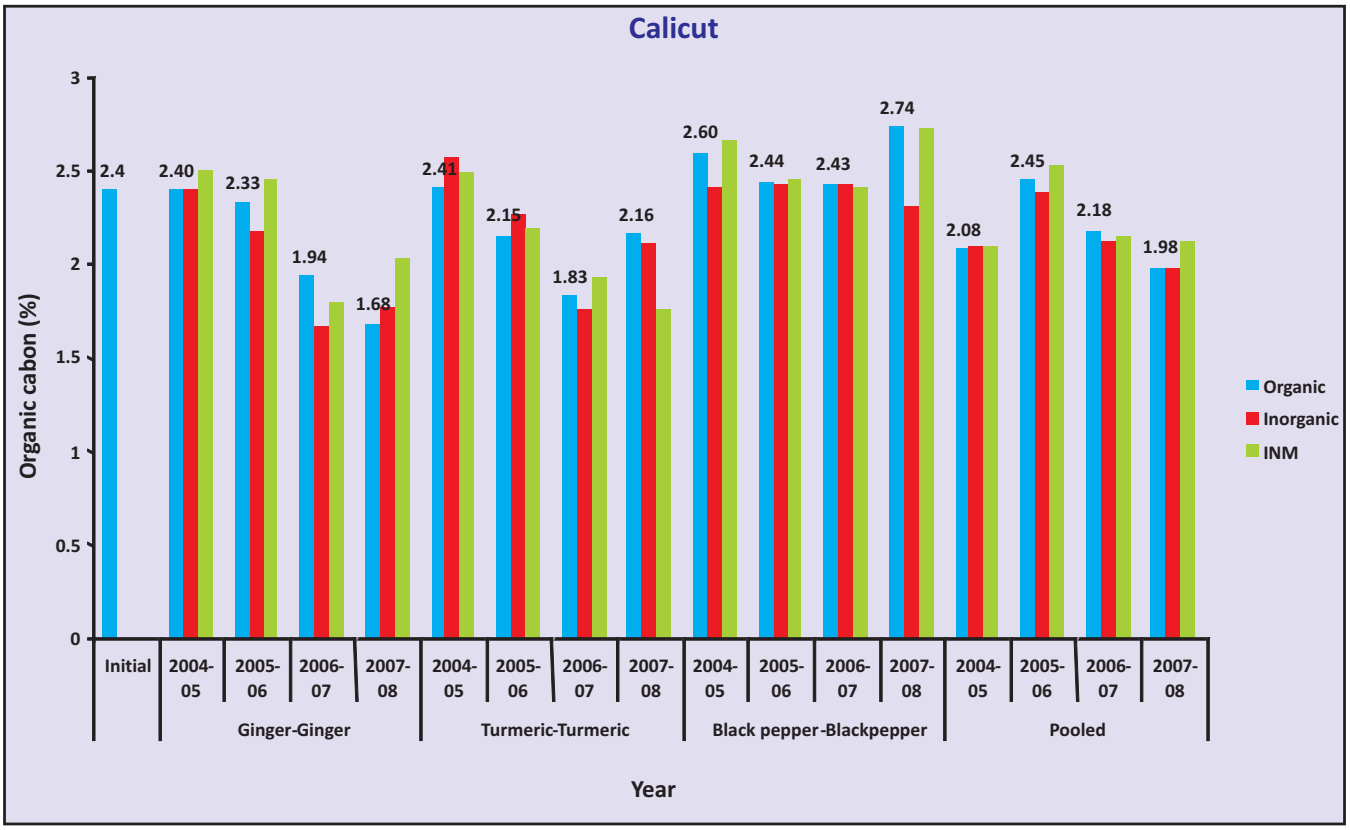
Fig. 2. Temporal variation in organic carbon at various locations under organic, inorganic and INM package of different cropping systems

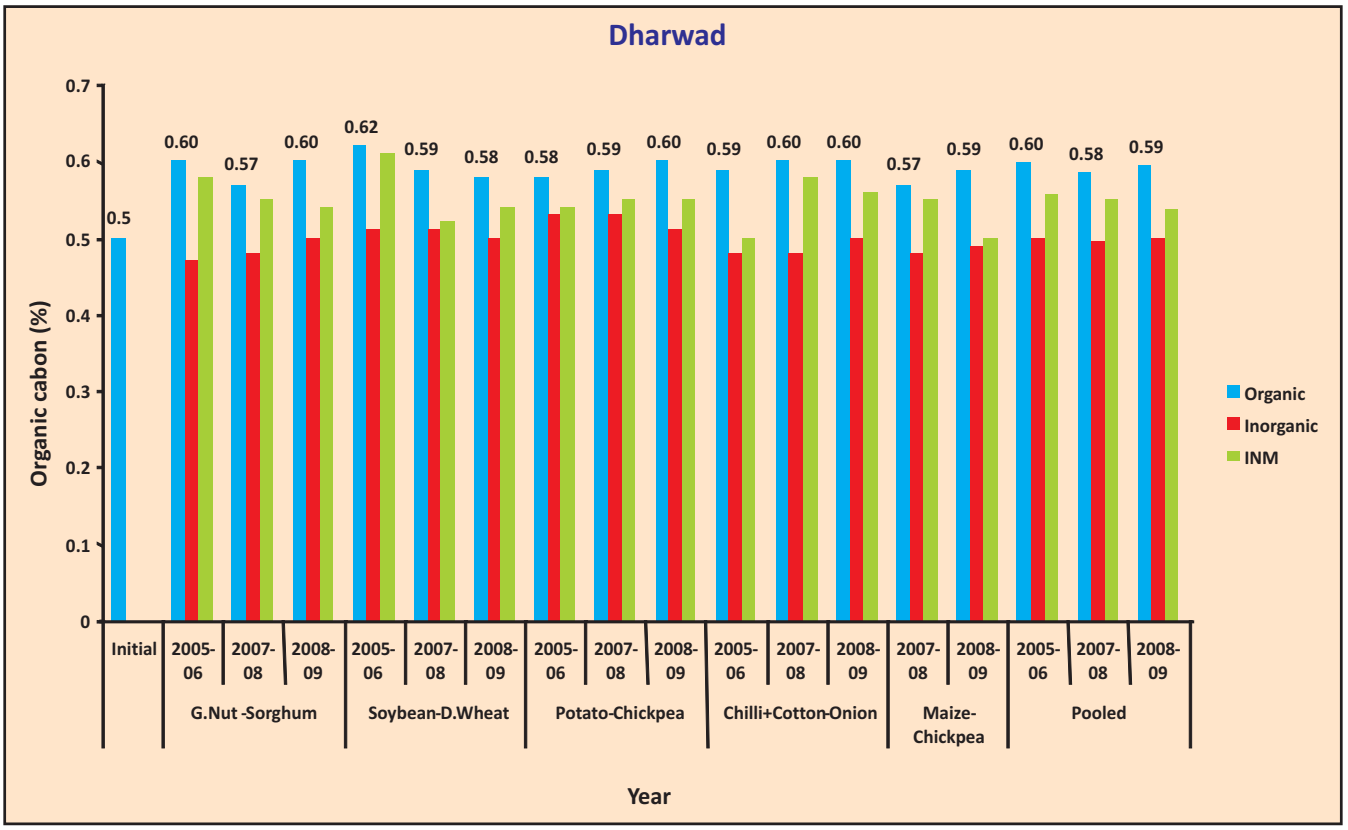


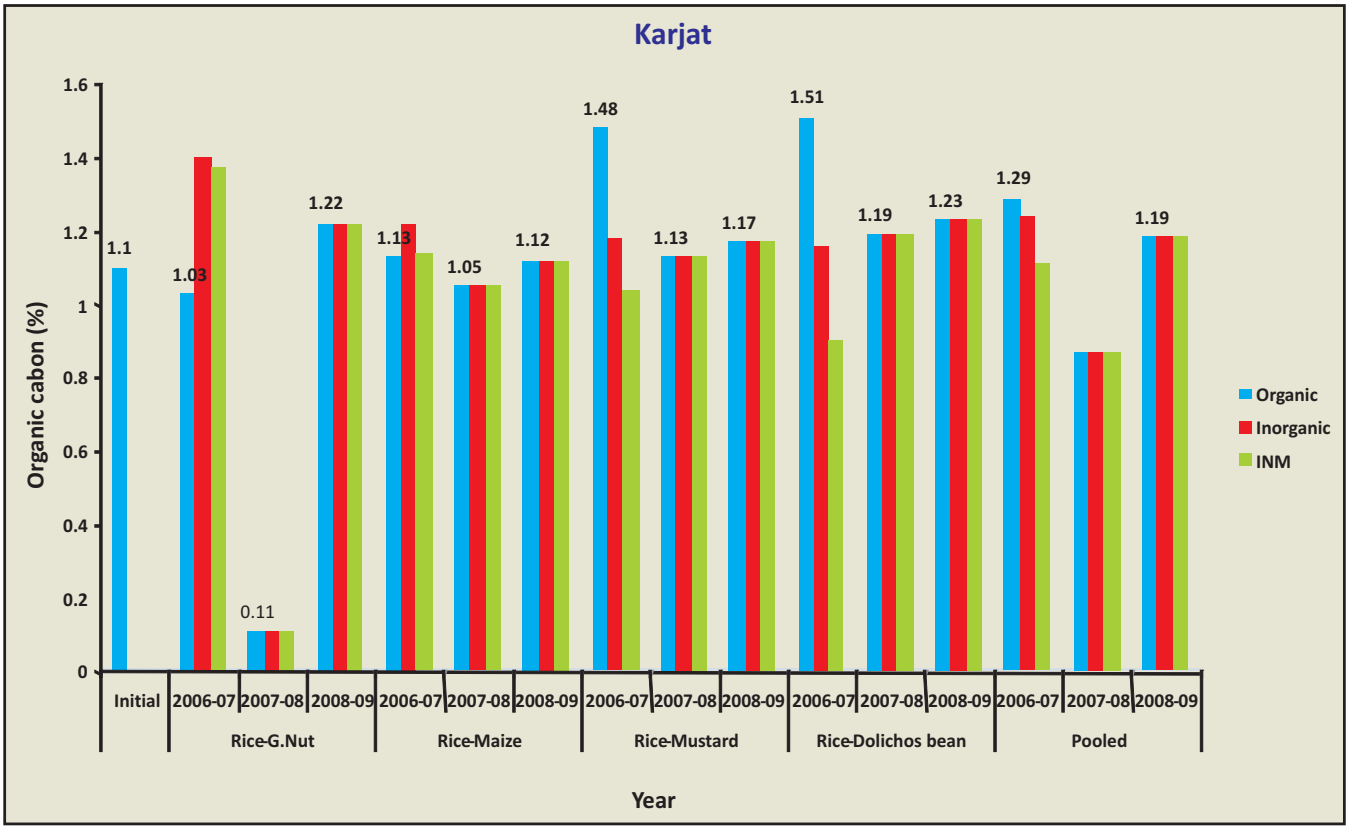


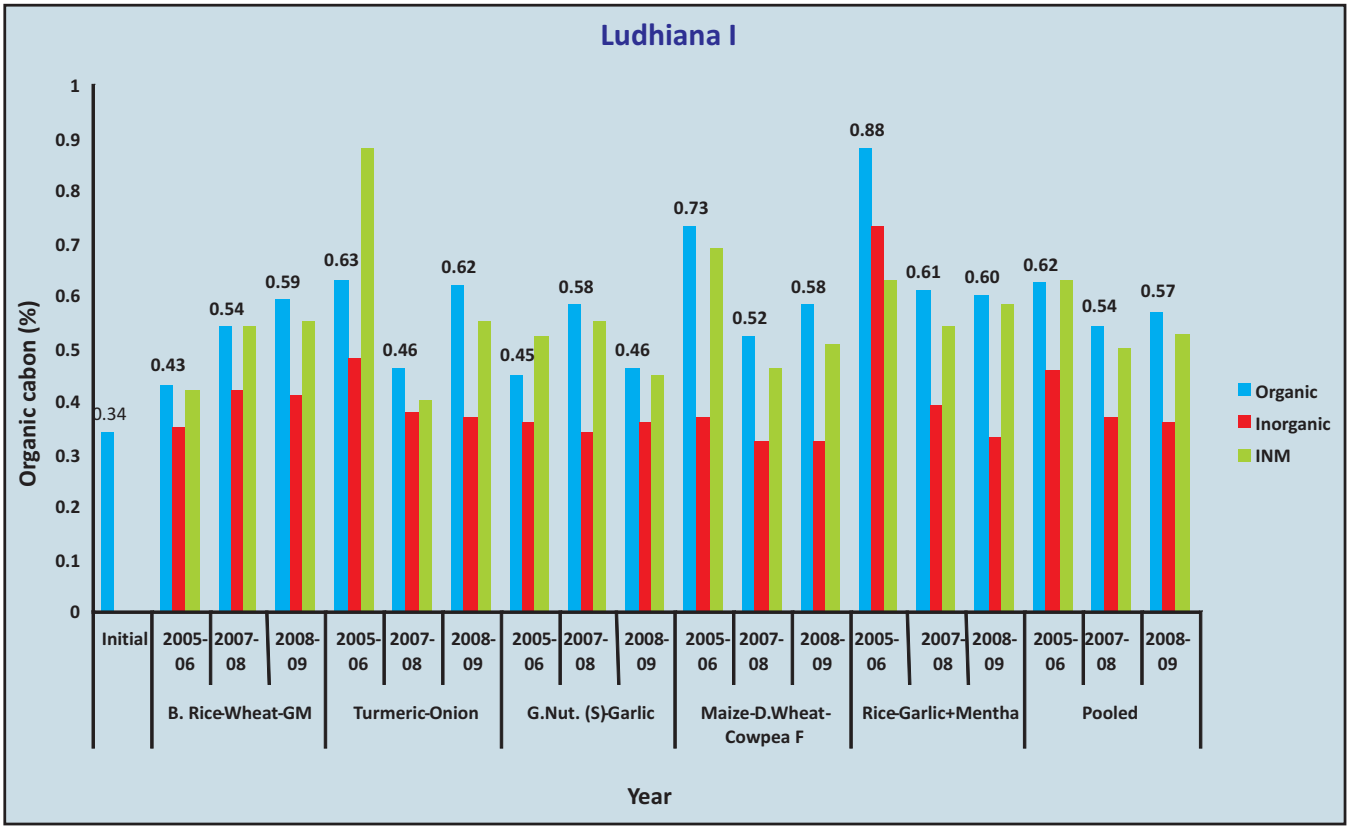

Coimbatore
Organic
Inorganic
INM
Organic cabon (%)
0.68
0.66
0.64
0.62
0.60
0.58
0.56
0.54
0.52
0.63
0.66
0.66
0.60
0.62
0.63
0.62
0.63
0.63
0.62
0.64
0.64
2007-08
2008-09
2009-10
Maize-Cotton-GM
Chilly-Onion-GM
Brinjal-Sunflower-GM
Pooled
Year

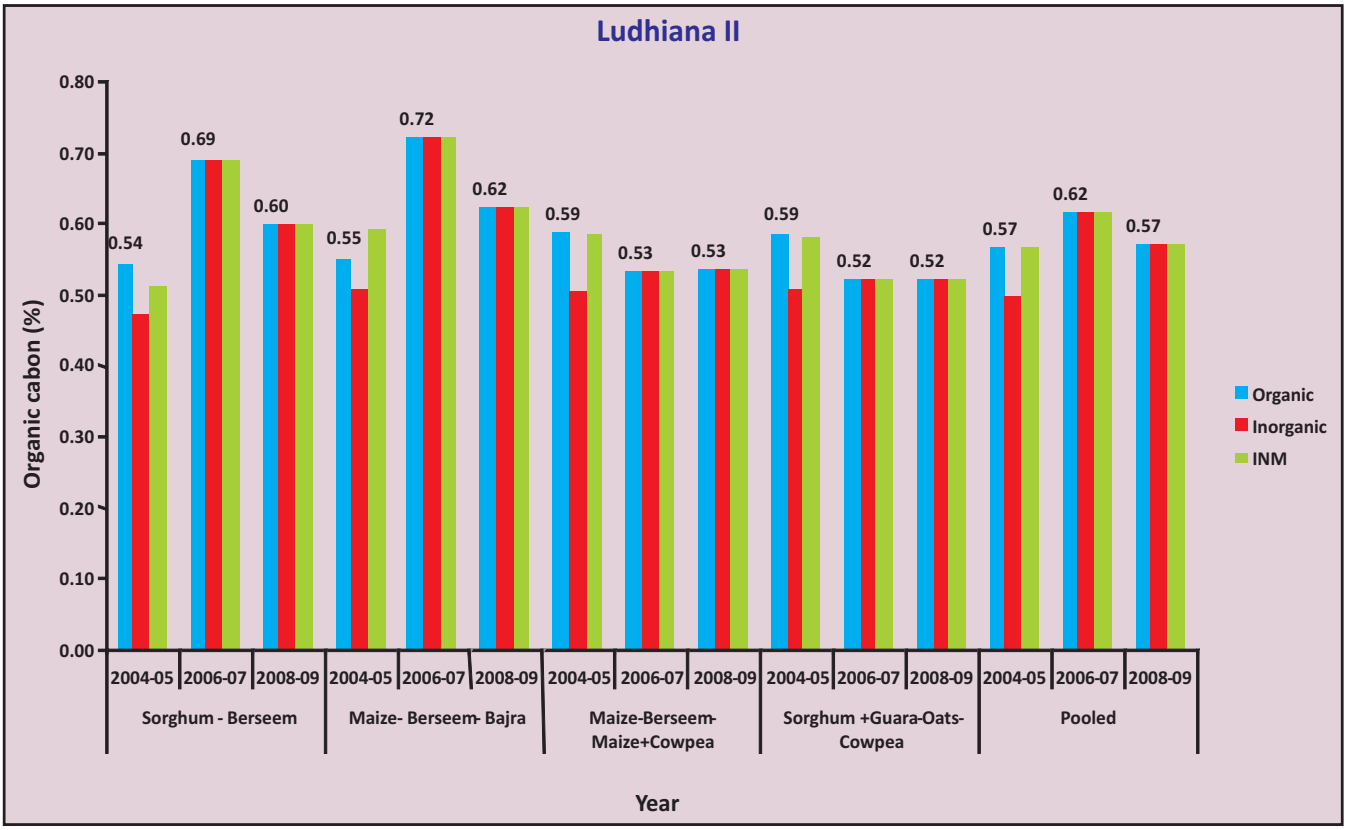

Raipur
Organic
Inorganic
INM
Organic cabon (%)
8
7
6
5
4
3
2
1
0
6.4
6.40
6.90
6.80
6.70
6.90
7.00
6.30
6.80
6.80
6.40
7.00
6.90
6.45
6.90
6.88
Initial
2004-05
2006-07
2008-09
Soybean-Wheat
Soybean-Berseem
Soybean-Mustard
Soybean-Chickpea
Pooled
Year

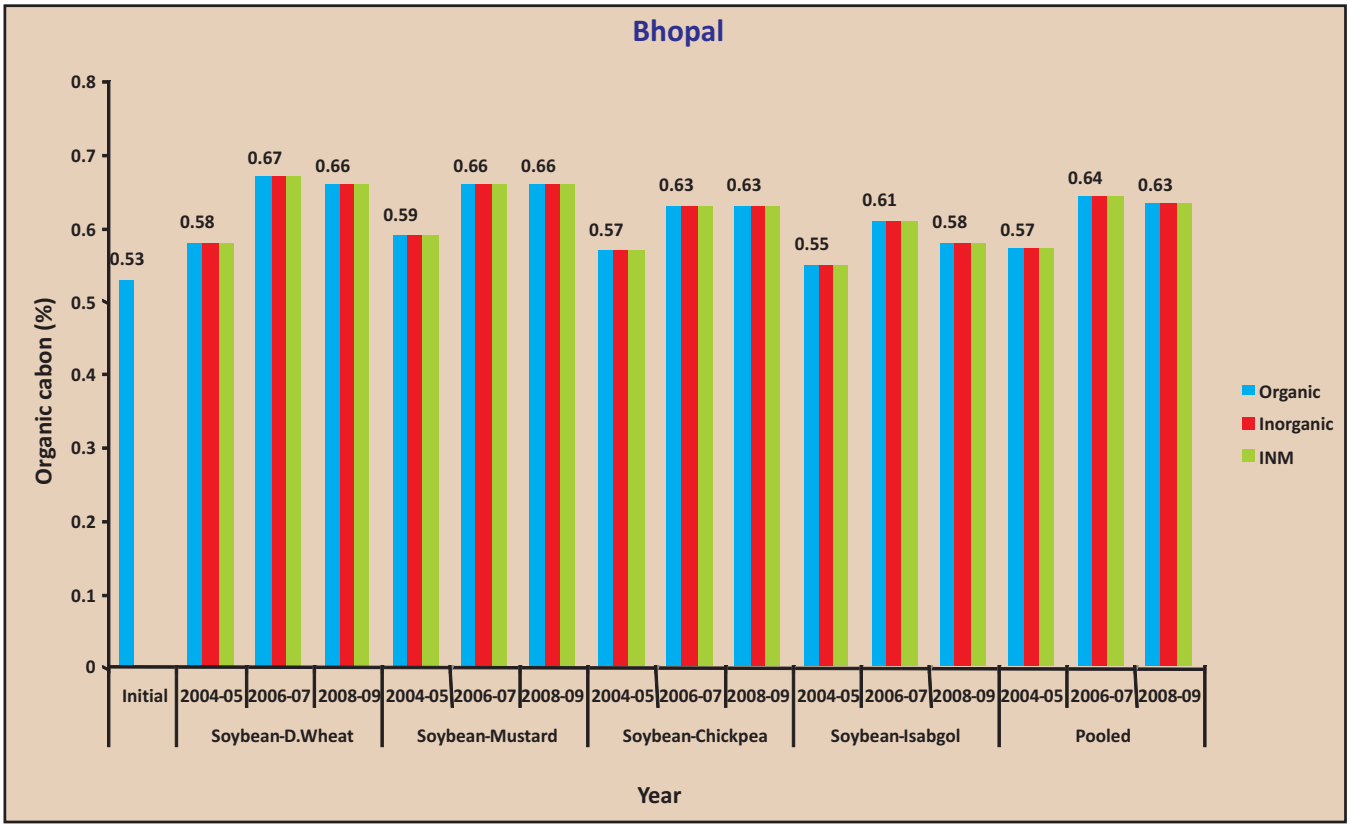

Calicut
Organic cabon (%)
3
2.5
2
1.5
1
0.5
0
2.4
2.40
2.33
1.94
1.68
2.41
2.15
1.83
2.16
2.60
2.44
2.43
2.74
2.08
2.45
2.18
1.98
Initial
2004-05
2005-06
2006-07
2007-08
2004-05
2005-06
2006-07
2007-08
2004-05
2005-06
2006-07
2007-08
2004-05
2005-06
2006-07
2007-08
Ginger-Ginger
Turmeric-Turmeric
Black pepper-Blackpepper
Pooled
Year
Organic
Inorganic
INM

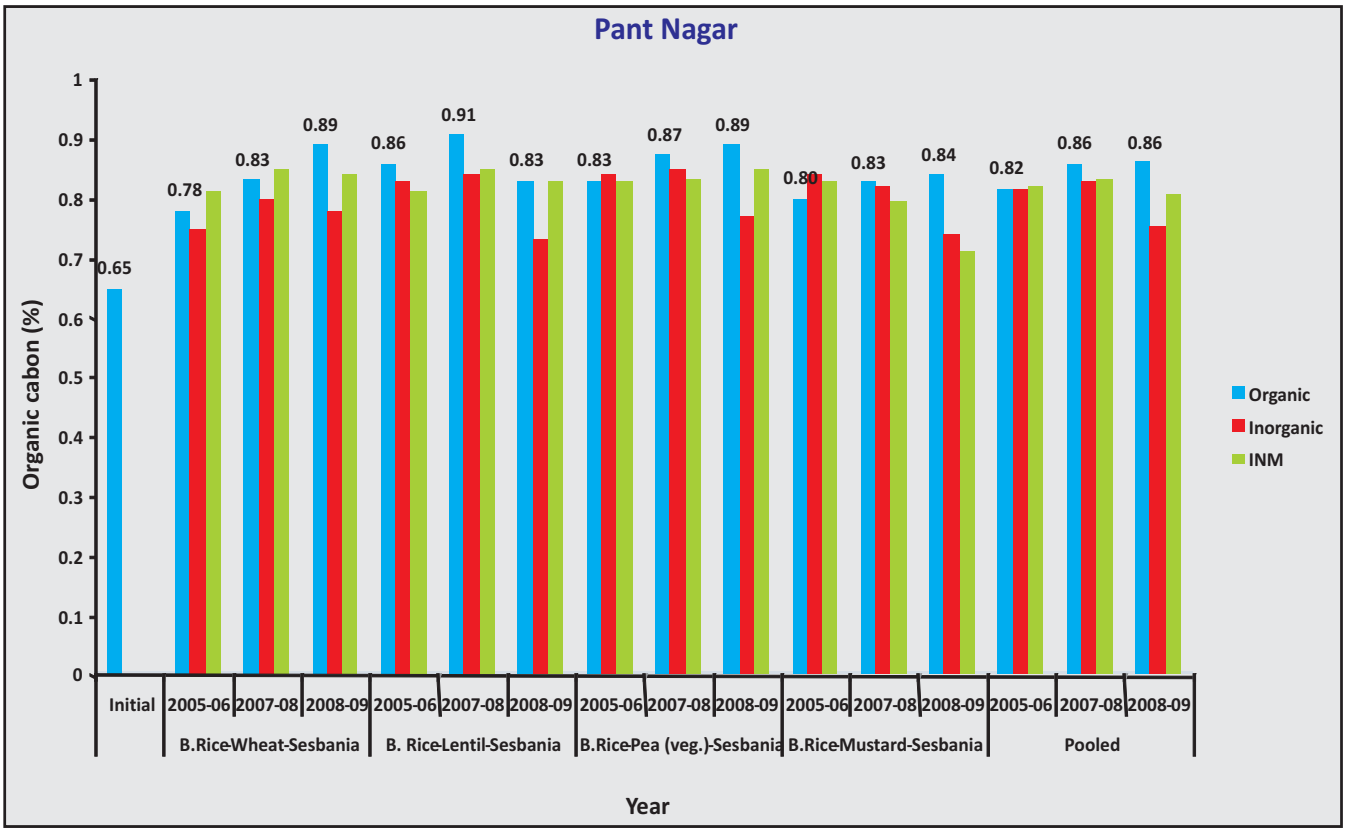

Dharwad
Organic cabon (%)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.5
0.60
0.57
0.60
0.62
0.59
0.58
0.58
0.59
0.60
0.59
0.60
0.60
0.57
0.59
0.60
0.58
0.59
Initial
2005-06
2007-08
2008-09
2005-06
2007-08
2008-09
2005-06
2007-08
2008-09
2005-06
2007-08
2008-09
2007-08
2008-09
2005-06
2007-08
2008-09
G.Nut -Sorghum
Soybean-D.Wheat
Potato-Chickpea
Chilli+Cotton-Onion
Maize-Chickpea
Pooled
Year
Organic
Inorganic
INM

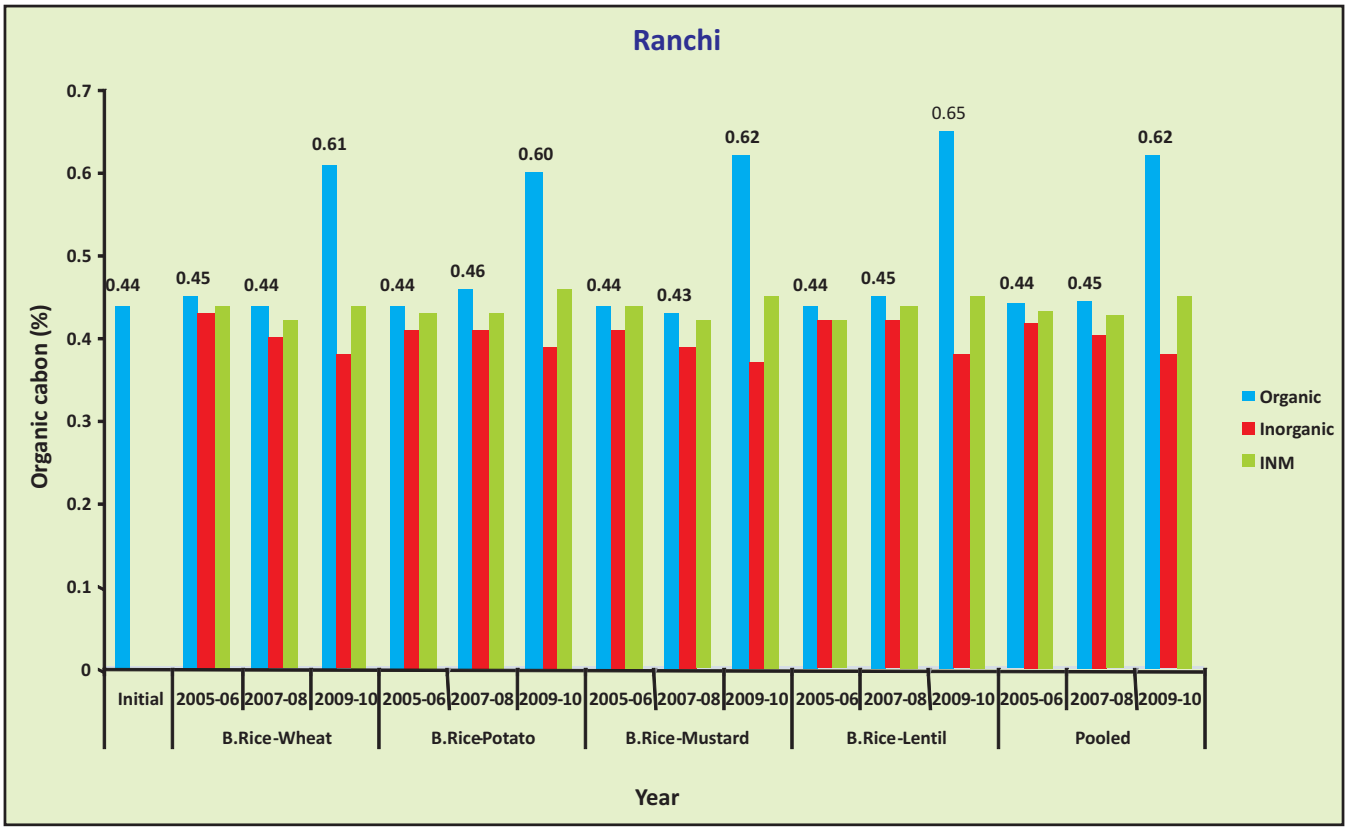

Karjat
Organic cabon (%)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1.1
1.03
0.11
1.22
1.13
1.05
1.12
1.48
1.13
1.17
1.51
1.19
1.23
1.29
1.19
Initial
2006-07
2007-08
2008-09
2006-07
2007-08
2008-09
2006-07
2007-08
2008-09
2006-07
2007-08
2008-09
2006-07
2007-08
2008-09
Rice-G.Nut
Rice-Maize
Rice-Mustard
Rice-Dolichos bean
Pooled
Year
Organic
Inorganic
INM


Ludhiana I
Organic cabon (%)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.34
0.43
0.54
0.59
0.63
0.46
0.62
0.45
0.58
0.46
0.73
0.52
0.58
0.88
0.61
0.60
0.62
0.54
0.57
Initial
2005-06
2007-08
2008-09
2005-06
2007-08
2008-09
2005-06
2007-08
2008-09
2005-06
2007-08
2008-09
2005-06
2007-08
2008-09
2005-06
2007-08
2008-09
B. Rice-Wheat-GM
Turmeric-Onion
G.Nut. (S)-Garlic
Maize-D.Wheat-Cowpea F
Rice-Garlic+Mentha
Pooled
Year
Organic
Inorganic
INM


Ludhiana II
Organic cabon (%)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.54
0.69
0.60
0.55
0.72
0.62
0.59
0.53
0.53
0.59
0.52
0.52
0.57
0.62
0.57
2004-05
2006-07
2008-09
Sorghum - Berseem
Maize- Berseem- Bajra
Maize-Berseem-Maize+Cowpea
Sorghum +Guara-Oats-Cowpea
Pooled
Year
Organic
Inorganic
INM


Bhopal
Organic cabon (%)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.53
0.58
0.67
0.66
0.59
0.66
0.66
0.57
0.63
0.63
0.55
0.61
0.58
0.57
0.64
0.63
Initial
2004-05
2006-07
2008-09
Soybean-D.Wheat
Soybean-Mustard
Soybean-Chickpea
Soybean-Isabgol
Pooled
Year
Organic
Inorganic
INM


Pant Nagar
Organic cabon (%)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.65
0.78
0.83
0.89
0.86
0.91
0.83
0.83
0.87
0.89
0.80
0.83
0.84
0.82
0.86
0.86
Initial
2005-06
2007-08
2008-09
2005-06
2007-08
2008-09
2005-06
2007-08
2008-09
2005-06
2007-08
2008-09
2005-06
2007-08
2008-09
B.Rice-Wheat-Sesbania
B. Rice-Lentil-Sesbania
B.Rice-Pea (veg.)-Sesbania
B.Rice-Mustard-Sesbania
Pooled
Year
Organic
Inorganic
INM


Ranchi
Organic cabon (%)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.44
0.45
0.44
0.61
0.44
0.46
0.60
0.44
0.43
0.62
0.44
0.45
0.65
0.44
0.45
0.62
Initial
2005-06
2007-08
2009-10
2005-06
2007-08
2009-10
2005-06
2007-08
2009-10
2005-06
2007-08
2009-10
2005-06
2007-08
2009-10
B.Rice-Wheat
B.RicePotato
B.Rice-Mustard
B.Rice-Lentil
Pooled
Year
Organic
Inorganic
INM

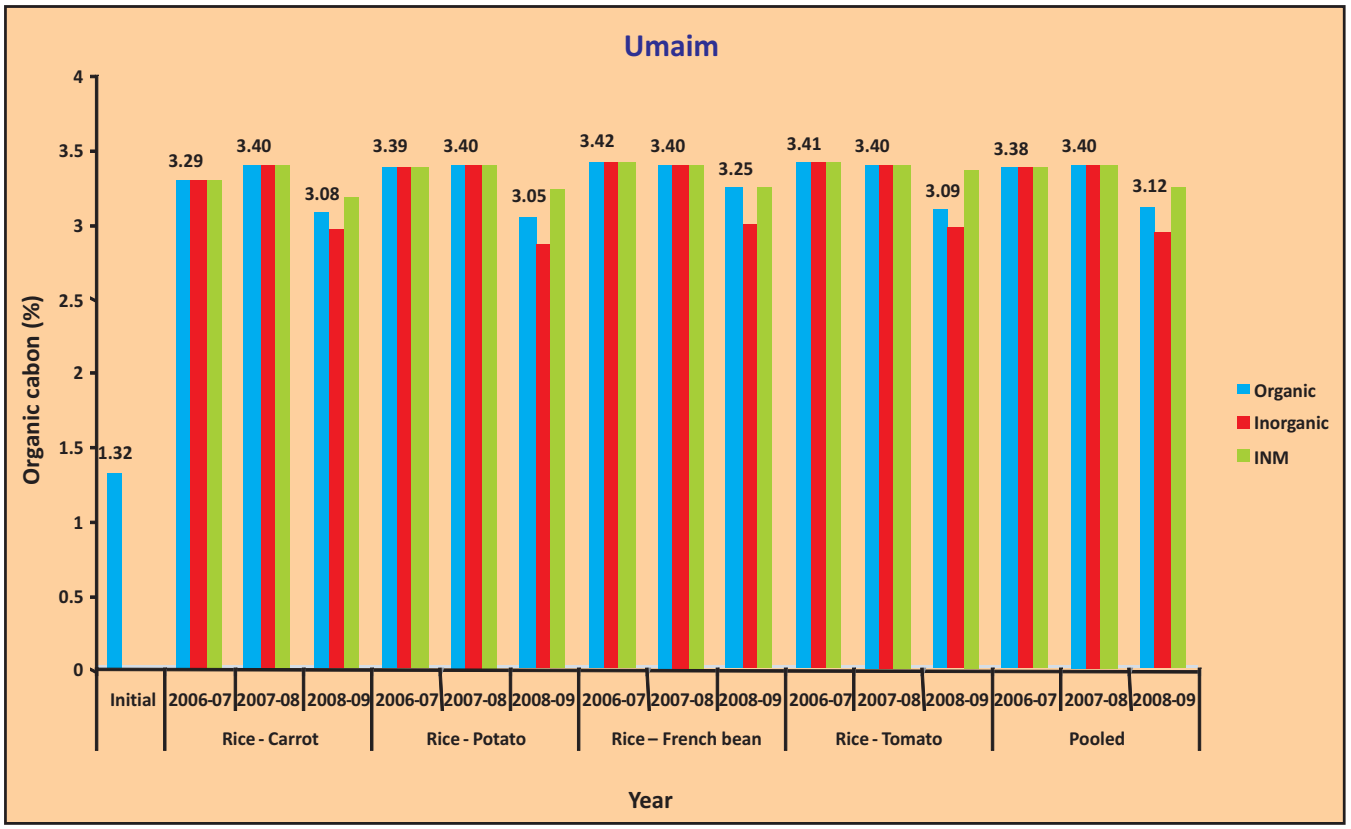

Umaim
Organic cabon (%)
4
3.5
3
2.5
2
1.5
1
0.5
0
1.32
3.29
3.40
3.08
3.39
3.40
3.05
3.42
3.40
3.25
3.41
3.40
3.09
3.38
3.40
3.12
Initial
2006-07
2007-08
2008-09
2006-07
2007-08
2008-09
2006-07
2007-08
2008-09
2006-07
2007-08
2008-09
2006-07
2007-08
2008-09
Rice - Carrot
Rice - Potato
Rice – French bean
Rice - Tomato
Pooled
Year
Organic
Inorganic
INM

Table 4. Influence of methods of nutrient application on soil available nitrogen, phosphorus and potassium at the end of in different crops and cropping system at various locations (2004-05 to 2009-10)

Cropping/Input system	Available N (kg/ha)				Available P (kg/ha)				Available K (kg/ha)			
	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean
1. Modipuram (mean of 2 years)												
Rice-Wheat	182	206	199	195	30	26	33	29	257	158	244	220
Rice-Potato-Radish	135	169	141	148	18	20	27	22	257	244	203	235
Babycorn - Potato-Green gram	118	137	134	130	32	19	25	25	175	166	188	176
Sorghum (F)-Pea-Okra	130	137	127	132	32	22	31	29	185	187	178	184
Rice –Barley + mustard-Green gram	371	311	361	348	22	29	27	26	317	143	210	224
Maize-Potato-Okra	321	301	321	314	19	25	23	23	268	145	225	213
Maize-Mustard-Radish-Green gram	381	361	331	358	19	24	22	22	355	234	246	279
Mean	182	206	199	195	30	26	33	29	259	182	214	
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		18.4	NS			3.5	NS			7.4	NS	
Input		4.3	13.9			2.1	7.0			6.1	NS	
Cropping X Input		19.6	NS			4.9	NS			12.4	NS	
Input X Cropping		8.5	NS			4.3	NS			12.1	NS	
2.Jabalpur (mean of 6 years)												
Rice-Wheat	282	266	278	276	13.02	12.25	12.55	12.61	290	273	286	283
Rice – potato -Okra	284	264	264	270	12.73	12.08	12.45	12.42	295	270	285	283
Rice – Berseem	282	267	272	274	12.55	12.05	12.5	12.37	297	271	285	284
Rice-Pea-Sorghum F	278	273	279	277	13.03	12.4	12.72	12.72	297	268	291	285
Mean	281	267	273		12.83	12.2	12.55		295	270	287	

Croppin\g/Input system	Available N (kg/ha)				Available P (kg/ha)				Available K (kg/ha)			
	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		0.86	2.58			0.84	2.53			0.90	NS	
Input		1.03	2.93			0.67	1.91			0.86	2.45	
Cropping X Input		1.89	5.45			1.37	4.01			1.66	4.82	
Input X Cropping		2.06	5.88			1.33	3.82			1.71	4.89	
3. Coimbatore (mean of 6 years)												
Maize-Cotton	239	229	232	233	22.97	21.53	22.43	22.31	699	688	693	694
Chilly-Onion	220	211	214	215	18.27	17.15	17.55	17.66	739	722	729	730
Brinjal-Sunflower	254	245	249	249	19.33	17.00	18.20	18.18	656	628	638	641
Turmeric+ Onion	263	258	264	262	26.53	24.63	24.93	25.36	797	781	794	791
Mean	244	236	239		21.77	20.08	20.78		723	705	714	
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		5.77	19.96			1.51	5.24			21.46	74.26	
Input		1.83	NS			0.24	0.71			4.26	NS	
Cropping X Input		6.49	NS			1.56	NS			22.56	NS	
Input X Cropping		3.65	NS			0.47	NS			8.52	NS	
4.Raipur (mean of 6 years)												
Soybean-Wheat	249	255	251	253	12.28	14.62	14.64	13.85	250	262	261	258
Soybean-Berseem	253	261	263	259	13.24	15.68	15.18	14.70	254	268	272	265
Soybean-Mustard	248	260	264	257	13.38	15.74	15.12	14.75	260	266	270	265
Soybean-Chickpea	257	264	268	263	14.17	16.34	16.28	15.60	264	275	276	272
Mean	252	260	263		13.27	15.60	15.31		257	268	270	
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		2.36	7.27			0.46	NS			2.95	9.08	
Input		1.32	3.79			0.28	0.81			2.31	6.65	

Cropping/Input system	Available N (kg/ha)				Available P (kg/ha)				Available K (kg/ha)			
	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean
Cropping X Input		3.19	NS			0.65	NS			4.79	NS	
Input X Cropping		2.64	NS			0.56	NS			4.62	NS	
5. Calicut (mean of 4 years)												
Ginger	135	136	143	138	9.66	7.50	9.51	8.89	156	185	169	170
Turmeric	137	137	139	138	4.37	5.06	5.31	4.91	147	176	181	168
Black pepper	153	144	177	158	9.63	4.68	6.64	6.98	179	209	215	201
Mean	142	139	153		7.88	5.75	7.15		160	190	188	
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		5.85	NS			3.63	NS			36.53	NS	
Input		4.17	NS			0.91	NS			15.88	NS	
Cropping X Input		7.58	NS			3.78	NS			40.87	NS	
Input X Cropping		5.90	NS			1.28	NS			22.46	NS	
6. Dharwad (mean of 5 years)												
G.Nut -Sorghum	255	240	254	250	25.18	21.62	24.51	23.77	372	340	360	357
Soybean- Wheat	269	240	258	255	25.76	21.16	24.73	23.88	372	338	361	357
Potato-Chickpea	265	238	250	251	25.07	21.71	24.07	23.61	380	337	370	362
Chilli+Cotton /Chilli+Cotton-Onion	280	206	260	249	26.14	21.31	25.28	24.24	379	347	369	365
Maize-Chickpea	264	244	255	255	29.22	25.38	27.52	27.37	362	311	336	336
Mean	267	234	255		26.27	22.23	25.22		373	334	359	
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		8.52	NS			0.383	NS			1.140	3.51	
Input		6.25	18.01			0.302	0.87			2.837	8.17	
Cropping X Input		13.29	NS			0.625	NS			4.771	NS	
Input X Cropping		12.51	NS			0.61	NS			5.67	NS	

Cropping/Input system	Available N (kg/ha)				Available P (kg/ha)				Available K (kg/ha)			
	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean
7. Karjat (mean of 4 years)												
Rice-Groundnut	248	225	217	230	24.60	21.75	23.37	23.24	296	308	301	302
Rice-Maize	215	222	229	222	23.88	20.98	19.99	21.62	303	331	293	309
Rice-Mustard	218	213	229	220	20.99	20.50	23.05	21.51	283	347	296	309
Rice-Dolichos bean	228	230	238	232	21.39	22.42	22.69	22.16	297	340	312	316
Mean	227	223	228		22.71	21.41	22.27		295	331	301	
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		7.62	NS			0.74	NS			13.30	NS	
Input		7.06	NS			0.83	NS			12.29	35.40	
Cropping X Input		13.82	NS			1.54	NS			24.08	NS	
Input X Cropping		14.12	NS			1.66	NS			24.58	NS	
8. Ludhiana I (mean of 4 years)												
Rice-Wheat-GM	241	250	260	251	64	60	61	62	174	160	153	162
Turmeric - Onion	263	231	268	254	66	57	58	60	180	143	144	156
Groundnut(S)- Garlic	258	214	243	238	58	58	59	58	153	120	136	136
Maize-Wheat-Cowpea(F)	274	229	241	248	68	61	55	61	167	125	130	140
Rice-Garlic + Mentha	242	201	242	228	66	47	48	54	141	146	122	136
Mean	256	225	251		64	57	56		163	139	137	
2008-09 (mean of 2 years)												
Cotton - Wheat	358	318	349	342	63	51	62	59	146	90	129	122
Maize-Gram	332	296	325	317	65	56	65	62	146	101	119	122
Maize -Potato-G.gram	341	237	341	306	70	56	72	66	195	140	196	177
Rice -Wheat-G. gram	360	289	355	334	75	59	71	68	207	193	162	187
Mean	348	285	342		68	55	68		174	131	152	
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		13.51	NS			2.34	NS			11.39	NS	

Cropping/Input system	Available N (kg/ha)				Available P (kg/ha)				Available K (kg/ha)			
	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean
Input		10.22	NS			2.19	6.32			7.26	20.97	
Cropping X Input		23.04	NS			4.63	NS			17.48	NS	
Input X Cropping		22.86	NS			4.89	NS			16.24	NS	
Ludhiana II (mean of 5 years)												
Sorghum - Berseem	251	258	261	257	59	59	59	59	148	140	142	143
Maize- Berseem- Bajra	278	282	290	283	63	61	62	62	139	132	131	134
Maize-Berseem-Maize +Cowpea	263	265	268	265	59	57	59	58	141	128	140	136
Sorghum +Guar-Oats-Cowpea	262	262	263	262	54	54	54	54	142	131	134	136
Mean	264	267	270		59	58	59		142	133	137	
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		12.17	NS			2.29	NS			3.90	NS	
Input		2.03	NS			0.40	NS			2.67	NS	
Cropping X Input		12.61	NS			2.38	NS			5.85	NS	
Input X Cropping		4.07	NS			0.79	NS			5.34	NS	
9. Bajaura (mean of 6 years)												
Cauliflower-Radish-Tomato	230	282	259	257	34	30	27	30	135	121	108	121
French bean-Cauliflower-French bean	246	340	290	292	38	24	31	31	97	105	87	96
Cabbage-Radish-Capsicum	258	283	284	275	33	27	31	30	93	99	109	101
Maize-Garlic	260	267	293	274	33	30	27	30	91	94	76	87
Mean	249	293	282		34	28	29		104	105	95	
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		9.66	NS			0.51	NS			4.69	14.98	
Input		5.37	NS			1.45	4.22			3.19	9.31	
Cropping X Input		13.05	40.08			2.41	NS			7.00	21.32	
Input X Cropping		10.75	31.36			2.89	NS			6.38	18.61	

Cropping/Input system	Available N (kg/ha)				Available P (kg/ha)				Available K (kg/ha)			
	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean
10. Bhopal (mean of 6 years)												
Soybean- Wheat	197	173	185	185	27.6	20.7	24.1	24.1	611	582	608	600
Soybean-Mustard	187	175	183	182	25.4	20.3	22.8	22.8	605	580	589	591
Soybean-Chickpea	184	176	181	180	23.0	19.5	21.1	21.2	609	581	581	594
Soybean-Isabgol	176	166	172	171	19.7	18.3	19.9	19.3	592	575	584	583
Mean	186	173	180		24.0	19.7	29.3		605	579	593	
11. Pantnagar (mean of 6 years)												
Rice-Wheat-Sesbania (GM)	246	239	250	245	22.8	23.5	26.9	24.4	166	170	167	168
Rice -Lentil-Sesbania (GM)	241	248	259	249	24.1	24.3	26.9	25.1	172	182	178	177
Rice -Pea (veg.)-Sesbania(GM)	250	234	235	239	26.0	28.8	25.8	26.9	168	171	176	172
Rice -Mustard-Sesbania (GM)	238	244	273	252	24.3	24.4	26.0	24.9	176	184	173	178
Mean	244	241	254		24.3	25.3	26.4		170	177	174	
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		6.22	NS			0.91	NS			2.02	6.22	
Input		3.12	NS			0.70	NS			1.80	NS	
Cropping X Input		8.05	NS			1.46	NS			3.56	NS	
Input X Cropping		6.24	NS			1.40	NS			3.59	NS	
12. Ranchi (mean of 4 years)												
Rice -Wheat	320	300	298	306	54.8	53.6	49.2	52.5	291	255	267	271
Rice -Potato	325	303	303	310	67.3	64.5	62.1	64.6	279	259	275	271
Rice -Mustard / Linseed	323	297	300	307	58.8	57.3	56.6	57.6	280	255	270	268
Rice -Lentil	325	293	311	309	59.4	54.0	55.7	56.4	291	254	265	270
Mean	323	298	303		60.1	57.4	55.9		285	256	269	
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		4.15	NS			3.07	NS			3.93	NS	

Cropping/Input system	Available N (kg/ha)				Available P (kg/ha)				Available K (kg/ha)			
	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean	Organic	Inorganic	INM	Mean
Input		3.03	8.85			0.89	NS			4.20	12.26	
Cropping X Input		6.46	NS			3.40	NS			7.91	NS	
Input X Cropping		6.07	NS			1.78	NS			8.40	NS	
13. Umiam (mean of 3 years)												
Rice - Carrot	227	227	231	229	12.9	12.6	15.0	13.5	269	263	275	269
Rice - Potato	228	225	232	228	13.1	11.6	14.8	13.1	270	266	277	271
Rice – French bean	222	219	224	221	15.7	14.4	16.9	15.6	268	262	275	268
Rice - Tomato	225	220	227	224	15.7	15.4	17.7	16.3	265	262	273	266
Mean	226	223	228		14.3	13.5	16.1		268	263	275	
		SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		5.39	NS			1.71	NS			3.48	NS	
Input		1.46	NS			0.68	NS			2.92	NS	
Cropping X Input		5.90	NS			2.04	NS			5.91	NS	
Input X Cropping		2.93	NS			1.36	NS			5.85	NS	

Table 5. Influence of methods of nutrient application on soil micronutrients at the end of in different crops and cropping system at various locations (2004-05 to 2009-10)

Cropping /Input system	Mn (ppm)				Zn (ppm)				Cu (ppm)				Fe (ppm)			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
1. Modipuram (mean of 1 year)																
Rice-Wheat	6.92	3.07	5.48	5.16	1.73	0.47	1.34	1.18	2.77	0.78	1.84	1.80	14.80	3.96	11.10	9.95
Rice-Potato-Radish	5.32	1.16	4.25	3.58	1.13	0.76	1.04	0.98	2.13	1.12	1.43	1.56	11.40	3.32	7.86	7.53
Babycorn-Potato-Greengram	6.39	3.21	4.43	4.68	0.99	0.24	0.69	0.64	2.45	1.26	2.12	1.94	15.40	4.63	8.45	9.49
Sorghum (F)-Pea-Okra	9.65	3.12	8.22	7.00	1.02	0.45	0.66	0.71	2.26	0.87	1.15	1.43	17.30	4.12	14.20	11.87
Mean	7.07	2.64	5.60		1.22	0.48	0.93		2.40	1.01	1.64		14.73	4.01	10.40	
2. Jabalpur (mean of 1 year)																
Rice-Wheat	20.60	13.00	15.80	16.47	-	-	-	-	-	-	-	-	-	-	-	-
Rice – potato -Okra	19.00	11.70	15.00	15.23	-	-	-	-	-	-	-	-	-	-	-	-
Rice – Berseem	19.60	12.00	15.50	15.70	-	-	-	-	-	-	-	-	-	-	-	-
Rice-Pea-Sorghum F	19.80	12.60	15.80	16.07	-	-	-	-	-	-	-	-	-	-	-	-
Mean	19.75	12.33	15.53	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Coimbatore (mean of 3 years)																
Maize-Cotton	18.12	17.27	17.61	17.67	4.57	3.93	4.06	4.19	1.70	1.53	1.59	1.61	28.57	26.49	27.45	27.51
Chilly-Onion	6.52	5.97	6.01	6.17	2.78	2.68	2.70	2.72	0.66	0.64	0.65	0.65	16.39	16.13	16.21	16.25
Brinjal-Sunflower	10.10	8.20	NR	9.15	9.60	7.40	8.50	8.50	2.72	2.30	2.65	2.56	29.20	27.90	28.00	28.37
Turmeric+ Onion	13.39	12.73	13.02	13.05	5.70	5.52	5.59	5.60	0.94	0.91	0.92	0.92	17.45	16.69	17.09	17.08
Mean	12.03	11.04	12.21		5.66	4.88	5.21		1.51	1.34	1.45		22.90	21.80	22.19	
4. Calicut	**Mean of 4 years**				**Mean of 6 years**				**Mean of 4 years**							
Ginger	8.63	11.52	10.10	10.08	1.58	0.93	1.02	1.18	11.54	1.86	1.80	5.07	49.01	50.81	46.66	48.83
Turmeric	9.59	9.86	10.19	9.88	1.92	0.88	1.10	1.30	1.97	1.78	1.73	1.83	54.35	51.47	52.86	52.90

Cropping /Input system	Mn (ppm)				Zn (ppm)				Cu (ppm)				Fe (ppm)			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
Black pepper	8.16	9.41	10.19	9.25	4.43	3.31	4.09	3.94	14.30	5.40	6.19	8.63	41.73	39.90	37.99	39.88
Mean	8.79	10.26	10.16		2.64	1.71	2.07		9.27	3.01	3.24		48.37	47.39	45.84	
		SEm±	CD			SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		0.09	NS			3.61	NS			1.22	NS			0.49	NS	
Input		0.85	NS			0.36	NS			1.89	NS			4.25	NS	
Cropping X Input		0.98	NS			3.65	NS			2.51	NS			4.93	NS	
Input X Cropping		1.20	NS			0.62	NS			2.68	NS			6.01	NS	
5. Dharwad (mean of 5 years)																
Groundnut -Sorghum	8.52	8.48	9.25	8.75	1.35	1.11	1.35	1.27	1.51	1.44	1.57	1.50	6.37	5.35	6.52	6.08
Soybean- Wheat	8.55	8.24	9.64	8.81	1.33	1.22	1.36	1.30	1.51	1.52	1.60	1.55	6.41	5.46	6.82	6.23
Potato-Chickpea	9.06	8.85	9.34	9.08	1.47	1.23	1.47	1.39	1.60	1.62	1.62	1.61	6.69	5.69	6.55	6.31
Chilli+Cotton /Chilli+Cotton-Onion	8.77	9.05	9.18	9.00	1.50	1.17	1.47	1.38	1.61	1.55	1.77	1.64	6.71	5.72	6.52	6.32
Maize-Chickpea	5.21	5.47	5.89	5.52	0.90	0.72	0.90	0.84	1.00	NR	0.88	0.94	3.96	3.20	4.04	3.73
Mean	8.02	8.02	8.66		1.31	1.09	1.31		1.45	1.53	1.49		6.03	5.08	6.09	
		SEm±	CD			SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		0.075	0.232			0.026	0.079			0.026	0.079			0.079	NS	
Input		0.088	0.253			0.025	0.072			0.032	NS			0.093	0.269	
Cropping X Input		0.162	0.474			0.048	NS			0.058	NS			0.171	NS	
Input X Cropping		0.176	0.506			0.050	NS			0.063	NS			0.186	NS	
6.Bajaura (mean of 6 years)																
Cauliflower-Radish-Tomato	11.51	3.09	6.63	7.07	3.06	0.78	1.38	1.74	2.07	0.31	0.92	1.10	53.02	30.63	26.11	36.59
French bean-Cauliflower-French bean	10.55	2.86	6.31	6.57	3.14	0.74	1.45	1.78	2.24	0.36	0.76	1.12	47.69	22.12	32.84	34.22
Cabbage-Radish-Capsicum	13.81	2.23	9.17	8.40	3.72	1.29	1.57	2.19	2.29	0.29	0.92	1.17	51.38	23.19	32.77	35.78
Maize-Garlic	12.62	2.98	8.73	8.11	2.84	0.95	0.90	1.56	2.74	0.31	0.73	1.26	47.13	26.15	33.23	35.50
Mean	12.12	2.79	7.71		3.19	0.94	1.32		2.34	0.32	0.83		49.81	25.52	31.24	

Cropping /Input system	Mn (ppm)				Zn (ppm)				Cu (ppm)				Fe (ppm)			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
		SEm±	CD			SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		0.479	NS			0.054	0.17			0.022	NS			1.237	NS	
Input		1.001	2.92			0.131	0.38			0.105	0.31			3.209	9.37	
Cropping X Input		1.703	NS			0.221	NS			0.173	NS			5.384	NS	
Input X Cropping		2.001	NS			0.262	NS			0.211	NS			6.418	NS	
7. Pantnagar (mean of 2 years)																
Rice-Wheat-Sesbania (GM)	7.90	8.87	7.81	8.19	0.68	0.69	0.75	0.70	8.62	9.00	8.25	8.62	31.33	29.94	28.43	29.90
Rice -Lentil-Sesbania (GM)	8.78	8.18	9.01	8.65	1.09	0.79	1.00	0.96	7.00	8.42	8.27	7.90	36.15	29.99	37.40	34.51
Rice -Pea (veg) -Sesbania(GM)	9.43	10.20	8.36	9.33	1.07	0.86	0.82	0.92	5.36	9.99	6.12	7.16	25.72	33.33	32.18	30.41
Rice -Mustard-Sesbania (GM)	7.94	8.76	8.73	8.48	0.86	0.74	0.74	0.78	7.76	8.01	8.21	7.99	29.19	29.77	31.31	30.09
Mean	8.51	9.00	8.48		0.92	0.77	0.82		7.18	8.85	7.71		30.60	30.76	32.33	
8. Umiam (mean of 1 year)																
Rice - Carrot	7.30	7.30	7.30	7.30	0.11	0.11	0.11	0.11	2.10	2.10	2.10	2.10	186.8	186.8	186.8	186.8
Rice - Potato	8.00	8.00	8.00	8.00	0.12	0.12	0.12	0.12	2.24	2.24	2.24	2.24	202.6	202.6	202.6	202.6
Rice – French bean	7.66	7.66	7.66	7.66	0.12	0.12	0.12	0.12	2.04	2.04	2.04	2.04	208.6	208.6	208.6	208.60
Rice - Tomato	7.30	7.30	7.30	7.30	0.12	0.12	0.12	0.12	2.06	2.06	2.06	2.06	201.7	201.7	201.7	201.7
Mean	7.57	7.57	7.57		0.12	0.12	0.12		2.11	2.11	2.11		199.9	199.9	199.9	

Soil microbial population (Table 6 and Fig. 3)

Soil microbes such as *azotobacter* and fungi at various locations in different cropping systems under organic, inorganic and INM systems were observed. The location wise pooled results are presented in Table 6.

Jabalpur: All the four microbes *viz., Azotobacter*, fungi, bacteria and *actinomycetes* were estimated for 5 years and pooled results indicates significant influence of cropping and input system on microbial count. Organic system recorded 41.5% improvement in *Azotobacter*, 26.5% improvement in fungi, 60.8% in bacteria and 89.3% in *actinomycetes* over inorganic system. INM had also improved the soil microbial count to the tune of 10.6%, 8.6%, 20.3% and 48.9% of *Azotobacter*, fungi, bacteria and *actinomycetes* respectively over inorganic system irrespective of the cropping system. Population of azatobacter, fungi and *actinomycetes* were higher in rice-wheat system while bacteria count was higher in rice-pea-fodder sorghum system.

Raipur: Soil bacterial count was taken for 5 years continuously at the end of each cropping cycle and the mean data reveals that 65% increase in bacterial count was observed with INM while only 21% improvement was observed under organic system compared to Inorganic system. Soybean-chickpea and soybean-berseem had the highest count of 5.8 and 5.76 x 10^4 CFU/g respectively while soybean-wheat had lesser bacterial count (1.90 x 10^4 CFU/g). In almost all the cropping systems evaluated INM recorded higher bacterial count than organic and inorganic system.

Calicut : Fungal count was taken for 5 years in all the crops (ginger, turmeric and black pepper) while bacterial and actinomycetes were estimated for 6 years at the end of cropping cycle. Fungal population was higher with inorganic system while bacterial count registered higher with INM practice. Actinomycetes population are 218% higher with organic than inorganic system. Response of each species of microbial count are also different with various crops. Fungal count was higher with ginger cultivation while black pepper recorded maximum count of bacteria (45.86 x 10^4 CFU/g). *Actinomycetes* were higher with turmeric cultivation.

Dharwad: Fungal count was taken for 5 years while bacteria and actinomycetes are observed for 6 years at the end of each cropping cycle. Though various cropping systems had no influence on the microbial count, input systems did influence significantly on the count of fungi and actinomycetes. Organic system resulted in 56.2% improvement in fungal count while INM recorded only 8.8% improvement over inorganic system. The improvement in actinomycetes was 31.4% with organic system over inorganic system. Numerically higher bacterial count was recorded under organic and INM practice than inorganic system. Interaction between cropping and input system were absent.

Ludhiana : Fungi, bacteria and actinomycetes count was observed for 4 years continuously in the two set of experiments and results were pooled and presented . In the first set of experiment, higher count of fungi, bacteria and actinomycetes was observed under organic system. The increase in population was to the tune of 16.7, 37.4 and 39.8% for fungi, bacteria and actinomycetes respectively over inorganic system. INM had also recorded around 16.9% and 24.9% improvement in population of bacteria and actinomycetes respectively even though fungal count remained on par between INM and inorganic system. Among the cropping system, rice-wheat-green manure had highest fungal count while rice-garlic + mentha (for oil) registered higher bacteria and actinomycetes count. Contrary to the first set of cropping system, bacterial count was not significantly influenced by the input system, as only very marginal improvement in fungi, bacteria and actinomycetes was observed with organic system over inorganic system. Microbial count did not very among different cropping system also.

Bajaura: Fungi, bacteria and actinomycetes count was observed for 2 years under various cropping systems and three input systems. Pooled results indicates organic system recorded an increase of 32.1 %, 104.4% and 90.6% in fungal, bacteria and actinomycetes respectively, than inorganic system. INM had 34.4%, 63.2% and 66.2% improvement respectively . Among the cropping systems, french bean-

cauliflower-french bean registered higher fungi (195 x 10^4 CFU/g) and bacteria (117 x 10^4 CFU/g) while cauliflower-radish-tomato recorded higher actinomycetes (149 x 10^4 CFU/g) population.

Pantnagar: Fungi, bacteria and actinomycetes were recorded for one year only at the end of cropping system and it reveals that INM had higher count of fungi (46.98 x 10^4 CFU/g), bacteria (56.99 x 10^4 CFU/g) and actinomycetes (78.84 x 10^4 CFU/g) than inorganic and organic system. The improvement in fungi, bacteria and actinomycetes was to the tune of 74.4%, 65% , 60.3% respectively with INM and 33.7% , 47.4% and 39.6% with organic system over inorganic system. Among the cropping system, rice-mustard-sesbania (GM) registered higher microbial count than other systems . The results infers that INM with green manuring are found to improve the soil microbial population.

Ranchi: Fungal and actinomycetes population was estimated for one year with four cropping systems and three input system and the results indicates marginal improvement in actinomycetes population with organic and INM practice over inorganic system while not much variation was observed for fungal population. The improvement in actinomycetes population was 3.2 % and 1.9% with organic and INM practice respectively over inorganic system. No significant variation in microbial population was observed among different cropping systems.

Umiam: Fungi, bacteria and actinomycetes population was counted in soil for 2 years at the end of each cropping cycle and pooled analysis reveals that fungal and actinomycetes population was significantly influenced by cropping and input system and their interactions. However, bacterial count was only influenced by input system. Organic system registered 9.8% higher fungi count while 11.4% higher count was recorded with INM than inorganic system. Around 85.8% higher bacterial count was recorded with organic system than inorganic system. Actinomycetes registered 33.6 % higher count with INM followed by 27.9% with organic system compared to inorganic system. Among the cropping systems, rice-frenchbean system had the higher fungi while bacterial and actinomycetes count was higher in rice-tomato system. In general, all the cropping system responded well to the organic practice by recording higher microbial count leading to better soil and crop productivity.

Table 6. Influence of methods of nutrient application on soil microbial count (x10^4 CFU/g) at the end of in different crops and cropping system at various locations (2004-05 to 2009-10)

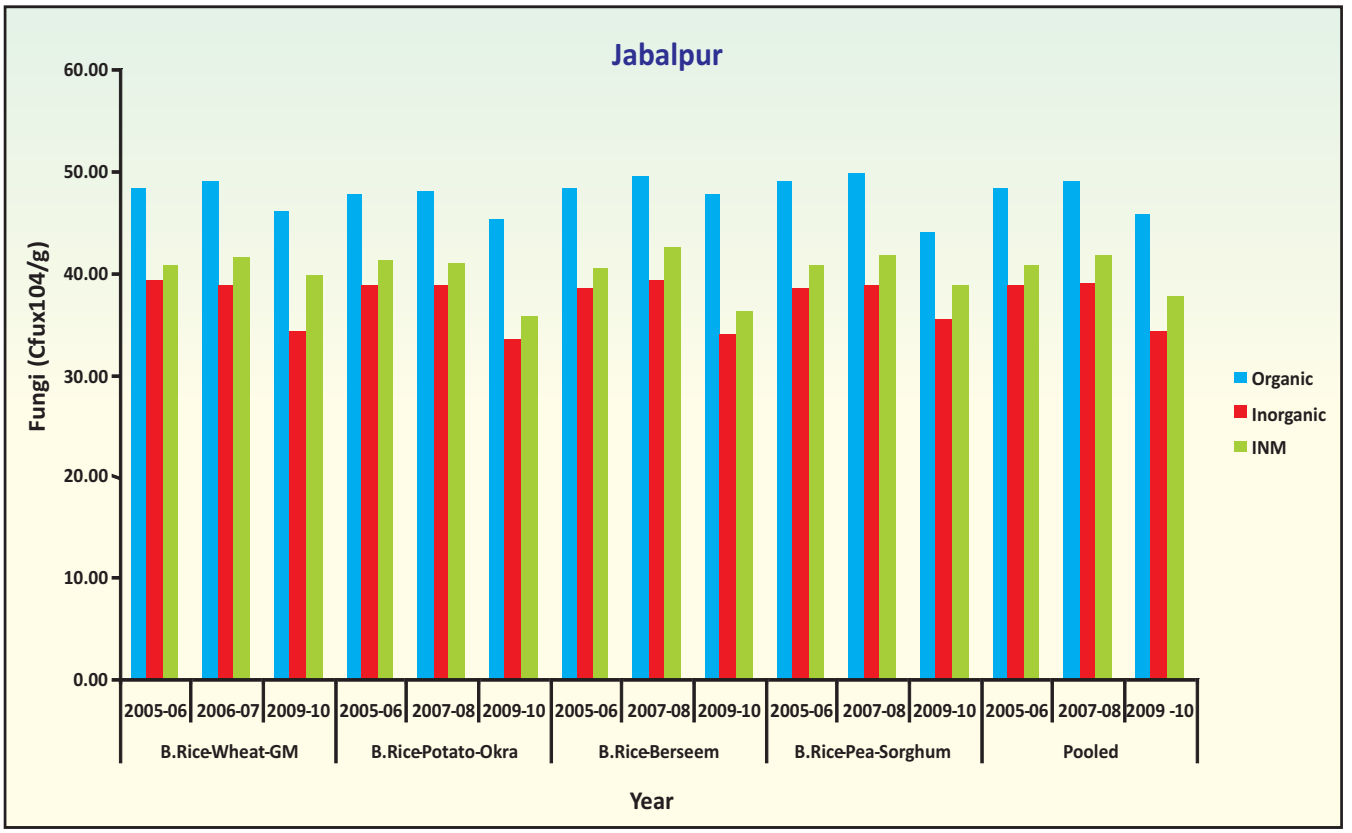
Cropping/ Input	Azotobacter				Fungi				Bacteria				Actinomycetes			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
1. Jabalpur (mean of 5 years)																
Rice-Wheat	30.26	23.40	24.32	25.99	48.34	37.78	41.48	42.53	56.88	35.28	42.54	44.90	15.04	7.52	11.20	11.25
Rice – Potato -Okra	29.60	20.30	23.98	24.63	46.80	37.50	40.20	41.50	56.24	34.92	42.24	44.47	13.70	7.30	10.80	10.60
Rice –Berseem	29.98	21.54	24.30	25.27	48.04	37.60	40.70	42.11	56.46	35.56	42.56	44.86	13.68	7.36	11.08	10.71
Rice-Pea-Sorghum F	30.46	22.64	24.58	25.89	47.68	37.94	41.44	42.35	57.50	35.44	42.56	45.17	13.70	7.44	11.06	10.73
Mean	30.08	21.97	24.30		47.72	37.71	40.96		56.77	35.30	42.48		14.03	7.41	11.04	
		SEm±	CD			SEm±	CD			SEm±	CD			SEm±	CD	
Cropping		0.343	1.03			0.15	0.45			0.23	NS			0.11	0.33	
Input		0.338	0.96			0.29	0.82			0.53	1.52			0.07	0.21	
Cropping X Input		0.649	NS			0.49	NS			0.89	NS			0.16	0.47	
Input X Cropping		0.676	NS			0.58	NS			1.06	NS			0.15	0.42	
2. Raipur (mean of 5 year)																
Soybean-Wheat	-	-	-	-	-	-	-	-	1.86	1.33	2.51	1.90	-	-	-	-
Soybean-Berseem	-	-	-	-	-	-	-	-	5.35	4.45	7.47	5.76	-	-	-	-
Soybean-Mustard	-	-	-	-	-	-	-	-	2.89	3.04	4.50	3.48	-	-	-	-
Soybean-Chickpea	-	-	-	-	-	-	-	-	5.83	4.35	7.23	5.80	-	-	-	-
Mean	-	-	-	-	-	-	-	-	3.98	3.29	5.43		-	-	-	-
3. Calicut					Mean of 5 years								Mean of 6 years			
Ginger	-	-	-	-	8.27	18.30	11.35	12.64	35.10	33.72	42.33	37.05	14.29	13.57	16.86	14.91
Turmeric	-	-	-	-	11.73	11.32	11.18	11.41	42.96	35.44	49.61	42.67	56.33	8.66	9.33	24.77
Black pepper	-	-	-	-	10.69	6.87	5.80	7.79	44.20	36.44	56.94	45.86	-	-	-	-
Mean	-	-	-	-	10.23	12.16	9.44		40.75	35.20	49.63		35.31	11.12	13.10	

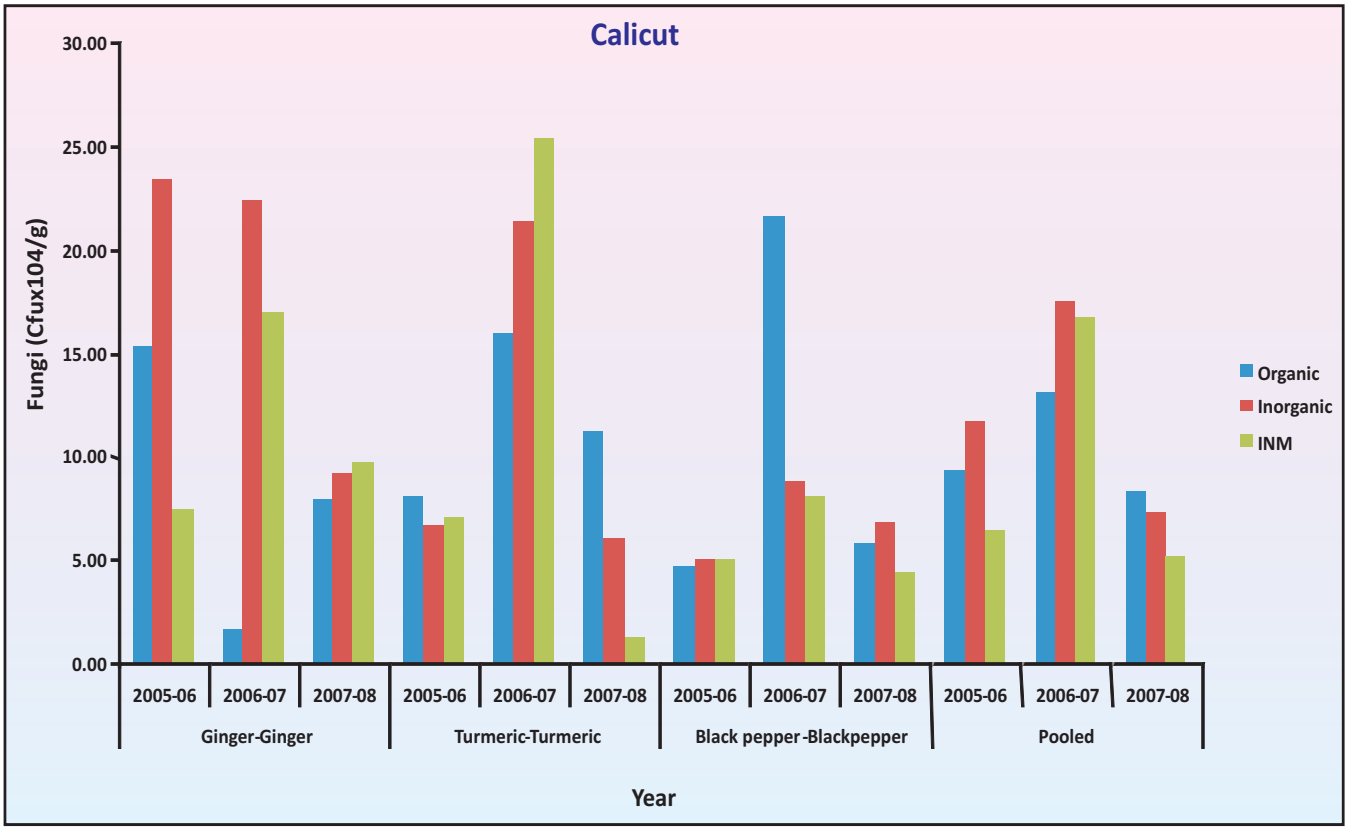
Cropping/ Input	Azotobacter				Fungi				Bacteria				Actinomycetes			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
4. Dharwad						Mean of 5 years								Mean of 6 years		
Groundnut -Sorghum					34.20	14.20	21.80	23.40	53.67	41.50	42.67	45.94	25.33	18.50	18.33	20.72
Soybean- Wheat					28.60	16.00	20.60	21.73	45.00	38.17	33.00	38.72	26.70	18.40	17.35	20.82
Potato-Chickpea					25.60	17.00	17.20	19.93	49.17	43.83	41.17	44.72	25.63	19.40	19.00	21.34
Chilli+Cotton /Chilli+Cotton-Onion					19.67	18.33	16.33	18.11	59.25	52.00	69.50	60.25	43.75	34.00	35.00	37.58
Maize-Chickpea					24.00	19.00	16.00	19.67	82.33	71.00	68.67	74.00	53.33	42.67	40.67	45.56
Mean					26.41	16.91	18.39		57.88	49.3	51		34.95	26.59	26.07	29.204
						SEm±	CD			SEm±	CD			SEm±	CD	
Cropping						2.347	NS			4.330	NS			2.321	NS	
Input						2.624	7.656			3.114	NS			1.619	4.723	
Cropping X Input						4.391	NS			6.176	NS			3.260	NS	
Input X Cropping						4.544	NS			5.394	NS			2.804	NS	
5. Ludhiana I (mean of 4 years)																
Rice-Wheat-GM	-	-	-	-	49.95	41.6	37.4	42.98	32.57	18.27	17.07	22.63	35.93	26.97	34.43	32.44
Turmeric - Onion	-	-	-	-	28.56	27.08	27.12	27.59	27.54	27.40	29.40	28.11	25.84	18.56	19.66	21.35
Groundnut (S)- Garlic	-	-	-	-	36.12	29.12	29.9	31.72	41.75	18.70	18.20	26.22	45.03	42.33	48.75	45.37
Maize-Wheat-Cowpea(F)	-	-	-	-	32.22	26.07	27.95	28.75	32.60	20.85	20.55	24.67	40.38	42.75	36.55	39.89
Rice-Garlic + Mentha oil	-	-	-	-	33.47	30.7	31.4	31.86	33.03	19.53	37.23	29.93	75.50	28.77	59.73	54.67
Mean	-	-	-	-	36.07	30.92	30.75		33.49	20.95	24.49		44.54	31.87	39.83	38.75
New system from 2008-09 (mean of 2 years)																
Cotton - Wheat	-	-	-	-	17.6	28.5	19.5	21.87	11.8	8.9	9.1	9.93	6.40	5.80	8.40	6.87
Maize-Gram	-	-	-	-	21.7	22.5	27.1	23.77	26	9.1	36.8	23.97	23.50	12.40	14.20	16.70
Maize -Potato- Moong (S)	-	-	-	-	16.4	10.5	18.7	15.20	17.8	15.7	20.4	17.97	21.50	5.90	16.00	14.47
Rice -Wheat- Moong (S)	-	-	-	-	36.8	11.3	14.9	21.00	26.5	20.7	21.5	22.90	15.50	13.50	15.60	14.87
Mean	-	-	-	-	23.13	18.20	20.05		20.53	13.60	21.95		16.73	9.40	13.55	

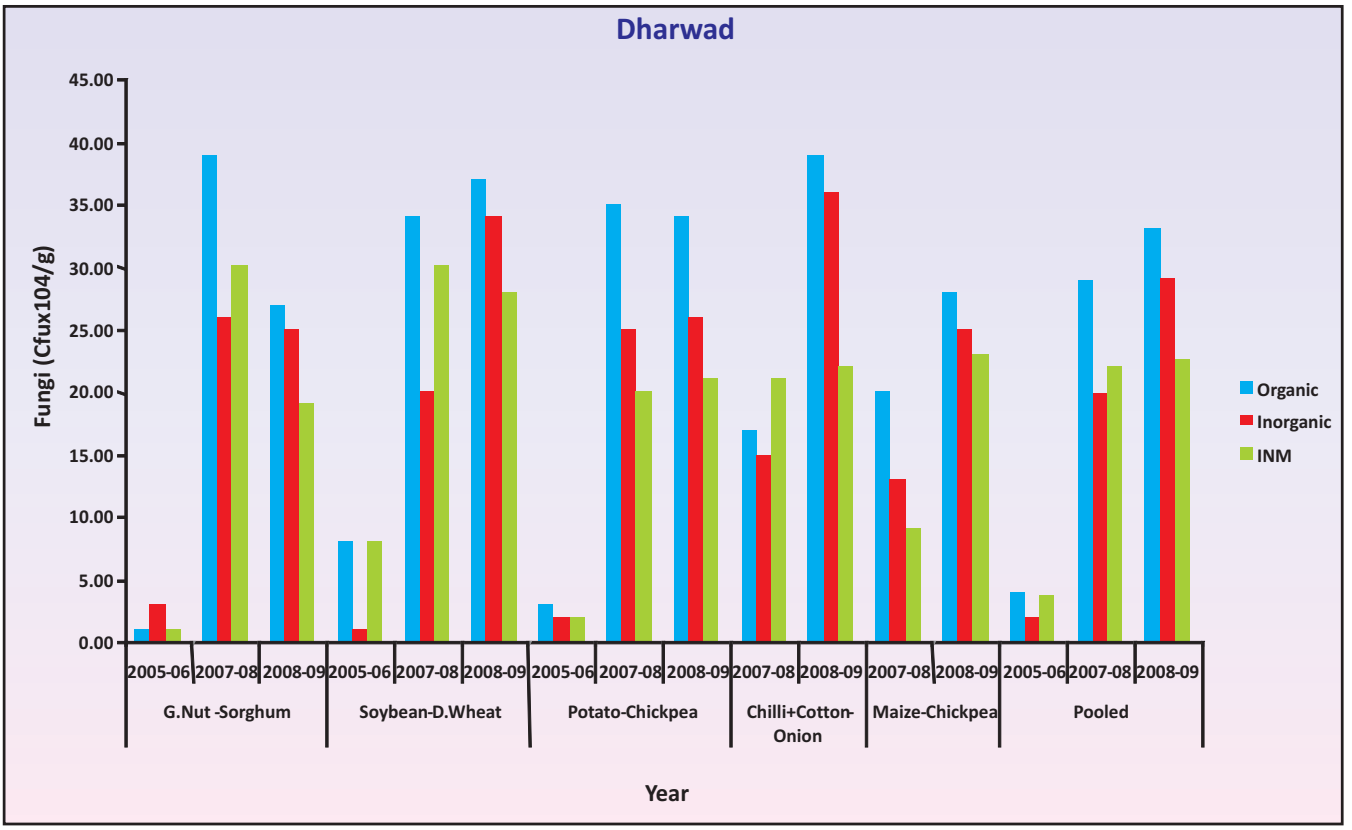
Cropping/ Input	Azotobacter				Fungi				Bacteria				Actinomycetes			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
Ludhiana II (mean of 4 years)																
Sorghum - Berseem	-	-	-	-	48.03	43.50	34.95	42.16	41.38	27.95	33.70	34.34	58.73	47.80	43.73	50.08
Maize- Berseem- Bajra	-	-	-	-	36.38	43.58	45.60	41.85	26.25	36.23	27.23	29.90	41.38	59.93	47.75	49.68
Maize-Berseem-Maize + Cowpea	-	-	-	-	49.88	39.43	40.78	43.36	29.33	30.40	24.40	28.04	49.78	39.28	44.55	44.53
Sorghum +Guar-Oats-Cowpea	-	-	-	-	36.48	29.33	39.93	35.24	20.65	23.83	46.35	30.28	40.80	44.33	51.13	45.42
Mean	-	-	-	-	42.69	38.96	40.31		29.40	29.60	32.92		47.67	47.83	46.79	
						SEm±	CD			SEm±	CD			SEm±	CD	
Cropping						2.85	NS			2.86	NS			3.39	NS	
Input						2.97	NS			3.76	NS			3.53	NS	
Cropping X Input						5.62	NS			6.78	NS			6.68	NS	
Input X Cropping						5.94	NS			7.53	NS			7.05	NS	
6. Bajaura (mean of 2 years)																
Cauliflower-Radish-Tomato	-	-	-	-	-	133	181	157	140	66	90	99	175	113	160	149
French bean-Cauliflower-French bean	-	-	-	-	-	180	210	195	153	70	128	117	162	111	143	139
Cabbage-Radish-Capsicum	-	-	-	-	-	123	185	154	142	75	118	111	176	71	133	126
Maize-Garlic	-	-	-	-	173	86	127	128	122	61	111	98	144	52	134	110
Mean					173	131	176		139	68	111		164	86	143	
7. Pantnagar (mean of 1 year)																
Rice-Wheat-Sesbania (GM)	-	-	-	-	29.52	19.15	39.12	29.26	39.53	19.21	50.08	36.27	58.31	40.92	76.93	58.72
Rice -Lentil-Sesbania (GM)	-	-	-	-	37.32	24.36	45.89	35.86	50.80	31.88	52.97	45.22	69.21	42.19	72.82	61.41
Rice -Pea (veg.)-Sesbania(GM)	-	-	-	-	35.09	28.36	52.31	38.59	56.30	42.06	58.03	52.13	71.89	50.26	79.21	67.12
Rice -Mustard-Sesbania (GM)	-	-	-	-	42.18	35.87	50.58	42.88	56.89	44.95	66.89	56.24	75.25	63.28	86.41	74.98
Mean	-	-	-	-	36.03	26.94	46.98		50.88	34.53	56.99		68.67	49.16	78.84	

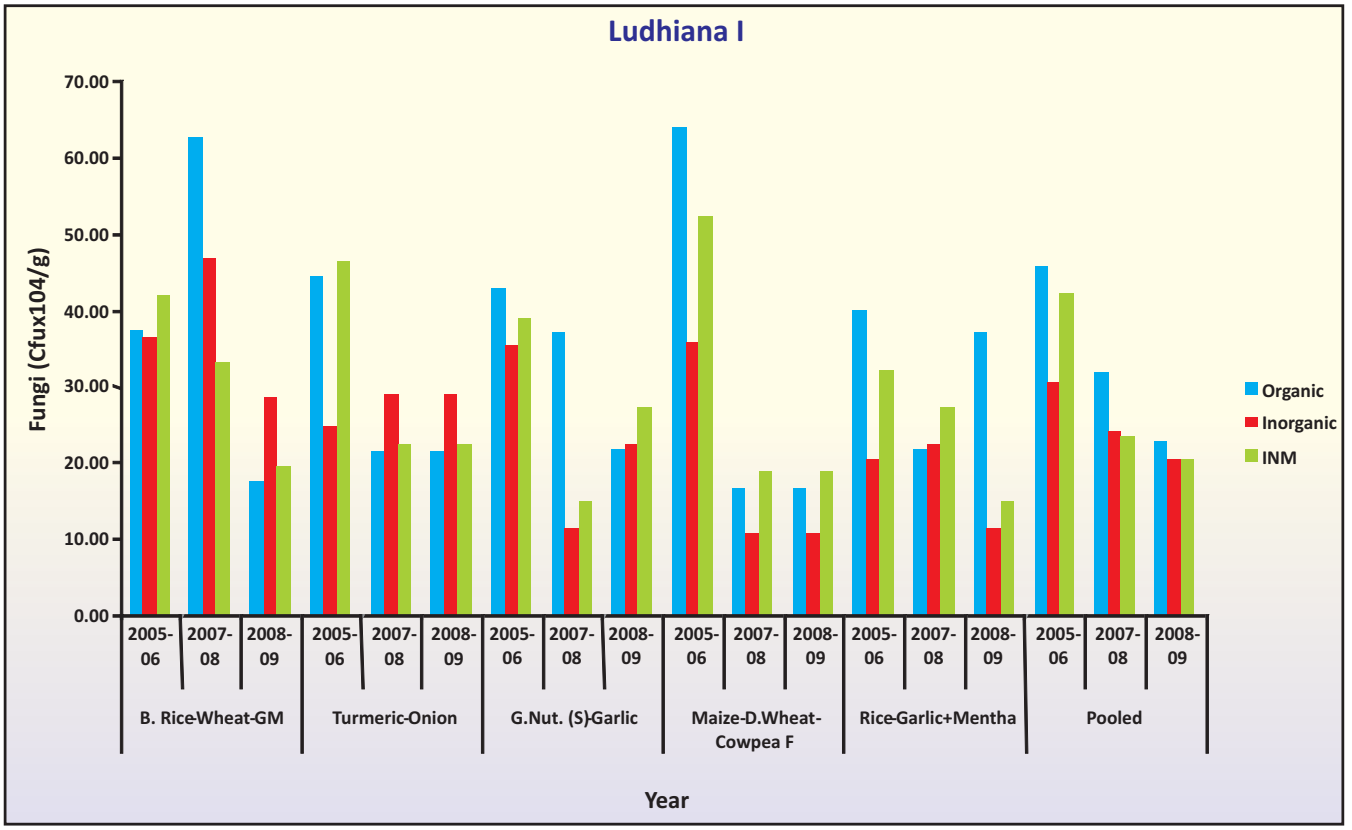
Cropping/ Input	Azotobacter				Fungi				Bacteria				Actinomycetes			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
8. Ranchi (mean of 1 year)																
Rice -Wheat	-	-	-	-	80.67	78.00	78.00	78.89	-	-	-	-	89.33	87.00	88.15	88.16
Rice -Potato	-	-	-	-	81.00	78.75	81.36	80.37	-	-	-	-	89.95	86.25	88.00	88.07
Rice -Mustard / Linseed	-	-	-	-	81.33	79.33	79.25	79.97	-	-	-	-	88.50	85.00	87.70	87.07
Rice -Lentil	-	-	-	-	80.22	78.32	79.16	79.23	-	-	-	-	88.33	86.72	88.00	87.68
Mean	-	-	-	-	80.81	78.60	79.44		-	-	-	-	89.03	86.24	87.96	
9. Umiam (mean of 2 years)																
Rice - Carrot	-	-	-	-	72.15	81.10	71.45	74.90	161.9	88.80	146.4	132.38	72.15	72.70	66.00	70.28
Rice - Potato	-	-	-	-	57.10	53.70	80.15	63.65	166.3	88.45	127.3	127.37	66.20	43.75	67.05	59.00
Rice – French bean	-	-	-	-	101.0	84.50	84.60	90.03	181.2	93.05	130.3	134.85	79.50	55.50	92.50	75.83
Rice - Tomato	-	-	-	-	89.70	72.15	88.35	83.40	173.1	96.95	144.2	138.10	82.50	62.90	88.20	77.87
Mean	-	-	-	-	79.99	72.86	81.14		170.6	91.81	137.0		75.09	58.71	78.44	
						SEm±	CD			SEm±	CD			SEm±	CD	
Cropping						2.94	10.15			6.85	NS			2.54	8.80	
Input						1.54	4.61			6.76	20.25			3.11	9.30	
Cropping X Input						3.87	12.62			12.99	NS			5.67	NS	
Input X Cropping						3.08	9.23			13.51	NS			6.21	NS	

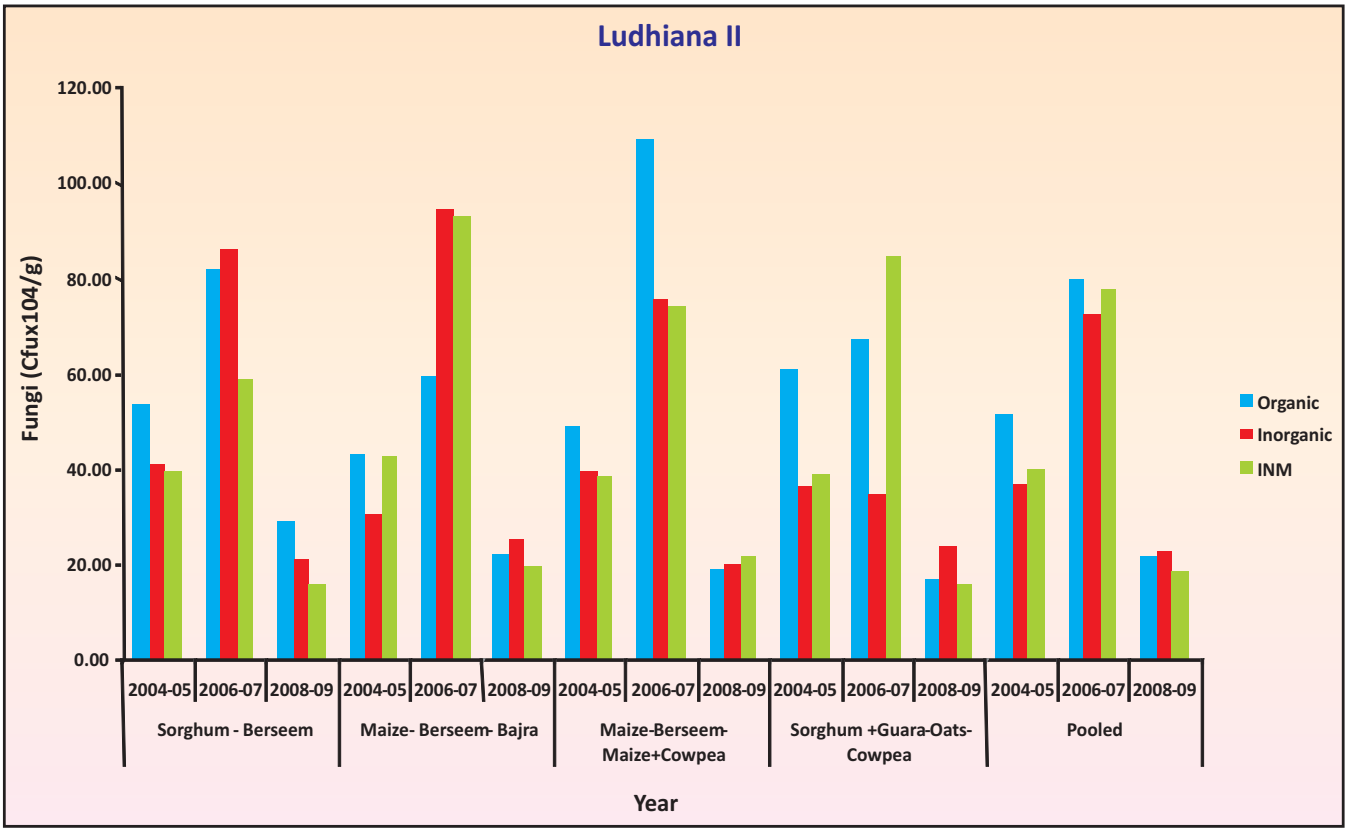
Fig. 3. Temporal variation in fungi population at various locations under organic, inorganic and INM package of different cropping systems

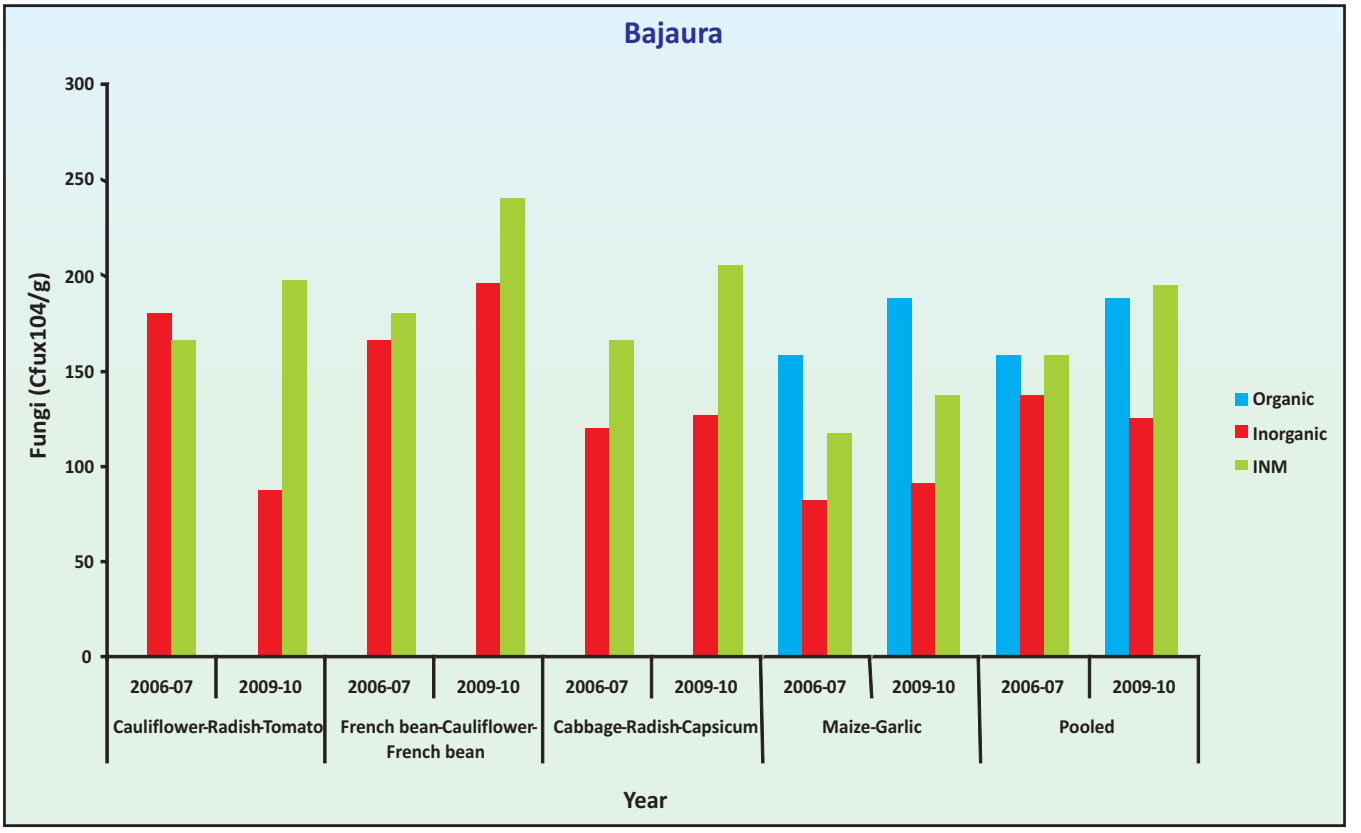


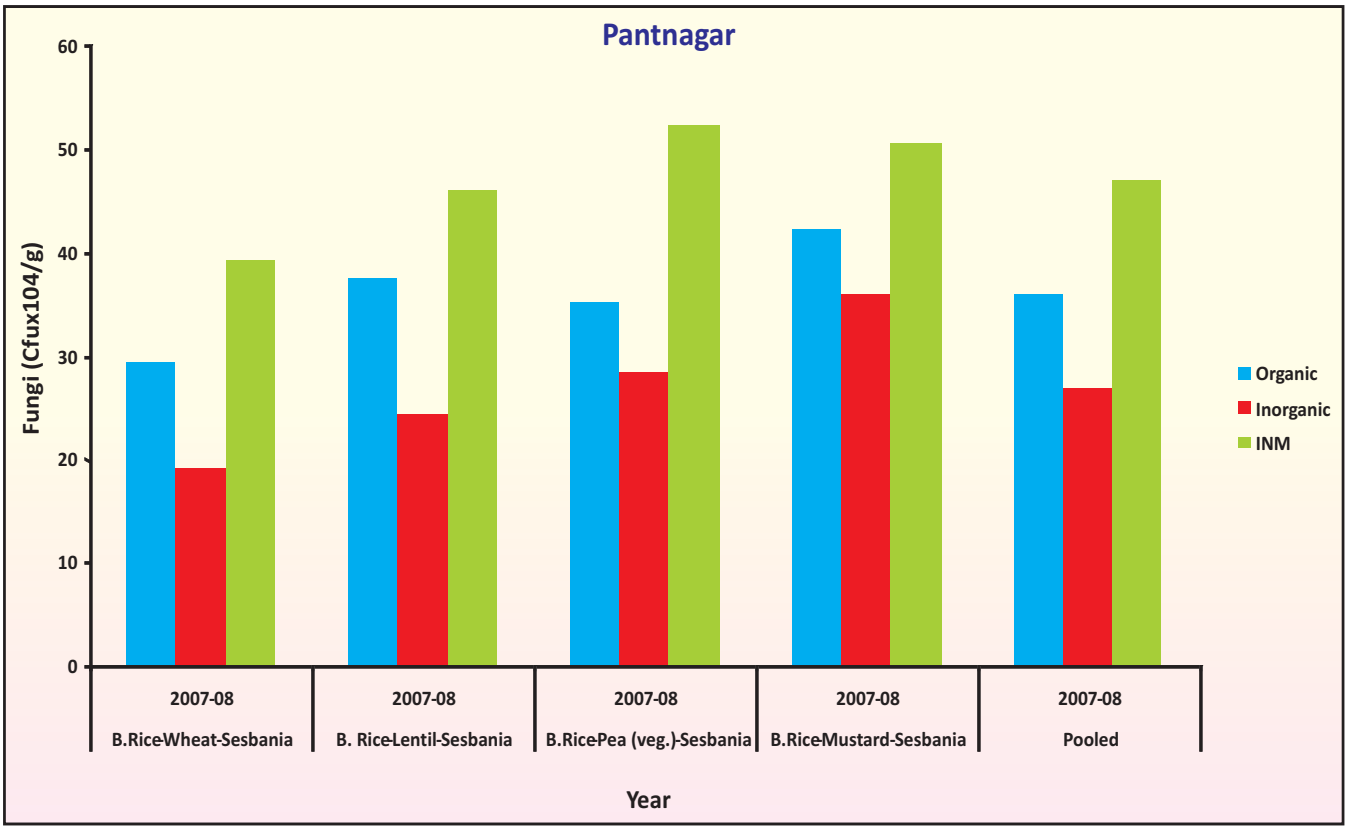


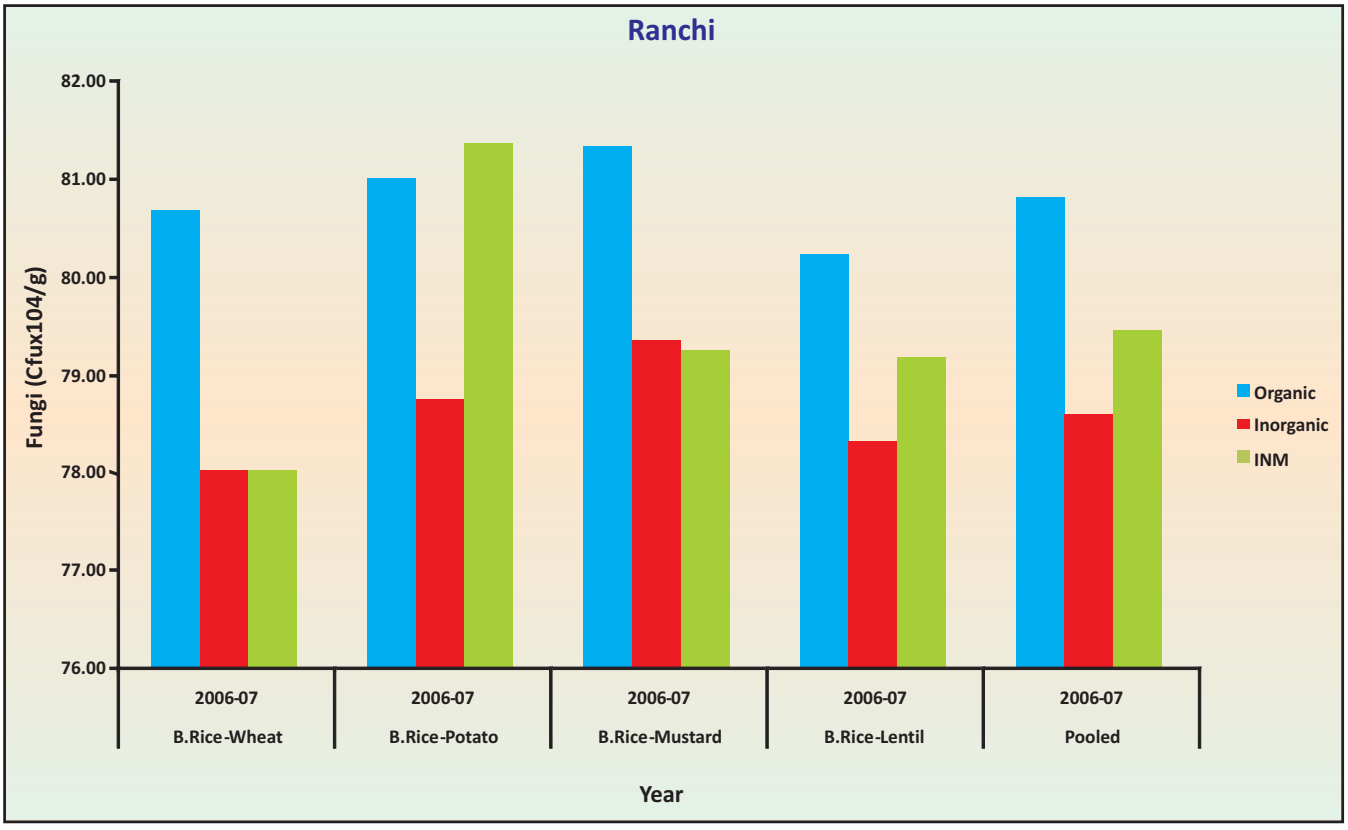

Dharwad
Fungi (Cfux104/g)
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
2005-06
2007-08
2008-09
G.Nut -Sorghum
Soybean-D.Wheat
Potato-Chickpea
Chilli+Cotton-Onion
Maize-Chickpea
Pooled
Year
Organic
Inorganic
INM

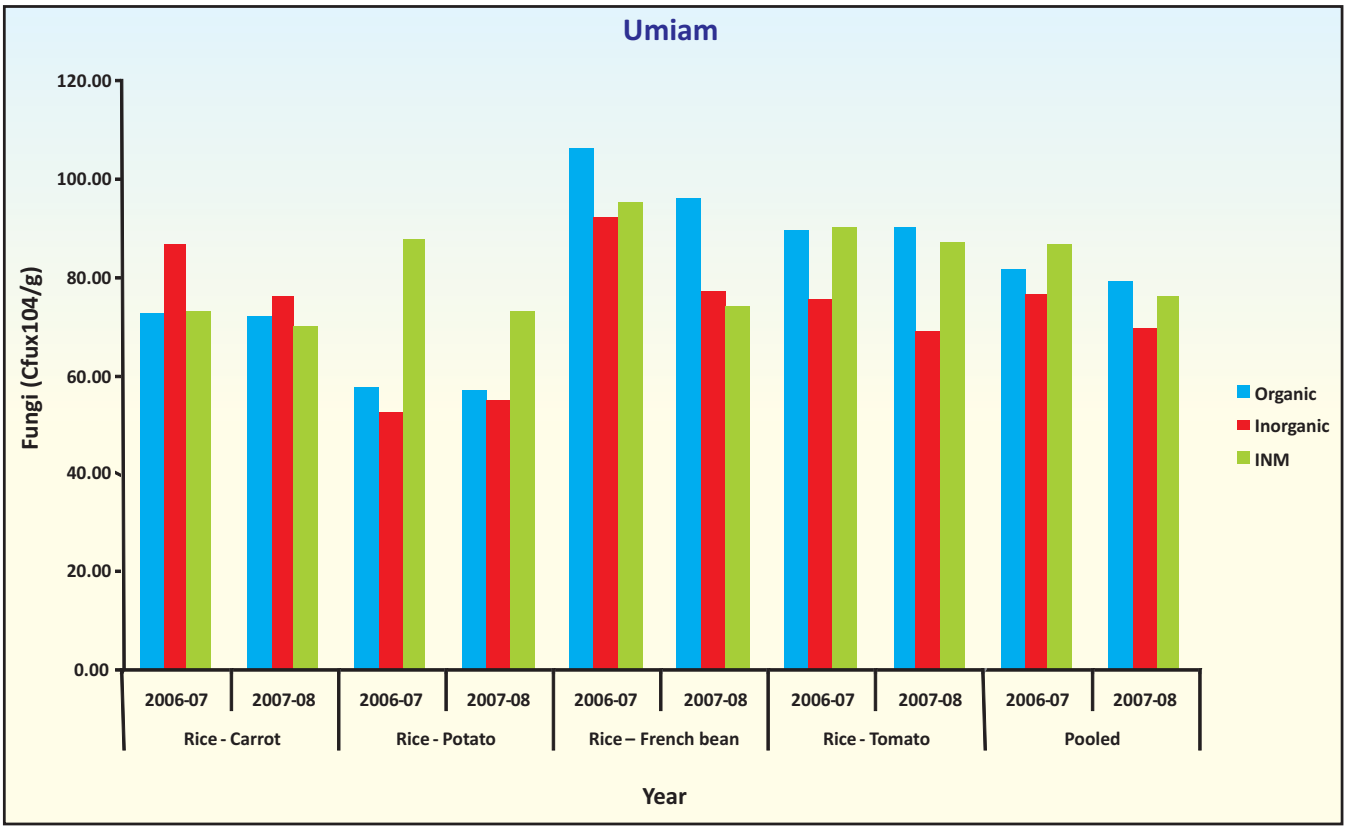

Ludhiana I
Fungi (Cfux104/g)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
2005-06
2007-08
2008-09
B. Rice-Wheat-GM
Turmeric-Onion
G.Nut. (S)-Garlic
Maize-D.Wheat-Cowpea F
Rice-Garlic+Mentha
Pooled
Year
Organic
Inorganic
INM


Ludhiana II
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Fungi (Cfux104/g)
Organic
Inorganic
INM
2004-05
2006-07
2008-09
Sorghum - Berseem
Maize- Berseem- Bajra
Maize-Berseem-Maize+Cowpea
Sorghum +Guara-Oats-Cowpea
Pooled
Year


Bajaura
300
250
200
150
100
50
0
Fungi (Cfux104/g)
Organic
Inorganic
INM
2006-07
2009-10
Cauliflower-Radish-Tomato
French bean-Cauliflower-French bean
Cabbage-Radish-Capsicum
Maize-Garlic
Pooled
Year


Pantnagar
Fungi (Cfux104/g)
60
50
40
30
20
10
0
2007-08
B.Rice-Wheat-Sesbania
2007-08
B. Rice-Lentil-Sesbania
2007-08
B.Rice-Pea (veg.)-Sesbania
2007-08
B.Rice-Mustard-Sesbania
2007-08
Pooled
Year
Organic
Inorganic
INM


Ranchi
Fungi (Cfux104/g)
82.00
81.00
80.00
79.00
78.00
77.00
76.00
2006-07
B.Rice-Wheat
2006-07
B.Rice-Potato
2006-07
B.Rice-Mustard
2006-07
B.Rice-Lentil
2006-07
Pooled
Year
Organic
Inorganic
INM



Economics (Table 7, Fig. 4 and Appendix II)

Economics of different cropping systems with organic, inorganic and INM as inputs were evaluated in 13 locations. Gross returns, cost of cultivation, net returns and B:C ratio were computed based on the performance of crops as well as input cost of each system. The results are presented in Table 7.

Modipuram: Economics were calculated for 2 years and mean data are presented which reveals that organic system recorded net return of ₹ 47486 ha^{-1} which is 5.6% higher than inorganic system. Among the cropping systems, net returns was higher with sorghum (F) –pea-okra, rice-barley+mustard-greengram, maize-potato-okra and maize-mustard – radish- greengram in organic system. B:C ratio was in the range of 2.0 to 2.1.

Growth of basmati rice at Modipuram under organic system

Jabalpur: Mean of 6 years data on economics reveals that irrespective of cropping system, organic system registered higher gross returns, net returns and B:C ratio compared to inorganic system even though cost of cultivation was higher with organic system. The % improvement in net return was to the tune of 10.6% with organic system over inorganic practice. Among the different cropping system, rice-potato-okra system registered higher net return (₹ 150821 ha^{-1}) followed by rice-berseem (₹ 106268 ha^{-1}) with organic system. B:C ratio remained almost same (3) for both organic and inorganic systems while INM recorded B:C ratio of 2.9 .

Coimbatore: Mean economics data of 5 years reveals that around ₹ 12000 ha^{-1} additional, gross returns can be obtained but with additional cost of Rs. 13453 ha^{-1} needs to be incurred for the same thus bringing down the B:C ratio . Net return remained almost same for all the input systems, however B:C ratio was higher with inorganic system (2.3) followed by INM (2.1) and organic system (2.0). Among the cropping systems, chilli-onion and bringal-sunflower responded much better with INM practice while maize –cotton and turmeric+ onion recorded higher net returns and B:C ratio with inorganic system.

Raipur: Pooled economic data of 5 years reveals that though organic system recorded higher gross returns of ₹ 70809 ha^{-1}, it is not reflected in net returns (₹ 39310 ha^{-1}) due to additional cost of ₹ 7812 incurred in the organic system over inorganic system. As a consequence of this B:C ratio was higher with inorganic system (1.6) followed by INM (1.3) and organic system (1.2). Among the different cropping systems, soybean-berseem registered higher net returns (₹ 48374 ha^{-1}) under organic system while all other systems performed better with inorganic system in terms of gross returns, net returns and B:C ratio.

Calicut: Ginger and turmeric crops were evaluated under three input systems and its economic values were assessed for 4 years. The mean data reveals that though gross returns was higher with organic system compared to inorganic system, due to high cost of cultivation of ₹ 37030 ha^{-1}, the net returns were not commensurated under organic system. INM practice found to be better as increased net return of ₹ 50343 ha^{-1} can be obtained with B: C ratio of 2.0 which is also higher than organic and inorganic system. Both ginger and turmeric responded better with INM than inorganic or organic by recording higher B:C ratio of 2.10 and 1.97 respectively with INM.

Dharwad: Mean of 5 years infers that organic system had advantage by recording higher gross (₹ 41590 ha^{-1}), net (₹ 26282 ha^{-1}) returns, B:C ratio (3.) and lower cost of cultivation (₹ 15804 ha^{-1}) compared to inorganic and INM. Around 17.6% higher net returns can be obtained with organic system compared to inorganic system. Among the different cropping systems, considerable response to organic farming was observed with groundnut –sorghum, soybean-wheat and chili – cotton-onion. Potato- chickpea system gave better net returns and B:C ratio with INM.

Karjat: Mean of 5 years infers that 28.9 and 15.6% higher cost needs to be incurred for organic and INM over inorganic system. The gross returns and net returns recorded with organic system are lesser than the inorganic system leading to lower B : C ratio of 1.0 with organic system compared to inorganic system (1.5). All the cropping systems registered better net returns and B : C ratio with inorganic indicating the region specific suitability of organic and inorganic system needs to be developed.

Ludhiana: Two set of experiments were conducted and economic evaluation were reported for 1 year. Net return is found to be better with organic system (₹ 89523 ha^{-1}) followed by INM (₹ 67497 ha^{-1}). In the second set of experiments also similar trend is observed as organic system registered 40% higher net return and INM recorded 30% higher net return over inorganic system. Prominent systems which responded better with organic practice are turmeric-onion, maize-gram, maize-potato-summer moong, rice-wheat-moong, maize-berseem-bajra and maize –berseem-maize+ cowpea. The cost of cultivation remained almost closer among three input systems indicating usefulness of organic system in improving crop and soil productivity.

Bengal gram at Ludhiana evaluated for organic input system

Bajaura: Mean of 4 years reveals that though no significant variation in gross returns were observed among different input systems, INM practice and organic system resulted in 30.5 and 16.7% higher net returns respectively owing to reduction in cost of cultivation to the tune of 8.7% compared to inorganic systems. The same was also reflected in B: C ratio as INM recorded higher B: C ratio of 1.3 followed by organic system (1.2) . Inorganic system had lower B: C ratio of 1.1 indicating the higher cost of cultivation and lesser returns per rupee invested. Among the various cropping systems, considerably higher net returns and B: C ratio was recorded with french bean- cauliflower-french bean (₹ 89299 ha^{-1} and 1.05) and maize-garlic (₹ 133201 ha^{-1} and 2.42) under INM while cauliflower- radish-tomato and cabbage-radish-capsicum performed better under organic systems.

Bhopal: Economic evaluation for 5 years indicates that organic system registers B: C ratio of 2.8 with net return of ₹ 31373 ha^{-1}. The cost of cultivation remained almost same among the three input systems. Among the different cropping systems, soybean-wheat-registered higher B:C ratio (3.01) followed by soybean mustard system.

Pantnagar: Mean data of 6 years of cropping and input system evaluation for economics reveals that inorganic system had higher gross returns (₹ 56297 ha^{-1}), net returns (₹ 37302 ha^{-1}), B:C ratio (1.6) and lower cost of cultivation of ₹ 32786 ha^{-1}. Among the organic and INM practice, INM found to be better in terms B: C ratio as it registered 1.5 compared to organic system (1.4). Among the different cropping systems, rice-pea (veg)- sesbania responded well to organic system by recording 49.8% higher net returns over inorganic system. Similarly rice-wheat-sesbania recorded 55.1% higher net returns with INM Practice. Other systems had better returns and B:C ratio under inorganic system.

Ranchi: Five years mean of net returns and B:C ratio infers that organic system recorded 11.3% higher net returns than inorganic system. Net benefit between INM and inorganic system is only ₹ 1461 ha^{-1}. The net benefit of 11.3% obtained with organic system is not reflected in B: C ratio as inorganic system recorded B: C ratio of 1.5 which is higher than the organic and INM (1.3). It is mainly due to the cost involved in organic and INM practices. Though all the systems registered higher net returns with organic system, only rice-potato and rice-lentil recorded higher B: C ratio of 1.42 and 1.39 respectively with organic system. The other two systems (rice-wheat and rice-mustard/linseed) recorded higher B: C ratio of 1.83 and 1.39 with inorganic system.

Umiam : Net returns and B:C ratio are reported for only one year which reveals that INM had recorded additional net return of ₹ 30620 ha^{-1} $annum^{-1}$ while organic system registered only ₹ 23306 ha^{-1} $annum^{-1}$ indicating the benefit of integrated nutrient management practices. The same trend is reflected in B: C ratio also as INM recorded 4.4 followed by inorganic system (3.9). Organic system had lower B: C ratio of 3.6. Among the cropping system, rice-carrot system recorded maximum net return of ₹ 1,85130 ha^{-1} $annum^{-1}$ with B: C ratio of 5.28. This was followed by rice-tomato system having recorded net return of ₹ 172095 ha^{-1} $annum^{-1}$ with B: C ratio of 4.64. Yield of all the crops were increasing over the years with organic system and INM compared to inorganic system.

Tomato crop applied with vermicompost at vegetative stage at Umiam

Table 7. Influence of methods of nutrient application on economics of different crops and cropping system at various locations (2004-05 to 2009-10)

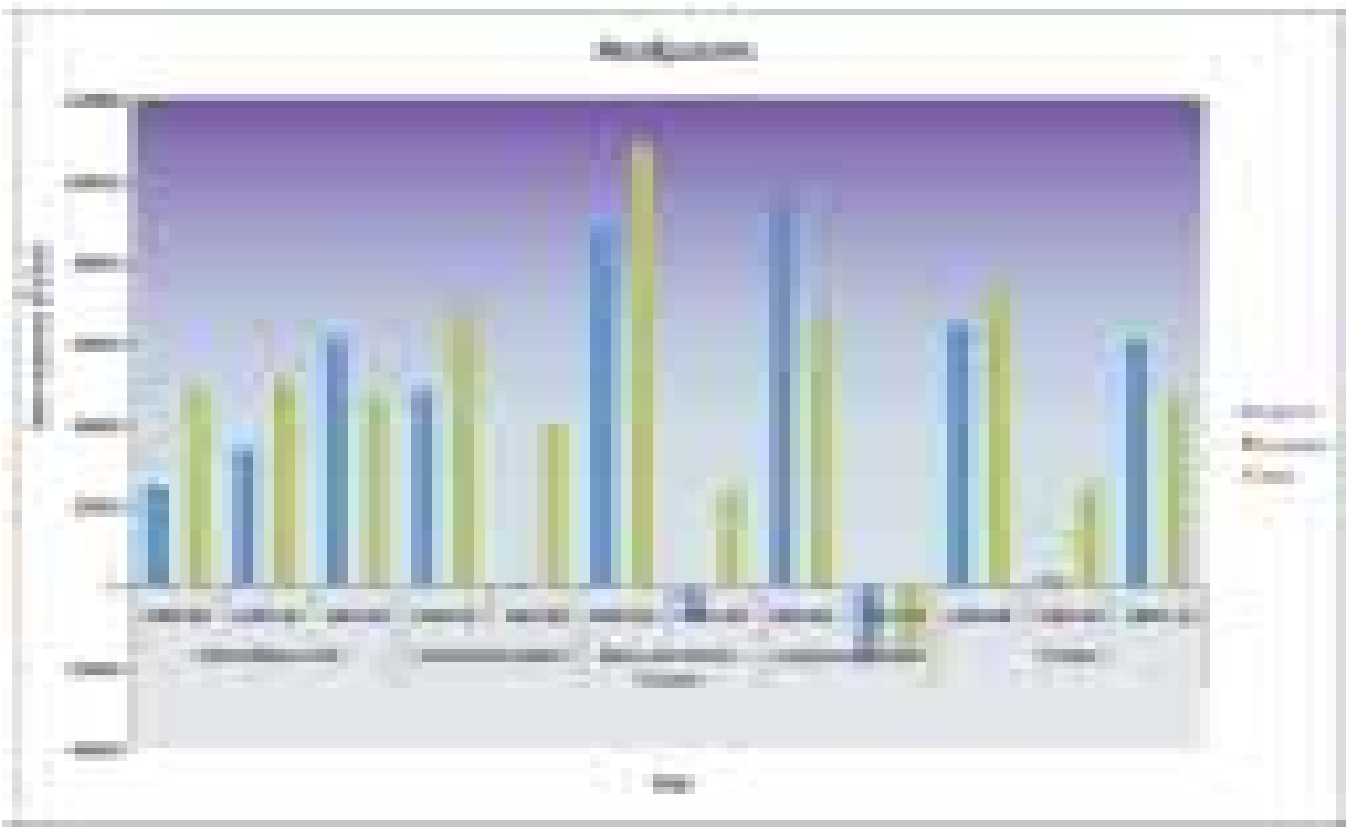
Cropping/Input system	Gross returns (₹/ha)				Cost of cultivation (₹/ha)				Net returns (₹/ha)				B:C ratio			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
1. Modipuram (mean of 2 years)																
Rice-Wheat	94331	-	116111	105221	65131	62032	66497	64553	39675	-	48647	44161	1.81	-	2.12	1.96
Rice-Potato-Radish	100330	-	140932	120631	78599	86394	86541	83845	24731	-	54391	39561	1.91	-	2.54	2.23
Babycorn -Potato-Green gram	106595	-	144140	125368	67013	69173	77834	71340	39582	-	66307	52945	2.38	-	2.86	2.62
Sorghum (F)-Pea-Okra	93700	-	68593	81146	54669	42070	47484	48074	39032	-	25656	32344	2.69	-	2.20	2.45
Rice –Barley+mustard-Green gram	-	-	-	-	-	-	-	-	58986	-	36522	47754	1.90	-	1.58	1.74
Maize-Potato-Okra	-	-	-	-	-	-	-	-	83762	-	62908	73335	1.73	-	1.56	1.65
Maize-Mustard-Radish-G. gram	-	111710	-	111710	-	-	-	-	46634	44947	37706	43096	1.87	2.13	1.72	1.91
Mean	98739	111710	117444		66353	64917	69589		47486	44947	47448		2.0	2.1	2.1	
2. Jabalpur (mean of 6 years)																
Rice-Wheat	96168	89587	89588	91781	40552	35591	37200	37781	55616	53997	52388	54000	2.30	2.56	2.40	2.42
Rice – potato -Okra	215130	201172	196311	204204	64309	55810	59591	59904	150821	145359	136720	144300	3.34	3.57	3.29	3.40
Rice – Berseem	148477	127461	127954	134631	42208	40793	40842	41281	106268	86668	87113	93349	3.46	3.15	3.13	3.25
Rice-Pea-Sorghum F	145383	131819	129456	135553	46843	45911	45511	46088	98540	85908	83945	89464	2.99	2.80	2.77	2.85
Mean	151290	137510	135827		48478	44526	45786		102811	92983	90042		3.0	3.0	2.9	
3. Coimbatore				**Mean of 3 years**								**Mean of 5 years**				**Mean of 5 years**
Maize-Cotton	85639	66733	73664	75345	45460	26472	39300	37077	34460	35170	33906	34512	2.60	3.30	2.70	2.87
Chilly-Onion	109204	99505	102442	103717	55621	41552	47324	48166	43678	42746	47223	44549	2.65	3.02	2.95	2.87
Brinjal-Sunflower	72969	63572	64365	66969	39240	32460	36030	35910	15063	14543	18929	16178	1.41	1.44	1.52	1.46
Turmeric+ Onion	49724	39427	42269	43807	39375	25400	34675	33150	10349	14327	7594	10757	1.26	1.57	1.22	1.35
Mean	79384	67309	70685		44924	31471	39332		25888	26697	26913		2.0	2.3	2.1	

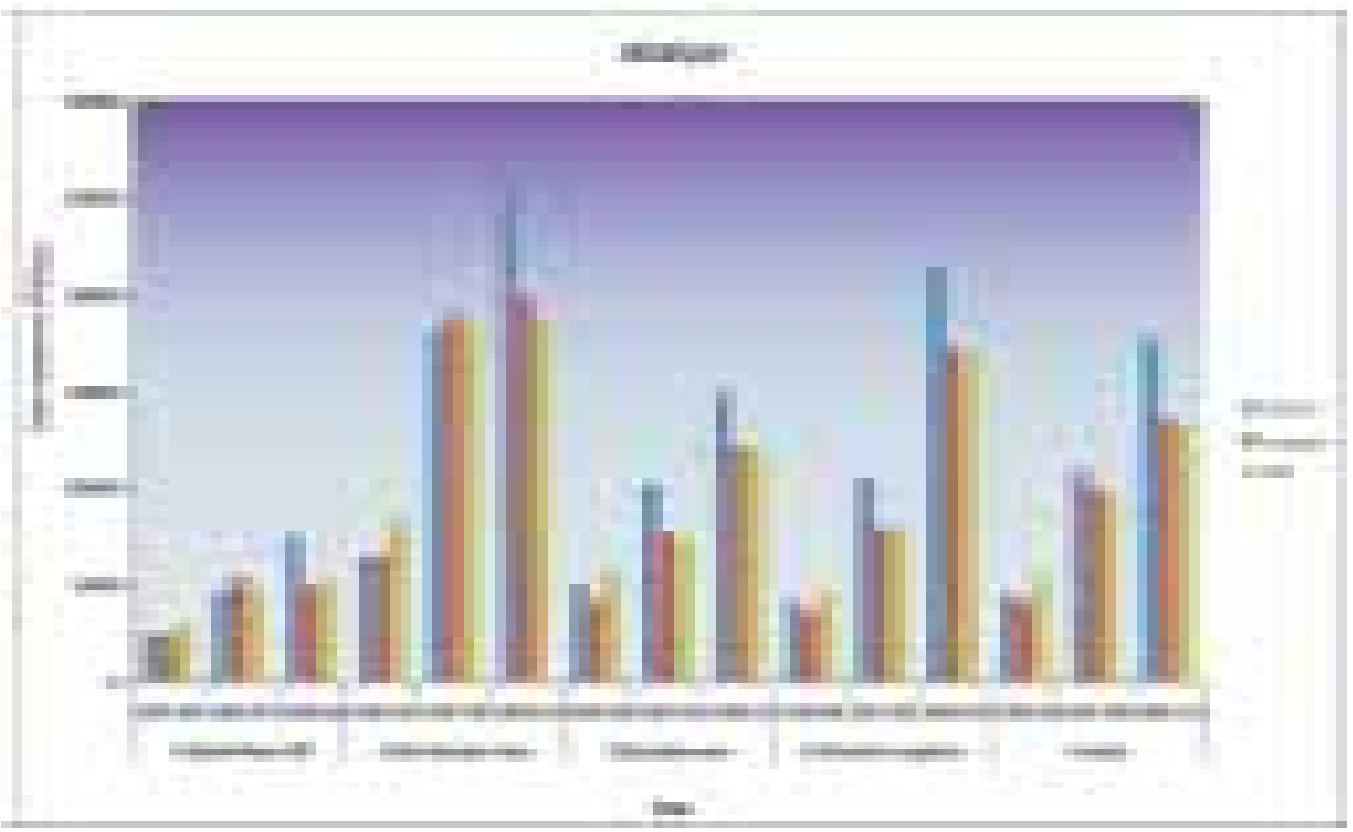
Cropping/Input system	Gross returns (₹/ha)				Cost of cultivation (₹/ha)				Net returns (₹/ha)				B:C ratio			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
4. Raipur (mean of 5 years)																
Soybean-Wheat	67527	60252	61973	63250	36302	25224	30827	30785	31411	35702	31571	32895	0.86	1.49	1.04	1.13
Soybean-Berseem	76819	65254	64415	68829	29255	23488	26021	26255	48374	42454	39093	43307	1.58	1.70	1.41	1.56
Soybean-Mustard	77054	75067	74821	75647	36171	26837	30171	31060	42020	49638	45861	45840	1.10	1.80	1.45	1.45
Soybean-Chickpea	61834	51453	52214	55167	26932	21861	24313	24369	35434	30357	28700	31497	1.45	1.47	1.25	1.39
Mean	70809	63007	63356		32165	24353	27833		39310	39538	36306		1.2	1.6	1.3	
5. Calicut (mean of 4 years)																
Ginger	296778	276890	342290	305319	166747	125781	149306	147278	130031	151109	192985	158041	1.97	2.11	2.10	2.06
Turmeric	236505	248465	330880	271950	174247	141152	164756	160052	62258	107314	166124	111898	1.91	1.76	1.97	1.88
Mean	266642	262678	336585		170497	133467	157031		96145	129212	179555		1.9	1.9	2.0	
6. Dharwad (mean of 5 years)																
Groundnut -Sorghum	55842	48758	53675	52758	18706	18169	18758	18544	36934	30396	33995	33775	3.52	3.28	3.51	3.44
Soybean- Wheat	32969	28352	40184	33835	13080	14248	16766	14698	19989	13893	17444	17109	2.99	2.30	2.56	2.62
Potato-Chickpea	47330	44742	50049	47374	18250	18241	18997	18496	29080	26205	31494	28926	3.06	2.89	3.04	3.00
Chilli+Cotton /Chilli+Cotton-Onion	32595	29816	35363	32591	13086	15032	15696	14605	18992	14711	19739	17814	2.76	2.37	2.54	2.56
Maize-Chickpea	39213	41909	40923	40681	15900	17017	18275	17064	26413	26576	25593	26194	2.88	2.66	2.44	2.66
Mean	41590	38715	44039		15804	16541	17698		26282	22356	25653		3.0	2.7	2.8	
7. Karjat (mean of 5 years)																
Rice-G.Nut	84568	89536	91827	88644	62052	50887	55186	56042	22128	38649	36641	32472	1.35	1.77	1.66	1.59
Rice-Maize	109165	166766	147404	141112	97112	78975	91457	89182	11665	87791	55947	51801	1.12	2.17	1.62	1.64
Rice-Mustard	39200	40367	40226	39931	54453	35462	44391	44769	-15642	4905	-4165	-4967	0.75	1.16	0.94	0.95
Rice-Dolichos bean	72582	63242	64971	66932	80769	62978	72837	72195	-8574	263	-7866	-5392	0.94	1.03	0.92	0.96
Mean	76379	89978	86107		73597	57076	65968		2394	32902	20139		1.0	1.5	1.3	

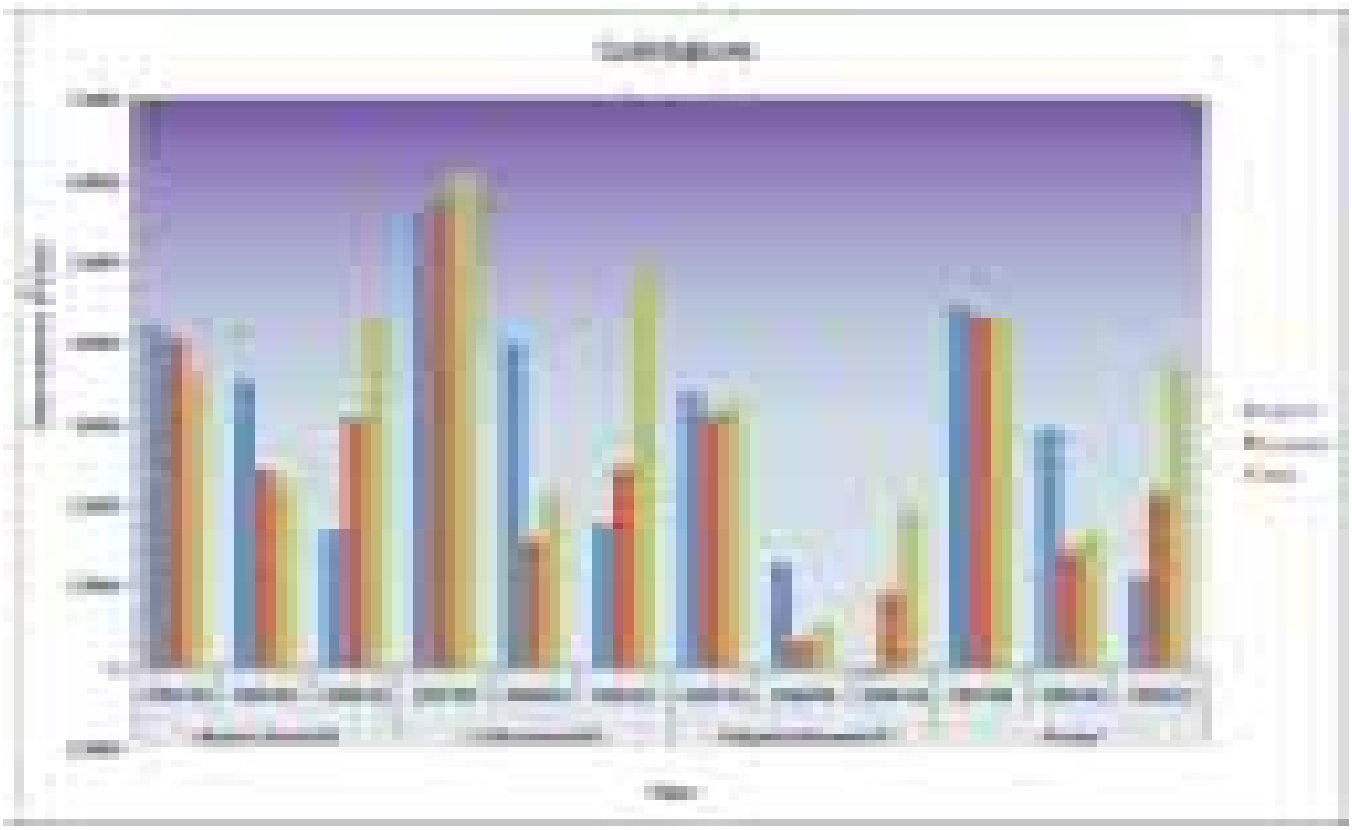
Cropping/Input system	Gross returns (₹/ha)				Cost of cultivation (₹/ha)				Net returns (₹/ha)				B:C ratio			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
8. Ludhiana I (mean of 1 year)																
Turmeric - Onion	-	-	-	-	64370	54234	59302	59302	168910	60366	85298	104858	-	-	-	-
2008-09 (mean of 2 years)																
Cotton - Wheat	-	-	-	-	44098	38243	41216	41186	50792	20056	17117	29322	-	-	-	-
Maize-Gram	-	-	-	-	41618	39365	40491	40491	69102	51270	59784	60052	-	-	-	-
Maize -Potato-Moong (S)	-	-	-	-	96038	87363	91701	91701	120116	61062	88594	89924	-	-	-	-
Rice -Wheat-Moong (S)	-	-	-	-	58823	58385	58604	58604	118083	92515	104492	105030	-	-	-	-
Mean	-	-	-	-	60144	55839	58003		89523	56226	67497		-	-	-	-
Ludhiana II (mean of 1 year)																
Sorghum - Berseem	-	-	-	-	17600	18312	18461	18124	46492	37218	45743	43151	-	-	-	-
Maize- Berseem- Bajra	-	-	-	-	22707	22660	23018	22795	58354	39817	53958	50710	-	-	-	-
Maize-Berseem-Maize +Cowpea	-	-	-	-	28269	28385	28827	28494	65572	46125	54882	55526	-	-	-	-
Sorghum +Guara-Oats-Cowpea	-	-	-	-	21650	21031	21884	21522	32094	21346	33322	28921	-	-	-	-
Mean	-	-	-	-	22557	22597	23048		50628	36127	46976		-	-	-	-
9. Bajaura (mean of 4 years)																
Cauliflower-Radish-Tomato	202938	174127	195775	190947	97363	107494	105613	103490	105576	66633	90163	87457	1.42	0.92	1.12	1.15
French bean-Cauliflower-French bean	212047	239453	247164	232888	152358	158895	157864	156372	59689	80567	89299	76518	0.86	0.95	1.05	0.95
Cabbage-Radish-Capsicum	132161	118393	141454	130669	87976	108628	107310	101304	44186	9758	34144	29363	0.81	0.39	0.56	0.59
Maize-Garlic	171482	180951	205109	185847	70769	72170	71909	71616	100714	108781	133201	114232	1.83	2.12	2.42	2.12
Mean	179657	178231	197376		102117	111797	110674		77541	66435	86702		1.2	1.1	1.3	
10. Bhopal (mean of 5 years)																
Soybean- Wheat	56591	53869	57941	56133	17878	18606	37954	24813	37947	36240	40351	38179	3.16	2.96	3.20	3.11
Soybean-Mustard	45810	44380	46591	45594	15516	16407	35657	22526	29795	28953	31483	30077	2.96	2.82	3.00	2.93
Soybean-Chickpea	46552	44862	48007	46474	15802	16956	36049	22936	30500	28884	32007	30463	2.94	2.75	3.00	2.90
Soybean-Isabgol	42826	39034	41009	40956	15644	16659	35855	22719	26249	23204	25512	24988	2.77	2.47	2.64	2.63
Mean	47945	45536	48387		16210	17157	36379		31123	29320	32338		2.96	2.75	2.96	

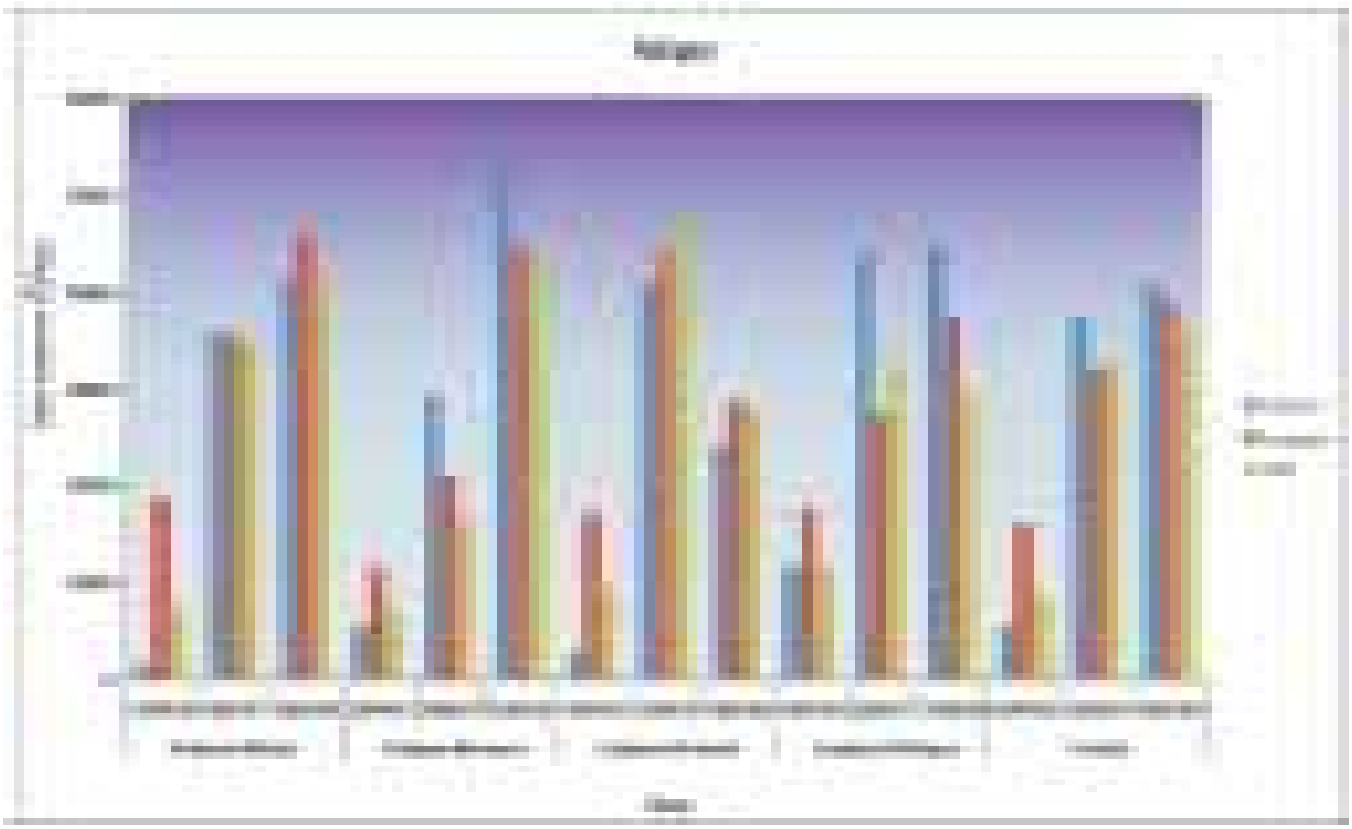
Cropping/Input system	Gross returns (₹/ha)				Cost of cultivation (₹/ha)				Net returns (₹/ha)				B:C ratio			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
11. Pantnagar				Mean of 3 years								Mean of 6 years				
Rice-Wheat-Sesbania (GM)	49951	59710	56101	55254	39970	36494	38409	38291	37918	29787	46202	37969	1.35	1.23	1.61	1.40
Rice -Lentil-Sesbania (GM)	40151	50159	43096	44469	37645	30346	27683	31891	19850	45188	35940	33660	0.97	1.94	1.78	1.56
Rice -Pea (veg.)-Sesbania(GM)	53851	62670	57640	58053	29028	28091	37291	31470	49484	33034	38024	40181	2.16	1.67	1.47	1.77
Rice -Mustard-Sesbania (GM)	37697	52650	45624	45324	33988	36214	34280	34827	24720	41198	21776	29231	1.19	1.57	1.12	1.29
Mean	45413	56297	50615		35158	32786	34416		32993	37302	35486		1.4	1.6	1.5	
12. Ranchi (mean of 5 years)																
Rice -Wheat	-	-	-	-	-	-	-	-	38932	36026	35317	36758	1.32	1.83	1.36	1.50
Rice -Potato	-	-	-	-	-	-	-	-	67679	60098	63022	63600	1.42	1.34	1.31	1.36
Rice -Mustard / Linseed	-	-	-	-	-	-	-	-	27434	25569	25574	26192	1.04	1.39	1.09	1.17
Rice -Lentil	-	-	-	-	-	-	-	-	31730	27257	30884	29957	1.39	1.34	1.40	1.38
Mean	-	-	-	-	-	-	-	-	41444	37238	38699		1.3	1.5	1.3	
13. Umiam (mean of 1 year)																
Rice - Carrot	-	-	-	-	-	-	-	-	164310	114106	185130	154515	4.34	4.05	5.28	4.56
Rice - Potato	-	-	-	-	-	-	-	-	117480	115367	133636	122161	2.71	3.02	3.12	2.95
Rice – French bean	-	-	-	-	-	-	-	-	117835	133332	166520	139229	3.18	4.14	4.45	3.92
Rice - Tomato	-	-	-	-	-	-	-	-	164530	172095	172095	169573	4.09	4.23	4.64	4.32
Mean	-	-	-	-	-	-	-	-	141039	133725	164345		3.6	3.9	4.4	

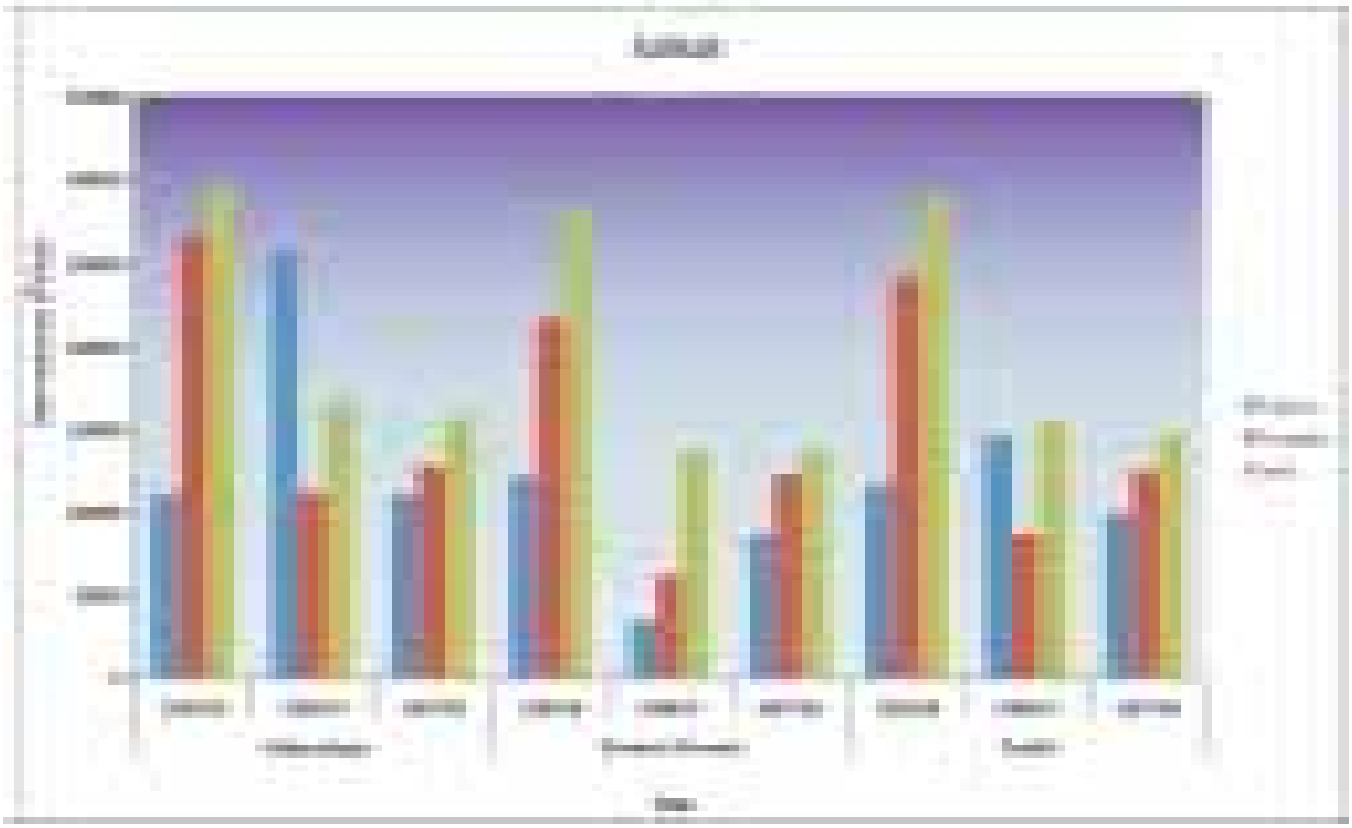
Fig. 4. Temporal variation in net returns at various locations under organic, inorganic and INM package of different cropping systems

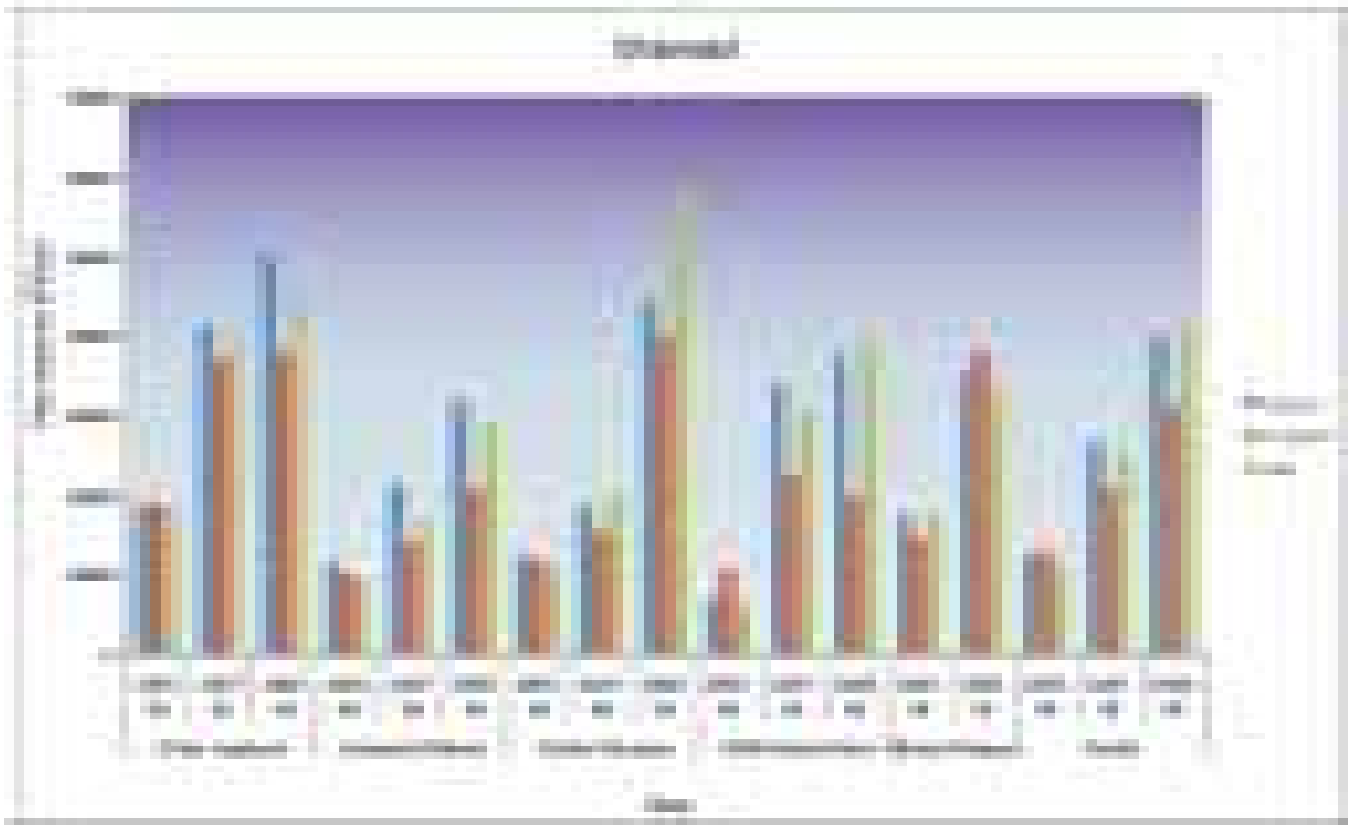


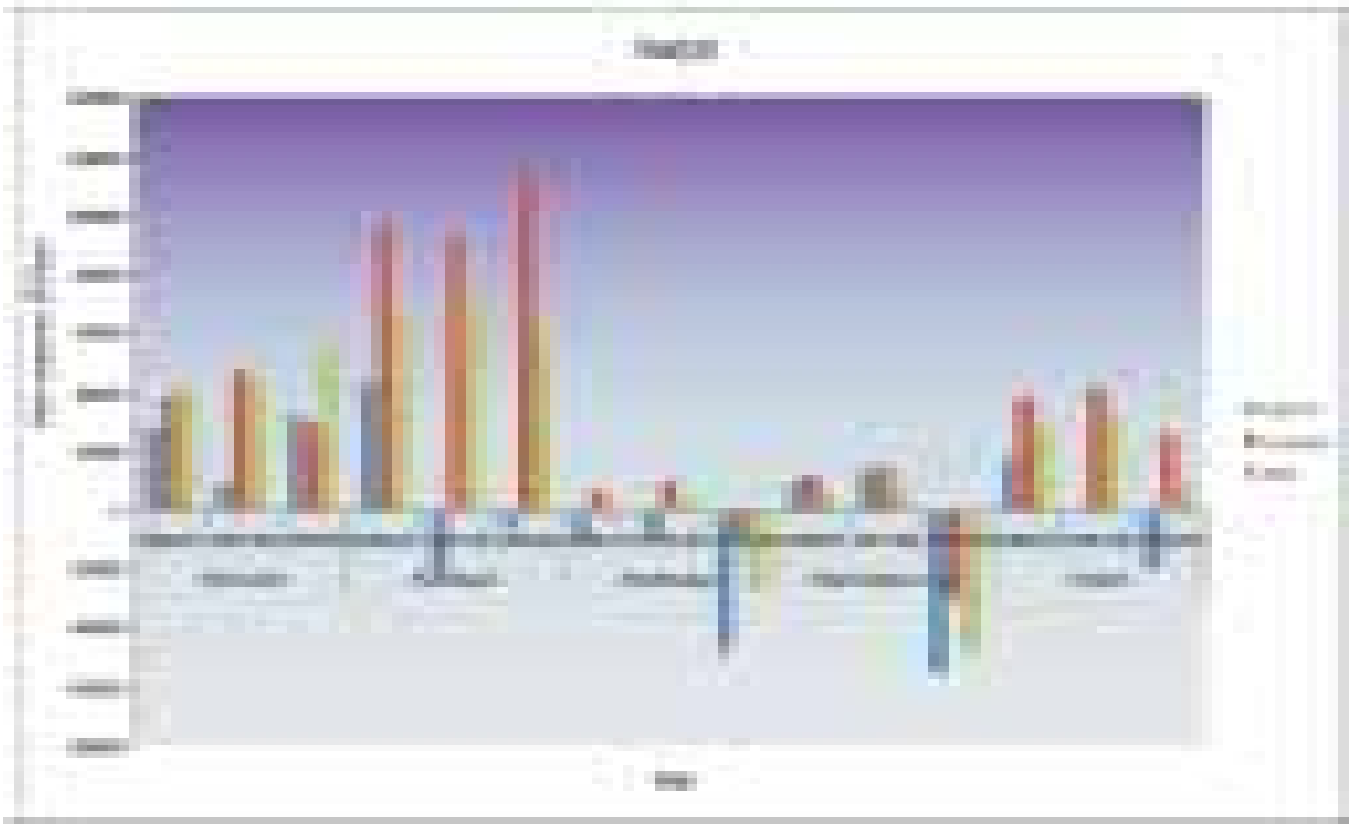


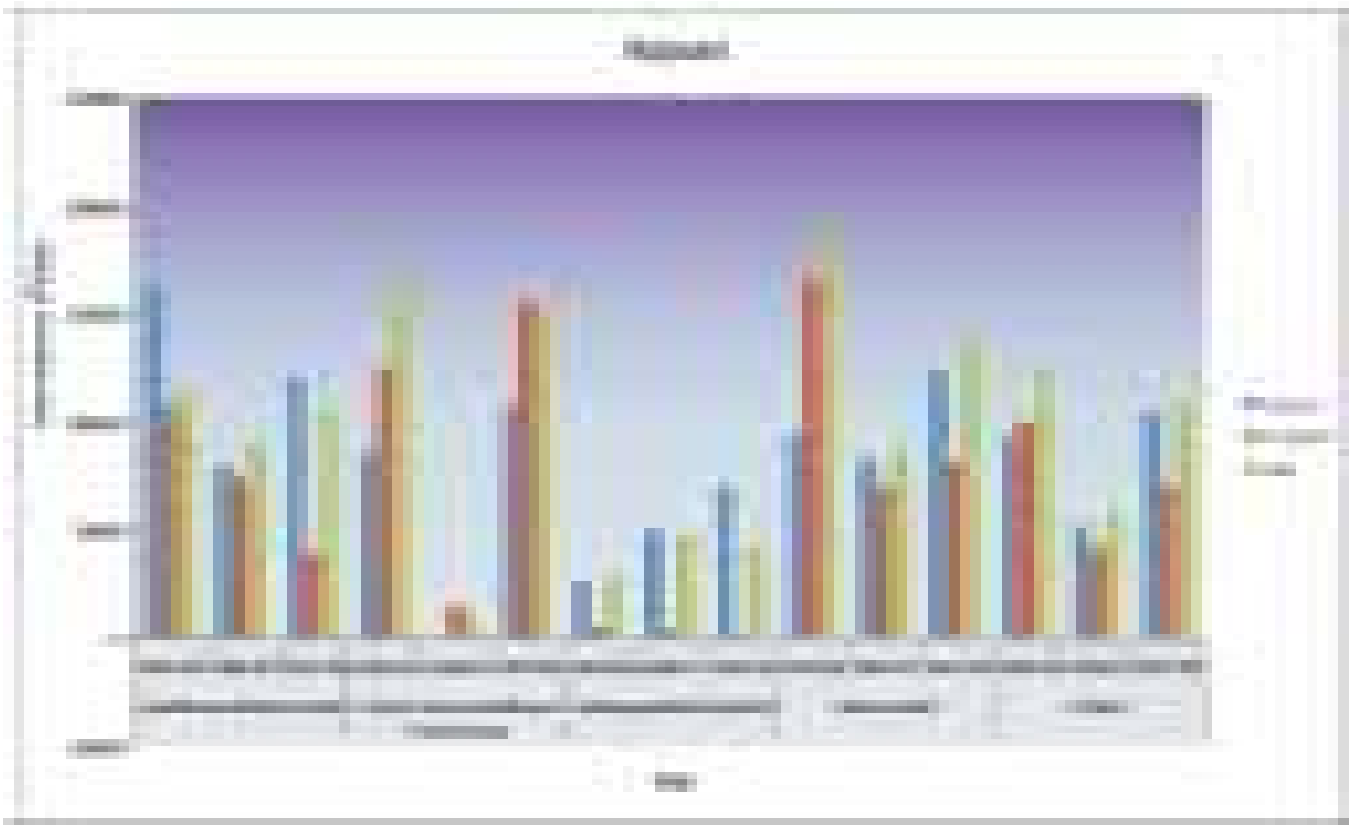


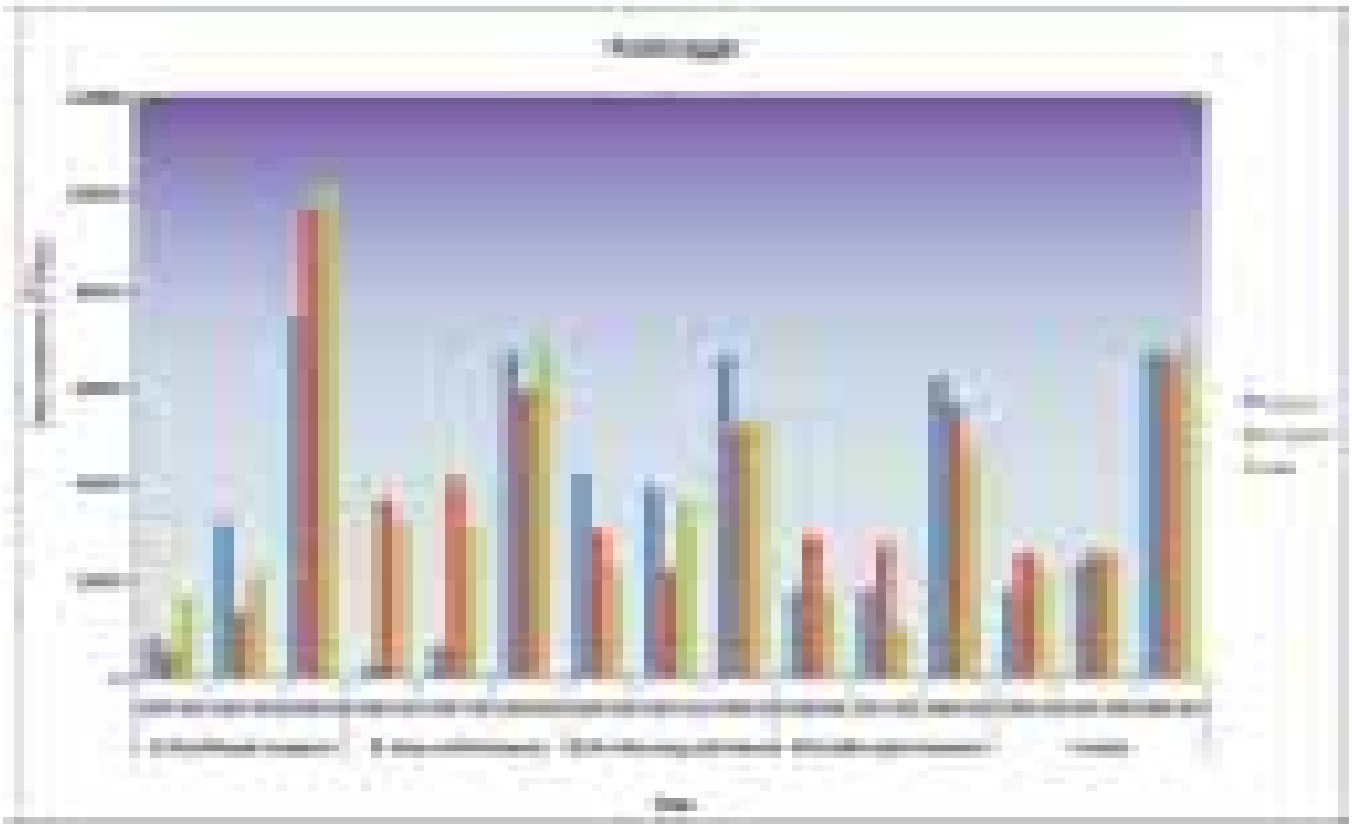


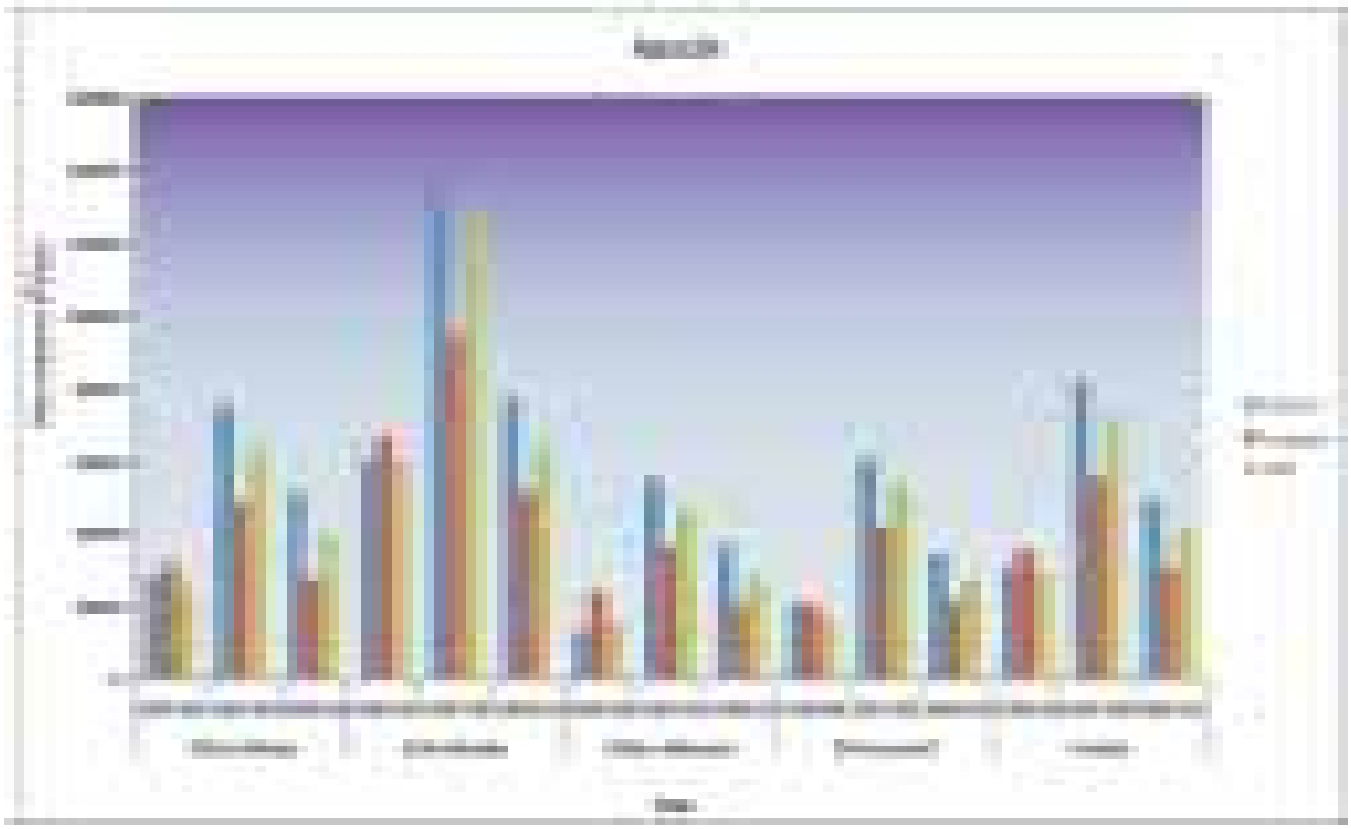


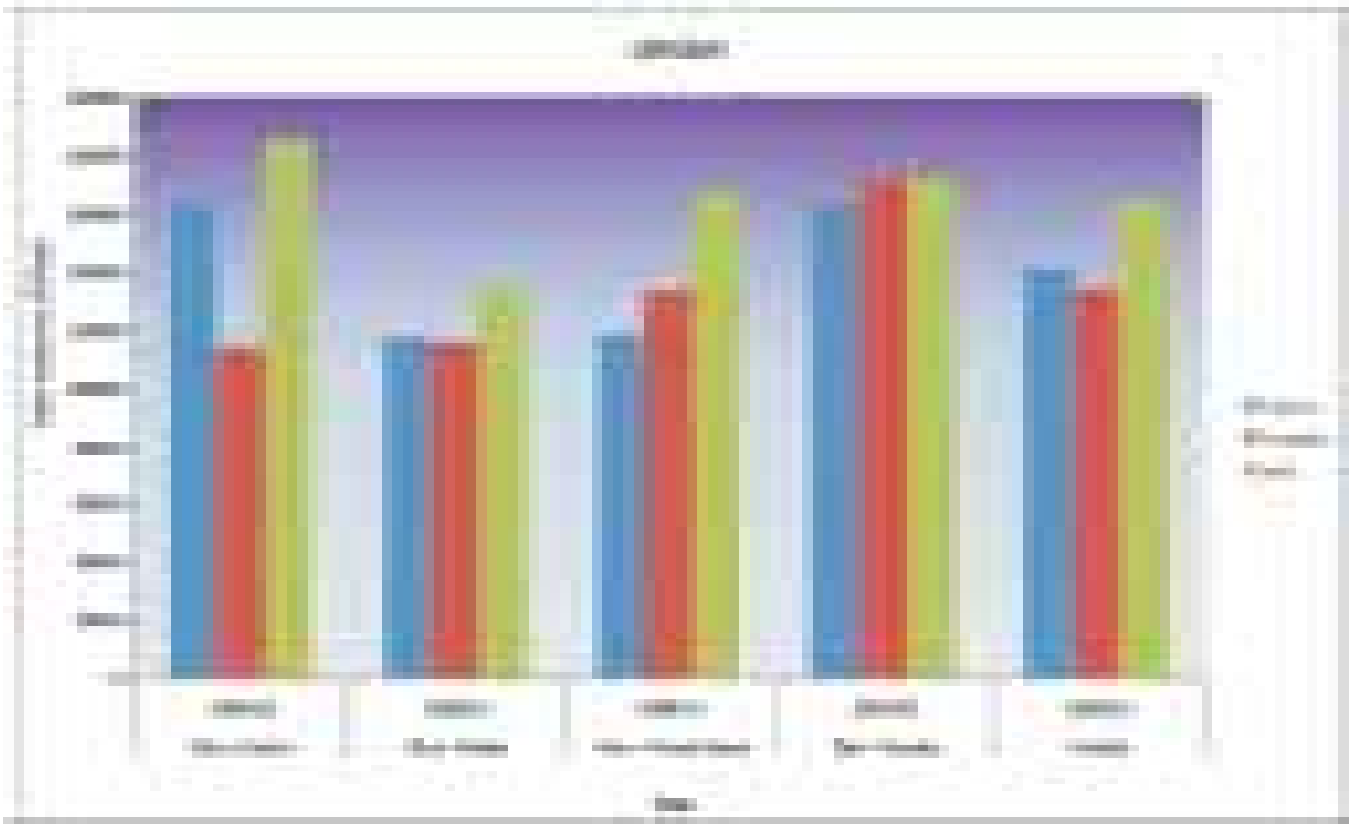












7.2 Evaluation of various organic input system

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

Objectives:

- To study the impact of various on-farm and off-farm produced organic resources 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 centers as cropping system and inputs for nutrients are varying from location to location. The details of treatments are given in Table 8 along with experimental results.

Year of start: 2004-05 with few centers 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 8 and Appendix III)

Modipuram: Two cropping systems along with different types of nutrient sources and control were evaluated for two years. Source of nutrients had significant influence on grain and straw yield. Application of nutrients through EC+VC+NEOC recorded higher grain yield of basmati rice (2797 kg ha^{-1}) which is 54.2 % higher than control during *kharif*. This was followed by application of EC+NEOC and NEOC+VC. Among the different combination of nutrient sources, EC+VC had lower grain yield of basmati rice. In wheat crop during *rabi* season, even though, there was significant difference among various source of nutrients, application of EC+VC+NEOC recorded 65.7% higher yield than control. Potato responded well to the combination of nutrient sources (EC+VC+NEOC) by recording 77% higher yield than control. Among the different combinations of nutrient sources, no significant variation was observed. In summer, onion recorded higher yield of 13677 kg ha^{-1} with EC+VC+NEOC combination followed by EC+VC (13516 kg ha^{-1}). The increase in yield of onion was 50.7% with EC+VC+NEOC over control. Straw yield also followed the similar trend as that of grain yield. An increase of 36.7 in straw yield was observed with EC+VC+NEOC combination than control.

Basmati rice and maize at Modipuram with different organic inputs

Jabalpur: Two cropping systems namely basmati rice-wheat and basmati rice-berseem + fodder sorghum were evaluated with 4 different combinations of nutrient sources along with control for 6 years. The pooled analysis of grain yield indicated significant difference among various combination of nutrient sources. Basmati rice recorded higher grain yield of 3558 kg ha^{-1} with FYM+Neem cake (50+50) during *kharif* which is 35.2% higher than control (2478 kg ha^{-1}). Wheat crop also responded well with 50:50 of FYM and neem cake by registering 40.1% higher yield (3124 kg ha^{-1}) which was closely followed by FYM + neem cake + VC @1/3 each during *rabi* season. Berseem had registered 17.3% higher yield than control with FYM+

neem cake + VC @ 1/3 each which was significantly higher than FYM +neem cake @ ½ each. Straw yield of rice and wheat also had the similar trend.

Coimbatore : Two cropping systems *viz*., rice-blackgram- sesame and maize-sunflower were evaluated for 3 years with 4 different combinations of nutrient sources along with control. Pooled results reveals application of nutrients through FYM+NEOC combination at ½ each are found to be better for basmati rice as it recorded higher grain yield of 3794 kg ha^{-1} followed by vermicomost alone (3391 kg ha^{-1}) during *kharif*. Similarly significantly higher grain yield of maize was recorded with FYM+NEOC @ ½ each (4288 kg ha^{-1}) followed by vermicompost alone (4022 kg ha^{-1}) . The increase in yield over control with application of FYM+ NEOC and vermicompost alone was found to be 63.7 and 53. 6% respectively. Blackgram and sesame registered higher grain yield with EC+VC +FYM @ 1/3 each during *rabi* and summer. The yield increase was to the tune of 101% and 130% respectively over control. Application of FYM+NEOC @ ½ each recorded significantly higher sunflower yield (1140 kg ha^{-1}) over control. However, it is on par with either VC or EC alone during *rabi* season. Straw yield of all the crops also followed the similar trend.

Performance of black gram under different organic inputs at Coimbatore

Raipur: Two cropping systems were evaluated with 4 different sources of nutrients along with control for 6 years and analysis of pooled results reveals that rice, chickpea, wheat and lentil recorded higher grain and straw yield with the combination of EC+VC+FYM @ 1/3 each. This was closely followed by EC+CDM @ ½ each. Around 19.8 % yield increase with EC+VC +FYM @ 1/3 each in basmati rice was observed, while it is 74.8% , 33.1% and 3.7% for wheat, chickpea and lentil respectively. Straw yield of rice, wheat, chickpea and lentil also followed the similar trend.

Calicut: Ginger and turmeric crops were tested with four different sources of nutrients along with control for 4 years. Significant influence on yield of turmeric and ginger was observed with various sources of nutrient application. Rhizome yield of 19000 kg ha^{-1} in ginger was observed with 15 t FYM+ 2t neem cake + 5 t coir compost application which is on par with other nutrient sources such as VC, FYM and coir compost but significantly higher than control. The % increase was found to be 30 over control. Application of 30 t FYM recorded rhizome yield of 24800 kg ha^{-1} in turmeric which is on par with 10 t coir compost + 8 t VC. The yield difference between these treatments was only 2.4%. Significantly lower yield of 19290 kg ha^{-1} in turmeric was observed in control. Interactions between cropping system and source of nutrients are found to be absent.

Dharwad: Six different combinations of nutrient sources were tested along with control in three cropping systems (groundnut-sorghum, soybean-wheat and chilli-cotton-onion) for 5 years. Groundnut, sorghum, soybean, wheat, chilli, and cotton recorded significantly higher yield with EC (3/8) +VC (3/8) + Green leaf manure (3/8) which is on par with application of VC (3/8) + FYM (3/8) + green leaf manure (3/8) . However, onion responded better with application of VC (3/8) + FYM (3/8) + green leaf manure (3/8) by registering 8194 kg ha^{-1} which is 58% higher than control. Like wise, 43.8 and 24% higher yield was recorded in groundnut and sorghum respectively with application of EC+VC+ GLM compared to control. The maximum difference in yield among various source of nutrient applications are only 224 kg for soybean and 105 kg for wheat. Difference of 400 kg was observed among various nutrient sources for groundnut. Onion recorded maximum difference of 1805 kg ha^{-1} between VC+FYM+GLM and VC+GLM indicating the importance of source of nutrient in enhancing the yield.

Karjat: Two cropping systems with four different source of nutrients alongwith control were evaluated for 5 years. Various combination of nutrient sources were evaluated during *kharif* and *rabi* seasons. No significant difference in yield of crops was observed among various source of nutrients. However application of FYM+ Paddy Straw + Gliricidia @ 1/3 each during *kharif* registered numerically higher grain yield of rice (3365 kg ha^{-1} and 3206 kg ha^{-1}) in both the systems. Similarly application of FYM+ Neem cake + Vermocompost @ 1/3 N each during *rabi* are found to be better for capsicum and cucumber (10363 and 9329 kg ha^{-1} respectively). Straw yield of rice and residues yield of capsicum and cucumber also recorded similar trend as that of grain/ economic yield. Response to the application of various sources of nutrients was higher for capsicum and cucumber (2365 and 2024 kg ha^{-1} respectively) compared to rice (294 kg ha^{-1}) .

Ludhiana: Two systems with four different combination of nutrient sources during *kharif* and *rabi* along with control were evaluated for 4 years. The pooled results reveals that application of green manure during *kharif* recorded higher maize grain yield (4786 kg ha^{-1}) followed by GM+FYM+VC (4638 kg ha^{-1}). FYM + crop residue incorporation during *rabi* led to higher gram yield of 3154 kg ha^{-1} compared to other nutrient sources. The yield increase is found to be 119% with FYM+crop residue than control. Application of green manure alone during *kharif* to rice recorded higher yield of 4120 kg ha^{-1} followed by GM+FYM+VC. Wheat responded well to FYM+ Jeen Amrit (JA) application during *rabi* by registering 129% higher yield than control. Maximum yield difference between best and least performing nutrient source was only 620 kg ha^{-1} for rice and 332 kg ha^{-1} for wheat. Straw yield also followed the similar trend.

Performance of berseem at Ludhiana with organic system

Bajaura: Four combinations of nutrient source involving FYM, VC and reinforced FYM were evaluated in cauliflower-pea/radish-tomato system. Significantly higher yield of cauliflower during *kharif* was recorded with reinforced FYM+ VC, which is 14.9% higher than the reinforced FYM alone. However, in case of radish, the yield difference between two nutrient source combination was only 495 kg ha^{-1}. Tomato responded well with application of reinforced FYM + vermicompost (18320 kg ha^{-1}) as it recorded 25.8% higher yield than the next best nutrient source combination of FYM+VC. Control had significantly lower yield in all the crops.

Bhopal: Four combinations of nutrient sources with two cropping systems were tested for six years and mean results are presented. CDM+PM+VC registered higher yield of soybean (1951 kg ha^{-1}) followed by CDM+PM . Significantly higher wheat yield of 4457 kg ha^{-1} was recorded with CDM-CDM+VC+PM followed by CDM-CDM+PM (4203 kg ha^{-1}) which is on par with CDM-CDM+VC and CDM-PM+VC. In case of mustard, CDM-CDM+PM recorded higher yield of 1908 kg ha^{-1} which is 7% higher than the next best combination of CDM-CDM+VC+PM. Around 44% lower mustard yield was observed with control. Straw yield had also recorded similar trend for all the crops.

Pantnagar: Three cropping systems involving rice-wheat, rice-chickpea and rice-vegetable pea were evaluated with four combination of nutrient sources for 3 years. The pooled results reveals that NEOC+VC @ ½ each recorded higher basmati rice yield (3314 kg ha^{-1}) followed by EC+VC+NEOC+FYM @ ¼ each (3270 kg ha^{-1}) during *kharif* season. Wheat and chickpea responded well with FYM+VC @ ½ each by recording 26.4 and 18.7% higher yield respectively than control. Response of vegetable pea was better with EC+VC+NEOC+FYM @ ¼ each than the combination of other nutrient sources. Straw yield of rice and wheat also had similar trend as that of grain yield.

Ranchi: Two systems *viz*., rice-wheat and rice – lentil/ potato were evaluated with four combinations of nutrients along with control for 2 years. The combined results of both the years infers that there is no significant difference in yield was observed with various combination of nutrient sources in rice during *kharif*. However, numerically higher yield of rice was recorded with FYM+VC @ ½ each (2612 kg ha^{-1}) and it is 33.5% higher than the control. Similarly in wheat, FYM+Neem cake + VC @ 1/3 each registered higher yield of 2309 kg ha^{-1} followed by VC+Neem cake @ ½ each (2224 kg ha^{-1}). The yield increase over control was found to be 45.7 % with FYM+ Neem cake +VC @ 1/3 each. No significant trend in yield of lentil was observed with various sources of nutrient applications. Straw yield of wheat and lentil had the similar trend as that of grain yield of these crops.

Umiam: Ten crops viz, rice, soybean, mustard, maize, tomato, groundnut, frenchbean, radish, potato and carrot with four sources of nutrients (FYM, vermicompost, local compost and integrated) alongwith control were evaluated in different combination of cropping system for 4 years and pooled results are presented. Out of ten crops evaluated tomato, maize, groundnut, french bean and radish recorded higher yield with FYM while application of vermicompost led to higher yield in mustard, potato and carrot. Integration of FYM+VC and local compost had the higher yield in rice and soybean crops. On an average, the yield difference between FYM and Integrated application of FYM+VC+LC are found to be 26.2, 4.8, 16, 11.3 and 8% for tomato, maize, groundnut, french bean and radish respectively. In case of mustard, potato and carrot, the yield difference between vermicompost and integrated application was found to be 1.7 , 17.3 and 21.7 % respectively. Rice and soybean recorded no significant difference in yield among various sources of nutrient application even though integrated application of FYM+VC+LC registered numerically higher yield. Among the various crops tested, vegetables such as frenchbean, radish and carrot are found to be better performing with organic manure application in different forms. What was true interms of grain or economic yield, is true for straw/ residual yield of other crops.

Table 8. Influence of source of nutrients on grain and straw yield (kg/ha) of crops at various locations (2004-05 to 2009-10)

Cropping system	Source of nutrient	Grain Yield (kg ha^{-1})			Straw Yield (kg ha^{-1})		
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
1. Modipuram (mean of 2 years)							
Basmati rice- Wheat	NS 1-EC + VC	2357	3275	-	4610	4171	-
	NS2- NEOC+VC	2529	3208	-	4592	4142	-
	NS3- EC + NEOC	2620	3260	-	4756	4496	-
	NS4- EC + VC + NEOC	2797	3419	-	5151	4448	-
	NS5-Control	1814	2063	-	3766	2429	-
	Mean	2423	3045	-	4575	3937	-
Basmati rice / Maize-	NS1-EC + VC	4117	11844	13516	11344	-	-
Potato- Onion	NS2- NEOC+VC	4232	10926	12375	12083	-	-
	NS3- EC + NEOC	4177	11682	13464	11948	-	-
	NS4- EC + VC + NEOC	4202	11736	13677	11804	-	-
	NS5-Control	2664	6621	9074	8792	-	-
	Mean	3878	10562	12421	11194	-	-
		Kharif (GY)		*Rabi* (GY)		*Kharif* (SY)	
		SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	768	NS	1799	NS	4200	NS

Cropping system	Source of nutrient	Grain Yield (kg ha^{-1})			Straw Yield (kg ha^{-1})		
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
	Method	130	425	547	1783	279	911
	Cropping X Method	786	NS	1927	NS	4215	NS
	Method X Cropping	184	NS	773	NS	395	NS
2. Jabalpur (mean of 6 years)							
Basmati rice-Wheat	NS1-FYM+VC(1/2+1/2)	3465	3071	-	6986	5135	-
	NS2-VC+Neem cake (1/2+1/2)	3399	3026	-	6638	5021	-
	NS3-FYM+Neem cake (1/2+1/2)	3558	3124	-	7089	4994	-
	NS4-FYM+Neem cake+VC (1/3+1/3+1/3)	3524	3075	-	6750	4964	-
	NS5-Control	2478	2217	-	5886	3190	-
	Mean	16424	14512	-	33348	23304	-
Basmati rice –	NS1-FYM+VC(1/2+1/2)	3433	36805(165)	-	6668	-	-
Berseem F/S	NS2-VC+Neem cake (1/2+1/2)	3387	36504(124)	-	6640	-	-
	NS3-FYM+Neem cake (1/2+1/2)	3512	37420(141)	-	7154	-	-
	NS4-FYM+Neem cake+VC (1/3+1/3+1/3)	3420	38480(117)	-	6841	-	-
	NS5-Control	2667	32804(134)	-	5330	-	-
	Mean	16418	182012(681)	-	32632	-	-
		Kharif (GY)		*Kharif* (SY)		*Rabi* (SY)	
		SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	34	NS	35	128	2750	9996
	Method	104	296	172	490	254	725
	Cropping X Method	136	NS	220	NS	2768	10035
	Method X Cropping	147	NS	243	NS	359	1025
3. Coimbatore (mean of 3 years)							
Rice -Black gram-	NS1-EC	2802	426	695	3357	-	-
Sesame/ GM	NS2-VC	3391	455	727	5152	-	-
	NS3-FYM+NEOC(1/2+1/2)	3794	502	784	5951	-	-
	NS4-EC+VC+FYM (1/3+1/3+1/3)	3193	512	843	4946	-	-
	NS5-Control	1495	254	352	2565	-	-
	Mean	2935	430	680	4394	-	
Maize-Sunflower	NS1-EC	3362	913	-	-	-	-
	NS2-VC	4022	1061	-	-	-	-
	NS3-FYM+NEOC(1/2+1/2)	4288	1140	-	-	-	-

Cropping system	Source of nutrient	Grain Yield (kg ha^{-1})			Straw Yield (kg ha^{-1})		
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
	NS4-EC+VC+FYM (1/3+1/3+1/3)	3649	1026	-	-	-	-
	NS5-Control	2618	435	-	-	-	-
	Mean	3588	915	-			-
		Kharif (GY)		*Rabi* (GY)			
		SEm±	CD	SEm±	CD		
	Cropping	161	NS	43	261		
	Method	92	277	13	39		
	Cropping X Method	199	NS	46	261		
	Method X Cropping	131	NS	18	55		
4. Raipur (mean of 6 years)							
Rice - Chickpea	NS1-EC+CDM(1/2+1/2)	3212	803	-	5324	1849	-
	NS2-NEOC+CDM(1/2+1/2)	2936	781	-	5123	1706	-
	NS3-FYM+NEOC(1/2+1/2)	3109	856	-	5232	1840	-
	NS4-NEOC+CDM+EC (1/3+1/3+1/3)	3200	876	-	5460	1756	-
	NS5-Control	2189	658	-	3789	1642	-
	Mean	2929	795	-	4985	1759	-
Rice – Wheat /	NS1-EC+CDM(1/2+1/2)	3151	1536(348)	-	5275	2549(1003)	-
Mustard+ Lentil*	NS2-VC	2917	1437(257)	-	4965	2315(764)	-
(2009-10)	NS3-FYM+NEOC(1/2+1/2)	3066	1644(318)	-	5254	2726(908)	-
	NS4-EC+VC+FYM (1/3+1/3+1/3)	3178	1780(351)	-	5610	2904(1002)	-
	NS5-Control	2171	1018(364)	-	3760	1953(1031)	-
	Mean	2897	1483(328)	-	4973	2489(942)	-
		Kharif (GY)		*Rabi* (GY)		*Kharif* (SY)	
		SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	47	NS	155	565	87	NS
	Method	113	323	50	144	253	724
	Cropping X Method	151	NS	168	591	332	NS
	Method X Cropping	160	NS	71	203	358	NS
5. Calicut (mean of 4 years)							
Ginger	NS1-15 t FYM+2t Neem cake+4tVC	18580	-	-	-	-	-
	NS2-15 t FYM+2t Neem cake+5tCoir compost	19000	-	-	-	-	-
	NS3-10tCoir compost+ 8t VC	18093	-	-	-	-	-
	NS4-30tFYM	18343	-	-	-	-	-

Cropping system	Source of nutrient	Grain Yield (kg ha^{-1})			Straw Yield (kg ha^{-1})		
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
	NS5-Control	14605	-	-	-	-	-
	Mean	17724	-	-	-	-	-
Turmeric	NS1-15 t FYM+2t Neem cake+4tVC	23290	-	-	-	-	-
	NS2-15 t FYM+2t Neem cake+5tCoir compost	23985	-	-	-	-	-
	NS3-10tCoir compost+8t VC	24213	-	-	-	-	-
	NS4-30tFYM	24800	-	-	-	-	-
	NS5-Control	19290	-	-	-	-	-
	Mean	23116	-	-	-	-	-
		Kharif					
		SEm±	CD				
	Cropping	3688	NS				
	Method	743	2167				
	Cropping X Method	3806	NS				
	Method X Cropping	1050	NS				
6. Dharwad (mean of 5 years)							
Groundnut-Sorghum	NS1-EC(3/4)+Green leaf manure(1/4)	2120	3746	-	-	-	-
	NS2-VC(3/4)+Green leaf manure(1/4)	2093	3710	-	-	-	-
	NS3-FYM(3/4)+Green leaf manure(1/4)	2178	3713	-	-	-	-
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	2493	3912	-	-	-	-
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	2391	3880	-	-	-	-
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	2425	3844	-	-	-	-
	NS7-Control	1733	3154	-	-	-	-
	Mean	2205	3708	-	-	-	-
Soybean-Wheat	NS1-EC(3/4)+Green leaf manure(1/4)	1290	1432	-	-	-	-
	NS2-VC(3/4)+Green leaf manure(1/4)	1221	1412	-	-	-	-
	NS3-FYM(3/4)+Green leaf manure(1/4)	1258	1421	-	-	-	-
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	1445	1517	-	-	-	-
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	1380	1499	-	-	-	-

Cropping system	Source of nutrient	Grain Yield (kg ha^{-1})			Straw Yield (kg ha^{-1})		
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	1400	1463	-	-	-	-
	NS7-Control	923	1104	-	-	-	-
	Mean	1274	1407	-	-	-	-
Chilli-Cotton-Onion	NS1-EC(3/4)+Green leaf manure(1/4)	434	539	6579	-	-	-
	NS2-VC(3/4)+Green leaf manure(1/4)	417	543	6389	-	-	-
	NS3-FYM(3/4)+Green leaf manure(1/4)	467	550	6991	-	-	-
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	501	599	6759	-	-	-
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	477	579	6806	-	-	-
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	454	579	8194	-	-	-
	NS7-Control	278	419	5185	-	-	-
	Mean	433	544	6700	-	-	-
		Kharif					
		SEm±	CD				
	Cropping	206	671				
	Method	32	91				
	Cropping X Method	212	687				
	Method X Cropping	56	157				
7. Karjat (mean of 5 years)							
Rice -Capsicum/ Red pumpkin	**K.** -NS1-FYM10+Glyricidia green leaves 1.83t/ha (50:50%N)**R**.-NS1-FYM 20 t/ha (100% N)	2819	7998	-	5043	2192	-
	K. -NS2-FYM10+Paddy straw 4.17t/ha(50:50%N) **R**.-NS2--FYM10+Vermi-compost1t/ha(50:50%N)	2962	8321	-	4906	2310	-
	K. -NS3-FYM10+Neem Cake 2.5 t/ha(50:50%N) **R**.-NS3-FYM10+Neem Cake2.5t/ha(50:50%N)	3111	8768	-	4482	2276	-
	K. -NS4-FYM 6.7+ Paddy straw3.8+ Glyricidia green leaves 1.2t/ha(1/3 N each throughFYM :PS:GLY) **R**.-NS4-FYM 6.7+Neem Cake 1.7+Vermicompost 0.7t/ha(1/3 N each throughFYM :NC:VC)	3365	10363	-	4966	2660	-

Cropping system	Source of nutrient	Grain Yield (kg ha^{-1})			Straw Yield (kg ha^{-1})		
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
	NS5-Control	2699	5315	-	4772	1601	-
	Mean	2991	8153	-	4834	2208	-
Rice - Cucumber	**K**. -NS1-FYM10+Glyricidia green leaves 1.83t/ha (50:50%N)**R**.-NS1-FYM 20 t/ha (100% N)	2912	7902	-	4690	812	-
	K. -NS2-FYM10+Paddy straw 4.17t/ha(50:50%N) **R**.-NS2-FYM10+Vermi-compost1t/ha(50:50%N)	3028	7380	-	4346	971	-
	K. -NS3-FYM10+Neem Cake 2.5 t/ha(50:50%N) **R**.-NS3-FYM10+Neem Cake2.5t/ha(50:50%N)	3065	7305	-	4666	1044	-
	K. -NS4-FYM 6.7+Paddy straw3.8+Glyricidia green leaves 1.2t/ha(1/3 N each throughFYM :PS:GLY) **R**.-NS4-FYM 6.7+Neem Cake 1.7+Vermicompost 0.7t/ha(1/3 N each throughFYM :NC:VC)	3206	9329	-	5121	1184	-
	NS5-Control	2929	5185	-	4632	789	-
	Mean	3028	7420	-	4691	960	-
		Kharif (GY)		*Rabi* (SY)		*Kharif* (GY)	
		SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	66	NS	2938	NS	86	NS
	Method	131	NS	526	1516	178	NS
	Cropping X Method	178	NS	3012	NS	241	NS
	Method X Cropping	185	NS	744	NS	252	NS
8. Ludhiana I (mean of 4 years)							
Maize -Gram	**K**.-NS1-GM+FYM **R**.-NS1-FYM+Crop residue	4484	3154		9084	4512	
	K.-NS2-GM + Jeen Amrit (JA) **R.**-NS2-FYM+JA	3996	3010		7828	4322	
	K.-NS3GM+-FYM+VC **R**.-NS3-FYM+VC+Crop residue	4638	3022		9056	4244	
	K.-NS4-GM **R**.-NS4-FYM	4786	3134		9294	4512	
	NS5-Control	2184	1338		3131	1790	
	Mean	4018	2732		7679	3876	
Rice - Wheat	**K**.-NS1-GM+FYM **R**.-NS1-FYM+Crop residue	3500	3300		18500	4230	
	K.-NS2-GM + Jeen Amrit (JA) **R.**-NS2-FYM+JA	3530	3330		17800	4800	

Cropping system	Source of nutrient	Grain Yield (kg ha^{-1})			Straw Yield (kg ha^{-1})		
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
	K.-NS3GM+-FYM+VC **R**.-NS3-FYM+VC+Crop residue	3580	3270		19500	4200	
	K.-NS4-GM **R**.-NS4-FYM	4120	2998		12046	3812	
	NS5-Control	2448	1454		6576	1960	
	Mean	5836	2870		14884	3800	
		Kharif		*Rabi*		*Kharif*	
		SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	132	396	204	611	527	1579
9. Bajura (mean of 1 year)							
Cauliflower - Pea/	NS1-VC	19317	10923	13511	-	-	-
Radish*(2006-07) -	NS2-FYM(RF)	20926	11131	14015	-	-	-
Tomato	NS3-FYM+VC	17909	10971	14563	-	-	-
	NS4-FYM(RF)+VC	24046	11626	18320	-	-	-
	NS5-Control	9566	6995	7566	-	-	-
	Mean	18353	10329	13595	-	-	-
Coriander – Pea /	NS1-VC	-	-	-	-	-	-
Spinach*(2006-07) -	NS2-FYM(RF)	-	-	-	-	-	-
Cabbage/Capsicum*	NS3-FYM+VC	-	-	-	-	-	-
(2006-07)	NS4-FYM(RF)+VC	-	-	-	-	-	-
	NS5-Control	-	-	-	-	-	-
	Mean	19317	10923	13511	-	-	-
10. Bhopal (mean of 6 years)							
Soybean - D.Wheat	NS1-CDM-CDM+PM	1330	4203	-	3270	5644	-
	NS2-CDM-CDM+VC	1236	4068	-	3091	5461	-
	NS3-CDM-PM+VC	1377	4054	-	3242	5519	-
	NS4-CDM-CDM+VC+PM	1378	4457	-	3309	6111	-
	NS5-Control	1050	2853	-	2661	4074	-
	Mean	1274	3927	-	3115	5362	-
Soybean - Mustard	NS1-CDM-CDM+PM	1834	1908	-	3547	5418	-
	NS2-CDM-CDM+VC	1573	1763	-	3244	5157	-
	NS3-CDM-PM+VC	1951	1707	-	3629	4966	-
	NS4-CDM-CDM+VC+PM	1892	1783	-	3605	5239	-
	NS5-Control	1382	1065	-	2811	3514	-
	Mean	1727	1645	-	3367	4859	-
		Kharif					
		SEm±	CD				
	Cropping	61	273				
	Method	53	154				

Cropping system	Source of nutrient	Grain Yield (kg ha^{-1})			Straw Yield (kg ha^{-1})		
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
	Cropping X Method	90	328				
	Method X Cropping	75	218				
11. Pantnagar (mean of 3 years)							
Basmati rice-Wheat	NS1EC+VC(1/2+1/2)	3156	2224	-	7200	3825	-
	NS2-NEOC+VC(1/2+1/2)	3314	2152	-	7282	3789	-
	NS3-FYM+VC(1/2+1/2)	3219	2314	-	7263	3737	-
	NS4-EC+VC+NEOC+FYM (1/4+1/4+1/4+1/4)	3270	2179	-	7175	3662	-
	NS5-Control	2989	1830	-	6679	3044	-
	Mean	3190	2140	-	7120	3611	-
B.Rice - Chickpea	NS1EC+VC(1/2+1/2)	3156	1420	-	7200	2938	-
	NS2-NEOC+VC(1/2+1/2)	3314	1333	-	7282	2703	-
	NS3-FYM+VC(1/2+1/2)	3219	1480	-	7263	2503	-
	NS4-EC+VC+NEOC+FYM (1/4+1/4+1/4+1/4)	3270	1402	-	7175	2698	-
	NS5-Control	2989	1247	-	6679	2647	-
	Mean	3190	1376	-	7120	2698	-
B.Rice – Vegetable	NS1EC+VC(1/2+1/2)	3156	2987	-	7200	-	-
Pea	NS2-NEOC+VC(1/2+1/2)	3314	2593	-	7282	-	-
	NS3-FYM+VC(1/2+1/2)	3219	2859	-	7263	-	-
	NS4-EC+VC+NEOC+FYM (1/4+1/4+1/4+1/4)	3270	3132	-	7175	-	-
	NS5-Control	2989	2596	-	6679	-	-
	Mean	3190	2833	-	7120	-	-
		Kharif					
		SEm±	CD				
	Cropping	491	NS				
	Method	53	154				
	Cropping X Method	497	NS				
	Method X Cropping	91	NS				
12. Ranchi (mean of 2 years)							
Rice - Wheat	NS1-FYM+VC(1/2+1/2)	2612	2146	-	-	1463	-
	NS2-FYM+Neem cake (1/2+1/2)	2199	1890	-	-	2736	-
	NS3-VC+Neem cake (1/2+1/2)	2579	2224	-	-	3134	-
	NS4-FYM+Neem cake+ VC(1/3+1/3+1/3)	2569	2309	-	-	3148	-

Cropping system	Source of nutrient	Grain Yield (kg ha^{-1})			Straw Yield (kg ha^{-1})		
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
	NS5-Control	1956	1585	-	-	2264	-
	Mean	2383	2031	-	-	2549	-
Rice - Lentil/Potato*	NS1-FYM+VC(1/2+1/2)	2612	8329	-	-	60	-
(2009-10)	NS2-FYM+Neem cake (1/2+1/2)	2199	3634	-	-	760	-
	NS3-VC+Neem cake (1/2+1/2)	2579	8426	-	-	773	-
	NS4-FYM+Neem cake+ VC(1/3+1/3+1/3)	2569	8116	-	-	1314	-
	NS5-Control	1956	8572	-	-	179	-
	Mean	2383	7415	-	-	617	-
		Kharif					
		SEm±	CD				
	Cropping	4984	NS				
	Method	1106	NS				
	Cropping X Method	5177	NS				
	Method X Cropping	1564	NS				
13. Umiam I (mean of 4 years)							
Rice-Soybean-Mustard	FYM	2199	1230	1135	4592	1634	1348
	Vermicompost	1892	1057	1176	4014	1479	1327
	Local compost	1588	985	871	3177	1336	1025
	Integrated	2277	1246	1156	4272	1563	1389
	Control	1021	531	221	2673	931	699
	Mean	1795	1010	912	3746	1389	1157
Rice +Soybean-Tomato	FYM	1889	1402	16295	4224	1669	1143
	Vermicompost	1705	1307	13179	3949	1574	1001
	Local compost	1365	1230	10070	2875	1454	917
	Integrated	2166	1339	12912	4111	1606	1128
	Control	855	488	6954	2621	906	829
	Mean	1596	1153	11882	3556	1442	1004
Maize +Soybean-	FYM	3868	1252	2132	10040	1882	-
Groundnut	Vermicompost	3578	1106	1716	8574	1596	-
	Local compost	2678	1013	1295	6695	1489	-
	Integrated	3692	1142	1838	9124	1736	-
	Control	1472	461	705	4481	918	-
	Mean	3058	995	1537	7783	1524	-
Maize +Soybean-	FYM	3905	1189	7475	9223	1661	2418
French bean	Vermicompost	3213	1037	6500	8168	1456	2548

Cropping system	Source of nutrient	Grain Yield (kg ha^{-1})			Straw Yield (kg ha^{-1})		
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
	Local compost	2471	914	3162	6117	1343	2218
	Integrated	3754	1040	6718	9027	1551	2576
	Control	1312	471	973	3841	956	1726
	Mean	2931	930	4965	7275	1393	2297
	Kharif (GY)		*Rabi* (GY)		*Summer* (GY)		*Kharif* (SY)	
	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
Cropping	76	263	44	153	3330	NS	709	2454
Method	128	368	31	88	221	636	239	687
Cropping X Method	241	NS	70	NS	3354	11577	828	2736
Method X Cropping	256	NS	61	NS	442	1272	477	1374
Umiam II (mean of 4 years)								
Maize +Soybean-	FYM	3627(1437)	-	-	10038(2144)	-	-
	Vermicompost	3097(1494)	-	-	9997(1851)	-	-
	Integrated	3536(1607)	-	-	10387(2155)	-	-
	Control	2139(1072)	-	-	7724(2131)	-	-
	Mean	3100(1403)	-	-	9536(2070)	-	-
Maize +Soybean-	FYM	3425(1543)	-	-	10381(2048)	-	-
	Vermicompost	2943(1299)	-	-	9196(1815)	-	-
	Integrated	3245(1343)	-	-	10607(2338)	-	-
	Control	2296(855)	-	-	8314(1379)	-	-
	Mean	2977(1260)	-	-	9624(1895)	-	-
Maize +Soybean-	FYM	3816(1495)	-	-	11059(2126)	-	-
	Vermicompost	3186(1541)	-	-	9228(2441)	-	-
	Integrated	3648(1639)	-	-	10940(2270)	-	-
	Control	1937(1151)	-	-	7300(2199)	-	-
	Mean	3147(1457)	-	-	9632(2259)	-	-
		Kharif (GY)		Intercrop (GY)		*Kharif (SY)*	
		SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	298	NS	97	NS	13.24	80.57
	Method	154	491	60	193	11.79	37.77
	Cropping X Method	377	NS	133	NS	22.10	93.58
	Method X Cropping	266	NS	105	NS	20.43	65.34
Umium III (2008-09)							
French bean-Tomato	FYM	13322	26259	-	5698	1886	-
	Vermicompost	11583	24547	-	5643	1804	-
	Integrated	12312	24409	-	5748	1837	-
	Control	7116	9785	-	3853	1254	-

Cropping system	Source of nutrient	Grain Yield (kg ha^{-1})			Straw Yield (kg ha^{-1})		
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
	Mean	11083	21250	-	5236	1695	-
Radish-Potato	FYM	44479	16357	-	-	-	-
	Vermicompost	43217	16463	-	-	-	-
	Integrated	41182	14039	-	-	-	-
	Control	36943	9279	-	-	-	-
	Mean	41455	14034	-	-	-	-
French bean-Carrot	FYM	17089	18296	-	-	-	-
	Vermicompost	15702	21020	-	-	-	-
	Integrated	16873	17276	-	-	-	-
	Control	11909	8615	-	-	-	-
	Mean	15393	16302	-	-	-	-
		Kharif		*Rabi*			
		SEm±	CD	SEm±	CD		
	Cropping	71	433	3322	NS		
	Method	226	722	1034	3306		
	Cropping X Method	346	1149	3666	NS		
	Method X Cropping	391	1250	1790	NS		

Note : K : *Kharif*. R : *Rabi*

Physical and chemical properties along with microbial count in soil (Table 9, 10 and Appendix III)

Modipuram: Soil pH, EC, OC, N, P, K and micronutrients such as Mn Zn, Cu and Fe were measured for 2 years and pooled results indicates, significant influence of nutrient sources on organic C, N, P and K. However pH and EC are not affected by different organic sources. Organic carbon content was found to be higher with EC+VC+NEOC (0.59%) followed by EC+VC. Around 28.9% increase in organic carbon was found in EC+VC+NEOC over control. Available N, P and K are also found to be better with

Performance of potato under organic system at Modipuram

Preparation of organic manures for NPOF experiment at Modipuram

EC+VC+NEOC and EC+VC compared to other combinations of nutrient sources and control. Among the two cropping systems, rice-potato-onion was found to better as it recorded numerically higher OC, N, P and K compared to basmati rice-wheat system. Soil micronutrients such as Mn, Zn, Cu and Fe are also found to be higher with EC+VC+NEOC in both rice-wheat and rice-potato-onion systems. The percent increase over control are found to be 264, 94, 52 and 265% for Mn, Zn, Cu and Fe respectively.

Jabalpur: Soil physical parameters bulk density was measured for 4 years while chemical parameters *viz*, pH, EC, OC , N, P and K was observed for 6 years. Soil microbial count of Azotobacter, fungi, bacteria and *actinomycetes* were taken for 5 years. The pooled results of all the parameters reveals that there is no significant influence on bulk density, pH, phosphorus and potassium was observed with either cropping system or different sources of nutrient supply and its interaction. pH, OC and available N are found to be better with FYM + neem cake + VC @ 1/3 each compared to other combination of nutrient sources. The increase in OC and nitrogen are to the tune of 5.8% and 6.5% respectively. Microbial count of all the species was influenced by different combination of nutrient sources. However, cropping system influenced only the bacterial population. Except bacteria, all other microbes was higher with FYM+ neem cake +VC @ 1/3 each .The bacterial count was higher with VC+ neem cake @ ½ each. The % increase in *azotobacter*, fungi and actinomycetes population under FYM+ neem cake+VC is found to be 34, 12.6 and 15% respectively over control. Basmati rice-berseem was found to be better than basmati rice-wheat system as it registered higher *azatobacter*, fungi, bacteria, and actinomycetes population.

Coimbatore: Organic carbon content of soil was estimated for 3 years while nitrogen was observed for 4 years. Remaining parameters such as P, K and micronutrient were estimated for 3 years. Pooled analysis of results indicates significant influence of nutrient sources and cropping system on soil organic carbon, available N,P K and micronutrients. EC+VC+FYM @ 1/3 each is found to be better as it recorded 66, 10.4, 17.5 and 12.4% higher organic carbon, available N, P and K than control. Among the two cropping systems, rice-blackgram-sesame/ green manure is found superior by recording 15.7, 12.1 , and 42.7% higher OC, N and P respectively than maize-sunflower system. Like OC, N, P and K, micronutrients such as Mn, Zn Cu and Fe are also found to be higher in EC+VC+FYM @ 1/3rd each than the other combination of nutrient sources. The % increase was found to be in the range of 16.4, 54.6, 62.5 and 20.8% for Mn, Zn Cu and Fe respectively over control. Among the cropping systems, maize-sunflower recorded higher availability of Mn, Zn and Fe while rice- blackgram-sesame/green manure recorded higher Cu content.

Raipur: Soil parameters such as bulk density, organic carbon, N, P, K and bacterial count were taken for 5 years while pH and EC was observed for only 4 years at the end of cropping cycle. Cropping system had no influence on any of the parameters except bacterial count. However, application of different sources of nutrients are found to be significantly influenced the soil bulk density, organic carbon, N,P, K and bacterial count. Bulk density was found to be higher in control in both the cropping systems. Organic carbon was found to be higher with NEOC+CDM+EC @ 1/3 each (2.84%) and it is on par with NEOC+CDM @ ½ each (2.83%). Available N was 16.4% higher with EC+VC+FYM than control. Initial level of K (252 kg ha^{-1}) got increased to 302 kg ha^{-1} with the same treatment. Among the two cropping systems, rice-chickpea is found to be better for increasing (1.4%) the organic carbon content of soil. Higher population of bacteria was observed with NEOC+CDM+EC @

Production of vermicompost for NPOF experiment using vermi bag

1/3 each (5.70 CFU/g) under rice-chickpea system, while EC+VC+FYM @ 1/3 each is found to be better for rice-wheat mustard system. Among the two cropping systems, rice-chickpea is better as it registered 41% higher bacterial population than rice-wheat system.

Calicut: Soil pH, organic carbon, N, P and K were observed for 4 yeas while micronutrients, fungi and bacteria are estimated for 3 years only. Pooled results of all the parameters indicates application of various sources of nutrients had significant influence on only organic carbon and Fe content of soil. Organic carbon content was found to be 10.5% higher with 30 t FYM application to ginger than control. Incorporation of 15 t FYM+2t neem cake +5t coir compost increased the organic carbon by 8.7% in turmeric than control. There is no significant variation in soil available N, P, K was observed among various combinations of nutrient source and also between turmeric and ginger. Fe content of soil was higher by 9.8% and 2.8% in ginger and turmeric respectively with the incorporation of 15 t FYM+2t neem cake + 4 t VC . Though there is no statistical significance in the count of fungi and bacteria was observed, application of 10 t coir compost + 8 t VC are found to record numerically higher bacterial count than other nutrient sources.

Dharwad: Soil bulk density, pH, micronutrients and microbial population except *azotobacter* were recorded for 3 years while EC was observed in 4 years. The other parameters such as OC, N,P, K are recorded for 5 years. Pooled data of all the parameters reveals that bulk density is higher in control (1.23 g cc^{-1}), where as organic carbon, available N and P were higher with application of EC+FYM+green leaf manures @ 3/8 each followed by FYM (¾) + green leaf manure (1/4) in groundnut-sorghum system. Higher available potassium of 372 kg ha^{-1} was observed with EC+VC+green leaf manure @ 3/8 each. Soybean-wheat system responded well with application of FYM (3/4) + green leaf manure (1/4) as it registered 22% higher organic carbon than control. In the same system available N was found to be higher with VC+FYM+green leaf manure @ 3/8 each. Around 376 kg of available K was observed with EC+FYM+green leaf manure @ 3/8 each. Chilli-cotton+onion system had also 22% higher organic carbon and 47% higher available P with incorporation of FYM (3/4) + green leaf manure (1/4) . Available N and K are found higher with the nutrient source combination of EC+VC+green leaf manure @ 3/8 each. In general different kind of nutrient sources are found to increase the micronutrient and microbial population in the soil. Chilli-cotton-onion had the higher residual Mn and Cu where as Zn and Fe are higher with groundnut-sorghum system. Irrespective of the cropping system, application of VC+FYM+green leaf manure @ 3/8 each recorded significantly higher count of fungi, bacteria and actinomycetes followed by EC+VC+ green leaf manure @ 3/8 each. The increase in count was to the level of 58, 86 and 16.6% for fungi, bacteria and actinomycetes respectively with the application of VC+FYM + green leaf manure over control. Among the cropping system groundnut – sorghum recorded higher count of bacteria (45.13 CFU/g) while soybean-wheat recorded higher fungi (24.17 CFU/g) count. Actinomycetes were higher with Chilli-cotton-onion system.

Karjat: Soil parameters such as pH, EC , OC, N, P and K were recorded for 3 years and pooled results are presented. Significant influence on soil parameters by various cropping system, nutrient sources and their interaction was observed. The initial content of organic carbon (0.65%) increased to 1.22% with the application of FYM+ Paddy straw + gliricidia green leaves @ 1/3 N each under rice-capsicum system and it raised to 1.18% with the same nutrient source under rice – cucumber system. On an average, the increase was observed to be 5.3% in FYM+ paddy straw + gliricida green leaf manuring over FYM + gliricidia green leaf manure alone. No significant difference in available N, P, K was observed among different nutrient sources and cropping system.

Ludhiana: Soil parameters such as pH, EC, organic carbon, available N, P, K and microbial count *viz*, fungi, bacteria and actinomycetes were observed for only one year in maize-gram and rice-wheat system. In both the cropping systems, application of green manure + FYM during *kharif* and FYM+crop residue during *rabi* are found to record higher organic carbon (0.63%), available nitrogen (274 kg ha^{-1}) and potassium (166 kg ha^{-1}) followed by green manure incorporation during *kharif* and FYM application during

rabi (0.57%, 274 kg ha^{-1} 153 kg ha^{-1} respectively). In maize-gram system, higher available P was observed in GM (*kharif*) + FYM (*rabi*) while it is better in GM+FYM+VC (*kharif*) and FYM+VC+crop residue (*rabi*) under rice-wheat system. Among the two systems, rice-wheat are found to be better for residual organic carbon and available N while maize-gram system recorded higher residual available P and K. Similarly, in maize-gram system, incorporation of green manure + Jeen amrit (JA) during *kharif* and FYM + Jeen amrit (JA) during *rabi* are found to increase 202% fungi count, 99% bacterial count and 39.2% *actinomycetes* count in soil over control. In rice-wheat system, incorporation of green manure during *kharif* and FYM during *rabi* gave 79%, 139, and 20.7% increase in fungi, bacteria and actinomycetes count in soil reflecting the usage of green manuring and FYM in improving microbial activity of soil thereby mineralization of nutrients.

Bajaura: Soil pH, organic carbon, available N, P and K along with micronutrients such as Mn, Zn, Cu and Fe were measured in cauliflower-pea/radish-tomato system for one year only and results indicates that soil were in slightly acidic condition with organic carbon ranging from 0.26 to 0.55%. The % increase in organic carbon was found to be higher (111 %) with reinforced FYM followed by reinforced FYM+VC. Available N, P and K increased by 68, 282 and 127% respectively over control with the application of reinforced FYM+ vermicompost. In case of micronutrients, Mn was found to be higher with FYM+VC and reinforced FYM while application of vermicompost alone recorded 256% increase in Zn content. Cu and Fe content were found to be higher with reinforced FYM (298%) and reinforced FYM+VC (159%).

Bhopal: Bulk density was estimated for 3 years while organic carbon, available N, P and K were observed for 5 years in two cropping systems namely soybean-wheat and soybean-mustard with four combinations of nutrient sources along with control. The pooled results indicates, no significant variation in bulk density. Organic carbon was estimated to be higher with application of CDM-CDM+VC+PM and CDM-CDM+PM. On an average, an increase of 37% organic carbon content in soil was observed with these sources than control. Available N, P and K also found to be higher with the nutrient source combination of CDM-CDM+VC+PM . Though not much variation in organic carbon, available P and K are found between two cropping system, soybean-mustard recorded higher available N (209 kg ha^{-1}) than soybean-wheat system (188 kg ha^{-1}).

Pantnagar: Bulk density, organic carbon, available P, K , Mn, Cu and Fe were measured for 2 years and available N was estimated for 3 years. Soil pH, EC and Zn were taken for one year only. The cumulative results of soil parameters indicates no significant variation in bulk density, pH, organic carbon, available N, P and micronutrients due to various combinations of nutrient sources. However, numerically higher organic carbon content was observed with EC+VC @ ½ each (0.93%) followed by FYM+VC @ ½ each (0.90%) in all the cropping systems. The % increase was found to be around 69% for EC+VC and 63% for FYM+VC over control under rice-wheat system. The same is 29.5% and 32% respectively with rice-chickpea system and 58.6% and 67% respectively with rice-vegetable pea system. Not much variation in soil available N, P , K were observed either among three systems or various nutrient sources and its interactions. Irrespective of the cropping systems, FYM+VC @ ½ each is found to be better in terms of micronutrients enrichment of soil as it registered 9.25 and 21.2% increase in Mn and Zn content in soil after the cropping cycle. Among the cropping system basmati rice-vegetable pea is found to be better in enriching the soil with micronutrient as it recorded higher Mn, Cu and Fe over the other systems.

Ranchi: Soil pH was measured in two years while organic carbon, available N, P and K were recorded for 3 years. Fungal and actinomycetes count was recorded for only 2 years in rice-wheat and rice-lentil/ potato system. The cumulative results reveals that VC+neem cake @ ½ each recorded higher organic carbon (0.49%), available N (289 kg ha^{-1}) and K (259 kg ha^{-1}) while available P was higher with FYM+ neem cake +VC @ 1/3 each under rice-wheat system. The same trend is also observed in rice-lentil/ potato system. Around 12% increase in organic carbon content of soil can be achieved with the application of EC+VC @ ½ each. FYM+neem cake +VC @ 1/3 each recorded 12.2% and 10.4% higher fungal and actinomycetes count than control.

Umiam: Two set of experiments with four inputs as nutrient sources and seven cropping systems were evaluated and observations on bulk density, soil pH and OC were recorded for 3 years in the first set of experiment while available N, P, K fungi, bacteria and actinomycetes were recorded for 2 years only. Micronutrients were tested for only one year. No significant variation in bulk density and pH were observed across the cropping system and various nutrient sources. In almost all the cropping systems evaluated, integrated application of FYM + vermicompost + local compost @ 1/3 each registered higher organic carbon, available N, P and K followed by FYM incorporation. On an average, the increase in organic carbon was 11.5% with integrated application and 6.8% with FYM over control. Among the various cropping systems evaluated, maize-soybean-french bean and maize+soybean–radish-potato recorded higher organic carbon (2.24%) , available N, (234 kg ha^{-1}). Though integrated application of organic sources recorded higher micronutrients such as Mn, Zn, Cu and Fe, it is not significantly higher with other sources. However, control registered lower micronutrient content in soil. On an average integrated application registered 64%, 271% and 5% increase in fungi, bacteria and actinomycetes respectively. Among the various cropping systems, maize+soybean-french bean and maize+soybean-radish-potato recorded higher soil microbial count indicating the better mineralization of soil nutrient in these systems leading to improvement in available nutrient status.

Table 9. Influence of source of nutrients on soil physical and chemical properties of soils after the cropping cycle at various locations (2004-05 to 2009-10)

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
1. Modipuram (mean of 2 years)								
Basmati rice - Wheat	NS1-EC + VC	-	7.65	0.24	0.55	169	33.30	202
	NS2- NEOC+VC	-	7.60	0.23	0.52	177	29.72	213
	NS3- EC + NEOC	-	7.35	0.25	0.53	197	31.25	217
	NS4- EC + VC + NEOC	-	7.55	0.26	0.60	193	33.25	218
	NS5-Control	-	7.70	0.26	0.46	159	21.37	158
	Mean	-	7.57	0.25	0.53	179	29.78	201
Basmati rice/Maize -	NS1-EC + VC	-	7.60	0.23	0.53	180	39.38	220
Potato - Onion	NS2- NEOC+VC	-	7.65	0.23	0.51	190	31.95	232
	NS3- EC + NEOC	-	7.55	0.25	0.51	211	36.70	237
	NS4- EC + VC + NEOC	-	7.65	0.25	0.58	207	38.68	239
	NS5-Control	-	7.60	0.25	0.45	169	24.44	171
	Mean	-	7.61	0.24	0.52	191	34.23	220
		SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	- -	0.028 NS	0.004 NS	0.008 NS	8.74 NS	3.15 NS	13.06 NS
	Method	- -	0.069 NS	0.009 NS	0.018 0.06	8.63 28.14	2.88 9.38	8.42 27.47
	Cropping X Method	- -	0.092 NS	0.012 NS	0.024 NS	13.98 NS	4.81 NS	16.86 NS
	Method X Cropping	- -	0.097 NS	0.012 NS	0.026 NS	12.20 NS	4.07 NS	11.91 NS
2. Jabalpur (mean of 4 years)					**Mean of 6 years**			
Basmati rice-wheat	NS1-FYM+VC(1/2+1/2)	1.39	7.08	0.48	0.72	272	12.40	293
	NS2-VC+Neem cake (1/2+1/2)	1.40	7.17	0.47	0.71	271	12.35	291
	NS3-FYM+Neem cake (1/2+1/2)	1.40	7.18	0.48	0.71	270	12.32	292

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
	NS4-FYM+Neem cake + VC (1/3 each)	1.40	7.12	0.47	0.72	275	12.33	290
	NS5-Control	1.39	7.20	0.47	0.68	264	12.35	292
	Mean	1.40	7.15	0.47	0.71	270	12.35	292
Basmati rice –	NS1-FYM+VC(1/2+1/2)	1.39	7.05	0.48	0.72	272	12.37	287
Berseem F/S	NS2-VC+Neem cake(1/2+1/2)	1.39	7.03	0.47	0.71	271	12.80	244
	NS3-FYM+Neem cake(1/2+1/2)	1.38	7.17	0.47	0.71	269	12.38	286
	NS4-FYM+Neem cake+VC (1/3+1/3+1/3)	1.39	7.23	0.48	0.73	279	12.70	293
	NS5-Control	1.40	7.17	0.48	0.69	262	12.17	287
	Mean	1.39	7.13	0.48	0.71	270	12.48	279
		SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	- -	0.020 NS	0.002 NS	0.008 NS	1.18 NS	0.09 NS	2.10 NS
	Method	- -	0.020 0.080	0.003 NS	0.005 0.014	1.80 5.14	0.10 NS	2.95 NS
	Cropping X Method	- -	0.041 NS	0.004 NS	0.007 NS	2.56 NS	0.15 NS	4.29 NS
	Method X Cropping	- -	0.040 NS	0.004 NS	0.007 NS	2.54 NS	0.13 NS	4.18 NS
3. Coimbatore					**2 years**	**4 years**	**mean of 3 years**	
Rice -Black gram-	NS1-EC	-	-	-	0.47	267	17.37	714
Sesame/GM	NS2-VC	-	-	-	0.46	271	17.47	710
	NS3-FYM+NEOC(1/2+1/2)	-	-	-	0.48	274	17.40	723
	NS4-EC+VC+FYM (1/3+1/3+1/3)	-	-	-	0.50	276	18.13	727
	NS5-Control	-	-	-	0.30	250	15.43	647
	Mean	-	-	-	0.44	268	17.16	704
Maize-Sunflower	NS1-EC	-	-	-	0.39	245	12.31	716
	NS2-VC	-	-	-	0.40	239	12.29	713

Cropping system	Source of nutrient	BD (g/cc)		pH		EC (dS/m)		OC (%)		N (kg/ha)		P (kg/ha)		K (kg/ha)	
	NS3-FYM+NEOC(1/2+1/2)	-		-		-		0.42		252		14.59		738	
	NS4-EC+VC+FYM (1/3+1/3+1/3)	-		-		-		0.42		244		12.69		731	
	NS5-Control	-		-		-		0.26		217		8.23		629	
	Mean	-		-		-		0.38		239		12.02		705	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	-	-	-	-	-	-	-	-	3.01	18.29	0.65	3.93	20.45	NS
	Method	-	-	-	-	-	-	-	-	2.74	8.20	0.19	0.56	6.59	19.75
	Cropping X Method	-	-	-	-	-	-	-	-	4.58	19.83	0.69	3.93	22.08	NS
	Method X Cropping	-	-	-	-	-	-	-	-	3.87	11.59	0.27	0.79	9.32	NS
4. Raipur (mean of 5 years)				**mean of 4 years**								**mean of 5 years**			
Rice - Chickpea	NS1-EC+CDM(1/2+1/2)	1.27		7.04		0.21		2.77		215		14.40		290	
	NS2-NEOC+CDM(1/2+1/2)	1.27		7.01		0.22		2.83		211		14.48		291	
	NS3-FYM+NEOC(1/2+1/2)	1.30		7.07		0.19		2.79		221		14.46		290	
	NS4-NEOC+CDM+EC (1/3+1/3+1/3)	1.25		7.03		0.21		2.84		226		15.06		302	
	NS5-Control	1.35		7.07		0.19		2.62		194		12.56		272	
	Mean	1.29		7.04		0.20		2.77		213		14.19		289	
Rice – Wheat /	NS1-EC+CDM(1/2+1/2)	1.27		6.96		0.20		2.72		215		15.06		294	
Mustard + Lentil *	NS2-VC	1.30		7.03		0.22		2.72		207		14.81		295	
(2009-10)	NS3-FYM+NEOC(1/2+1/2)	1.27		7.08		0.19		2.74		219		15.09		298	
	NS4-EC+VC+FYM (1/3+1/3+1/3)	1.29		7.07		0.20		2.79		234		16.34		308	
	NS5-Control	1.35		7.23		0.21		2.67		193		12.95		274	
	Mean	1.30		7.07		0.20		2.73		214		14.85		294	

Cropping system	Source of nutrient	BD (g/cc)		pH		EC (dS/m)		OC (%)		N (kg/ha)		P (kg/ha)		K (kg/ha)	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	0.005	NS	0.024	NS	0.006	NS	0.040	NS	2.29	NS	0.32	NS	3.44	NS
	Method	0.015	0.04	0.045	NS	0.008	NS	0.038	0.11	3.87	11.07	0.36	1.02	4.17	11.91
	Cropping X Method	0.019	NS	0.061	NS	0.011	NS	0.063	NS	5.41	NS	0.56	NS	6.30	NS
	Method X Cropping	0.021	NS	0.063	NS	0.011	NS	0.054	NS	5.48	NS	0.51	NS	5.89	NS
5. Calicut (mean of 4 years)															
Ginger	NS1-15 t FYM+2t Neem cake+4tVC	-		5.01		-		2.16		148		4.95		137	
	NS2-15 t FYM+2t Neem cake+5tCoir compost	-		5.07		-		2.11		150		5.60		150	
	NS3-10tCoir compost+8t VC	-		4.98		-		2.10		150		4.52		145	
	NS4-30tFYM	-		5.11		-		2.21		151		3.61		142	
	NS5-Control	-		4.93		-		2.00		147		2.10		130	
	Mean	-		5.02		-		2.12		149		4.16		141	
Turmeric	NS1-15 t FYM+2t Neem cake+4tVC	-		5.25		-		2.09		152		3.57		157	
	NS2-15 t FYM+2t Neem cake+5tCoir compost	-		5.29		-		2.24		149		3.37		162	
	NS3-10tCoir compost+8t VC	-		5.28		-		1.99		150		1.97		158	
	NS4-30tFYM	-		5.32		-		2.17		149		3.51		146	
	NS5-Control	-		5.34		-		2.06		142		2.56		133	
	Mean	-		5.29		-		2.11		148		3.00		151	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	-	-	0.21	NS	-	-	0.19	NS	31.82	NS	0.84	NS	13.43	NS
	Method	-	-	0.04	NS	-	-	0.03	0.10	2.40	NS	0.57	NS	5.79	NS
	Cropping X Method	-	-	0.21	NS	-	-	0.07	NS	10.45	NS	1.11	NS	15.30	NS
	Method X Cropping	-	-	0.06	NS	-	-	0.05	NS	3.39	NS	0.81	NS	8.19	NS

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
6. Dharwad		mean of 3 years		4 years		mean of 5 years		
Groundnut-Sorghum	NS1-EC(3/4)+Green leaf manure(1/4)	1.25	7.34	0.22	1.62	265	24.04	362
	NS2-VC(3/4)+Green leaf manure(1/4)	1.25	7.41	0.24	1.59	264	23.94	362
	NS3-FYM(3/4)+Green leaf manure(1/4)	1.23	7.30	0.21	1.66	263	23.77	363
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	1.24	7.37	0.20	1.62	271	24.07	372
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	1.24	7.33	0.18	1.66	268	24.01	366
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	1.23	7.39	0.21	1.61	266	23.26	364
	NS7-Control	1.27	7.38	0.23	1.34	235	16.44	314
	Mean	1.24	7.36	0.21	1.59	262	22.79	358
Soybean-Wheat	NS1-EC(3/4)+Green leaf manure(1/4)	1.23	7.36	0.20	1.62	264	24.18	371
	NS2-VC(3/4)+Green leaf manure(1/4)	1.23	7.28	0.22	1.60	264	24.28	367
	NS3-FYM(3/4)+Green leaf manure(1/4)	1.21	7.28	0.19	1.66	263	24.11	367
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	1.23	7.26	0.20	1.62	267	23.92	376
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	1.23	7.21	0.21	1.65	265	23.19	376
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	1.22	7.23	0.20	1.62	269	23.23	370
	NS7-Control	1.26	7.31	0.23	1.36	239	16.16	327
	Mean	1.23	7.28	0.21	1.59	262	22.73	365

Cropping system	Source of nutrient	BD (g/cc)		pH		EC (dS/m)		OC (%)		N (kg/ha)		P (kg/ha)		K (kg/ha)	
Chilli-Cotton-Onion	NS1-EC(3/4)+Green leaf manure(1/4)	1.23		7.27		0.20		1.67		266		24.40		370	
	NS2-VC(3/4)+Green leaf manure(1/4)	1.23		7.23		0.23		1.62		266		24.18		372	
	NS3-FYM(3/4)+Green leaf manure(1/4)	1.21		7.24		0.21		1.69		266		24.74		372	
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	1.23		7.30		0.20		1.66		272		23.98		376	
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	1.22		7.25		0.21		1.67		270		24.10		375	
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	1.22		7.27		0.20		1.63		271		23.56		373	
	NS7-Control	1.26		7.34		0.25		1.38		238		16.81		306	
	Mean	1.23		7.27		0.21		1.62		264		23.11		363	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	0.007	NS	0.04	NS	0.002	NS	0.012	NS	1.19	NS	0.09	0.30	4.37	NS
	Method	0.004	0.01	0.03	NS	0.009	0.02	0.043	0.12	2.34	6.59	0.72	2.03	5.54	15.62
	Cropping X Method	0.009	NS	0.07	NS	0.014	NS	0.070	NS	3.94	NS	1.16	NS	9.90	NS
	Method X Cropping	0.007	NS	0.05	NS	0.015	NS	0.075	NS	4.05	NS	1.25	NS	9.60	NS
7. Karjat (mean of 3 years)															
Rice -Capsicum/ Red pumpkin	K. -NS1-FYM10+Glyricidia green leaves 1.83t/ha (50:50%N) R.-NS1-FYM 20 t/ha (100% N)	-		6.59		0.40		1.21		231		14.38		362	
	KR. -NS2-FYM10+ Paddy straw 4.17t/ha (50:50%N)-FYM 75+ PS31.25kg/plot	-		6.72		0.41		1.16		208		17.86		329	

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
	KR. -NS3-FYM10+Neem Cake 2.5 t/ha(50:50%N)-FYM 75+NC18.75kg/plot	-	6.68	0.41	1.11	241	16.15	335
	KR: NS 4: FYM 6.7 + Paddy straw 3.8 + Glyricidia green leaves 1.2 t/ha (1/3 N each through FYM:PS:GLY) (50 + 20.83 + 9.12 kg/plot)	-	6.67	0.45	1.22	216	17.09	347
	NS5-Control	-	6.65	0.38	1.20	214	14.00	297
	Mean	-	6.66	0.41	1.18	222	15.90	334
Rice - Cucumber	KR. -NS1-FYM10+Glyricidia green leaves 1.83t/ha (50:50%N)-FYM 75+ Gly 1.69kg/plot	-	6.63	0.33	1.07	208	16.22	338
	KR. -NS2-FYM10+Paddy straw 4.17t/ha(50:50%N)-FYM 75+PS31.25kg/plot KR. -NS3-FYM10+Neem Cake 2.5 t/ha(50:50%N)-FYM 75+NC18.75kg/plot	-	6.72	0.40	1.03	191	14.56	347
	KR: NS 4: FYM 6.7 + Paddy straw 3.8 + Glyricidia green leaves 1.2 t/ha (1/3 N each through FYM:PS:GLY) (50 + 20.83 + 9.12 kg/plot)	-	6.71	0.42	1.18	218	15.28	314
	NS5-Control	-	6.71	0.36	1.23	233	17.00	371
	Mean	-	6.61	0.43	0.95	203	14.93	294
		-	6.68	0.39	1.09	210	15.60	333

	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
Cropping	-	-	0.009	NS	0.015	NS	0.045	NS	3.21	NS	0.46	NS	9.16	NS
Method	-	-	0.040	NS	0.026	NS	0.044	NS	7.93	NS	0.60	NS	17.34	NS
Cropping X Method	-	-	0.052	NS	0.036	NS	0.071	NS	10.53	NS	0.88	NS	23.77	NS
Method X Cropping	-	-	0.057	NS	0.036	NS	0.062	NS	11.22	NS	0.84	NS	24.52	NS

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
8. Ludhiana (mean of 1 year)								
Maize -Gram	K.-NS1-GM+FYM R.-NS1-FYM+Crop residue	7.40	0.20	0.63	274	60.98	166	
	K.-NS2-GM + Jeen Amrit (JA) R.-NS2-FYM+JA	7.47	0.18	0.48	268	62.63	161	
	K.-NS3GM+-FYM+VC R.-NS3-FYM+VC+Crop residue	7.42	0.17	0.50	260	61.43	140	
	K.-NS4-GM R.-NS4-FYM	7.43	0.19	0.57	274	65.15	153	
	NS5-Control	7.63	0.19	0.35	195	35.14	105	
	Mean	7.47	0.19	0.51	254	57.07	145	
Rice - Wheat	K.-NS1-GM+FYM R.-NS1-FYM+Crop residue	-	7.64	0.25	0.61	378	62.00	103
	K.-NS2-GM + Jeen Amrit (JA) R.-NS2-FYM+JA	-	7.61	0.31	0.61	403	61.20	127
	K.-NS3GM+-FYM+VC R.-NS3-FYM+VC+Crop residue	-	7.69	0.28	0.59	403	63.30	106
	K.-NS4-GM R.-NS4-FYM	-	7.45	0.19	0.56	276	57.31	117
	NS5-Control	-	7.59	0.21	0.37	199	31.76	94
	Mean	-	7.60	0.25	0.55	332	55.11	109
		SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	- -	0.05 0.14	0.01 0.04	0.03 0.10	10.20 30.58	2.60 7.78	6.21 18.60
9. Bajura (mean of 1 year)								
Cauliflower - Pea/	NS1-VC	-	5.10	-	0.40	170	33.70	160
Radish*(2006-07) -	NS2-FYM(RF)	-	5.20	-	0.55	176	35.70	178
Tomato	NS3-FYM+VC	-	5.10	-	0.46	183	38.90	184
	NS4-FYM(RF)+VC	-	5.20	-	0.47	200	55.50	198
	NS5-Control	-	5.50	-	0.26	119	14.50	87
	Mean	-	5.22	-	0.43	170	35.66	161

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
10. Bhopal (mean of 3 years)						mean of 5 years		
Soybean - D.Wheat	NS1-CDM-CDM+PM	1.25	-	-	0.70	197	27.96	591
	NS2-CDM-CDM+VC	1.25	-	-	0.66	187	23.49	593
	NS3-CDM-PM+VC	1.25	-	-	0.68	195	27.47	606
	NS4-CDM-CDM+VC+PM	1.26	-	-	0.70	198	29.19	603
	NS5-Control	1.28	-	-	0.50	162	11.87	528
	Mean	1.26	-	-	0.65	188	24.00	584
Soybean - Mustard	NS1-CDM-CDM+PM	-	-	-	0.70	216	33.69	579
	NS2-CDM-CDM+VC	-	-	-	0.63	206	23.27	576
	NS3-CDM-PM+VC	-	-	-	0.70	219	31.92	600
	NS4-CDM-CDM+VC+PM	-	-	-	0.71	220	32.89	592
	NS5-Control	-	-	-	0.51	182	11.43	531
	Mean	-	-	-	0.65	209	26.64	576
11. Pantnagar		2 years	mean of 1 year		2 years	3 years	mean of 2 years	
B.Rice-Wheat	NS1EC+VC(1/2+1/2)	1.37	6.74	0.49	0.93	229	31.90	103
	NS2-NEOC+VC(1/2+1/2)	1.37	6.87	0.18	0.86	217	20.99	99
	NS3-FYM+VC(1/2+1/2)	1.37	6.54	0.18	0.90	239	25.26	116
	NS 4: EC+VC_NEOC+FYM ((1/4+1/4+1/4+1/4)	1.40	6.32	1.38	0.81	244	25.97	109
	NS5-Control	1.38	6.83	0.16	0.55	212	33.51	96
	Mean	1.38	6.66	0.48	0.81	228	27.52	105
B.Rice - Chickpea	NS1EC+VC(1/2+1/2)	1.37	6.89	0.16	0.92	257	34.35	99
	NS2-NEOC+VC(1/2+1/2)	1.36	6.78	0.14	0.96	257	26.39	100
	NS3-FYM+VC(1/2+1/2)	1.38	6.68	0.30	0.94	247	28.59	107

Cropping system	Source of nutrient	BD (g/cc)		pH		EC (dS/m)		OC (%)		N (kg/ha)		P (kg/ha)		K (kg/ha)	
	NS 4: EC+VC_NEOC+FYM ((1/4+1/4+1/4+1/4)	1.38		6.93		0.14		1.07		263		25.72		97	
	NS5-Control	1.37		6.89		0.17		0.71		232		28.49		92	
	Mean	1.37		6.83		0.18		0.92		251		28.71		99	
B.Rice - Veg.Pea	NS1EC+VC(1/2+1/2)	1.39		6.70		0.17		0.92		225		26.95		100	
	NS2-NEOC+VC(1/2+1/2)	1.36		6.84		0.17		0.79		246		29.33		96	
	NS3-FYM+VC(1/2+1/2)	1.36		6.98		0.22		0.97		243		27.39		115	
	NS 4: EC+VC_NEOC+FYM ((1/4+1/4+1/4+1/4)	1.37		6.88		0.17		0.93		225		27.36		100	
	NS5-Control	1.36		6.67		0.17		0.58		217		27.13		96	
	Mean	1.37		6.81		0.18		0.83		231		27.63		101	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	0.005	NS	-	-	0.015	NS	-	-	4.79	18.81	0.08	0.31	2.25	NS
	Method	0.005	NS	-	-	0.036	0.104	-	-	6.13	NS	2.28	NS	2.73	7.96
	Cropping X Method	0.009	NS	-	-	0.057	NS	-	-	10.64	NS	3.53	NS	4.79	NS
	Method X Cropping	0.008	NS	-	-	0.062	NS	-	-	10.62	NS	3.94	NS	4.73	NS
12. Ranchi				**2 years**						**mean of 3 years**					
Rice - Wheat	NS1-FYM+VC(1/2+1/2)	-		5.61		-		0.47		283		46.91		258	
	NS2-FYM+Neem cake (1/2+1/2)	-		5.58		-		0.46		284		41.95		249	
	NS3-VC+Neem cake (1/2+1/2)	-		5.56		-		0.49		289		43.72		259	
	NS4-FYM+Neem cake+ VC(1/3+1/3+1/3)	-		5.55		-		0.48		281		49.02		257	
	NS5-Control	-		5.48		-		0.44		262		39.52		230	
	Mean	-		5.55		-		0.47		280		44.22		251	

Cropping system	Source of nutrient	BD (g/cc)		pH		EC (dS/m)		OC (%)		N (kg/ha)		P (kg/ha)		K (kg/ha)	
Rice - Lentil/Potato*	NS1-FYM+VC(1/2+1/2)	-		5.61		-		0.47		280		44.24		251	
(2009-10)	NS2-FYM+Neem cake(1/2+1/2)	-		5.58		-		0.46		281		41.61		250	
	NS3-VC+Neem cake(1/2+1/2)	-		5.56		-		0.49		311		41.39		255	
	NS4-FYM+Neem cake+VC (1/3+1/3+1/3)	-		5.55		-		0.49		281		44.35		255	
	NS5-Control	-		5.48		-		0.45		262		39.52		231	
	Mean	-		5.55		-		0.47		283		42.22		248	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	-	-	-	-	-	-	-	-	16.40	NS	-	-	-	-
	Method	-	-	-	-	-	-	-	-	29.34	NS	-	-	7.10	NS
	Cropping X Method	-	-	-	-	-	-	-	-	40.58	NS	-	-	8.99	NS
	Method X Cropping	-	-	-	-	-	-	-	-	41.50	NS	-	-	10.05	NS
13. Umiam I		**mean 3 years**						**3 years**				**mean of 2 years**			
Rice +Soybean-Mustard	FYM	1.06		5.11		-		2.05		234		17.47		227	
	Vermicompost	1.06		5.08		-		2.00		230		15.36		221	
	Local compost	1.08		4.89		-		1.96		226		14.81		215	
	Integrated	1.06		5.15		-		2.14		240		17.71		225	
	Control	1.09		4.84		-		1.92		219		13.09		213	
	Mean	1.07		5.02		-		2.01		230		15.68		220	
Rice +Soybean-Tomato	FYM	1.04		5.11		-		2.23		232		18.79		240	
	Vermicompost	1.05		5.07		-		2.17		227		16.09		235	
	Local compost	1.07		4.92		-		2.03		222		15.92		229	
	Integrated	1.08		5.15		-		2.27		237		20.27		243	
	Control	1.13		4.96		-		2.01		215		13.40		228	
	Mean	1.08		5.04		-		2.14		227		16.89		235	

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
Maize +Soybean-	FYM	1.07	5.28	-	2.12	239	17.03	228
Groundnut	Vermicompost	1.05	5.24	-	2.04	232	16.22	222
	Local compost	1.09	5.15	-	2.02	227	15.75	218
	Integrated	1.08	5.27	-	2.22	242	19.04	232
	Control	1.09	4.97	-	1.97	215	12.67	216
	Mean	1.07	5.18	-	2.07	231	16.14	223
Maize +Soybean-	FYM	1.03	5.27	-	2.34	243	21.45	246
French bean	Vermicompost	1.04	5.19	-	2.21	234	19.01	239
	Local compost	1.05	5.12	-	2.17	228	18.64	234
	Integrated	1.03	5.32	-	2.36	245	22.19	250
	Control	1.06	5.01	-	2.12	226	15.39	232
	Mean	1.04	5.18	-	2.24	235	19.34	240
		SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	0.008 NS	0.102 NS	- -	0.020 0.07	3.58 NS	0.49 1.70	7.65 NS
	Method	0.011 NS	0.062 0.18	- -	0.051 0.15	4.54 13.08	1.21 3.45	3.38 9.75
	Cropping X Method	0.021 NS	0.151 NS	- -	0.093 NS	8.88 NS	2.22 NS	9.75 NS
	Method X Cropping	0.022 NS	0.124 NS	- -	0.101 NS	9.08 NS	2.42 NS	6.77 NS
Umiam II		mean of 3 years			3 years		mean of 2 years	
Maize +Soybean-	FYM	1.15	5.04	-	2.11	240	33.25	242
French bean-Tomato	Vermicompost	1.12	4.99	-	2.07	239	30.60	240
	Integrated	1.11	5.06	-	2.15	242	33.55	244
	Control	1.13	4.94	-	2.08	235	28.17	231
	Mean	1.13	5.01	-	2.10	239	31.39	239

Cropping system	Source of nutrient	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
Maize +Soybean-	FYM	1.14	5.05	-	2.30	241	32.39	209
Radish-Potato	Vermicompost	1.14	5.00	-	2.27	233	30.20	205
	Integrated	1.14	5.08	-	2.25	238	32.42	213
	Control	1.17	4.98	-	2.15	225	28.67	200
	Mean	1.15	5.03	-	2.24	234	30.92	207
Maize +Soybean-	FYM	1.20	5.11	-	2.30	243	29.02	210
French bean-Carrot	Vermicompost	1.18	5.09	-	2.27	241	27.50	207
	Integrated	1.21	5.08	-	2.24	244	29.57	215
	Control	1.20	5.06	-	2.10	234	24.67	201
	Mean	1.20	5.09	-	2.23	241	27.69	208

K : *Kharif*, R : *Rabi*

Table 10. Influence of source of nutrients on soil micro nutrients (ppm) and microbial count (x 10^4 CFU/g) after the cropping cycle at various locations (2004-05 to 2009-10)

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Azb	Fungi	Bacteria	Actinomy-cetes
1. Modipuram (mean of 1 year)									
Basmati rice-Wheat	NS1-EC + VC	3.06	0.94	2.06	5.90	-	-	-	-
	NS2- NEOC+VC	3.70	0.95	2.16	7.15	-	-	-	-
	NS3- EC + NEOC	3.97	0.96	2.29	7.66	-	-	-	-
	NS4- EC + VC + NEOC	4.91	0.99	2.55	9.49	-	-	-	-
	NS5-Control	1.35	0.51	1.68	2.60	-	-	-	-
	Mean	3.40	0.87	2.15	6.56	-	-	-	-
Basmati rice/Maize-	NS1-EC + VC	4.25	1.27	2.48	8.85	-	-	-	-
Potato-Onion	NS2- NEOC+VC	5.15	1.29	2.59	10.72	-	-	-	-
	NS3- EC + NEOC	5.51	1.30	2.75	11.49	-	-	-	-
	NS4- EC + VC + NEOC	6.83	1.33	3.06	14.23	-	-	-	-
	NS5-Control	1.87	0.57	1.38	3.89	-	-	-	-
	Mean	4.72	1.15	2.45	9.84	-	-	-	-
2. Jabalpur (mean of 5 years)									
Basmati rice-Wheat	NS1-FYM+VC(1/2+1/2)	-	-	-	-	28.62	44.34	53.86	13.52
	NS2-VC+Neem cake (1/2+1/2)	-	-	-	-	29.76	44.12	48.20	13.24
	NS3-FYM+Neem cake (1/2+1/2)	-	-	-	-	29.68	43.76	55.20	13.00
	NS4-FYM+Neem cake+ VC(1/3+1/3+1/3)	-	-	-	-	30.38	45.80	54.32	12.90
	NS5-Control	-	-	-	-	19.62	40.28	49.92	10.46
	Mean	-	-	-	-	27.61	43.66	52.30	12.62

Cropping system	Source of nutrient	Mn		Zn		Cu		Fe		Azb		Fungi		Bacteria		Actinomy-cetes	
Basmati rice –	NS1-FYM+VC(1/2+1/2)	-		-		-		-		29.68		44.44		54.96		13.04	
	NS2-VC+Neem cake (1/2+1/2)	-		-		-		-		28.84		44.26		54.82		12.88	
	NS3-FYM+Neem cake (1/2+1/2)	-		-		-		-		28.92		44.06		54.52		12.36	
	NS4-FYM+Neem cake+ VC(1/3+1/3+1/3)	-		-		-		-		29.42		46.06		54.42		13.30	
	NS5-Control	-		-		-		-		21.94		40.92		50.32		11.56	
	Mean	-		-		-		-		27.76		43.95		53.81		12.63	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	-	-	-	-	-	-	-	-	0.1	NS	0.10	NS	0.36	1.2	0.04	NS
	Method	-	-	-	-	-	-	-	-	0.7	2.2	0.41	1.7	0.71	2.0	0.21	0.6
	Cropping X Method	-	-	-	-	-	-	-	-	0.9	NS	0.53	NS	0.96	2.8	0.27	0.7
	Method X Cropping	-	-	-	-	-	-	-	-	1.0	NS	0.58	NS	1.00	2.8	0.30	0.8
3. Coimbatore (mean of 3 years)																	
Rice-Blackgram-	NS1-EC	7.99		5.49		3.34		20.83		-		-		-		-	
Sesame/GM	NS2-VC	7.88		5.60		3.42		20.55		-		-		-		-	
	NS3-FYM+NEOC(1/2+1/2)	8.05		6.01		3.65		21.56		-		-		-		-	
	NS4-EC+VC+FYM (1/3+1/3+1/3)	8.01		6.40		4.34		21.86		-		-		-		-	
	NS5-Control	6.88		4.14		2.67		18.10		-		-		-		-	
	Mean	7.76		5.53		3.48		20.58		-		-		-		-	
Maize-Sunflower	NS1-EC	8.78		9.86		2.80		25.39		-		-		-		-	
	NS2-VC	8.75		9.85		2.72		26.10		-		-		-		-	
	NS3-FYM+NEOC(1/2+1/2)	9.26		11.08		3.34		27.27		-		-		-		-	

Cropping system	Source of nutrient	Mn		Zn		Cu		Fe		Azb		Fungi		Bacteria		Actinomy-cetes	
	NS4-EC+VC+FYM (1/3+1/3+1/3)	8.83		10.37		2.89		26.22		-		-		-		-	
	NS5-Control	4.31		4.91		2.23		16.84		-		-		-		-	
	Mean	7.98		9.21		2.80		24.36		-		-		-		-	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	0.59	NS	0.67	NS	0.29	NS	1.39	NS	-	-	-	-	-	-	-	-
	Method	0.17	0.49	0.16	0.48	0.15	0.46	0.44	1.3	-	-	-	-	-	-	-	-
	Cropping X Method	0.63	3.60	0.70	4.05	0.35	NS	1.50	8.4	-	-	-	-	-	-	-	-
	Method X Cropping	0.24	0.71	0.23	0.67	0.23	NS	0.63	1.8	-	-	-	-	-	-	-	-
4. Raipur (mean of 5 years)																	
Rice - Chickpea	NS1-EC+CDM(1/2+1/2)	-		-		-		-		-		-		4.21		-	
	NS2-NEOC+CDM(1/2+1/2)	-		-		-		-		-		-		3.81		-	
	NS3-FYM+NEOC(1/2+1/2)	-		-		-		-		-		-		4.66		-	
	NS4-NEOC+CDM+EC (1/3+1/3+1/3)	-		-		-		-		-		-		5.70		-	
	NS5-Control	-		-		-		-		-		-		2.28		-	
	Mean	-		-		-		-		-		-		4.13		-	
Rice – Wheat /	NS1-EC+CDM(1/2+1/2)	-		-		-		-		-		-		3.31		-	
Mustard + Lentil*	NS2-VC	-		-		-		-		-		-		2.76		-	
(2009-10)	NS3-FYM+NEOC(1/2+1/2)	-		-		-		-		-		-		2.83		-	
	NS4-EC+VC+FYM (1/3+1/3+1/3)	-		-		-		-		-		-		4.04		-	
	NS5-Control	-		-		-		-		-		-		1.70		-	
	Mean	-		-		-		-		-		-		2.93		-	

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Azb	Fungi	Bacteria	Actinomy-cetes
								SEm± CD	
	Cropping	-	-	-	-	-	-	0.25 0.92	-
	Method	-	-	-	-	-	-	0.25 0.72	-
	Cropping X Method	-	-	-	-	-	-	0.41 NS	-
	Method X Cropping	-	-	-	-	-	-	0.35 NS	-
5. Calicut (mean of 3 years)									
Ginger	NS1-15 t FYM+2t Neem cake+4tVC	11.98	1.57	11.16	50.73	-	6.77	30.87	-
	NS2-15 t FYM+2t Neem cake+5tCoir compost	12.60	2.04	11.40	45.70	-	7.07	36.37	-
	NS3-10tCoir compost+ 8t VC	11.21	1.28	10.28	49.70	-	9.63	34.40	-
	NS4-30tFYM	12.26	1.37	11.72	46.23	-	8.03	35.17	-
	NS5-Control	10.02	1.55	10.86	46.20	-	12.23	23.00	-
	Mean	11.61	1.56	11.08	47.71	-	8.75	31.96	-
Turmeric	NS1-15 t FYM+2t Neem cake+4tVC	10.62	1.42	4.11	51.00	-	8.47	40.33	-
	NS2-15 t FYM+2t Neem cake+5tCoir compost	12.15	1.86	2.80	45.90	-	9.00	31.23	-
	NS3-10tCoir compost+ 8t VC	9.21	1.86	2.58	49.84	-	7.87	53.10	-
	NS4-30tFYM	10.27	1.73	3.49	43.40	-	5.67	41.67	-
	NS5-Control	9.93	1.51	3.51	49.60	-	9.83	41.70	-
	Mean	10.43	1.68	3.30	47.95	-	8.17	41.61	-
		SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	1.61 NS	0.13 NS	5.5 NS	0.9 NS	- -	0.31 NS	6.32 NS	- -
	Method	0.91 NS	0.19 NS	0.4 NS	1.5 4.53	- -	1.35 NS	5.58 NS	- -
	Cropping X Method	1.98 NS	0.28 NS	5.5 NS	2.1 NS	- -	1.74 NS	9.48 NS	- -
	Method X Cropping	1.29 NS	0.27 NS	0.6 NS	2.2 NS	- -	1.91 NS	7.89 NS	- -

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Azb	Fungi	Bacteria	Actinomy-cetes
6. Dharwad (mean of 3 years)									
Groundnut-Sorghum	NS1-EC(3/4)+Green leaf manure(1/4)	9.58	1.06	1.40	8.56	-	28.21	43.11	22.55
	NS2-VC(3/4)+Green leaf manure(1/4)	9.14	1.10	1.40	9.00	-	21.54	40.98	18.98
	NS3-FYM(3/4)+Green leaf manure(1/4)	9.42	1.28	1.58	8.33	-	23.22	42.89	20.87
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	10.16	1.25	1.41	9.41	-	28.98	55.78	24.21
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	9.27	1.22	1.35	9.03	-	19.21	47.98	19.87
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	9.10	1.22	1.43	8.82	-	26.56	55.44	18.66
	NS7-Control	8.34	0.96	1.45	7.41	-	16.75	29.77	16.00
	Mean	9.29	1.16	1.43	8.65	-	23.50	45.13	20.16
Soybean-Wheat	NS1-EC(3/4)+Green leaf manure(1/4)	11.79	1.12	1.54	8.35	-	20.66	38.50	10.19
	NS2-VC(3/4)+Green leaf manure(1/4)	11.42	1.17	1.63	8.47	-	23.77	34.73	12.99
	NS3-FYM(3/4)+Green leaf manure(1/4)	11.39	1.23	1.61	8.17	-	26.07	40.74	23.58
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	13.76	1.24	1.66	8.50	-	29.08	40.75	14.69
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	13.44	1.24	1.62	7.55	-	30.41	50.07	26.22
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	12.56	1.13	1.61	7.49	-	27.38	52.49	28.29
	NS7-Control	9.90	0.85	1.38	6.21	-	11.81	27.32	15.08
	Mean	12.04	1.14	1.58	7.82	-	24.17	40.66	18.72

Cropping system	Source of nutrient	Mn		Zn		Cu		Fe		Azb		Fungi		Bacteria		Actinomy-cetes	
Chilli-Cotton-Onion	NS1-EC(3/4)+Green leaf manure(1/4)	12.49		1.19		1.81		7.77		-		17.00		41.84		20.17	
	NS2-VC(3/4)+Green leaf manure(1/4)	12.14		1.10		1.83		7.96		-		19.00		37.17		19.50	
	NS3-FYM(3/4)+Green leaf manure(1/4)	12.67		1.26		1.87		8.17		-		20.17		43.00		21.50	
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	13.88		1.23		1.77		8.68		-		23.67		57.00		30.84	
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	13.05		1.18		1.78		7.78		-		23.00		43.67		25.17	
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	12.42		1.13		1.71		8.14		-		27.50		42.34		26.67	
	NS7-Control	9.76		0.90		1.39		6.68		-		11.67		29.67		15.50	
	Mean	12.35		1.14		1.74		7.88		-		20.29		42.10		22.76	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	0.95	NS	0.011	NS	0.070	NS	0.27	NS	-	-	0.88	NS	-	-	0.88	NS
	Method	0.36	1.01	0.044	0.12	0.074	NS	0.23	0.6	-	-	2.09	6.11	-	-	1.53	NS
	Cropping X Method	1.11	NS	0.072	NS	0.137	NS	0.45	NS	-	-	2.88	NS	-	-	2.19	NS
	Method X Cropping	0.62	NS	0.076	NS	0.128	NS	0.39	NS	-	-	2.96	NS	-	-	2.96	NS
7. Ludhiana I (mean of 1 year)																	
Maize -Gram	K.-NS1-GM+FYM R.-NS1-FYM+Crop residue	-		-		-		-		-		41.40		26.35		151.30	
	K.-NS2-GM + Jeen Amrit (JA) R.-NS2-FYM+JA	-		-		-		-		-		81.20		40.25		164.60	
	K.-NS3GM+-FYM+VC R.-NS3-FYM+VC+Crop residue	-		-		-		-		-		43.30		28.00		138.50	
	K.-NS4-GM R.-NS4-FYM	-		-		-		-		-		34.20		29.55		114.20	
	NS5-Control	-		-		-		-		-		26.80		20.20		118.20	
	Mean	-		-		-		-		-		45.38		28.87		137.36	

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Azb	Fungi	Bacteria	Actinomy-cetes
Rice - Wheat	K.-NS1-GM+FYM R.-NS1-FYM+Crop residue	-	-	-	-	-	-	-	-
	K.-NS2-GM + Jeen Amrit (JA) R.-NS2-FYM+JA	-	-	-	-	-	-	-	-
	K.-NS3GM+-FYM+VC R.-NS3-FYM+VC+Crop residue	-	-	-	-	-	-	-	-
	K.-NS4-GM R.-NS4-FYM	-	-	-	-	-	79.30	24.65	181.40
	NS5-Control	-	-	-	-	-	44.30	10.30	150.30
	Mean	-	-	-	-	-	-	-	-
8. Bajura (mean of 1 year)									
Cauliflower – Pea /	NS1-VC	24.70	1.82	1.53	65.80	-	-	-	-
Radish*(2006-07) -	NS2-FYM(RF)	26.10	1.78	1.59	67.50	-	-	-	-
Tomato	NS3-FYM+VC	26.10	1.75	1.57	67.60	-	-	-	-
	NS4-FYM(RF)+VC	25.90	1.80	1.55	69.40	-	-	-	-
	NS5-Control	9.70	0.51	0.40	26.80	-	-	-	-
	Mean	22.50	1.53	1.33	59.42	-	-	-	-
9. Pantnagar		**2 years**	**1 year**	**2 years**					
B.Rice-Wheat	NS1EC+VC(1/2+1/2)	7.11	0.63	6.07	29.71	-	-	-	-
	NS2-NEOC+VC(1/2+1/2)	7.66	0.54	7.71	30.61	-	-	-	-
	NS3-FYM+VC(1/2+1/2)	7.59	0.57	6.25	31.23	-	-	-	-
	NS4-EC+VC+NEOC+FYM (1/4+1/4+1/4+1/4)	7.43	0.53	6.09	28.55	-	-	-	-
	NS5-Control	6.95	0.47	7.11	30.95	-	-	-	-
	Mean	7.35	0.55	6.65	30.21	-	-	-	-
B.Rice - Chickpea	NS1EC+VC(1/2+1/2)	7.75	0.66	7.58	32.97	-	-	-	-
	NS2-NEOC+VC(1/2+1/2)	7.75	0.61	6.62	32.01	-	-	-	-
	NS3-FYM+VC(1/2+1/2)	8.05	0.64	7.77	29.28	-	-	-	-

Cropping system	Source of nutrient	Mn		Zn		Cu		Fe		Azb		Fungi		Bacteria		Actinomy-cetes	
	NS4-EC+VC+NEOC+ FYM(1/4+1/4+1/4+1/4)	8.05		0.62		6.79		31.41		-		-		-		-	
	NS5-Control	7.20		0.61		6.94		31.35		-		-		-		-	
	Mean	7.76		0.63		7.14		31.40		-		-		-		-	
B.Rice - Veg.Pea	NS1EC+VC(1/2+1/2)	9.18		0.62		7.73		33.68		-		-		-		-	
	NS2-NEOC+VC(1/2+1/2)	8.25		0.63		6.76		30.54		-		-		-		-	
	NS3-FYM+VC(1/2+1/2)	9.02		0.62		9.22		32.10		-		-		-		-	
	NS4-EC+VC+NEOC+ FYM(1/4+1/4+1/4+1/4)	8.92		0.63		9.04		32.49		-		-		-		-	
	NS5-Control	7.86		0.62		7.92		32.25		-		-		-		-	
	Mean	8.64		0.62		8.13		32.21		-		-		-		-	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	0.36	NS	-	-	0.93	NS	0.98	NS	-	-	-	-	-	-	-	-
	Method	0.23	NS	-	-	0.41	NS	1.08	NS	-	-	-	-	-	-	-	-
	Cropping X Method	0.51	NS	-	-	1.12	NS	1.93	NS	-	-	-	-	-	-	-	-
	Method X Cropping	0.40	NS	-	-	0.71	NS	1.86	NS	-	-	-	-	-	-	-	-
10. Ranchi (mean of 2 year)																	
Rice - Wheat	NS1-FYM+VC(1/2+1/2)	-		-		-		-		-		78.06		-		84.22	
	NS2-FYM+Neem cake (1/2+1/2)	-		-		-		-		-		75.94		-		81.83	
	NS3-VC+Neem cake (1/2+1/2)	-		-		-		-		-		78.12		-		84.08	
	NS4-FYM+Neem cake+ VC(1/3+1/3+1/3)	-		-		-		-		-		79.78		-		85.12	
	NS5-Control	-		-		-		-		-		71.11		-		77.11	
	Mean	-		-		-		-		-		76.60		-		82.47	

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Azb	Fungi	Bacteria	Actinomy-cetes
Rice - Lentil/Potato*	NS1-FYM+VC(1/2+1/2)	-	-	-	-	-	78.63	-	81.73
(2009-10)	NS2-FYM+Neem cake (1/2+1/2)	-	-	-	-	-	79.02	-	81.71
	NS3-VC+Neem cake (1/2+1/2)	-	-	-	-	-	80.80	-	82.11
	NS4-FYM+Neem cake+ VC(1/3+1/3+1/3)	-	-	-	-	-	80.75	-	83.94
	NS5-Control	-	-	-	-	-	72.64	-	76.17
	Mean	-	-	-	-	-	78.37	-	81.13
							SEm± CD		SEm± CD
	Cropping	- -	- -	- -	- -	- -	0.97 NS	- -	0.38 NS
	Method	- -	- -	- -	- -	- -	3.23 NS	- -	3.44 NS
	Cropping X Method	- -	- -	- -	- -	- -	4.20 NS	- -	4.37 NS
	Method X Cropping	- -	- -	- -	- -	- -	4.57 NS	- -	4.86 NS
11. Umiam I		mean of 1 year					mean of 2 years		
Rice +Soybean-Mustard	FYM	2.76	0.67	1.48	158.93	-	34.60	188.20	20.50
	Vermicompost	2.76	0.67	1.48	158.93	-	29.80	110.50	25.00
	Local compost	2.76	0.67	1.48	158.93	-	35.50	60.25	16.45
	Integrated	2.76	0.67	1.48	158.93	-	37.00	187.50	15.90
	Control	2.76	0.67	1.48	158.93	-	28.15	50.60	15.15
	Mean	2.76	0.67	1.48	158.93	-	33.01	119.41	18.60
Rice +Soybean-Tomato	FYM	3.00	0.70	1.56	160.00	-	42.80	177.15	25.20
	Vermicompost	3.00	0.70	1.56	160.00	-	35.95	149.50	25.55
	Local compost	3.00	0.70	1.56	160.00	-	41.15	71.35	18.00
	Integrated	3.00	0.70	1.56	160.00	-	46.10	182.25	24.40
	Control	3.00	0.70	1.56	160.00	-	28.05	49.00	23.30
	Mean	3.00	0.70	1.56	160.00	-	38.81	125.85	23.29

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Azb	Fungi	Bacteria	Actinomy-cetes
Maize +Soybean-G.Nut	FYM	3.32	0.75	1.58	168.47	-	22.10	168.90	19.00
	Vermicompost	3.32	0.75	1.58	168.47	-	38.20	122.40	17.05
	Local compost	3.32	0.75	1.58	168.47	-	21.70	79.40	16.25
	Integrated	3.32	0.75	1.58	168.47	-	36.70	128.15	36.95
	Control	3.32	0.75	1.58	168.47	-	36.90	66.70	38.25
	Mean	3.32	0.75	1.58	168.47	-	31.12	113.11	25.50
Maize +Soybean-	FYM	3.54	0.77	1.56	173.40	-	41.50	198.15	30.25
French bean	Vermicompost	3.54	0.77	1.56	173.40	-	42.00	129.00	26.80
	Local compost	3.54	0.77	1.56	173.40	-	47.75	102.75	22.70
	Integrated	3.54	0.77	1.56	173.40	-	41.95	194.65	31.05
	Control	3.54	0.77	1.56	173.40	-	36.40	93.15	11.70
	Mean	3.54	0.77	1.56	173.40	-	41.92	143.54	24.50
		SEm± CD	SEm± CD	SEm± CD	SEm± CD		SEm± CD	SEm± CD	SEm± CD
	Cropping	- -	- -	- -	- -	-	3.45 NS	4.66 NS	1.32 NS
	Method	- -	- -	- -	- -	-	1.89 NS	3.80 10.9	3.21 NS
	Cropping X Method	- -	- -	- -	- -	-	4.83 15.3	8.23 25.2	5.88 NS
	Method X Cropping	- -	- -	- -	- -	-	3.77 10.8	7.59 21.8	6.41 NS
Umiam II		**mean 1 year**		**mean of 2 years**					
Maize +Soybean-	FYM	2.67	0.74	1.33	157.38	-	101.10	94.30	75.20
French bean-Tomato	Vermicompost	2.67	0.74	1.33	157.38	-	43.15	91.40	41.65
	Integrated	2.67	0.74	1.33	157.38	-	77.95	92.45	113.00
	Control	2.67	0.74	1.33	157.38	-	51.25	37.70	48.35
	Mean	2.67	0.74	1.33	157.38	-	68.36	78.96	69.55

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Azb	Fungi		Bacteria		Actinomy-cetes	
Maize +Soybean-	FYM	2.73	0.75	1.33	164.04	-	53.70		85.95		46.25	
Radish-Potato	Vermicompost	2.73	0.75	1.33	164.04	-	60.10		75.85		61.70	
	Integrated	2.73	0.75	1.33	164.04	-	76.15		80.30		80.55	
	Control	2.73	0.75	1.33	164.04	-	40.60		39.50		31.05	
	Mean	2.73	0.75	1.33	164.04	-	57.64		70.40		54.89	
Maize +Soybean-	FYM	0.83	0.43	1.50	82.64	-	117.00		164.05		43.50	
French bean-Carrot	Vermicompost	0.83	0.43	1.50	82.64	-	127.50		145.20		113.50	
	Integrated	0.83	0.43	1.50	82.64	-	125.10		161.80		117.50	
	Control	0.83	0.43	1.50	82.64	-	55.00		54.00		47.50	
	Mean	0.83	0.43	1.50	82.64	-	106.15		131.26		80.50	
							SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	-	-	-	-	-	6.6	NS	12.3	NS	9.3	NS
	Method	-	-	-	-	-	6.1	19.6	5.6	18.0	6.5	21.0
	Cropping X Method	-	-	-	-	-	11.3	47.3	15.0	NS	13.6	62.0
	Method X Cropping	-	-	-	-	-	10.6	33.9	9.7	NS	11.4	36.4

K : *Kharif*, R : *Rabi*

Economics of nutrient sources and cropping system (Table 11 and Appendix III)

Modipuram: Economics of the various cropping systems were worked out for 2 years and the results reveals that among the various sources of nutrients, EC+VC+NEOC recorded higher gross returns (₹ 76078 ha^{-1}), net returns (₹ 32738 ha^{-1}) and B:C ratio (1.89) with basmati rice-wheat system. In case of basmati rice/maize-potato-onion, even though NEOC+VC recorded higher gross returns of ₹ 184610 ha^{-1}, it registered lower net returns (₹ 80039 ha^{-1}) and B:C ratio (2.55) than EC+VC which registered net return of Rs. 98407 ha^{-1} and B:C ratio of 2.92. Around 124% higher B:C ratio was observed with EC+VC+NEOC than control. Among the two cropping systems, net returns and B:C ratio was higher with basmati rice/ maize-potato-onion (₹ 90836 ha^{-1} and 2.48 respectively) than basmati rice-wheat system (₹ 24149 ha^{-1} and 1.68).

Good crop of potato under INM package at Modipuram

Jabalpur: Economic indicates such as gross returns, net returns B:C ratio were recorded for six years and mean values indicates FYM+neem cake @ ½ each recorded higher gross (₹ 98246 ha^{-1}), net (₹ 62749 ha^{-1}) returns and B:C ratio (2.75) with basmati rice-wheat system. In case of basmati rice-berseem system, application of FYM+neem cake @ ½ each recorded higher gross and net returns but B: C ratio was lower (2.77) than the FYM+neem cake +VC @ 1/3 each (2.82). Among the two cropping systems, basmati rice-berseem is found to be better as it recorded higher net returns (₹ 60286 ha^{-1}) and B:C ratio (2.65) than basmati rice-wheat system.

Coimbatore: Economic indicators were calculated for three years and pooled results indicates higher gross returns and net returns are observed with FYM+ NEOC @ ½ each under rice-black gram-sesame/ GM system. EC+VC+FYM @ 1/3 each also contributed net return of ₹ 15573 ha^{-1}. In maize-sunflower system also, FYM+NEOC @ ½ each recorded higher gross (₹ 74730 ha^{-1}) and net returns (₹ 34683 ha^{-1}). Among the two cropping systems evaluated, maize-sunflower were found to record 93% higher net returns than rice-blackgram-sesame/GM system.

Raipur: Gross and net returns were calculated for 5 yeas and results indicates under rice-chickpea system, application of NEOC+CDM+EC @ 1/3 each had higher gross (₹ 72666 ha^{-1}), net (₹ 44149 ha^{-1}) returns and B:C ratio (1.59) followed by FYM+NEOC @ ½ each. Similarly in rice-wheat / mustard/ lentil had also recorded better returns and B:C ratio with application of NEOC+VC+FYM @ 1/3 each. Among the two cropping systems, rice – chickpea had higher gross, net returns and B: C ratio as it recorded 105% higher B:C ratio than rice-wheat/mustard+lentil system.

Calicut: Ginger and turmeric were evaluated for four years for their economic indicators with different nutrient sources. The mean data of gross, net returns and B:C ratio indicates , application of 30 t FYM to ginger and turmeric recorded higher gross, net returns and B: C ratio. The net return was 34% higher in ginger and 54% higher in turmeric. Incorporation of 15t FYM+2t neem cake + 5t coir compost had recorded next best B: C ratio for ginger and turmeric (2.29 and 1.57 respectively). Among the crops, ginger registered higher net returns (₹ 153093 ha^{-1}) and B: C ratio (2.24) than turmeric (₹ 71686 ha^{-1} and 1.55 respectively).

Dharwad: Economic evaluation of different sources of nutrients were done for four years in three cropping systems and pooled results reveals that though higher gross and net returns were recorded with

EC+VC+green leaf manure @ 3/8 each, B:C ratio was higher (4) with EC+FYM+green leaf manure @ 3/8 each in groundnut-sorghum system which is mainly due to lower cost of cultivation. In soybean-wheat system, EC+FYM+Green leaf manure @ 3/8 each recorded higher net returns (₹ 237271 ha^{-1}) and B:C ratio (3.71) followed by EC+VC+green leaf manure @ 3/8 each. Application of EC+FYM + green leaf manure @ 3/8 each and VC+FYM+ green leaf manure @ 3/8 each had recorded B:C ratio of 3.16 in chilli-cotton-onion system. Among the three systems evaluated, groundnut- sorghum had higher B:C ratio of 3.64 which is 11 and 27% higher than soybean-wheat and chilli-cotton –onion system respectively.

Karjat: Gross, net returns and B:C ratio were evaluated for 5 years in two cropping systems and mean values indicated application of FYM+paddy straw+*gliricidia* green leaves @ 1/3 each during *kharif* and FYM+neem cake+vermicompost @1/3 N each during *rabi* recorded higher net returns and B:C ratio in both the cropping systems *viz*., rice-capsicum/red pumpkin and rice –cucumber. This was closely followed by FYM+ gliricida green leaves @1/2 each during *kharif* and FYM@ 20t /ha during *rabi*. Among the two cropping systems, even though gross return was higher with rice-cucumber system, rice-capsicum/ red pumpkin recorded better net returns (₹ 27345 ha^{-1}) and B:C ratio (1.48).

Bajaura: Four yeas economic evaluation of different nutrient sources indicates incorporation of reinforced FYM with vermicompost is found to give better net returns and B:C ratio in cauliflower-pea/radish–tomato (2006-07) and coriander-pea/spinach (2006-07), cabbage/capsicum(2006-07) systems. This was closely followed by reinforced FYM in both the systems. Among the two cropping systems, cauliflower-pea/radish–tomato recorded 431 and 103% higher net returns and B: C ratio than coriander-pea-spinach-cabbage/ capsicum system.

Bhopal: Economic evaluation of soybean-wheat system with four different combination of nutrient sources, for four years indicates CDM-CDM+VC+PM recorded higher gross (₹ 55715 ha^{-1}), net (₹ 37766 ha^{-1}) and B:C ratio (3.08) followed by CDM-CDM-PM. The % increase in net returns and B:C ratio was 62 and 46 with CDM-CDM+VC+PM and 57 and 17 with CDM-CDM+PM. Irrespective of nutrient sources, soybean-wheat system recorded net return of ₹ 33470 ha^{-1} and B:C ratio of 2.91.

Pantnagar: Economic evaluation of four combinations of nutrient sources along with control were evaluated in three cropping systems for three years and results revealed that control recorded higher net returns and B: C ratio in all the cropping systems even though gross return was higher with either application of EC+VC @ ½ each or FYM+VC @ ½ each which is mainly due to the high cost of cultivation involved in different nutrient sources. Among the various systems, evaluated, rice-chickpea is found to give higher net returns (₹ 28598/ha) and B: C ratio (1.32) followed by basmati rice-vegetable pea system. Basmati rice-wheat system recorded lower net returns (₹ 10224 ha^{-1}) and B:C ratio (0.86).

Ranchi: Net returns and B:C ratio were computed for two systems namely rice-wheat and rice-lentil/ potato (2009-10) with various combinations of nutrient sources along with control for 5 years . Though net return was higher in FYM+neemcake+ VC @ 1/3 each (₹ 44975 ha^{-1}), the B:C ratio was higher with FYM+neem cake @ ½ each (1.84) under rice –wheat system. In rice –lentil/ potato (2009-10) system FYM+neem cake @ ½ each had higher net returns (₹ 35096 ha^{-1}) and B:C ratio (2.19). Among cropping systems, rice-wheat recorded 41% higher net returns while rice-lentil/potato (2009-10) recorded 11% higher B:C ratio than rice-wheat system.

Table 11. Influence of source of nutrients on economics of different cropping systems at various locations (2004-05 to 2009-10)

Cropping system	Source of nutrient	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
1. Modipuram		**Mean of 1 year**		**2 years**	**1 year**
Basmati rice-Wheat	NS1-EC + VC	68541	50965	28526	1.86
	NS2- NEOC+VC	74499	57645	24991	1.79
	NS3- EC + NEOC	65291	52895	26252	1.69
	NS4- EC + VC + NEOC	76078	53845	32738	1.89
	NS5-Control	48761	36745	8238	1.16
	Mean	66634	50419	24149	1.68
Basmati rice/Maize-	NS1-EC + VC	175885	94938	98407	2.92
Potato-Onion	NS2- NEOC+VC	184610	107538	80039	2.55
	NS3- EC + NEOC	161421	98538	94580	2.69
	NS4- EC + VC + NEOC	170952	100338	96551	2.94
	NS5-Control	109374	67938	84605	1.31
	Mean	160448	93858	90836	2.48
2. Jabalpur (mean of 6 years)					
Basmati rice-Wheat	NS1-FYM+VC(1/2+1/2)	95644	38121	57523	2.47
	NS2-VC+Neem cake(1/2+1/2)	93523	34388	59135	2.68
	NS3-FYM+Neem cake(1/2+1/2)	98246	35498	62749	2.75
	NS4-FYM+Neem cake+VC (1/3+1/3+1/3)	92850	34175	58675	2.72
	NS5-Control	70652	29317	41335	2.31
	Mean	90183	34300	55883	2.58
Basmati rice –	NS1-FYM+VC(1/2+1/2)	98958	36501	62458	2.65
Berseem F/S	NS2-VC+Neem cake(1/2+1/2)	96046	35738	60175	2.61
	NS3-FYM+Neem cake (1/2+1/2)	100602	35422	65181	2.77
	NS4-FYM+Neem cake+VC (1/3+1/3+1/3)	98511	34407	64105	2.82
	NS5-Control	81897	32385	49512	2.43
	Mean	95203	34890	60286	2.65
3. Coimbatore (mean of 3 years)					
Rice -Black gram-	NS1-EC	51360	35192	16168	-
Sesame/GM	NS2-VC	58460	56808	1455	-
	NS3-FYM+NEOC(1/2+1/2)	64557	38622	25935	-
	NS4-EC+VC+FYM (1/3+1/3+1/3)	59757	44183	15573	-

Cropping system	Source of nutrient	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
	NS5-Control	29525	28458	1067	-
	Mean	52732	40653	12040	-
Maize-Sunflower	NS1-EC	59231	29318	29580	-
	NS2-VC	70504	50237	20254	-
	NS3-FYM+NEOC(1/2+1/2)	74730	40047	34683	-
	NS4-EC+VC+FYM (1/3+1/3+1/3)	64955	42443	22511	-
	NS5-Control	30261	20655	9606	-
	Mean	59936	36540	23327	-
4. Raipur		**5 years**	**4 years**	**5 years**	
Rice - Chickpea	NS1-EC+CDM(1/2+1/2)	70128	29195	42036	1.50
	NS2-NEOC+CDM(1/2+1/2)	63437	26458	37511	1.40
	NS3-FYM+NEOC(1/2+1/2)	71467	29909	42781	1.51
	NS4-NEOC+CDM+EC (1/3+1/3+1/3)	72666	29643	44149	1.59
	NS5-Control	49835	27462	24396	0.88
	Mean	65507	28533	38174	1.38
Rice - Wheat/Mustard+	NS1-EC+CDM(1/2+1/2)	62937	35588	28216	0.69
Lentil* (2009-10)	NS2-VC	61993	35993	26117	0.61
	NS3-FYM+NEOC(1/2+1/2)	61749	35993	25874	0.57
	NS4-EC+VC+FYM (1/3+1/3+1/3)	66471	35102	31485	0.77
	NS5-Control	36231	20591	15708	0.70
	Mean	57876	32653	25480	0.67
5. Calicut (mean of 4 years)					
Ginger	NS1-15 t FYM+2t Neem cake+4tVC	314220	157247	156974	2.15
	NS2-15 t FYM+2t Neem cake+5tCoir compost	321890	156622	165269	2.29
	NS3-10tCoir compost+8t VC	304190	150897	153294	2.20
	NS4-30tFYM	316230	148397	166334	2.40
	NS5-Control	244990	121397	123594	2.19
	Mean	300304	146912	153093	2.24
Turmeric	NS1-15 t FYM+2t Neem cake+4tVC	224533	169247	63754	1.48

Cropping system	Source of nutrient	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
	NS2-15 t FYM+2t Neem cake+5tCoir compost	225133	167997	71966	1.57
	NS3-10tCoir compost+8t VC	248833	164647	78079	1.54
	NS4-30tFYM	242033	161147	87729	1.62
	NS5-Control	184533	137147	56904	1.54
	Mean	225013	160037	71686	1.55
6. Dharwad		**4 years**	**4 years**	**mean of 5 years**	
Groundnut-Sorghum	NS1-EC(3/4)+Green leaf manure(1/4)	52183	17636	38863	3.58
	NS2-VC(3/4)+Green leaf manure(1/4)	51257	19265	35780	3.21
	NS3-FYM(3/4)+Green leaf manure(1/4)	53821	17233	39981	3.75
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	60263	18437	46728	3.83
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	58616	17316	45220	4.00
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	59018	18133	44509	3.81
	NS7-Control	42553	15624	29425	3.29
	Mean	53959	17663	40072	3.64
Soybean-Wheat	NS1-EC(3/4)+Green leaf manure(1/4)	30717	10675	21209	3.16
	NS2-VC(3/4)+Green leaf manure(1/4)	29733	12424	18082	2.67
	NS3-FYM(3/4)+Green leaf manure(1/4)	30003	9974	21021	3.39
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	33322	11249	23623	3.35
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	32728	10044	23727	3.71
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	32612	11117	22533	3.28
	NS7-Control	23670	8162	15460	3.40
	Mean	30398	10521	20808	3.28
Chilli-Cotton-Onion	NS1-EC(3/4)+Green leaf manure(1/4)	37023	14449	21983	2.83
	NS2-VC(3/4)+Green leaf manure(1/4)	36709	16561	19352	2.47

Cropping system	Source of nutrient	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
	NS3-FYM(3/4)+Green leaf manure(1/4)	39758	15642	23199	2.91
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	40998	16250	24232	2.80
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	40192	14283	25239	3.16
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	40762	13595	25691	3.16
	NS7-Control	26671	9795	15184	2.81
	Mean	37444	14368	22126	2.87
7. Karjat (mean of 5 years)					
Rice -Capsicum/	K. -NS1-FYM10+Glyricidia green leaves 1.83t/ha (50:50%N) R.-NS1-FYM 20 t/ha (100% N)	87940	62375	26440	1.53
Red pumpkin	K. -NS2-FYM10+Paddy straw 4.17t/ha(50:50%N) R.-NS2-FYM10+Vermi-compost1t/ha(50:50%N)	91646	70977	20272	1.36
	K. -NS3-FYM10+Neem Cake 2.5 t/ha(50:50%N) R.-NS3-FYM10+Neem Cake2.5t/ha(50:50%N)	96000	78204	25919	1.48
	K. -NS4-FYM 6.7+Paddy straw3.8+Glyricidia green leaves 1.2t/ha(1/3 N each throughFYM :PS:GLY) R.-NS4-FYM 6.7+Neem Cake 1.7+Vermicompost 0.7t/ha(1/3 N each through FYM :NC:VC)	111795	69424	44943	1.56
	NS5-Control	66467	46863	19151	1.49
	Mean	90770	65569	27345	1.48
Rice - Cucumber	K. -NS1-FYM10+Glyricidia green leaves 1.83t/ha (50:50%N) R.-NS1-FYM 20 t/ha (100% N)	98710	67927	29945	1.43
	K. -NS2-FYM10+Paddy straw 4.17t/ha(50:50%N) R.-NS2-FYM10+Vermi-compost1t/ha(50:50%N)	97294	76542	18647	1.24
	K. -NS3-FYM10+Neem Cake 2.5 t/ha(50:50%N) R.-NS3-FYM10+Neem Cake2.5t/ha(50:50%N)	98032	83923	21035	1.27

Cropping system	Source of nutrient	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
	K. -NS4-FYM 6.7+Paddy straw3.8+Glyricidia green leaves 1.2t/ha(1/3 N each throughFYM :PS:GLY) R.-NS4-FYM 6.7+Neem Cake 1.7+Vermicompost 0.7t/ha(1/3 N each through FYM :NC:VC)	128162	81346	39101	1.48
	NS5-Control	73000	52361	17272	1.31
	Mean	99040	72420	25200	1.35
8. Bajura (mean of 4 years)					
Cauliflower - Pea/	NS1-VC	184483	95022	89477	1.12
Radish*(2006-07) -	NS2-FYM(RF)	207715	94653	113059	1.42
Tomato	NS3-FYM+VC	190840	94500	96340	1.21
	NS4-FYM(RF)+VC	239790	94979	144812	1.83
	NS5-Control	121960	80947	42284	0.71
	Mean	188957	92020	97194	1.26
Coriander - Pea/	NS1-VC	79460	71907	7553	0.50
Spinach*(2006-07) -	NS2-FYM(RF)	99539	70075	29464	0.81
Cabbage/Capsicum*	NS3-FYM+VC	91406	71382	20024	0.68
(2006-07)	NS4-FYM(RF)+VC	119643	72027	47615	1.02
	NS5-Control	47788	64537	-13199	0.10
	Mean	87567	69986	18291	0.62
9. Bhopal (mean of 4 years)					
Soybean - D.Wheat	NS1-CDM-CDM+PM	54554	17861	36693	3.03
	NS2-CDM-CDM+VC	53271	18287	34985	2.90
	NS3-CDM-PM+VC	52325	17775	34549	2.93
	NS4-CDM-CDM+VC+PM	55715	17949	37766	3.08
	NS5-Control	37843	14486	23358	2.59
	Mean	50742	17271	33470	2.91
10. Pantnagar (mean of 3 years)					
B. Rice-Wheat	NS1EC+VC(1/2+1/2)	52008	43228	8779	0.53
	NS2-NEOC+VC(1/2+1/2)	52057	52727	-670	0.72
	NS3-FYM+VC(1/2+1/2)	53529	42728	10801	0.86
	NS4-EC+VC+NEOC+FYM (1/4+1/4+1/4+1/4)	52495	44028	8466	0.87
	NS5-Control	48970	25228	23741	1.31

Cropping system	Source of nutrient	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
	Mean	51812	41588	10224	0.86
B.Rice - Chickpea	NS1EC+VC(1/2+1/2)	68797	41018	27779	1.20
	NS2-NEOC+VC(1/2+1/2)	67836	50518	17351	0.93
	NS3-FYM+VC(1/2+1/2)	71362	40518	30843	1.22
	NS4-EC+VC+NEOC+FYM (1/4+1/4+1/4+1/4)	67264	41818	25446	1.22
	NS5-Control	64590	23018	41572	2.03
	Mean	67970	39378	28598	1.32
B.Rice - Veg.Pea	NS1EC+VC(1/2+1/2)	56708	41068	15640	0.91
	NS2-NEOC+VC(1/2+1/2)	54339	50568	3771	0.66
	NS3-FYM+VC(1/2+1/2)	55927	40568	15359	0.89
	NS4-EC+VC+NEOC+FYM (1/4+1/4+1/4+1/4)	55978	41868	14109	0.98
	NS5-Control	53085	23068	25957	1.71
	Mean	55207	39428	14967	1.03
11. Ranchi (mean of 5 years)					
Rice - Wheat	NS1-FYM+VC(1/2+1/2)	-	-	44662	1.74
	NS2-FYM+Neem cake(1/2+1/2)	-	-	40680	1.84
	NS3-VC+Neem cake(1/2+1/2)	-	-	43088	1.55
	NS4-FYM+Neem cake+VC (1/3+1/3+1/3)	-	-	44975	1.71
	NS5-Control	-	-	24060	1.05
	Mean	-	-	39493	1.58
Rice - Lentil/	NS1-FYM+VC(1/2+1/2)	-	-	30051	1.88
Potato*(2009-10)	NS2-FYM+Neem cake(1/2+1/2)	-	-	35096	2.19
	NS3-VC+Neem cake(1/2+1/2)	-	-	30209	1.82
	NS4-FYM+Neem cake+VC (1/3+1/3+1/3)	-	-	32720	2.07
	NS5-Control	-	-	11877	0.86
	Mean	-	-	27991	1.76

K: *Kharif*, R: *Rabi*

7.3 Pest and disease management under organic farming

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

Objectives: 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 and Locations: As given below

Sl. No.	Centre	Year of start	Number of years
1.	Modipuram	2007-08 (Ist Set)2009-10(2nd Set)	1, 1
2.	Jabalpur	2005-06 (Ist Set)2009-10(Ist Set)	1, 4
3.	Coimbatore	2004-05 (Ist Set)2005-06 (IIst Set)	3, 5
4.	Raipur	2004-05	3
5.	Calicut	2005-06	3
6.	Dharwad	2005-06	3
7.	Karjat	2004-05	5
8.	Ludhiana	2004-05, 2007-08	3, 2
9.	Bajura	2004-05	4
10	Umiam	2007-08	2

Treatments: There are no common treatments for all the centers, but they vary from location to location. The number of cropping system tested varied from 1 to 3. The details of treatments are given in Table 12 to 20 along with experimental results. Under the experiment number 3 on pest and disease management, two set of treatments were evaluated by the centers for various cropping system. The first set of treatments with summer ploughing and green manures were evaluated in only three centers. The center wise data on grain yield, soil properties, microbial count and economics are presented in table 13-15 and results are given below.

Results

Experiment set 1

Modipuram (Table 12, 13, 15)

Summer ploughing and green manuring practices were evaluated with treated and untreated under basmati rice-chickpea and basmati rice/maize-mustard system for one year only. The yield of basmati rice was higher with summer ploughing treated (2570 kg ha^{-1}) and green manure treated (2700 kg ha^{-1}) during *kharif* season. In *rabi*, chickpea and mustard recorded higher yield of 1330 kg ha^{-1} and 920 kg ha^{-1} respectively with summer ploughing treated plots indicating usefulness of summer ploughing in organic farming practice. Organic carbon content was found to be 56% higher with summer ploughing treated plots compared to untreated in basmati rice –chickpea system. Similarly in basmati rice-mustard recorded

Damaged plants due to soil born diseases under control at Modipuram

higher organic carbon (0.76%) with green manure treated plots. No significant variation in available N, P, K were observed among the summer ploughing and green manure treated plots as well as among the two cropping systems. In line with the yield of crops, gross and returns were higher in summer ploughing treated plots in basmati rice-chickpea system while it is better in green manure treated plots with basmati rice-mustard system. The % increase in net returns was found to be 2.1% with summer ploughing treated for basmati rice-chickpea system and 18% with green manure treated for basmati rice-mustard system over respective untreated plots.

Jabalpur (Table 12, 15)

Five weed management practices were evaluated in basmati rice-wheat system for one year in order to evaluate the weed management practices on pest and disease management. Among the treatments, keeping the field free from weeds recorded higher grain yield of 3273 kg ha^{-1} of basmati rice and 3080 kg ha^{-1} of wheat, which is 67% and 64% higher than unweeded control respectively. Combination of two hand or mechanical weeding along with spray of weedicide at 3-4 leaf stage is found to be next best in terms of grain yield. The straw yield also recorded similar trend. Higher gross and net returns were observed in weed free condition even though the cost of cultivation was higher. Combination of mechanical and chemical control recorded next higher net returns which is 58% higher than unweeded control.

Coimbatore (Table 12, 12a, 14, 15)

Seven treatments involving summer ploughing, cultural methods of pest and disease management biological, botanical and behavioral methods of insects and their combination were evaluated for 3 years in rice-rice-sesame system. Combination of cultural, biological, botanical, physical, mechanical and behavioral methods of insect/ disease management had recorded higher yield of rice in both *kharif* (4601 kg ha^{-1}) and *rabi* (3068 kg ha^{-1}) . The yield increase with this method is found to be 127,22,16,22,26 and 29% over control, physical + mechanical +behavioral methods, botanical, biological cultural methods and summer ploughing practices of pest and disease management respectively. Straw yield also recorded the similar trend. Observations on microbial count for 3 years indicated 122,53 and 78% higher fungi, bacteria and actinomycetes respectively with the combination of cultural +biological + botanical +physical, mechanical and behavioral methods of pest and disease management over control. Similar to the grain yield and microbial count, the same combinations of treatments recorded higher gross (₹ 66965 ha^{-1}) and net returns (₹ 36985 ha^{-1}) than control. The increase in net return was found to be 234% over control even though an additional amount of ₹ 5683 ha^{-1} spent on cost of cultivation. Contribution of botanical methods in pest and disease control of rice-rice-sesame

Rice crop at Coimbatore evaluated for different organic inputs

system was also found to be better as it also recorded around 178% increase in net returns over control. Among the various methods of pest and disease control, cultural methods had lowest cost of cultivation followed by summer ploughing alone. Hence, combination of all the available methods of pest and disease management are found to be better for organic farming. The pest population and natural enemy counts were higher in control. Among the treatments, natural enemy was higher with biological and botanical methods in both maize and rice crops.

Experiment set 2

In the second set of treatments in pest and disease management, other applications of pest and weed management combinations were studied at 10 centres . The data on grain, straw yield, soil physical and chemical properties, soil microbial population and economics are presented in Table 16-20 and centre wise results are given below.

Modipuram (Table 16, 17 and 20)

Two cropping systems *viz*., basmati rice-wheat and rice-potato are evaluated for one year with six various combination of seed, soil and chemical treatments for pest, disease and weed control. In rice, either soil application of neem cake and foliar spray of *Trichoderma harzianum* or soil application of *Trichoderma harzianum* + two spray of neem oil at maximum tillering and panicle initiation stages are found to record higher grain yield (2889 and 3389 kg ha^{-1} respectively) during *kharif* season. In both green manure and summer ploughing plots in *rabi*, wheat yield was higher in seed treatment with PsF and soil application of *Trichoderma harzianum* under both green manure and summer ploughing plots. In case of potato, combination of soil application of *Aspusillvo miger* var An 27 (Kalisena) and soil application of neem cake along with installation of pheromone trap is found to be better with green manure (88 kg ha^{-1}) while soil application of neem cake and installation of pheromone trap alone performed better with green manuring (9166 kg ha^{-1}). The trend of straw yield also almost on the same line as that of grain yield of various crops. Net return of basmati rice –wheat system was found to be higher in seed treatment with *Pseudomonas* fluorescence (PsF)+ pheromone traps + *Trichogramma japanicum* in *kharif* and seed treatment with PsF and soil application of *Trichoderma harzianum* in *rabi* under both green manuring and summer ploughing conditions. Rice-potato system had better net returns with soil application of *Trichoderma harzianum* + two spray of neem oil at medium tillering and panicle initiation stages in *kharif* and soil application of *Trichoderma harzianum* + two spray of neem oil in *rabi* under both green manuring and summer ploughing practices (₹ 15079 and 7616 ha^{-1} respectively).

Visit of Member of Parliament to NPOF experiments at Modipuram

Better performance of Chickpea at Modipuram with bio control agents *(Pseudomonas + Trichoderma)* treatment

Jabalpur : (Table 16, 17 and 20)

Five various combinations of biological agents with neem cake applications were evaluated along with control in basmati rice-wheat system for four years. All the treatments were evaluated under both green manuring and summer ploughing practices. The pooled results indicates, soil application of *Pseudomonas fluorescence* (PsF)+ two spray of neem extract at tillering and panicle initiation stages are found to be better for basmati rice under green manuring (3919 kg ha^{-1}) and summer ploughing practices (3668 kg ha^{-1}). The yield increase over control was found to be only 2.7% with green manuring and 1.2% with summer ploughing practices. In case of wheat, seed treatment with *Trichoderna* and *Pseudomonas fluorescence* in 1:1 ratio gave only 1.4% higher yield with green manuring and 1% with summer ploughing practices inferring very little effect of bio-control agents on wheat yield. In terms of economics, net returns and B:C ratio was higher with soil application of *Pseudomonas fluorescence* + two spray of neeem extract at tillering and panicle initiation stages (₹ 73929 ha^{-1} and 2.81 respectively) with green manuring practice while it was higher with soil application of *Pseudomonas fluorescence* + light trap + bird preaches at ear head stages in *kharif* and seed treatment with *Trichoderna Sp* and *Pseudomonas fluorescence* in 1:1 ratio with summer ploughing practice (₹ 59198 ha^{-1} and 2.51 respectively).

Coimbatore (Table 16, 17 and 20)

Eight treatments having various combinations of seed and soil application with bio control agents and botanicals were evaluated in rice-chickpea system for 5 years. Higher yield of rice (3421 kg ha^{-1}) and chickpea (835 kg ha^{-1}) was recorded with neem+mahua cake+ *Trichogramma* + neem spray+ bird perches during *kharif* and neem +mahua cake + spray of organic substances + bird perches during *rabi* season. The % increase in yield was 19.5 and 63 in rice and chickpea respectively with the above combination of pest management practices. Straw yield of rice also exhibited the similar trend. Higher gross (₹ 78565 ha^{-1}) and net returns (₹ 50442 ha^{-1}) was also observed with the same treatment combination. Increase in net return was to the tune of 73% with neem + mahua cake + *Trichogramma* + neem spray + bird perches in *kharif* and spray of organic substances+ bird perches along with neem +mahua+ *Trichogramma* in *rabi* season over control. The net returns of other treatments ranged from ₹ 44609 ha^{-1} to ₹ 49004 ha^{-1} indicating effectiveness of various bio control agents, soil cakes and bird perches under organic farming as these practices recorded higher net returns than control (₹ 29202 ha^{-1}).

Raipur (Table 16, 17, 18 and 20)

Eight treatments involving the various combinations of bio control agents, botanicals, oil cakes and other resources were evaluated in rice-chickpea system for 3 years. The pooled results reveals that neem + mahua cake + *Trichogramma*+neem spray + bird perches during *kharif* and spray of organic substances +bird perches along with neem + mahua cake were found to record higher grain yield of rice (3383 kg ha^{-1}) and chickpea (782 kg ha^{-1}). The percent increase over control by this treatment was 14 and 25 respectively for rice and chickpea. Straw yield also had the similar trend as that of grain yield of both the crops. No definite variation and significant influence was observed with soil parameters such as bulk density,

Visit of monitoring team to NPOF experiments at Raipur

pH, EC, OC, N, P and K as all the treatments were related to management of pest and diseases. Gross and net returns were also higher with same treatment in which higher grain yield was recorded in both the crops. However, the difference between control and other treatments in terms of net returns was much lower mainly due to low cost of cultivation (₹ 29346 ha^{-1}) in control.

Calicut (Table 16 and 19)

Nine combinations of biological, botanical, physical and other methods of pest and disease management were evaluated for three years in ginger and turmeric. In ginger, microbial culture combination of IISR-6+IISR-8+IISR-13+ IISR-51 +IISR-151 and PB 21+ PIAR6 had recorded higher rhizome yield of 22543 kg ha^{-1} which is 54% higher than the absolute control. The next best treatment IISR-6, IISR-8, IISR-13, IISR-51, IISR-151 and IISR-853 registered 3.7% lesser rhizome yield of turmeric than control. Significant variation in fungi, bacteria and actinomycetes count in soil was observed with various microbial culture treatments to rhizomes of ginger. Around 74% increase in fungi, and 97% increase in bacteria was observed with inoculation of various cultures over chemical control (COC 3% and bordeaux mixture 1%)

Dharwad (Table 16, 17 and 20)

Four treatments having various combinations of bio-botanic –oil cakes were evaluated in chili crop for 3 years and the results reveals that *Verticillium lecani* + Econeem (neem product) + neem seed kernel extract +botanicals (Pancha gavvya +neem seed kernel extract + Ha NPV+ GCV extract + release of *Trichogramma chilonis* @ 150,000^{-1} acre is found to record higher dry chilli yield (2146 kg ha^{-1}) which is 24% higher than the *Verticilium lecani*+Eco neem (neem product) +neem seed kernel extract +botanicals + pancha gavya +neem seed kernel extract Ha NPV. The residues yield of chilli also followed the similar trend. Eventhough the later treatment recorded higher gross returns (₹ 24,444 ha^{-1}) and net returns (₹ 15195 ha^{-1}), B:C ratio (2.20) was higher with the T_2 treatment which recorded the higher dry chili yield.

Karjat (Table 16 and 20)

Mango crop was evaluated with six combinations of bio pest and disease management along with control for 5 years. Application of vermicompost @ 100 kg +20 kg *gliricidia* leaves $plant^{-1}$ as basal dose (T_1) recorded higher fruit yield of 5689 kg/ha which is six times higher than the control (836 kg ha^{-1}). All the other treatments performed equally as the yield range was only 1707 to 2619 kg ha^{-1}. Even though gross (₹ 195436 ha^{-1}) and net return (₹ 123019 ha^{-1}) was higher with the above treatments, B:C ratio was found to be lower (3.31) than application of 155 kg gliricidia as a basal dose $tree^{-1}$ (T_2) (3.58) which is mainly due to higher cost of cultivation. The cost of cultivation between T_2 and T_6 is ₹ 45453 ha^{-1}. All the other treatments recorded lower net returns and B: C ratio.

Growth of wheat crop at Ludhiana under organic system

Ludhiana (Table 16, 17, 18 and 19)

Basmati rice-wheat system was evaluated with five combinations of bio-botanical treatments for three years and results indicates that seed treatment with neem cake +2 sprays of *Trichoderma harzianum* recorded higher rice yield (4480 kg ha^{-1}) followed by root dipping in cow dung and urine +soil application of neem cake +2 sprays of *Trichoderma harzianum* (4407 kg ha^{-1}). In wheat, soil application

of *Trichoderma harzianum* registered higher yield (3900 kg ha^{-1}) than other treatments. During 2007-2009, other combinations involving bio control agents were tested in basmati rice-wheat system. Application of *Trichogramma chilonis/ Trichogramma japonicum* + Bt spray +foliar application of *Trichoderma harzianum* recorded higher grain yield of rice (3526 kg ha^{-1}) while application of bio control agents and hand weeding had higher yield in wheat. Straw yield of rice and wheat in both the experiments followed the similar trend as that of grain yield. No significant and definite trend was observed with the application of various bio control agents for pest control in respect bulk density, pH, EC, N, P and K. The organic carbon content of soil ranged from 0.4 to 0.7% in various combinations of bio –botanical treatments. Almost all the treatments had equal effect on improving the soil microbes such as fungi, bacteria and actinomycetes. Seed treatment with PsF+ pheromone traps + *Trichogramma* releases recorded higher count of fungi (102 CFU/g), bacteria (33.3 CFU/g) and actinomycetes (53.9 CFU/g) indicating the usefulness of this combination in improving the soil biodiversity.

Bajaura (Table 16 and 20)

Eight combinations of bio-botanical treatments were evaluated in tomato-cabbage system for 4 years. Mean data of tomato indicates spray of a aqueous leaf extract of bhang (*Cannabis sativa*) recorded higher tomato yield of 23592 kg ha^{-1} which is closely followed by spray of aqueous leaf extract of carvi. The yield increase over control (without any spray) by these sprays were 5.3 and 4.4% respectively. In terms of gross, net returns and B:C ratio, spray of aqueous leaf extract of Kaner (*Nerium* sp) recorded better as it registered 82% higher net returns than the spray of aqueous leaf extract of bhang (*Cannabis sativa*) indicating the economical spray by using extract of Kaner. Control (without any spray) recorded loss of ₹ 4266 ha^{-1}.

Umiam (Table 16 and 17)

Nine combinations of botanicals and biological control methods were evaluated in maize-soybean-tomato system for 2 years. The results indicate that spray of Karanji @ 3 ml/lit recorded higher yield of maize (3520 kg ha^{-1}) and soybean (1391 kg ha^{-1}) than control. The increase in yield over control was found to be 42.2% and 40.9% respectively. In both the crops, the spray of Karanji @ 3 ml/ lit was closely followed by Trichocards @ 50,000/ha + Anomine @ 3 ml/ lit (T_6) and Anomine @ 3 ml/lit+panchagavya @ 3% + lentana leaf extract @ 10% + Vermiwash 10% (T_8) Spray. In case of tomato, higher yield of 14405 kg ha^{-1} was observed with T_8 treatment followed by spraying panchagavya @ 3% (T_3). The yield increase in T_8 and T_3 over control was found to be 10.8 and 8.7% respectively. Straw yield of maize was found to be higher in control (9438 kg /ha). Residues yield of soybean and tomato was found to follow the similar pattern as that of grain and fruit yield of the respective crops.

Table 12. Influence of weed, pest and disease management practices under organic farming on grain and straw yield (kg/ha) of crops at various locations (2004-05 to 2009-10)

Cropping system	Weed, pest and disease management	Grain Yield		Straw Yield	
		Kharif	*Rabi*	*Kharif*	*Rabi*
1. Modipuram (mean of 1 year)					
Basmati rice- Chick pea	Summer Ploughing-Untreated	2470	1270	5400	-
	Summer Ploughing-Treated	2570	1330	5400	-
	Green Manure-Treated	2470	1280	5830	-
	Green Manure-Untreated	2200	1220	5400	-
Basmati rice/Maize-Mustard	Summer Ploughing-Untreated	2130	873	5530	-
	Summer Ploughing-Treated	2500	920	5830	-
	Green Manure-Treated	2700	830	5933	-
	Green Manure-Untreated	2330	770	5400	-
2. Jabalpur (mean of 1 year)					
Basmati rice- D.Wheat	Unweeded control	1955	1879	3353	3028
	Two hand weeding/mechanical	2684	2615	4088	3871
	Spray at 3-4 leaf stage of weed	2092	2281	4068	3552
	Two hand weeding/mechanical + Spray at 3-4 leaf stage of weed	2867	2708	5693	3925
	Weed free	3273	3080	5802	4524
3. Coimbatore (mean of 3 years)					
Maize/Rice - Rice/Black	Summer ploughing	3574	2716	-	5600
gram - Sesame/GM	Cultural methods of pest and disease management	3647	2762	-	5700
	Biological methods	3764	2822	-	5773
	Botanical methods	3980	2958	-	6147
	Physical,mechanical and behavioral methods	3777	2809	-	5907
	Cultural + Biological + Botanical+ Physical, mechanical and behavioral methods of pest and disease management	4601	3068	-	6320
	Control	2025	2181	-	4299

Table 12a. Influence of weed, pest and disease management practices under organic farming on pest and natural enemy population in Maize-rice cropping system at Coimbatore (mean of 2 years)

Weed, pest and disease management	Pest Population (count/plot)						Natural enemy population (no's/plot)					
	Maize			Rice			Maize			Rice		
	I *	II	III	I	II	III	I	II	III	I	II	III
Summer ploughing	48.3	43.3	33.3	9.0	17.3	16.2	22.3	21.0	15.0	41.6	45.0	33.0
Cultural methods of pest and disease management	40.3	39.0	30.3	8.5	15.9	14.5	23.3	21.3	11.6	37.6	40.0	27.6
Biological methods	31.6	26.3	21.3	7.7	11.8	13.5	18.3	20.3	13.0	31.0	30.0	18.0
Botanical methods	22.6	22.6	14.0	7.2	15.2	12.5	27.3	12.6	8.6	26.3	25.0	13.3
Physical,mechanical and behavioral methods	27.0	40.3	20.0	6.9	13.8	14.1	24.6	19.0	13.3	34.0	36.6	23.3
Cultural + Biological + Botanical+ Physical, mechanical and behavioral methods of pest and disease management	13.3	17.3	9.0	5.9	10.6	10.3	27.6	25.0	12.3	14.0	18.3	9.6
Control	69.6	53.6	39.0	10.4	27.6	23.1	44.3	34.3	21.6	56.0	52.6	38.3

*count

Table 13. Influence of weed, pest and disease management practices under organic farming on soil chemical properties after the cropping cycle at Modipuram (2004-05 to 2009-10)

Cropping system	Weed, pest and disease management	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
Modipuram (mean of 1 year)							
Basmati rice-	Summer Ploughing-Untreated	7.81	0.19	0.59	525	19.3	267
Chick pea	Summer Ploughing-Treated	8.02	0.19	0.92	555	19.6	281
	Green Manure-Treated	7.83	0.21	0.59	544	19.9	271
	Green Manure-Untreated	7.98	0.19	0.61	551	20.1	259
Basmati rice/	Summer Ploughing-Untreated	8.06	0.16	0.80	566	25.2	259
Maize-Mustard	Summer Ploughing-Treated	7.96	0.20	0.71	582	19.8	312
	Green Manure-Treated	8.04	0.18	0.76	536	18.7	273
	Green Manure-Untreated	7.94	0.18	0.73	555	18.1	317

Table 14. Influence of weed, pest and disease management practices under organic farming on soil microbial count (x10^4 CFU/g) after the cropping cycle at Coimbatore (2004-05 to 2009-10)

Cropping system	Weed, pest and disease management	Fungi	Bacteria	Actinomycetes
Coimbatore (mean of 3 years)				
Maize/Rice-Rice/Black gram-Sesame/GM	Summer ploughing	10.3	85.6	33.6
	Cultural methods of pest and disease management	12.6	108.5	45.5
	Biological methods	12	94.6	43.2
	Botanical methods	12.1	93.7	38.6
	Physical,mechanical and behavioral methods	10.6	90.9	36.2
	Cultural + Biological + Botanical+ Physical, mechanical and behavioral methods of pest and disease management	15.1	110.3	47.1
	Control	6.8	72	26.4

Table 15. Influence of weed, pest and disease management practices under organic farming on economics of different cropping systems at various locations (2004-05 to 2009-10)

Cropping system	Weed, pest and disease management	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)
1. Modipuram (1 year)				
Basmati rice-Chick pea	Summer Ploughing-Untreated	79880	36770	43110
	Summer Ploughing-Treated	83080	39070	44010
	Green Manure-Treated	80120	37160	42960
	Green Manure-Untreated	73280	35060	38220
Basmati rice/	Summer Ploughing-Untreated	70540	37240	33300
Maize-Mustard	Summer Ploughing-Treated	79040	39540	39500
	Green Manure-Treated	81060	34640	46420
	Green Manure-Untreated	71680	32340	39340
2. Jabalpur (1 year)				
Basmati rice-D.Wheat	Unweeded control	79722	31900	47822
	Two hand weeding/mechanical	108606	38400	70206
	Spray of 3-4 leaf stage of weed	90779	31550	59229
	Two hand weeding/mechanical + Spray at 3-4 leaf stage of weed	115428	39900	75528
	Weed free	131034	42600	88434
3. Coimbatore (mean of 3 years)				
Maize/Rice - Rice/	Summer ploughing	54025	25583	28475
Black gram - Sesame/GM	Cultural methods of pest and disease management	55004	25017	29988
	Biological methods	56817	26507	30310
	Botanical methods	59779	28167	31642
	Physical,mechanical and behavioral methods	55863	27690	28173
	Cultural + Biological + Botanical+ Physical, mechanical and behavioral methods of pest and disease management	66965	29973	36985
	Control	35366	24290	11076

Table 16. Influence of weed, pest and disease management practices under organic farming on grain yield (kg/ha) of crops at various locations (2004-05 to 2009-10)

Cropping system	Weed, pest and disease management	Green Manure			Summer ploughing	
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*
1. Modipuram (1 year)						
Basmati rice- Wheat	T_1: *Kharif* : Solar seed treatment + two need based manual weeding after 20 days of transplanting + seedling root dipping with fermented produce of cow dung and urine, *Rabi*: Soil application of *Aspergillus niger* Var. AN 27 (Kalisena)	2556	2778	-	2556	1944
	T_2: *Kharif*: Soil application of *Trichoderma harzianum*+ two spray of neem oil at maximum tillering and panicle initiation stages, *Rabi*: Soil application of *Trichoderma harzianum*+ two sprays of neem oil	2611	2639	-	2667	2222
	T_3: *Kharif*: Soil application of neem cake and foliar application of *Trichoderma harzianum*, *Rabi*: Soil application of neem cake and installation of pheromone traps	2889	3111	-	2722	2667
	T_4: *Kharif*: Seed treatment with *Pseudomonas fluorescence* (PsF) + pheromone traps + *Trichogramma japonicum*, *Rabi*: Seed treatment with PsF and soil application of *Trichoderma harzianum*	2806	3167	-	2556	2917
	T_5: T_1 +T_3	2583	2639	-	2830	2555
	T_6: Control	2417	3111	-	2472	2222
Rice-Potato	T_1: *Kharif* : Solar seed treatment + two need based manual weeding after 20 days of transplanting + seedling root dipping with fermented produce of cow dung and urine, *Rabi*: Soil application of *Aspergillus niger* Var. AN 27 (Kalisena)	2972	7972	-	2444	7500
	T_2: *Kharif*: Soil application of *Trichoderma harzianum*+ two spray of neem oil at maximum tillering and panicle initiation stages, *Rabi*: Soil application of *Trichoderma harzianum*+ two sprays of neem oil	3389	8416	-	2861	7778
	T_3: *Kharif*: Soil application of neem cake and foliar application of *Trichoderma harzianum*, *Rabi*: Soil application of neem cake and installation of pheromone traps	3000	7778	-	2806	9166

Cropping system	Weed, pest and disease management	Green Manure			Summer ploughing	
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*
	T_4: *Kharif*: Seed treatment with *Pseudomonas fluorescence* (PsF) + pheromone traps +*Trichogramma japonicum*, *Rabi*: Seed treatment with PsF and soil application of *Trichoderma harzianum*	3333	8139	-	2500	7861
	T_5: T_1 +T_3	3333	8806	-	2861	7778
	T_6: Control	3111	8139	-	2806	7583
2. Jabalpur (mean of 4 years)						
Basmati rice-Wheat	T_1: *Kharif* : Control, *Rabi*: Control	3818	3072	-	3626	2989
	T_2: *Kharif*: Seed treatment with *Trichoderma sp*+ root dip in fermented urine + two spray of neem extract at tillering and panicle initiation stages., *Rabi:* Seed treatment withl *Trichoderma sp*	3847	3072	-	3665	2977
	T_3: *Kharif*: Solar seed treatment + root dip in fermented urine + two spray of neem extract at tillering and panicle initiation stages., *Rabi*: Solar treatment of seeds,	3837	3028	-	3597	2989
	T_4: *Kharif*: Soil application of *Pseudomonas fluorescence* (PsF)+ two spray of neem extract at tillering and panicle initiation stages., *Rabi*: Seed treatment with *Pseudomonas fluorescence* (PsF),	3919	3068	-	3668	3009
	T_5: *Kharif*:. Soil application of *Pseudomonas fluorescence* + light trap + bird preachers at earhead stage, *Rabi*: Seed treatment with (ii)+(iv) in 1:1 ratio	3858	3115	-	3655	3011
3. Coimbatore (mean of 5 years)						
Rice - Chickpea	T_1: *Kharif* : *Trichoderma viride*, *Rabi*: *Trichoderma viride*	3295	773	-	-	-
	T_2: *Kharif*: *Pseudomonas florescence*., *Rabi*: *Pseudomonas florescence*	3172	775	-	-	-
	T_3: *Kharif*: *Trichogramma* +Neen spray+Bird perches, *Rabi*: Spray of organic substanse+Bird perches	3264	755	-	-	-
	T_4: *Kharif*: Spray karanj oil+Marigold leaves extract+Cow urine + pheromone traps *Rabi*: Spray karanj oil+Merigold leaves extract + pheromone traps	3275	782	-	-	-

Cropping system	Weed, pest and disease management	Green Manure			Summer ploughing	
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*
	T_5: *Kharif*: Neem+Mahua cake+T_3 , *Rabi*: Neem+Mahua cake+T_3	3421	835	-	-	-
	T_6: *Kharif*: Neem+Mahua cake+T_4 , *Rabi*: Spent subtract of mushroom	3367	809	-	-	-
	T_7: *Kharif*: Achook spray + Neem gold spray *Rabi*: T_1 + use of HNPY	3214	829	-	-	-
	T8: *Kharif*: control, *Rabi*: control	2862	628	-	-	-
4. Raipur (mean of 3 years)						
Rice - Chickpea	T_1: *Kharif* : *Trichoderma viride*, *Rabi*: Trichoderma viride	3178	707	-	-	-
	T_2: *Kharif*: *Pseudomonas florescence*., *Rabi*: *Pseudomonas florescence*	3140	674	-	-	-
	T_3: *Kharif*: *Trichogramma* +Neem spray+Bird perches, *Rabi*: Spray of organic substanse+Bird perches	3190	719	-	-	-
	T_4: *Kharif*: Spray karanj oil+Merigold leaves extract+Cow urine + pheromone traps, *Rabi*: Spray karanj oil+Merigold leaves extract + pheromone traps	3303	711	-	-	-
	T_5: *Kharif*: Neem+Mahua cake+T_3 , *Rabi*: Neem+Mahua cake	3383	782	-	-	-
	T_6: *Kharif*: T5+T3, *Rabi*: Spent subtract of mushroom	3370	737	-	-	-
	T_7: *Kharif*: Neem product spray, *Rabi*: T_1 + use of HNPY	3101	750	-	-	-
	T_8: *Kharif*: control. , *Rabi*: control	2967	2628	-	-	-
5. Calicut (mean of 3 years)						
Ginger	T_1: Absolute control	14607	-	-	-	-
	T_2: .Media (Nutrient broth alone)	17647	-	-	-	-
	T_3: IISR-6, IISR-8, IISR-13, IISR-51, IISR-151, and PB21	18563	-	-	-	-
	T_4: IISR-6, IISR-8, IISR-13, IISR-51, IISR-151, and P1AR6	20067	-	-	-	-
	T_5: .IISR-6, IISR-8, IISR-13, IISR-51, IISR-151, and IISR-853	20687	-	-	-	-

Cropping system	Weed, pest and disease management	Green Manure			Summer ploughing	
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*
	T_6. IISR-6, IISR-8, IISR-13, IISR-51, IISR-151, and IISR-859	20947	-	-	-	-
	T_7. P26(Trichoderma)	19720	-	-	-	-
	T_8. .IISR-6, IISR-8, IISR-13, IISR-51, IISR-151, and PB21+P1AR6	22543	-	-	-	-
	T_9. Chemical control (COC-3%) / (Brodeaux mixture-1%) 2006-07	20990	-	-	-	-
Turmeric	T_1: Absolute control	23330	-	-	-	-
	T_2: .Media (Nutrient broth alone)	20467	-	-	-	-
	T_3: IISR-6, IISR-8, IISR-13, IISR-51, IISR-151, and PB21	22210	-	-	-	-
	T_4: IISR-6, IISR-8, IISR-13, IISR-51, IISR-151, and P1AR6	20473	-	-	-	-
	T_5: .IISR-6, IISR-8, IISR-13, IISR-51, IISR-151, and IISR-853	22473	-	-	-	-
	T_6. IISR-6, IISR-8, IISR-13, IISR-51, IISR-151, and IISR-859	21240	-	-	-	-
	T_7. P26(Trichoderma)	21223	-	-	-	-
	T_8. .IISR-6, IISR-8, IISR-13, IISR-51, IISR-151, and PB21+P1AR6	21150	-	-	-	-
	T_9. Chemical control (COC-3%) / (Brodeaux mixture-1%) 2006-07	21810	-	-	-	-
6. Dharwad (mean of 3 years)						
Chilli	T_1: *Verticillium lecani*+Eco neem(neem product) Neem seed kernel extract+botanicals Panchagavvya + Neem seed kernel extract Ha NPV	1734	-	-	-	-
	T_2: Verticillium lecani+Econeem(neem product) Neem seed kernel extract+botanicals Panchagavvya+Neem seed kernel extract Ha NPV GCA extract Release of *Trichogramma chilonis* @150000/acre	2146	-	-	-	-
	T_3: Verticillium lecani+Econeem(neem product) Panchagavvya+ Neem seed kernel extract NSKE+cow urine Botanical muixture+ sulphur Aver mactin benzote	2111	-	-	-	-
	T_4: KK herbal products Metarhyzium,Nomuraea spray NSKE+ cow urine Bio - dynamic muixture+sulphur Aver mactin benzote	1898	-	-	-	-

Cropping system	Weed, pest and disease management	Green Manure			Summer ploughing	
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*
7. Karjat (mean of 5 years)						
Mango	T_1: 150kg FYM+20kgGlyricidia as a basal dose/tree	2433	-	-	-	-
	T_2: 300kg FYM+20kgGlyricidia as a basal dose/tree	1803	-	-	-	-
	T_3: 155kg Glyricidia as a basal dose/tree	1707	-	-	-	-
	T_4: 290kg Glyricidia as a bbasal dose/tree	1780	-	-	-	-
	T_5: Vermicompost 50kg+20kgGlyricidia as a basal dose/tree	2619	-	-	-	-
	T_6: Vermicompost 100 kg+20kg Glyricidia as a basal dose/tree	5689	-	-	-	-
	$T_{7:}$ Control	836	-	-	-	-
8. Ludhiana (mean of 3 years)						
Rice - Wheat	T_1: Root dipping in cow dung and urine , GM+ Manual weeding	4283	3797	-	-	-
	T_2: Soil application of *Trichoderma harzianum*+2 sprays of neem oil	4160	3900	-	-	-
	T_3: Seed treatment of neem cake + 2 sprays of *Trichoderma harzianum*	4480	3747	-	-	-
	T_4: Seed treatment with PsF + pheromone traps+ *Trichogramma* releases	4137	3710	-	-	-
	T_5. Root dipping in cow dung and urine+Soil application of neem cake+2 sprays of *Trichoderma harzianum* , GM+Manual weeding+Soil application of neem cake+2 sprays of *Trichoderma harzianum*	4407	3753	-	-	-
Ludhiana (2007-08)						
Basmati Rice - Wheat	T_1: *Kharif* : *T.chilonis/T.japonicum*+foliar application of PsF, *Rabi*: Sorghum extract	3442	2030	-	-	-
	T_2: *Kharif*: *T.chilonis/T.japonicum*+Bt. Spray+foliar application of *Trichoderma harzianum*., *Rabi*: Sorghum extract	3526	1925	-	-	-
	T_3: *Kharif*: *T.chilonis/T.japonicum*+neem oil Spray+foliar application of *Trichoderma harzianum* and PsF, *Rabi*: Sorghum extract	3469	1880	-	-	-
	T_4: *Kharif*: Control, *Rabi*: Rice straw mulch	3214	2075	-	-	-
	T_5:, *Rabi*: Hand weeding	-	2095	-	-	-
	T_6: *Rabi*: Unweeded control	-	2025	-	-	-

Cropping system	Weed, pest and disease management	Green Manure			Summer ploughing	
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*
9. Bajaura (mean of 4 years)						
Tomato- Cabbage	T_1: *Bacillus thuringienses* var kurstaki	22137	-	-	-	-
	T_2: Aqueous neem seed kernel extract	22810	-	-	-	-
	T_3: Aqueous leaf extract of karvi	23402	-	-	-	-
	T_4: Aqueous leaf extract of eucalyptus	21785	-	-	-	-
	T_5: Aqueous leaf extract of kaner (*Nerium sp.)*	21832	-	-	-	-
	T_6: Aqueous leaf extract of bhang(*Cannabis sativa*),	23592	-	-	-	-
	T_7: Aqueous leaf extract of darek (*Melia sp.*)	23077	-	-	-	-
	T_8: Control (crop without any spray)	22407	-	-	-	-
10. Umiam (mean of 2 years)						
Maize + Soybean -Tomato	T_1 Control	2461	987	13000	-	-
	T_2: Neem oil @ 5ml/lit	2634	1268	10345	-	-
	T_3: Panchgavya 3%	2505	1115	14130	-	-
	T_4: *T. roseum*+ *Beauveria bassiana* @ 5g/lit., *Beauveria* (w.e.f. Feb. 2009)	2506	1108	11743	-	-
	T_5:, Compost tea (10ml*lit.), Karanjin @ 3ml/lit.(w.e.f. Feb. 2009)	2532	1122	11730	-	-
	T_6: Tricho cards (50000/ha), Anonine @ 3ml/lit.(w.e.f. Feb. 2009)	3416	1348	13410	-	-
	T_7. Karanjin @ 3ml/lit. Botanicals (w.e.f. Feb. 2009)	3500	1391	12228	-	-
	T_8. Anonine @ 3ml/lit., Panchgavya 3%+lantana leaf extract 10%+vermiwash 10% (w.e.f. Feb. 2009)	3452	1363	14405	-	-
	T_9. Botanicals , Karanjin +panchagavya (w.e.f. Feb. 2009)	2483	1054	8985	-	-
	T_{10}. Panchgavya 3%+lantana leaf extract 10%+vermiwash 10%, Karanjin 3ml/lit.+panchgavya 3%+cow urine 3% (w.e.f. Feb. 2009)	3019	1228	13285	-	-

Table 17. Influence of weed, pest and disease management practices under organic farming on straw yield (kg/ha) of crops at various locations (2004-05 to 2009-10)

Cropping system	Weed, pest and disease management (Treatment details in Table 16)	Green Manure			Summer ploughing	
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*
1. Modipuram (1 year)						
Basmati rice-Wheat	T_1	4950	3056	-	4944	2972
	T_2	4292	3194	-	4035	2500
	T_3	4938	3917	-	4104	2889
	T_4	4798	3583	-	4202	3278
	T_5	4660	3111	-	4349	2639
	T_6	3590	3639	-	3965	2694
Rice-Potato	T_1	3111	-	-	2694	-
	T_2	3250	-	-	3056	-
	T_3	3556	-	-	3194	-
	T_4	3750	-	-	2861	-
	T_5	3778	-	-	3250	-
	T_6	3417	-	-	3056	-
2. Jabalpur (mean of 4 years)						
Basmati rice-Wheat	T_1	7110	4828	-	7248	4654
	T_2	7406	4860	-	7362	4659
	T_3	7295	4794	-	7171	4542
	T_4	7420	4795	-	7271	4617
	T_5	7002	4927	-	6890	4504
3. Coimbatore (mean of 5 years)						
Rice - Chickpea	T_1	5148	-	-	-	-
	T_2	4957	-	-	-	-
	T_3	5229	-	-	-	-
	T_4	5101	-	-	-	-
	T_5	5554	-	-	-	-
	T_6	4961	-	-	-	-
	T_7	5140	-	-	-	-
	T_8	4561	-	-	-	-

Cropping system	Weed, pest and disease management (Treatment details in Table 16)	Green Manure			Summer ploughing	
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*
4. Raipur (mean of 3 years)						
Rice - Chickpea	T_1	5092	1283	-	-	-
	T_2	5029	1205	-	-	-
	T_3	4920	1240	-	-	-
	T_4	5292	1280	-	-	-
	T_5	5468	1432	-	-	-
	T_6	5340	1359	-	-	-
	T_7	4891	1345	-	-	-
	T_8	4680	1174	-	-	-
5. Dharwad (mean of 3 years)						
Chilli	T_1	2124	-	-	-	-
	T_2	2763	-	-	-	-
	T_3	2794	-	-	-	-
	T_4	2636	-	-	-	-
6. Ludhiana (mean of 3 years)						
Rice - Wheat	T_1	12250	5550	-	-	-
	T_2	10185	5690	-	-	-
	T_3	13165	5245	-	-	-
	T_4	12135	5395	-	-	-
	T_5	12440	5190	-	-	-
Ludhiana (2007-08)						
Basmati Rice - Wheat	T_1	18927	3845	-	-	-
	T_2	18565	3695	-	-	-
	T_3	18302	3660	-	-	-
	T_4	17115	4015	-	-	-
	T_5	-	3635	-	-	-
	T_6	-	3685	-	-	-
7. Umiam (mean of 2 years)						
Maize - Soybean -Tomato	T_1	9438	1212	813	-	-
	T_2	8771	1389	767	-	-
	T_3	7610	1369	903	-	-
	T_4	6741	1382	848	-	-
	T_5	6887	1325	847	-	-
	T_6	7137	1523	906	-	-
	T_7	6973	1538	829	-	-
	T_8	6853	1533	929	-	-
	T_9	6403	1323	824	-	-
	T_{10}	6620	1425	830	-	-

Table 18. Influence of weed, pest and disease management practices under organic farming on soil physical and chemical properties after cropping cycle at various locations (2004-05 to 2009-10)

Cropping system	Weed, pest and disease management *(Treatment details in Table 16)*	BD (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
1. Raipur (1 year)								
Rice - Chickpea	T_1	1.35	7.2	0.21	6.1	230	16	258
	T_2	1.37	7.3	0.19	6.2	221	15	254
	T_3	1.35	7.3	0.23	6.0	232	16	264
	T_4	1.34	7.3	0.21	6.0	241	15	258
	T_5	1.33	7.4	0.20	6.6	246	17	269
	T_6	1.35	7.1	0.20	6.2	250	15	262
	T_7	1.33	7.4	0.18	6.7	226	15	257
	T_8	1.37	7.2	0.20	6.0	217	15	254
2. Ludhiana I (mean of 3 years)								
Rice - Wheat	T_1	-	7.4	0.19	0.48	222	64	161
	T_2	-	7.4	0.17	0.48	233	68	143
	T_3	-	7.3	0.18	0.50	223	63	142
	T_4	-	7.4	0.17	0.47	234	67	145
	T_5	-	7.9	0.17	0.50	224	64	146
Ludhiana II (mean of 2 years)								
Basmati Rice - Wheat	T_1	-	7.1	0.17	0.68	302	60	150
	T_2	-	7.1	0.16	0.70	282	66	144
	T_3	-	7.1	0.20	0.71	291	62	158
	T_4	-	7.1	0.18	0.60	288	63	141

Table 19. Influence of weed, pest and disease management practices under organic farming on soil microbial population (x10⁴ CFU/g) after cropping cycle at various locations (2004-05 to 2009-10)

Cropping system	Weed, pest and disease management *(Treatment details in Table 16)*	Fungi	Bacteria	Actinomycetes
1. Calicut (1 year)				
Ginger	T_1	15.2	17.5	10.2
	T_2	16.2	40.0	12.4
	T_3	12.5	15.6	19.6
	T_4	14.1	38.3	10.4
	T_5	7.6	44.1	7.8
	T_6	15.1	19.9	7.2
	T_7	15.9	32.6	13.6
	T_8	6.7	51.5	16.4
	T9	9.3	26.2	19.2
Turmeric	T_1	9.8	20.6	2.2
	T_2	14.5	30.0	10.8
	T_3	8.7	16.1	25.2
	T_4	7.9	16.3	-
	T_5	5.8	66.1	12.4
	T_6	14.3	30.0	10.4
	T_7	8.1	19.4	11.4
	T_8	8.1	111.5	11.0
	T_9	9.7	14.8	-
2. Ludhiana (mean of 2 years)				
Rice -Wheat	T_1	61.2	32.9	47.4
	T_2	77.9	29.7	57.9
	T_3	88.2	33.2	53.5
	T_4	102.0	33.3	53.9
	T_5	92.2	31.3	60.5
Ludhiana (2007-08)				
Basmati Rice - Wheat	T_1	16.5	21.9	13.0
	T_2	23.1	17.9	19.0
	T_3	20.5	26.9	11.2
	T_4	15.0	18.1	11.4

Table 20. Influence of weed, pest and disease management practices under organic farming on economics of cropping systems at various locations (2004-05 to 2009-10)

Cropping system	Weed, pest and disease management (*Treatment details Table 16)*	Green Manure				Summer ploughing			
		Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
1. Modipuram (1 year)									
Basmati rice- Wheat	T_1	76350	47945	28450	-	67154	47945	19209	-
	T_2	75827	48805	27022	-	70505	48055	22450	-
	T_3	87911	54700	33211	-	76827	53950	22877	-
	T_4	85391	48620	36771	-	77912	47870	30042	-
	T_5	79007	54700	24307	-	73548	53950	19598	-
	T_6	79053	48595	30458	-	67995	47485	20150	-
Rice-Potato	T_1	79738	70478	9260	-	72689	69728	2961	-
	T_2	85787	70698	15079	-	77564	69948	7616	-
	T_3	88984	82383	6601	-	77239	81633	-4394	-
	T_4	83483	70723	12760	-	75790	69973	5817	-
	T_5	88484	79483	9001	-	77612	78733	-1121	-
	T_6	81974	70278	11696	-	75734	69528	6206	-
2. Jabalpur (mean of 4 years)									
Basmati rice- Wheat	T_1	112112	39750	72362	2.78	97857	38825	59032	2.49
	T_2	112901	39750	73151	2.82	96945	38825	58120	2.47
	T_3	112268	39750	72518	2.78	96471	38825	57646	2.47
	T_4	113686	39775	73929	2.81	97704	38825	58879	2.49
	T_5	110694	39600	71095	2.77	97773	38575	59198	2.51

Cropping system	Weed, pest and disease management (*Treatment details Table 16)*	Green Manure				Summer ploughing			
		Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
3. Coimbatore (1 year)									
Rice - Chickpea	T_1	74494	25553	48942	-	-	-	-	-
	T_2	72288	25553	46736	-	-	-	-	-
	T_3	74383	25767	48616	-	-	-	-	-
	T_4	74984	25981	49004	-	-	-	-	-
	T_5	78565	28123	50442	-	-	-	-	-
	T_6	73375	28767	44609	-	-	-	-	-
	T_7	73756	26196	47561	-	-	-	-	-
	T_8	54541	25339	29202	-	-	-	-	-
4. Raipur (mean of 3 years)									
Rice - Chickpea	T_1	48878	24267	28418	-	-	-	-	-
	T_2	51393	24267	27230	-	-	-	-	-
	T_3	52947	24471	28582	-	-	-	-	-
	T_4	54151	24674	29268	-	-	-	-	-
	T_5	55454	26709	29526	-	-	-	-	-
	T_6	55159	27320	28149	-	-	-	-	-
	T_7	52446	24478	27851	-	-	-	-	-
	T_8	49142	24064	29346	-	-	-	-	-
5. Dharwad (mean of 2 years)									
Chilli	T_1	24444	12460	11170	1.90	-	-	-	-
	T_2	28278	12660	15195	2.20	-	-	-	-
	T_3	26944	12880	13827	2.08	-	-	-	-
	T_4	18360	10295	10810	2.08	-	-	-	-

Cropping system	Weed, pest and disease management (*Treatment details Table 16)*	Green Manure				Summer ploughing			
		Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
6. Karjat (mean of 5 years)									
Mango	T_1	79064	33076	45188	2.82	-	-	-	-
	T_2	101574	47553	53997	2.74	-	-	-	-
	T_3	82510	26964	55547	3.58	-	-	-	-
	T_4	83368	32372	50996	2.79	-	-	-	-
	T_5	118251	40247	69697	2.72	-	-	-	-
	T_6	195436	72417	123019	3.31	-	-	-	-
	T_7	30485	52023	14318	2.90	-	-	-	-
7. Bajaura (mean of 2 years)									
Tomato- Cabbage	T_1	40385	40751	-366	-	-	-	-	-
	T_2	38325	39401	-1076	-	-	-	-	-
	T_3	44460	41351	5059	1.08	-	-	-	-
	T_4	45000	37851	7149	1.19	-	-	-	-
	T_5	46555	38351	8204	1.21	-	-	-	-
	T_6	42865	38351	4514	1.12	-	-	-	-
	T_7	41765	36851	4914	1.13	-	-	-	-
	T_8	30485	34751	-4266	-	-	-	-	-

7.4 Weed management under organic farming

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

Objectives: To study on the effect of weed management treatments on weed dynamics, crop 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 center but they vary from location to location. The number of cropping systems tested at each location ranges from 2 to 3. The details of treatments are given in Table 21 along with experimental results.

Locations

S.I.No	Centre	Year of start	Number of years
1.	Coimbatore	2005-06	3
2.	Pantnagar	2007-08	1
3.	Ranchi I set, II set	2009-10, 2007-08	1, 1
4.	Umiam	2007-08	2

Results

Coimbatore (Table 21, 23, 24, 27 and 28)

Five weed management practices involving stale seed bed, hand weeding, inter cropping and mechanical weeding were evaluated along with unweeded control in two cropping systems namely blackgram-sorghum-sesame and sunflower-cotton-green manure for three years. In all the crops, hand weeding twice recorded higher yield followed by mechanical weeder +hand weeding once. The difference between the two treatments are found to be only 3, 4, 8.7, and 6.8% for blackgram, sorghum, sesame, sunflower and cotton respectively. On an average, 68.5% reduction in yield was observed with unweeded control in blackgram-sorghum-sesame system while it is only 29.5% with sunflower-cotton-green manure system. Higher count of fungi, bacteria and actinomycetes were observed with mulching +hand weeding once followed by inter cropping with *dhaincha* as smother crop and its incorporation with one hand weeding. An increase of 60% , 40% and 62% count was observed in fungi, bacteria and actinomycetes respectively with mulching + one hand weeding over unweeded control. Even though gross return was higher with two hand weeding, mechanical weeder +one hand weeding recorded higher net returns (₹ 38097 ha^{-1}), which is 24.8% higher than two hand weeding. Around 30% lesser cost of cultivation in mechanical weeder + one hand weeding than two hand weeding was observed inferring the mechanical method of weed control is essentially to be integrated in organic system.

Pantnagar (Table 21, 22, 25, 26 and 28)

Four weed control practices involving stale bed, and hand weeding were evaluated in three cropping systems namely basmati rice-wheat, basmati rice-lentil and basmati rice-*brassiaca napus* for one year. The results reveals that higher grain yield of rice and lentil was observed with 2 hand hoeing at 20 and 40 days after sowing during *rabi*. Mustard (*Brassica napus*) yield was found to be higher with stale bed + 2 hand hoeing at 20 and 40 DAS (915 kg ha^{-1}) followed by 2 hand hoeing alone (840 kg ha^{-1}). The wheat with either two hand weeding at 20 and 40 DAS alone or with stale bed technique during *rabi*

season. The % increase in yield with either 2 hand weeding or stale bed + 2 hand weeding over stale bed alone was found to be 12.6% 75%, 58.3% and 143% in rice, wheat, lentil and mustard. What was true in terms of grain yield was also true for straw yield of all the crops. No significant variation in soil physical (bulk density) and chemical properties (pH, EC, OC, and P) was observed among the weed control treatments as well as various cropping systems. However, K was found to vary with weed management treatment in basmati rice-wheat system while organic carbon and available nitrogen varied significantly with basmati rice-lentil and basmati rice-*Brassica napus* systems. Around 15% higher K was observed with two hand hoeing at 20 and 40 DAS over stale bed alone in basmati rice-wheat system while it is 12.5% higher organic carbon and 3.2 % higher available N in the same treatment over stale bed alone in basmati rice-lentil system. In basmati rice-*Brassica napus* system, 12% higher organic carbon and 5.5% higher available N was observed with stale bed +2 hand hoeing at 20 and 40 DAS in *rabi* over 2 hand hoeing alone indicating the beneficial effect of stale bed in basmati rice-*Brassica napus* system. Though not much variation in micronutrients such as Mn, Zn, Cu and Fe are observed, 2 hand hoeing at 20 and 40 DAS recorded higher Mn, Zn and Cu in basmati rice-wheat system, higher Zn and Cu in basmati rice–lentil system and Fe in basmati rice-brassica napus system. It was also found that stale bed alone contributed higher Fe in basmati rice-wheat system and Zn and Cu in basmati rice-*Brassica napus* system. Compared to other management practices, combination of stale bed and either 1 or 2 hand hoeing contributed to raise in the levels of Mn and Fe in basmati rice-lentil system and Mn in basmati rice-*Brassica napus* system. In terms of economics, stale bed alone during *rabi* recorded lower cost of cultivation in all the systems which ranged from ₹ 31462 to ₹ 34065 ha^{-1}. Gross, net returns and B:C ratio was found to be higher with 2 hand hoeing at 20 and 40 DAS (₹ 58818 ha^{-1}, ₹ 24087 ha^{-1} and 1.03 respectively in basmati rice-wheat system. In basmati rice-lentil and basmati rice-brassica napus system, it was found that combination of stale bed +2 hand hoeing at 20 and 40 DAS was found to record higher gross, net returns and B:C ratio. The increase in net returns over stale bed and 2 hand hoeing alone was worked out to be 45.7% and 23.8% for basmati rice-lentil and 57% and 4% for basmati rice-*Brassica napus* system respectively in the combined treatment of stale bed with 2 hand hoeing at 20 and 40 DAS.

Ranchi (Table 21, 22, 24, 25 and 28)

Two set of experiments were conducted using various weed management strategies in three cropping systems namely basmati rice-wheat, basmati rice-linseed and basmati rice-mustard for one year. The results reveals that keeping the field weed free with manual method are found to be better for basmati rice as it registered 135% higher yield than unweeded control. This was closely followed by spraying of aqueous leaf extract at 3-4 leaf stages of weeds with two hand hoeing. The same treatments i.e. either weed free (manual) or spray of aqueous leaf extract +two hand hoeing recorded higher wheat (29.5%) and lentil yield (78%) than unweeded control. In the other set of treatments, it was observed that weeding by conoweeder twice at 25 and 40 DAT during *kharif* and stale bed with 1 hand weeding at 30 DAT during *rabi* was found to increase the yield of basmati rice by 9.7% than only with hand weeding twice during *kharif* and *rabi.* Wheat, lentil and mustard recorded higher grain yield of 2364, 1489 and 490 kg ha^{-1} respectively with weeding by conoweeder at 25 DAT + hand weeding at 40 DAT during *kharif* and stale bed +2 hand weeding at 30 and 40 DAS during *rabi*. The yield increase was found to be 9.2, 21.8% and 67.8% in wheat, lentil and mustard respectively over two hand weeding each during *kharif* and *rabi* in wheat, lentil and weeding with conoweeder in *kharif* and stale bed in *rabi* in mustard which registered lower yield among the various weed management options . Straw yield recorded the same trend as that grain yield of other crops. No significant variation in physical and chemical properties of soil was observed in all the cropping systems. Organic carbon content of soil ranged from 0.47 to 0.56%. Though weeding by conoweeder once at 25 DAT +hand weeding once at 40 DAT in *kharif* and stale bed + 2 hand weeding at 30 and 40 DAS recorded higher net returns, the B: C ratio was found to be higher with weeding by conoweeder twice at 25 and 40 DAT in *kharif* and stale bed + 1 hand weeding at 30 DAS in *rabi* (4) under basmati rice-wheat system. In basmati rice-lentil system, net returns (₹ 79121 ha^{-1}) and B: C ratio (5.07) was found to be better with weeding by conoweeder once at 25 DAT + hand weeding once at 40

DAT during *kharif* and stale bed +2 hand weeding at 30 and 40 DAS during *rabi*. B: C ratio of 3.56 was recorded in basmati rice-mustard system with each two hand weedings during *kharif* and *rabi* even though net return of ₹ 58016 ha^{-1} was recorded with weeding by conoweeder, stale bed and hand weeding combination during *kharif* and *rabi* seasons. Among the three cropping systems, basmati rice-lentil recorded higher B:C ratio (4.9) followed by basmati rice-wheat (3.6) and basmati rice-mustard (3.4) systems.

Umiam (Table 21, 23 and 25)

Eight treatments involving mechanical, mulching, intercropping and hand weeding methods were evaluated alone with weed free and weedy checks in maize-mustard system for 2 years. Maize and mustard recorded higher yield in mulching with fresh *Eupatorium* / *Ambrosia* + one hand weeding followed by mulching with fresh *eupatorium* / *Ambrosia* (after earthing up) alone. The yield increase in maize under mulching +hand weeding was found to be 35.4 and 47% higher than weed free and weedy checks respectively. In case of mustard, yield difference of 93 and 87% was observed over weed free and weedy checks. Lower yield of maize was observed in weedy check while inter cropping with soybean (2:2) + one hand weeding recorded lower yield in mustard. Among the weed control treatments, mulching with fresh *Eupatorium*/*Ambrosia* + one hand weeding recorded higher organic carbon (2%) which is 67% higher than the weedy and 9.2% higher than weed free checks. No significant variation in soil pH,, available N and K was observed among weed control practices. Higher available P was observed in mulching +hand weeding followed by mulching with *Eupatorium/Ambrosia* alone. The increase in available P was observed to be 79% over weedy check while it is only 17% over weed free check. Available N and K were found to increase 5.2 and 13.1% only in mulching + hand weeding over weedy check.

Table 21. Influence of weed management practices under organic farming on grain yield (kg/ha) of crops at various locations (2004-05 to 2009-10)

Cropping system/ weed management practices	Black gram-Sorghum-Sesame			Sunflower-Cotton-Green manure			-		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
1. Coimbatore (mean of 3 years)									
W_1: Stale seedbed + HW once	459	3099	525	1127	1030	-	-	-	-
W_2: Mulching + HW once	486	3321	575	1173	989	-	-	-	-
W_3: Hand weeding twice	575	3531	698	1353	1323	-	-	-	-
W_4: Intercropping with smothering crop (*Dhaincha*) and incorporation + HW once	511	3173	603	1077	983	-	-	-	-
W_5: Mechanical Weeder + HW once	557	3385	642	1337	1239	-	-	-	-
W_6: Unweeded control	258	388	268	918	954	-	-	-	-

Cropping system/ weed management practices	Black gram-Sorghum-Sesame			Sunflower-Cotton-Green manure			-		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
2. Pantnagar (1 year)	**Basmati rice -Wheat**			**Basmati rice–Lentil**			**Basmati rice-*Brassica napus***		
W_1: *Rabi:* Stale Bed	2835	1088	-	-	799	-	-	376	-
W_2: *Rabi:* Stale Bed + 1 Hand hoeing at 20 DAS	2924	1630	-	-	1190	-	-	734	-
W_3: *Rabi:* Stale Bed + 2 Hand hoeing at 20 DAS & 40DAS	3027	1910	-	-	1193	-	-	915	-
W_4: *Rabi:* 2 Hand hoeing at 20 DAS & 40DAS	3195	1900	-	-	1265	-	-	840	-
3. Ranchi I (1 year)	**Basmati rice - Wheat**			**Basmati rice - Linseed**			**-**		
W_1: Unweeded control	1069	1818	-	1069	450	-	-	-	-
W_2: Two hand hoeing	2351	2273	-	2351	690	-	-	-	-
W_3: Aqueous leaf extract at 3-4 leaf stage of weeds	1466	1879	-	1466	500	-	-	-	-
W_4: Two hand hoeing + Aqueous leaf extract at 3-4 leaf stage of weeds	2489	2242	-	2489	720	-	-	-	-
W_5: Weedfree (manual)	2519	2354	-	2519	800	-	-	-	-
W_6: One hand weeding/ hoeing+Aqueous leaf extract at 3-4 leaf stage of weeds	1664	2151	-	1664	540	-	-	-	-
Ranchi II (1 year)	**Basmati rice -Wheat**			**Basmati rice – Lentil**			**Basmati rice -Mustard**		
W_1: *Kharif:* Weeding by cono weeder once at 25 DAT*Rabi:* Stale Bed	3164	1818	-	3076	1155	-	3129	292	-
W_2: *Kharif:* Weeding by cono weeder twice at 25 and 40 DAT*Rabi:* Stale Bed + 1 Hand Weeding at 30 DAS	3413	2091	-	3164	1244	-	3396	467	-
W_3: *Kharif:* Weeding by cono weeder once at 25 DAT + Hand Weeding once at 40DAT *Rabi:* Stale Bed + 2Hand Weeding at 30 & 40 DAS	3307	2364	-	3093	1489	-	3236	490	-
W_4: *Kharif:* Hand Weeding twice at 25 and 40 DAT*Rabi:* 2 Hand Weeding at 30 & 40 DAS	3111	2030	-	2898	1222	-	2880	452	-

Cropping system/ weed management practices	Black gram-Sorghum-Sesame			Sunflower-Cotton-Green manure			-		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
4. Umiam (2 year mean)	**Maize - Mustard**			**Maize - Mustard**			**-**		
W_1: Mechanical weeding (20DAS) + HW once	2900	1030	-	6330	1360	-	-	-	-
W_2: Mulching with fresh Eupatorium/Ambrosia (after earthing up)	3640	1210	-	8770	1760	-	-	-	-
W_3: Mulching with fresh Eupatorium/Ambrosia+ HW once	3780	1490	-	8990	1930	-	-	-	-
W_4: Intercropping with soybean(2:2) + HW once	2310	890	-	6280	890	-	-	-	-
W_5: Soybean green manure incorporation in situ(1:1)+ HW once	3080	1010	-	8730	1480	-	-	-	-
W_6: Hand weeding twice	2980	944	-	6210	1080	-	-	-	-
W_7: Weed free Check	3010	1000	-	6640	1000	-	-	-	-
W_8: Weedy check	2570	760	-	6100	1030	-	-	-	-

Table 22. Influence of weed management practices under organic farming on straw yield (kg/ha) of crops at various locations (2004-05 to 2009-10)

Cropping system/ weed management practices (Treatment details in Table 21)	Basmati rice-Wheat		Basmati rice – Lentil		Basmati rice-*Brassica napus*	
	Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*
1. Pantnagar (1 year)						
W_1	4897	3363	-	4071	-	2088
W_2	5672	3395	-	3949	-	2742
W_3	6312	3696	-	3647	-	3781
W_4	6820	3587	-	3872	-	3563
2. Ranchi I (1 year)	**Basmati rice-Wheat**		**Basmati rice-Linseed**		-	
W_1	1788	3027	1788	875	-	-
W_2	3585	2482	3585	1127	-	-
W_3	2518	3245	2518	938	-	-
W_4	3794	3573	3794	1246	-	-
W_5	3820	3646	3820	1421	-	-
W_6	2712	3245	2712	1022	-	-
Ranchi II (1 year)	**Basmati rice -Wheat**		**Basmati rice – Lentil**		**Basmati rice -Mustard**	
W_1	3861	2129	3752	2010	3817	500
W_2	4267	2539	3956	2170	4244	806
W_3	4067	2875	3805	2597	3980	863
W_4	3764	2487	3506	2119	3456	767

Table 23. Influence of weed management practices under organic farming on weed count (no's/m²) of crops at various locations

Cropping system/ weed management practices (Treatment details in Table 21)	*Kharif*			*Rabi*			*Summer*		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
1. Coimbatore (Blackgram-sorghum-sesame									
2005-06									
W_1	76.3	72.0	57.0	54.0	68.0	47.0	69.6	53.6	47.0
W_2	68.3	61.0	44.0	46.0	54.0	27.3	57.3	52.0	46.6
W_3	53.6	47.6	33.0	30.0	40.0	20.0	26.0	56.3	44.6
W_4	73.0	69.3	55.3	54.3	60.3	36.6	52.6	56.6	48.0
W_5	63.6	53.6	40.3	42.0	45.3	33.0	32.3	53.6	45.3
W_6	155.3	269.3	171.3	124.6	264.6	77.0	129.3	243.3	201.3
2006-07									
W_1	80.9	74.1	51.0	54.0	65.2	44.1	75.8	80.1	69.8
W_2	70.1	65.7	47.0	45.7	51.3	26.1	59.4	71.3	62.7
W_3	54.8	43.1	30.1	29.3	35.4	15.0	28.0	59.4	40.5
W_4	75.7	64.2	54.5	49.1	40.7	31.2	64.3	64.3	59.7
W_5	62.0	54.8	39.0	37.2	41.3	30.7	34.7	61.4	49.2
W_6	164.8	290.1	197.3	133.7	291.4	100.2	140.3	268.9	217.8
2. Raipur (Rice-mustard)									
Weedy check	-	27.4	-	-	151.3	-	-	-	-
Use of cono weeder with square planting	-	8.8	-	-	90.9	-	-	-	-
One hand weeding at 25-30 DAT	-	13.1	-	-	50.7	-	-	-	-
Two hand weeding at 25-30 and 45-50 DAT	-	3.4	-	-	11.7	-	-	-	-
Aqueous spray at 15-20 DAT+1 HW at 40-50 DAT	-	7.1	-	-	16.6	-	-	-	-
3. Umiam (Maize-toria)									
W_1	100.5	35.5	-	-	-	-	-	-	-
W_2	253.5	99.0	-	-	-	-	-	-	-
W_3	185.0	84.0	-	-	-	-	-	-	-
W_4	150.5	50.0	-	-	-	-	-	-	-
W_5	359.5	101.5	-	-	-	-	-	-	-
W_6	260.0	96.0	-	-	-	-	-	-	-
W_7	-	-	-	-	-	-	-	-	-
W_8	365.5	98.5	-	-	-	-	-	-	-

Table 24. Influence of weed management practices under organic farming on NPK uptake by crops and NPK removal by weeds at Coimbatore and Ranchi

Cropping system/ weed management practices (Treatment details in Table 21)	NPK uptake by crop (kg/ha)									NPK removal by weeds (kg/ha)								
	Kharif			Rabi			Summer			Kharif			Rabi			Summer		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
1. Coimbatore (Blackgram-sorghum-sesame)																		
2005-06																		
W_1	20.9	10.5	19.9	125.8	13.9	128.6	35.1	9.2	45.5	12.0	2.6	13.2	13.4	3.4	13.4	16.1	3.6	13.1
W_2	22.3	11.3	20.5	131.5	14.6	134.2	36.5	10.3	49.9	10.9	1.9	12.4	11.7	2.2	11.9	13.1	2.3	12.7
W_3	26.5	12.8	22.9	145.2	16.5	146.5	53.8	11.5	56.8	9.3	0.9	10.7	10.7	1.1	10.8	9.2	1.2	11.2
W_4	21.5	10.8	20.4	128.5	14.3	129.5	35.8	9.9	48.6	11.3	2.1	12.9	12.3	2.7	12.6	15.7	3.1	12.9
W_5	23.4	11.7	21.6	135.6	15.8	139.8	49.2	10.9	51.4	9.9	1.3	11.3	11.2	1.8	11.7	10.7	1.9	12.0
W_6	15.6	9.2	18.2	102.5	10.2	100.4	23.3	6.5	32.5	26.9	3.8	19.8	26.7	5.1	21.8	25.7	4.9	20.5
2006-07																		
W_1	21.6	10.9	20.0	128.6	15.0	132.2	38.6	9.9	48.2	13.4	4.2	14.8	14.8	4.9	14.9	17.8	4.9	15.4
W_2	23.5	11.9	20.7	134.8	15.2	139.8	40.2	11.6	50.1	11.4	2.8	13.2	12.9	4.0	13.2	15.2	3.2	13.9
W_3	27.2	12.9	21.9	149.8	17.2	149.8	55.7	13.6	58.2	10.2	1.9	12.6	11.9	3.2	11.9	11.0	3.2	12.9
W_4	22.6	11.2	20.2	131.9	15.1	131.6	39.5	10.8	50.1	12.8	3.4	13.8	14.4	4.0	13.9	17.2	4.5	14.6
W_5	24.8	12.2	21.2	139.8	16.9	142.6	51.6	12.8	53.5	10.4	2.2	12.3	13.1	3.8	12.7	11.8	4.1	13.1
W_6	16.8	9.8	18.9	109.8	11.1	102.6	29.8	7.5	34.5	27.4	4.9	21.2	27.6	6.9	22.8	26.9	5.8	22.3
2. Ranchi I (Rice-wheat & Rice-linseed) (2009-10)																		
W_1	23.7	9.9	34.9	29.1	8.0	26.3	-	-	-	-	-	-	-	-	-	-	-	-
W_2	41.6	15.3	47.7	52.7	9.7	35.0	-	-	-	-	-	-	-	-	-	-	-	-
W_3	25.6	11.9	39.0	32.6	8.3	30.6	-	-	-	-	-	-	-	-	-	-	-	-
W_4	41.6	16.0	45.2	56.2	9.5	28.6	-	-	-	-	-	-	-	-	-	-	-	-
W_5	47.9	17.8	52.2	66.8	10.2	33.7	-	-	-	-	-	-	-	-	-	-	-	-
W_6	31.1	14.0	39.1	39.7	9.3	32.5	-	-	-	-	-	-	-	-	-	-	-	-

Table 25. Influence of weed management practices under organic farming on soil physical and chemical properties after the cropping cycle at various locations (2004-05 to 2009-10) (BD: g/cc, EC: dS/m, OC: %, N, P, K: kg/ha)

Cropping system weed management practices* (Treatment details in Table 21)	Basmati rice -Wheat							Basmati rice - Lentil							Basmati rice -*Brassica napus*						
	BD	pH	EC	OC	N	P	K	BD	pH	EC	OC	N	P	K	BD	pH	EC	OC	N	P	K
1. Pantnagar (mean of 3 years)																					
W_1	1.37	6.20	0.17	0.95	229	26.0	143	1.42	6.21	0.25	0.80	243	20.4	161	1.42	6.77	0.36	0.84	248	24.6	148
W_2	1.38	6.65	0.14	0.88	226	23.6	149	1.36	6.67	0.35	0.80	225	21.3	161	1.38	6.38	0.26	0.85	226	27.0	151
W_3	1.34	6.24	0.32	0.93	226	27.7	162	1.42	6.64	0.36	0.80	236	20.8	163	1.36	6.48	0.28	0.94	237	20.1	145
W_4	1.35	6.57	0.32	0.85	232	20.4	165	1.41	6.36	0.17	0.90	251	21.2	163	1.40	6.58	0.17	0.80	225	22.2	154
2. Ranchi		Basmati rice -Wheat							Basmati rice - Lentil							Basmati rice -Mustard					
W_1		5.48	-	0.47	241	27.0	158	-	5.62	-	0.52	260	21	136	-	5.62	-	0.47	231	23	140
W_2		5.78	-	0.48	262	30.0	173	-	5.48	-	0.50	297	24	157	-	5.75	-	0.56	254	28	169
W_3		5.52	-	0.45	273	33.0	188	-	5.76	-	0.50	300	27	161	-	5.62	-	0.50	295	29	174
W_4		5.65	-	0.45	253	28.0	173	-	5.75	-	0.52	289	25	153	-	5.78	-	0.53	276	23	167
3. Umiam		Maize - Mustard							-							-					
W_1		4.75	-	1.8	157.8	13.6	291	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W_2		4.84	-	1.8	163.6	17.2	314	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W_3		4.94	-	2.0	166.8	17.9	319	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W_4		4.86	-	2.0	161.4	15.7	312	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W_5		4.73	-	1.9	163.9	15.5	313	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W_6		4.86	-	1.8	160.9	15.8	294	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W_7		4.79	-	1.83	161.1	15.4	299	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W_8		4.83	-	1.2	158.5	10.0	282	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 26. Influence of weed management practices under organic farming on soil micronutrient (ppm) after the cropping cycle at Pantnagar (2004-05 to 2009-10)

Cropping system/ weed management practices (Treatment details in Table 21)	Basmati rice-Lentil				Basmati rice – *napus*				Basmati rice -*Brassica*			
	Mn	Zn	Cu	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu	Fe
1. Pantnagar												
W_1	6.2	0.94	6.3	31.4	6.4	0.65	6.1	28.1	6.0	1.01	8.0	28.4
W_2	6.3	0.84	8.4	30.5	5.2	0.79	6.2	29.8	7.6	0.94	8.0	29.9
W_3	6.5	0.66	5.6	27.1	7.8	0.79	7.3	34.7	7.0	0.39	6.8	30.6
W_4	6.7	0.97	10.1	30.4	6.8	0.97	7.7	33.5	6.9	0.94	6.3	30.7

Table 27. Influence of weed management practices under organic farming on soil microbial population (x10^4 CFU/g) after the cropping cycle at Coimbatore (2004-05 to 2009-10)

Cropping system/ weed management practices (Treatment details in Table 21)	Fungi	Bacteria	Actinomycetes
1. Coimbatore (Black gram-Sorghum-Sesame)			
W_1	20.9	104	4.8
W_2	24.8	123.1	54.1
W_3	21.8	109.9	42.4
W_4	22.8	115.4	52.4
W_5	21.1	116.1	45.5
W_6	15.5	87.9	33.3

Table 28. Influence of weed management practices under organic farming on economics (₹/ha) of cropping systems at various locations (2004-05 to 2009-10)

Cropping system/ weed management practices (Treatment details in Table 21)	Gross returns	Cost of culti vation	Net returns	B:C ratio	Gross returns	Cost of culti-vation	Net returns	B:C ratio	Gross returns	Cost of culti-vation	Net returns	B:C ratio
1. Coimbatore	**Black gram-Sorghum-Sesame**						**-**				**-**	
W_1	57078	34423	21718	-	-	-	-	-	-	-	-	-
W_2	60970	32075	28895	-	-	-	-	-	-	-	-	-
W_3	71512	40993	30518	-	-	-	-	-	-	-	-	-
W_4	61517	29157	32360	-	-	-	-	-	-	-	-	-
W_5	66827	28730	38097	-	-	-	-	-	-	-	-	-
W_6	31002	25497	5506	-	-	-	-	-	-	-	-	-
2. Pantnagar	**Basmati rice -Wheat**				**Basmati rice – Lentil**				**Basmati rice -*Brassica napus***			
W_1	52874	34065	18809	0.90	51836	31462	20374	0.98	43896	32612	11284	0.68
W_2	55700	34732	20968	0.95	58491	32128	26362	1.14	47712	33278	14434	0.76
W_3	58195	35398	22797	0.98	63149	33462	29687	1.23	51677	33945	17732	0.86
W_4	58818	34732	24087	1.03	56107	32128	23978	1.08	50332	33278	17053	0.84
3. Ranchi	**Basmati rice -Wheat**				**Basmati rice - Lentil**				**Basmati rice -Mustard**			
W_1	-	-	63808	3.4	-	-	70976	4.7	-	-	49014	3.2
W_2	-	-	72309	4.0	-	-	74532	4.9	-	-	58016	3.4
W_3	-	-	74040	3.8	-	-	79121	5.0	-	-	55274	3.5
W_4	-	-	65694	3.2	-	-	68845	4.6	-	-	47929	3.5

8. GENERAL/MISCELLANEOUS

8.1 List of Publications

Modipuram

Gill, M.S., A.K.Shukla, M.P.Singh, O.K.Tomar, K.Majumdar and K.N.Tiwari .2009. Evaluation of Nutrient Management Options for Yield, Economics and Nutrient Use Efficiency. *Better crops –India* (6) :12-15.

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Devasenapathy, P. S. Thiyageshwari and P.M. Shanmugam. 2009. Conservation of organic Carbon in Organic cropping Systems. Paper presented at *4th World Congress on Conservation Agriculture* on February 4-7, 2009 at New Delhi, India, pp. 143.

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Srinivasan V, Sangeeth KP, Samsudeen M, Thankamani CK, Hamza S, Zachariah TJ and Kumar A. 2010. Evaluation of organic management system for sustainable production of turmeric. In: Organic Horticulture – Principles, practices and technologies, Singh HP and George V Thomas (Edts), Westville Publishing House, New Delhi, 171-176.

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8.2 Human Resource Development

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

S.No.	Name & Year	Thesis title	Degree
Jabalpur			
1.	Mr. Rajeev Dubey, 2008	Studies on comparative efficiency of organic, chemical and integrated nutrient management practices on soil health and crop productivity under various cropping system	M. Sc
2.	Mr R. D. Soni, 2008	Management of soil fertility using organic inputs in important field crops based multiple cropping systems	Ph.D
3.	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
Calicut			
1.	Sangeeth K P, 2007	Development and formulation of effective biofertilizers for management of black pepper and cardamom	Ph.D.
2.	Princy P K, 2007	Evaluation of phosphate solubilizing bacteria (PSB) for soil nutrient mobilization in ginger	M. Sc
Dharwad			
1.	Bharati. S.M., 2005	Role of organic and indigenous components against *Spodopterea litura Fab* in groundnut and soybean	M. Sc. (Ag)
2.	Kavita. A.S, 2009	Ecofriendly practices against major pests in different cropping systems with special reference to groundnut	M. Sc. (Ag)
3.	Vijayavathi, 2010	Effect of nutrient management practices on soil health and crop response under different cropping system in vertisol of Northern Transitional zone of Karnataka	Ph.D
4.	Shwetha. B.N., 2007	Studies on nutrient management through organics in soybean- wheat cropping system	M. Sc (Ag)
Pantnagar			
1	Ms. Devjaani Sanyal, 2008	Soil fertility management in green manure-basmati rice based cropping system under organic mode.	Ph. D.
2.	Mr. Shubhash Singh, 2008	Impact of various cropping system and modes of cultivation on soil quality	M. Sc.
3	Ms. Sushmita Munda, 2008	Studies on weed management in green manure basmati rice based cropping systems under organic mode of cultivation	M. Sc.
4	Mr. Rajnish Singh,2010	Studies on scented rice based cropping systems under different modes of cultivation	Ph. D.
5	Ms. Mamta Arora, 2010	Evaluation of quality characteristics of Basmati rice (var. PUSA BASMATI - 1) grown using different modes of farming'	M. Sc. (Food Tech.)
6	Ms. Kavita Bhatia, 2010	Evaluation of quality characteristics of basmati rice (var. Pusa - 1121) grown using different treatments of organic farming	M. Sc. (Food Tech.)

2. Participation of Scientists in Seminars/workshops

Pantnagar

- Workshop on 'Best Pracxtices for Organic Farming in Uttrakhand Hills' on 25th February, 2009 organized by Uttarakhand Oragnic Commodity Board, Dehradun.
- Workshop on 'Best Pracxtices for Organic Farming in Uttrakhand Hills' on 27th August, 2009 organized by Uttarakhand Oragnic Commodity Board at Dehradun.
- National Conference on 'Holistic Rural Development through Organic Farming' organized by SURABHI foundation and Ministry of Agriculture held from 11-12 September, 2009 at IARI, New Delhi.
- Annual Group Meeting of Network Project on Organic Farming held 4-6 March, 2009 at CSK HPKVV, HAREC, Bajaura (Kullu).
- National Symposium on 'Resource Management Approach towards Livelihood Security' held Dec. 2-4,2010at UAS, Bangalore (Karnataka)

Ludhiana

- Training course on 'Standards and Certification Systems for Organic Food Production and Processing 12-17 July 2010, Manila, Philippines, sponsored and organized by Asian Productivity Organization, Japan.

Umiam

- International Conference on "Organic Food - *nature 2004*" organised at ICAR Research Complex for NEH Region, Umiam, Meghalaya, India from 15-17th February 2004.
- National Seminar on "Potential and Prospects of Organic Farming in North East India" organised by ICAR Research Complex for NEH Region, Umiam, Meghalaya at Umiam from 30 to 31st October 2006.
- Annual Group Meeting of Network Project on Organic Farming (NPOF) organised by University of Agricultural Sciences, Krishinagar, Dharwad (Karnataka) from March 10-11, 2008.
- ICAR Training-Cum-Workshop on "Intellectual Property and Technology Management 2008" (Theme: Protection of Microorganisms), sponsored by ICAR and organised by ICAR Research Complex for NEH Region, Umiam, Meghalaya from 20-22 November, 2008.
- India Organic 2008 International Seminar (Theme: "Global Organic Agribusiness: India Arrives!") organised by International Competence Centre for Organic Agriculture (ICCOA), NCOF & APEDA at IARI, New Delhi from 27-29 November 2008.
- Annual Group Meeting of Network Project on Organic Farming (NPOF) organised by CSK HPKV-Hill Agil. Res. & Extension Centre, Bajaura, Kullu (H.P.) from 4- 6 March, 2009.

3. Training of Stake holders on Organic Farming

Institute/ Organization	Title	Farmer's/AO's (No)	Duration of the training
Bhopal			
Jamui Distt., Bihar under ATMA Project	Different composting technologies and organic farming	25	6 days (May, 24-29, 2009)
Paschim Champaran District, Bihar under ATMA Project	Different composting technologies and organic farming	25	6 days (June, 17-22, 2009)
Gaya District, Bihar under ATMA Project	Different composting technologies and organic farming	25	6 days (August, 17-22, 2009)
Banka District, Bihar under ATMA Project during	Different composting technologies and organic farming	25	6 days (Oct., 26-31, 2009)
Madhepura- District, Bihar under ATMA Project	Different composting technologies and organic farming	25	6 days (Nov., 16-21, 2009)
Winter school sponsored by ICAR	Efficient Farm Wastes Utilization for Sustainable Agriculture and Enhancing Soil and Produce Quality	23 Scientists/ Teachers	21 days (Dec., 1-21, 2009)
M. P. Rajya Krishak Ayog, Bhopal	Organic farming, various composting techniques and methodology of soil testing	50	1 day (12/03/2010)
State Department of Agriculture, Goa	Organic farming, various composting techniques and methodology of soil testing	15 Agricultural Officers Hon,ble Speaker Goa	2 days February, 5-5, 2010)
Supoul District, Bihar under ATMA Project	Organic farming, various composting techniques and methodology of soil testing	25	6 days (December, 18-23, 2010)
Shekhpura- District, Bihar under ATMA Project	Organic farming, various composting techniques and methodology of soil testing	15	8 days (February, 20-27,2011)
Farmers Welfare and Agriculture Department, Indore, Madhya Pradesh	Organic farming, various composting techniques and methodology of soil testing	20	3 days (January, 17-19, 2011)
Farmers Welfare and Agriculture Department , Indore, Madhya Pradesh	Organic farming, various composting techniques and methodology of soil testing	20	3 days (February, 17-19, 2011)

4. Training Organized for students

Name of college	Name of trainee and degree programme	Topic	Duration
Bhopal			
Barkatullah University Bhopal	Ms. Sarita Gour, M.Sc.	Biochemical and microbiological studies under various nutrient management practices.	02/01/07 to 30/06/07
Govt. Home science college, Hoshangabad	Ms.Madhuri Rajput	Effect of organic, inorganic and integrated nutrient sources on biochemical and biological properties of soil.	Three months
Biotechnology Safia college of Science and Education Bhopal	Ms. Archna Raghuwanshi	Effect of various organic nutrient sources on biochemical and biological properties of soil under organic farming.	July - Sep 05
Safia college of Science and Education Bhopal	Ms. Chetna Sharma	Effect of organic nutrient sources on soil biological parameters under organic farming.	Aug - Oct 2004
Barkatullah University Bhopal	Mr. Nishant Sharma M.Sc. Student.	Biochemical quality evaluation of soybean seed under different nutrient management systems.	Three months

8.3 Radio talks

Ranchi

- "Vermicomposting and their use" broadcasted on 22.10.2008.
- "Integrated nutrient management for more production" broadcasted on 25.10.2010.

Workshops / Meetings

Dr S. Ayyappan, Secretary, DARE & Director General, ICAR in consultation meeting on Organic Farming held on 23 April 2010 at New Delhi

Dr B. Gangwar, Project Director, PDFSR addressing the participants in workshop cum consultation meeting on NPOF held during 21-23 February 2011 at PDFSR, Modipuram

Dr J.S. Samra, Ex DDG (NRM) and Dr S.K. Sharma, Ex Project Director, PDFSR in National workshop on Organic Farming held during 22-23 May 2004 at PDFSR, Modipuram

Dr A.K. Singh, DDG (NRM) addressing the participants of Annual group meeting of NPOF during 10-11 March 2008 at Dharwad

Visit to organic farming exhibition at Dharwad by Dr A.K. Singh, DDG (NRM) along with Dr M.S. Gill, Ex Project Director, PDFSR

Expert addressing the consultation meeting of organic farming

9. APPENDICES

Appendix I. Details of crops and varieties used in experiment at various locations

Crop	Variety	Duration / days
1. Modipuram		
Rice	Saket-4	122
Barley	Ajad	156
G.Gram	SML-668	84
Mustard	Pusa bold	152
Radish	Early menu	114
B.Rice	B-370	131
Wheat	PBW -343	137
Maize	Pro-11	73
Potato	K. bahar	122
Okra	A. Anamika	106
2. Jabalpur		
Rice	Pusa Basmati	-
Wheat	HD-4672	-
Potato	K.Sinduri	-
Barseem	JB-1	-
Vegetable Pea	Arkel	-
Okra	Parbhani Kranti	-
Sorghum Fodder	MP Chari	-
3. Coimbatore		
Maize	CO-1	-
Cotton	MCU 12	-
Chilli	PKM 1	-
Onion /Sunflower	CO 4	-
Brinjal	K 2	-
Sunflower	CO 4	-

Crop	Variety	Duration / days
4. Raipur		
Soybean	JS -335	Medium / 112
Berseem	JB -2	Medium
Isabgol	GI -2	Medium / 118-20
Onion	Nasik red	Medium / 119
Safflower	JS -1	Medium / 149
5. Calicut		
Ginger	Vardha, Rejatha and Mahima	Short / 240-250
Turmeric	Alleppey supreme, Prathiba	Short / 245-260
Black peper	Sreekara, Panniyur-1	Long
6. Dharwad		
Groundnut	GPBD-4	Medium /98-100
Sorghum	DSV -4	Medium / 125
Soybean	JS - 335	Medium / 98
Durum wheat	DWR -2006	Medium / 120
Potato	K. Jawahar	Medium / 100
Chickpea	Annigeri-1	Medium / 123
Maize	DMH -2	120
Chilli	Byadagidabbi	Medium / 170-75
Cotton	Jayadhar	Long / 180-85
7. Karjat		
Rice	Pusa Sugandha-3,Karjat-4	Early
Groundnut	SB-XI	Early
Maize (Sweet corn)	Sugar-75	Early
Mustard	Varuna	Early
Dolichos bean	Konkan Bhushan	Early
8. Bajaura		
Cauliflower	Swati	-
Radish / Pea	Long white /GC-477	-
Tomato	D-4/7730(NH)	-
French bean	Contender	-
Cabbage/Cauliflower	Varun/Swati	-
Capsicum/ Cabbage	Indira/Varun	-

Crop	Variety	Duration / days
9. Bhopal		
Soybean	JS-335	-
D. Wheat	HI-8498	-
Mustard	Pusa bold	-
Chickpea	JG-74	-
Isabgol / Linseed	GI-2	-
10. Pantnagar		
Basmati rice	PB-1	-
Wheat	PSW-343	-
Lentil	Pant L-406	-
Pea (veg)	Arkil	-
Mustard	HPN-1/GLS-1	-
11. Ranchi		
Rice	Basmati	125-135
Wheat	K-9107	130
Potato	K. Ashoka	95
Linseed	Shekhar	140
Lentil	PL 406	115
12. Umiam		
Maize	DA 61-A	110
Soybean	JS-80-21	132
French bean	Naga local	100
Toria	M-27	120

Appendix II. Per cent increase or decrease in yield, net returns and organic carbon under organic and INM practices over inorganic system (mean of 6 years)

Cropping system	*Kharif*		*Rabi*		*Summer*		Net returns		Organic carbon	
	Organic	INM	Organic	INM	Organic	INM	Organic	INM	Organic	INM
1. Modipuram										
Rice-Wheat	-5.7	5.9	-15.5	-1.0	-	-	-	-	50.9	32.1
Rice-Potato-Radish	-9.4	1.1	-25.9	-2.1	-56.7	-27.4	-	-	39.2	33.3
Babycorn-Potato-Greengram	-5.6	9.5	-28.1	10.7	-5.1	6.4	-	-	59.2	12.2
Sorghum (F)-Pea-Okra	6.4	-	32.9	1.1	34.6	17.0	-	-	72.5	39.2
Rice –Barley + mustard-Greengram	-11.8	-5.4	20.7	7.0	16.2	-	-	-	78.2	76.4
Maize-Potato-Okra	8.0	19.8	-88.3	3.3	49.5	11.8	-	-	24.2	19.7
Maize-Mustard-Radish-Greengram*	2.6	13.8	32.8	20.3	19.2	8.8	3.8	-16.1	152.6	28.1
2. Jabalpur										
Rice-Wheat	-9.1	-3.6	-18.9	-2.3	-	-	3.0	-3.0	10.0	4.3
Rice – potato -Okra	-12.6	-7.5	-17.0	-2.2	-6.0	-3.1	3.8	-5.9	7.1	1.4
Rice – Berseem	-11.4	-5.2	2.1	0.5	0.0	0.0	22.6	0.5	7.0	2.8
Rice-Pea-Sorghum F	-10.3	-2.5	-8.9	-5.1	-10.5	-6.2	14.7	-2.3	8.6	5.7
3. Coimbatore										
Maize-Cotton	8.4	9.2	26.7	7.1	-	-	-2.0	-3.6	-100.0	3.4
Chilly-Onion	0.0	-0.1	0.0	0.0	-	-	2.2	10.5	6.9	1.7
Brinjal-Sunflower	3.4	8.9	7.4	19.0	-	-	3.6	30.2	6.8	3.4
Turmeric+ Onion	50.6	11.4	-	-	-	-	-27.8	-47.0	-	-
4. Raipur										
Soybean-Wheat	-3.4	1.1	-15.3	0.1	-	-	-12.0	-11.6	2.9	-0.9
Soybean-Berseem	2.3	-2.1	-1.5	6.8	-	-	13.9	-7.9	6.3	1.8
Soybean-Mustard	-5.7	2.0	-27.3	-4.4	-	-	-15.3	-7.6	2.7	0.2
Soybean-Chickpea	5.5	5.1	-7.0	4.6	-	-	16.7	-5.5	1.6	-1.8

Cropping system	*Kharif*		*Rabi*		*Summer*		Net returns		Organic carbon	
	Organic	INM	Organic	INM	Organic	INM	Organic	INM	Organic	INM
5. Calicut										
Ginger-Ginger-Ginger	22.7	27.3	33.8	48.6	3.3	16.1	-13.9	27.7	10.3	8.2
Turmeric- Turmeric- Turmeric	3.2	29.4	22.5	36.2	-7.4	2.3	-42.0	54.8	1.0	-4.3
Black pepper	47.3	19.2	-	-	-	-	-	-	6.8	4.7
6. Dharwad										
G.Nut -Sorghum	13.7	8.9	11.9	9.0	-	-	21.5	11.8	18.8	14.6
Soybean- Wheat	16.8	12.1	12.0	13.3	-	-	43.9	25.6	15.7	9.8
Potato-Chickpea	6.7	13.6	6.8	8.8	-	-	11.0	20.2	15.4	5.8
Chilli + Cotton / Chilli + Cotton-Onion	7.5	7.0	10.4	20.7	-	-	29.1	34.2	25.0	12.5
Maize-Chickpea	-1.7	4.8	5.8	8.7	-	-	-0.6	-3.7	18.4	8.2
7. Karjat										
Rice-G.Nut	-5.3	-3.0	-19.4	0.0	-	-	-42.7	-5.2	-3.3	-1.1
Rice-Maize	-4.4	0.6	-35.4	-12.9	-	-	-86.7	-36.3	-3.5	-2.7
Rice-Mustard	-5.5	0.0	-19.1	-1.6	-	-	-418.9	-184.9	6.0	-4.3
Rice-Dolichos bean	-8.7	-3.9	17.9	7.3	-	-	-3360.1	-3090.9	7.6	-6.7
8. Ludhiana I										
Rice-Wheat-GM	-6.1	7.3	0.4	6.0	2.2	4.3	-	-	14.0	4.7
Turmeric - Onion	112.2	76.2	27.7	32.3	-	-	179.8	41.3	39.5	32.6
G.Nut.(S)- Garlic	1.9	4.4	20.8	21.8	-	-	-	-	43.2	35.1
Maize-Wheat-Cowpea(F)	15.7	13.9	0.7	4.4	32.1	16.4	-	-	37.5	25.0
Rice-Garlic+Mentha oil	-3.6	9.7	34.0	22.2	-	-	-	-	32.0	16.0
Ludhiana (2008-10)										
Cotton - Wheat	79.0	51.9	-10.7	-15.1	-	-	153.3	-14.7	43.9	34.1
Maize-Gram	19.2	21.3	-13.6	-14.6	-	-	34.8	16.6	27.8	25.0
Maize -Potato-Moong (S)	32.5	23.2	51.9	82.8	22.8	21.8	96.7	45.1	81.3	59.4
Rice -Wheat-Moong (S)	7.1	11.8	-13.3	-2.2	-6.5	13.1	27.6	12.9	81.8	75.8
Ludhiana II										
Sorghum - Berseem	-	-	-	-	-	-	24.9	22.9	3.6	1.8
Maize- Berseem- Bajra	-	-	-	-	-	-	46.6	35.5	1.7	3.4
Maize-Berseem –Maize + Cowpea	-	-	-	-	-	-	42.2	19.0	3.8	3.8
Sorghum +Guara-Oats-Cowpea	-	-	-	-	-	-	50.4	56.1	3.8	3.8

Cropping system	*Kharif*		*Rabi*		*Summer*		Net returns		Organic carbon	
	Organic	INM	Organic	INM	Organic	INM	Organic	INM	Organic	INM
9. Bajaura										
Cauliflower-Radish-Tomato	0.5	14.6	-10.3	28.6	-19.8	-9.9	58.4	35.3	-	-
French bean-Cauliflower-French bean	5.4	-9.8	-18.6	13.1	-45.9	8.8	-25.9	10.8	-	-
Cabbage-Radish-Capsicum	-16.1	5.7	-9.4	48.9	3.8	0.7	352.8	249.9	-	-
Maize-Garlic	-5.2	20.5	-25.9	12.6	-	-	-7.4	22.4	-	-
10. Bhopal										
Soybean- Wheat	0.0	0.0	-0.9	7.8	-	-	-	-	0.0	0.0
Soybean-Mustard	0.0	0.0	-2.2	9.5	-	-	-	-	0.0	0.0
Soybean-Chickpea	0.0	0.0	1.0	7.4	-	-	-	-	0.0	0.0
Soybean-Isabgol	0.0	0.0	-23.2	9.1	-	-	-	-	0.0	0.0
11. Pantnagar										
Rice-Wheat-Sesbania (GM)	-	-	-30.4	-10.3	-	-	27.3	55.1	9.0	7.7
Rice -Lentil-Sesbania (GM)	-	-	-17.3	-10.0	-	-	-56.1	-20.5	7.3	6.1
Rice -Pea (veg.)-Sesbania(GM)	-	-	-11.5	-4.8	-	-	49.8	15.1	4.8	2.4
Rice -Mustard-Sesbania (GM)	-	-	-39.5	-10.7	-	-	-40.0	-47.1	6.3	3.8
12. Ranchi										
Rice -Wheat	-2.1	5.4	-5.6	4.9	-	-	8.1	-2.0	22.5	10.0
Rice -Potato	1.8	2.7	-11.4	8.1	-	-	12.6	4.9	22.5	10.0
Rice -Mustard / Linseed	8.8	11.4	-30.2	0.5	-	-	7.3	0.0	23.1	10.3
Rice -Lentil	-5.2	12.4	-4.6	8.6	-	-	16.4	13.3	22.0	7.3
13. Umiam										
Rice - Carrot	5.7	-7.9	24.8	27.9	-	-	44.0	62.2	1.2	2.2
Rice - Potato	13.2	-3.3	6.0	17.1	-	-	1.8	15.8	1.9	3.7
Rice – French bean	11.8	0.3	2.4	7.6	-	-	-11.6	24.9	2.8	2.4
Rice - Tomato	6.2	-11.4	23.1	20.4	-	-	-4.4	0.0	1.2	4.0

Appendix III. Per cent increase or decrease in yield, net returns and organic carbon in different sources of organics over control (mean of 6 years)

Centre/ cropping system	Treatment	Grain Yield			Net returns	Organic carbon
		Kharif	*Rabi*	Summer		
1. Modipuram						
Basmati rice-Wheat	NS1-EC + VC	29.9	58.7	-	246.3	19.57
	NS2- NEOC+VC	39.4	55.5	-	203.4	13.04
	NS3- EC + NEOC	44.4	58.0	-	218.7	15.22
	NS4- EC + VC + NEOC	54.2	65.7	-	297.4	30.43
Basmati rice/Maize-Potato-Onion	NS1-EC + VC	54.5	78.9	49.0	16.3	17.78
	NS2- NEOC+VC	58.9	65.0	36.4	-5.4	13.33
	NS3- EC + NEOC	56.8	76.4	48.4	11.8	13.33
	NS4- EC + VC + NEOC	57.7	77.3	50.7	14.1	28.89
2. Jabalpur						
Basmati rice-Wheat	NS1-FYM+VC(1/2+1/2)	39.8	38.5	-	39.2	5.88
	NS2-VC+Neem cake(1/2+1/2)	37.2	36.5	-	43.1	4.41
	NS3-FYM+Neem cake(1/2+1/2)	43.6	40.9	-	51.8	4.41
	NS4-FYM+Neem cake+VC (1/3+1/3+1/3)	42.2	38.7	-	41.9	5.88
Basmati rice –Berseem F/S	NS1-FYM+VC(1/2+1/2)	28.7	12.2	-	26.1	4.35
	NS2-VC+Neem cake(1/2+1/2)	27.0	11.3	-	21.5	2.90
	NS3-FYM+Neem cake(1/2+1/2)	31.7	14.1	-	31.6	2.90
	NS4-FYM+Neem cake+VC (1/3+1/3+1/3)	28.2	17.3	-	29.5	5.80
3. Coimbatore						
Rice -Black gram-Sesame/GM	NS1-EC	87.4	67.7	97.4	141.3	56.67
	NS2-VC	126.8	79.1	106.5	36.4	53.33
	NS3-FYM+NEOC(1/2+1/2)	153.8	97.6	122.7	233.6	60.00
	NS4-EC+VC+FYM (1/3+1/3+1/3)	113.6	101.6	139.5	135.5	66.67
Maize-Sunflower	NS1-EC	28.4	109.9	-	207.9	50.00
	NS2-VC	53.6	143.9	-	110.8	53.85
	NS3-FYM+NEOC(1/2+1/2)	63.8	162.1	-	261.1	61.54
	NS4-EC+VC+FYM (1/3+1/3+1/3)	39.4	135.9	-	134.3	61.54

Centre/ cropping system	Treatment	Grain Yield *Kharif*	*Rabi*	Summer	Net returns	Organic carbon
4. Raipur						
Rice - Chickpea	NS1-EC+CDM(1/2+1/2)	46.7	22.0	-	72.3	5.73
	NS2-NEOC+CDM(1/2+1/2)	34.1	18.7	-	53.8	8.02
	NS3-FYM+NEOC(1/2+1/2)	42.0	30.1	-	75.4	6.49
	NS4-NEOC+CDM+EC (1/3+1/3+1/3)	46.2	33.1	-	81.0	8.40
Rice - Wheat/Mustard+	NS1-EC+CDM(1/2+1/2)	45.1	50.9	-	79.6	1.87
Lentil* (2009-10)	NS2-VC	34.4	41.2	-	66.3	1.87
	NS3-FYM+NEOC(1/2+1/2)	41.2	61.5	-	64.7	2.62
	NS4-EC+VC+FYM (1/3+1/3+1/3)	46.4	74.9	-	100.4	4.49
5. Calicut						
Ginger	NS1-15 t FYM+2t Neem cake+4tVC	27.2	-	-	27.0	8.00
	NS2-15 t FYM+2t Neem cake+5tCoir compost	30.1	-	-	33.7	5.50
	NS3-10tCoir compost+8t VC	23.9	-	-	24.0	5.00
	NS4-30tFYM	25.6	-	-	34.6	10.50
Turmeric	NS1-15 t FYM+2t Neem cake+4tVC	20.7	-	-	12.0	1.46
	NS2-15 t FYM+2t Neem cake+5tCoir compost	24.3	-	-	26.5	8.74
	NS3-10tCoir compost+8t VC	25.5	-	-	37.2	-3.40
	NS4-30tFYM	28.6	-	-	54.2	5.34
6. Dharwad						
Groundnut-Sorghum	NS1-EC(3/4)+Green leaf manure(1/4)	22.3	18.8	-	32.1	20.90
	NS2-VC(3/4)+Green leaf manure(1/4)	20.8	17.6	-	21.6	18.66
	NS3-FYM(3/4)+Green leaf manure(1/4)	25.7	17.7	-	35.9	23.88
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	43.9	24.0	-	58.8	20.90
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	38.0	23.0	-	53.7	23.88
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	39.9	21.9	-	51.3	20.15

Centre/ cropping system	Treatment	Grain Yield *Kharif*	*Rabi*	Summer	Net returns	Organic carbon
Soybean-Wheat	NS1-EC(3/4)+Green leaf manure(1/4)	39.8	29.7	-	37.2	19.12
	NS2-VC(3/4)+Green leaf manure(1/4)	32.3	27.9	-	17.0	17.65
	NS3-FYM(3/4)+Green leaf manure(1/4)	36.3	28.7	-	36.0	22.06
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	56.6	37.4	-	52.8	19.12
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	49.5	35.8	-	53.5	21.32
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	51.7	32.5	-	45.8	19.12
Chilli-Cotton-Onion	NS1-EC(3/4)+Green leaf manure(1/4)	56.1	28.6	26.9	44.8	21.01
	NS2-VC(3/4)+Green leaf manure(1/4)	50.0	29.6	23.2	27.4	17.39
	NS3-FYM(3/4)+Green leaf manure(1/4)	68.0	31.3	34.8	52.8	22.46
	NS4-EC(3/8)+VC(3/8)+ Green leaf manure(3/8)	80.2	43.0	30.4	59.6	20.29
	NS5-EC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	71.6	38.2	31.3	66.2	21.01
	NS6-VC(3/8)+FYM(3/8)+ Green leaf manure(3/8)	63.3	38.2	58.0	69.2	18.12
7. Karjat						
Rice -Capsicum/Red pumpkin	**K.** -NS1-FYM10+Glyricidia green leaves 1.83t/ha (50:50%N)**R**.-NS1-FYM 20 t/ha (100% N)	4.4	50.5	-	38.1	0.83
	K. -NS2-FYM10+Paddy straw 4.17t/ha(50:50%N)**R**.-NS2-FYM10+Vermicompost1t/ha (50:50%N)	9.7	56.6	-	5.9	-3.33
	K. -NS3-FYM10+Neem Cake 2.5 t/ha(50:50%N)**R**.-NS3-FYM10+Neem Cake2.5t/ha (50:50%N)	15.3	65.0	-	35.3	-7.50
	K. -NS4-FYM 6.7+Paddy straw3.8+Glyricidia green leaves 1.2t/ha(1/3 N each throughFYM :PS:GLY)**R**.-NS4-FYM 6.7+Neem Cake 1.7+Vermicompost 0.7t/ha (1/3 N each through FYM :NC:VC)	24.7	95.0	-	134.7	1.67

Centre/ cropping system	Treatment	Grain Yield *Kharif*	*Rabi*	Summer	Net returns	Organic carbon
Rice - Cucumber	**K**. -NS1-FYM10+Glyricidia green leaves 1.83t/ha (50:50%N) **R**.-NS1-FYM 20 t/ha (100% N)	-0.6	52.4	-	73.4	-13.01
	K. -NS2-FYM10+Paddy straw 4.17t/ha(50:50%N) **R**.-NS2-FYM10+Vermi-compost1t/ha(50:50%N)	3.4	42.3	-	8.0	-16.26
	K. -NS3-FYM10+Neem Cake 2.5 t/ha(50:50%N) **R**.-NS3-FYM10+Neem Cake2.5t/ha (50:50%N)	4.6	40.9	-	21.8	-
	K. -NS4-FYM 6.7+Paddy straw3.8+Glyricidia green leaves 1.2t/ha(1/3 N each throughFYM :PS:GLY) **R**.-NS4-FYM 6.7+Neem Cake 1.7+Vermicompost 0.7t/ha (1/3 N each through FYM :NC:VC)	9.5	79.9	-	126.4	-4.07
8. Ludhiana						
Maize -Gram	**K**.-NS1-GM+FYM **R**.-NS1-FYM+Crop residue	105.3	135.7			80.00
	K.-NS2-GM + Jeen Amrit (JA) **R.**-NS2-FYM+JA	83.0	125.0			37.14
	K.-NS3GM+-FYM+VC **R**.-NS3-FYM+VC+Crop residue	112.4	125.9			42.86
	K.-NS4-GM **R**.-NS4-FYM	119.1	134.2			62.86
Rice - Wheat	**K**.-NS1-GM+FYM **R**.-NS1-FYM+Crop residue	206.4	127.0	-	-	64.86
	K.-NS2-GM + Jeen Amrit (JA) **R.**-NS2-FYM+JA	207.6	129.0	-	-	64.86
	K.-NS3GM+-FYM+VC **R**.-NS3-FYM+VC+Crop residue	209.6	124.9	-	-	59.46
	K.-NS4-GM **R**.-NS4-FYM	68.3	106.2	-	-	51.35
9. Bajaura						
Cauliflower - Pea/Radish*	NS1-VC	101.9	56.2	78.6	111.6	53.85
(2006-07) - Tomato	NS2-FYM(RF)	118.8	59.1	85.2	167.4	111.54
	NS3-FYM+VC	87.2	56.8	92.5	127.8	76.92
	NS4-FYM(RF)+VC	151.4	66.2	142.1	242.5	80.77
Coriander - Pea/Spinach*	NS1-VC	-	-	-	-157.2	-
(2006-07) - Cabbage/	NS2-FYM(RF)	-	-	-	-323.2	-
Capsicum* (2006-07)	NS3-FYM+VC	-	-	-	-251.7	-
	NS4-FYM(RF)+VC	-	-	-	-460.7	-

Centre/ cropping system	Treatment	Grain Yield *Kharif*	*Rabi*	Summer	Net returns	Organic carbon
10. Bhopal						
Soybean - D.Wheat	NS1-CDM-CDM+PM	26.7	47.3	-	57.1	40.00
	NS2-CDM-CDM+VC	17.7	42.6	-	49.8	32.00
	NS3-CDM-PM+VC	31.1	42.1	-	47.9	36.00
	NS4-CDM-CDM+VC+PM	31.2	56.2	-	61.7	40.00
Soybean - Mustard	NS1-CDM-CDM+PM	32.7	79.2	-	-	37.25
	NS2-CDM-CDM+VC	13.8	65.5	-	-	23.53
	NS3-CDM-PM+VC	41.2	60.3	-	-	37.25
	NS4-CDM-CDM+VC+PM	36.9	67.4	-	-	39.22
11. Pantnagar						
B.Rice-Wheat	NS1EC+VC(1/2+1/2)	5.6	21.5	-	-63.0	69.09
	NS2-NEOC+VC(1/2+1/2)	10.9	17.6	-	-102.8	56.36
	NS3-FYM+VC(1/2+1/2)	7.7	26.4	-	-54.5	63.64
	NS4-EC+VC+NEOC+FYM (1/4+1/4+1/4+1/4)	9.4	19.1	-	-64.3	47.27
B.Rice - Chickpea	NS1EC+VC(1/2+1/2)	5.6	13.9	-	-33.2	29.58
	NS2-NEOC+VC(1/2+1/2)	10.9	6.9	-	-58.3	35.21
	NS3-FYM+VC(1/2+1/2)	7.7	18.7	-	-25.8	32.39
	NS4-EC+VC+NEOC+FYM (1/4+1/4+1/4+1/4)	9.4	12.4	-	-38.8	50.70
B.Rice - Veg.Pea	NS1EC+VC(1/2+1/2)	5.6	15.1	-	-39.7	58.62
	NS2-NEOC+VC(1/2+1/2)	10.9	-0.1	-	-85.5	36.21
	NS3-FYM+VC(1/2+1/2)	7.7	10.1	-	-40.8	67.24
	NS4-EC+VC+NEOC+FYM (1/4+1/4+1/4+1/4)	9.4	20.6	-	-45.6	60.34
12. Ranchi						
Rice - Wheat	NS1-FYM+VC(1/2+1/2)	33.5	35.4	-	85.6	6.82
	NS2-FYM+Neem cake(1/2+1/2)	12.4	19.2	-	69.1	4.55
	NS3-VC+Neem cake(1/2+1/2)	31.9	40.3	-	79.1	11.36
	NS4-FYM+Neem cake+VC (1/3+1/3+1/3)	31.3	45.7	-	86.9	9.09
Rice - Lentil/Potato*(2009-10)	NS1-FYM+VC(1/2+1/2)	33.5	-2.8	-	153.0	4.44
	NS2-FYM+Neem cake(1/2+1/2)	12.4	-57.6	-	195.5	2.22
	NS3-VC+Neem cake(1/2+1/2)	31.9	-1.7	-	154.3	8.89
	NS4-FYM+Neem cake+VC (1/3+1/3+1/3)	31.3	-5.3	-	175.5	8.89

Centre/ cropping system	Treatment	Grain Yield *Kharif*	*Rabi*	Summer	Net returns	Organic carbon
13. Umiam I						
Rice +Soybean-Mustard	FYM	115.4	131.6	413.6	-	6.77
	Vermicompost	85.3	99.1	432.1	-	4.17
	Local compost	55.5	85.5	294.1	-	2.08
	Integrated	123.0	134.7	423.1	-	11.46
Rice +Soybean-Tomato	FYM	120.9	187.3	134.3	-	10.95
	Vermicompost	99.4	167.8	89.5	-	7.96
	Local compost	59.6	152.0	44.8	-	1.00
	Integrated	153.3	174.4	85.7	-	12.94
Maize +Soybean- G.Nut	FYM	162.8	171.6	202.4	-	7.61
	Vermicompost	143.1	139.9	143.4	-	3.55
	Local compost	81.9	119.7	83.7	-	2.54
	Integrated	150.8	147.7	160.7	-	12.69
Maize +Soybean-French bean	FYM	197.6	152.4	668.2	-	10.38
	Vermicompost	144.9	120.2	568.0	-	4.25
	Local compost	88.3	94.1	225.0	-	2.36
	Integrated	186.1	120.8	590.4	-	11.32
Umiam II						
Maize +Soybean-	FYM	69.6	-	-	-	-
	Vermicompost	44.8	-	-	-	-
	Integrated	65.3	-	-	-	-
Maize +Soybean-	FYM	49.2	-	-	-	-
	Vermicompost	28.2	-	-	-	-
	Integrated	41.3	-	-	-	-
Maize +Soybean-	FYM	97.0	-	-	-	-
	Vermicompost	64.5	-	-	-	-
	Integrated	88.3	-	-	-	-
Umiam II (2008-09)						
French bean-Tomato	FYM	87.2	168.4	-	-	-
	Vermicompost	62.8	150.9	-	-	-
	Integrated	73.0	149.5	-	-	-
Radish-Potato	FYM	20.4	76.3	-	-	-
	Vermicompost	17.0	77.4	-	-	-
	Integrated	11.5	51.3	-	-	-
French bean-Carrot	FYM	43.5	112.4	-	-	-
	Vermicompost	31.8	144.0	-	-	-
	Integrated	41.7	100.5	-	-	-

K : *Kharif*. R : *Rabi*

Appendix IV. Performance of different crops in terms of increase or decrease in yield under organic and INM over inorganic system across the locations (Mean of 6 years)

Yield range (%)	Increase (%) over inorganic Crop	Mean (%)	No. of locations	No. of times	Decrease (%) over inorganic Crop	Mean (%)	No. of locations	No. of times
I. Organic								
0 to 5	Maize	4.9	6	9	Rice	-2.6	6	22
	Soybean	1.7	3	9	Chickpea	-1.4	4	5
	Berseem	0.3	2	2	Groundnut	-1.3	3	3
	Brinjal	3.4	1	1	-	-	-	-
	Chiili	3.7	2	2	-	-	-	-
	Capsicum	3.8	1	1	-	-	-	-
	Tomato	1.7	2	2	-	-	-	-
	Sorghum	2.6	3	3	-	-	-	-
	Pea	4.1	3	3	-	-	-	-
	GM	2.2	1	1	-	-	-	-
5 to 10	Greengram	9.3	2	5	Mustard	-9.3	6	7
	Sunflower	7.4	1	1	Cauliflower	-9.1	1	2
	Garlic	9.6	2	3	Babycorn	-5.6	1	1
10 to 20	Onion	12.7	3	3	Wheat	-10.3	8	12
	Ginger	19.9	1	3	Potato	-11.5	6	7
	Dolichos bean	17.9	1	1	Cabbage	-16.1	1	1
	-	-	-	-	Frenchbean	-12.7	2	2
	-	-	-	-	Lentil	-11.0	2	2
>20	Okra	26.0	2	3	Radish	-25.5	2	3
	Turmeric	36.2	3	5	Isabgol	-23.2	1	1
	Cotton	52.8	2	2				
	Carrot	24.8	1	1	-	-	-	-
	Black pepper	47.3	1	1	-	-	-	-
	Cowpea	32.1	1	1	-	-	-	-

Yield range (%)	Crop	Increase (%) over inorganic Mean (%)	No. of locations	No. of times	Crop	Decrease (%) over inorganic Mean (%)	No. of locations	No. of times
Integrated Nutrient Managment								
0 to 5	Rice	0.7	6	22	Pea	-2.9	3	3
	Wheat	0.3	8	12	Lentil	-0.7	2	2
	Soybean	2.0	3	9	-	-	-	-
	Mustard	2.9	6	7	-	-	-	-
	Berseem	3.7	2	2	-	-	-	-
	Chickpea	3.0	4	5	-	-	-	-
	Groundnut	4.5	3	3	-	-	-	-
	Chiili	3.5	2	2	-	-	-	-
	Capsicum	0.7	1	1	-	-	-	-
	Frenchbean	2.2	2	3	-	-	-	-
	Sorghum	1.4	3	2	-	-	-	-
	GM	4.3	1	1	-	-	-	-
5 to 10	Okra	8.6	2	3	-	-	-	-
	Brinjal	8.9	1	1	-	-	-	-
	Cabbage	5.7	1	1	-	-	-	-
	Tomato	5.3	2	2	-	-	-	-
	Babycorn	9.5	1	1	-	-	-	-
	Dolichos bean	7.3	1	1	-	-	-	-
	Isabgol	9.1	1	1	-	-	-	-
10 to 20	Maize	12.6	6	9	-	-	-	-
	Potato	19.1	6	7	-	-	-	-
	Radish	16.7	2	3	-	-	-	-
	Greengram	12.5	2	4	-	-	-	-
	Onion	17.7	3	3	-	-	-	-
	Sunflower	19.0	1	1	-	-	-	-
	Cauliflower	13.8	1	2	-	-	-	-
	Black pepper	19.2	1	1	-	-	-	-
	Garlic	18.8	2	3	-	-	-	-
	Cowpea	16.4	1	1	-	-	-	-
>20	Turmeric	31.1	3	5	-	-	-	-
	Ginger	30.7	1	3	-	-	-	-
	Cotton	29.5	2	2	-	-	-	-
	Carrot	27.9	1	1	-	-	-	-

Appendix V. Performance of different cropping system in terms of increase or decrease in net returns under organic and INM over inorganic system across the locations (Mean of 6 years)

Range	Increase over inorganic (%)				Decrease over inorganic (%)			
	Cropping system	Mean (%)	No. of locations	No. of times	Cropping system	Mean (%)	No. of locations	No. of times
Organic								
0 to 5	Maize-Mustard-Radish-Greengram*	3.8	1	1	Maize-Cotton	-2.0	1	1
	Rice – potato -Okra	3.8	1	1	Rice - Tomato	-4.4	1	1
	Brinjal-Sunflower	3.6	1	1	-	-	-	-
5 to 10	Rice-Wheat	5.5	2	2	Maize-Garlic	-7.4	1	1
	Rice -Potato	7.2	2	2	-	-	-	-
10 to 20	Rice-Pea-Sorghum F	14.7	1	1	Soybean-Mustard	-15.4	1	1
	Chilli-Onion	15.6	2	2	Ginger-Ginger-Ginger	-14.0	1	1
	Soybean-Wheat	15.9	2	2	Rice -Lentil-Sesbania (GM)	-19.8	2	2
	Soybean-Berseem	13.9	1	1	Rice – French bean	-11.6	1	1
	Soybean-Chickpea	16.7	1	1	-	-	-	-
	Potato-Chickpea	11.0	1	1	-	-	-	-
>20	Rice – Berseem	22.6	1	1	Turmeric- Turmeric-Turmeric	-42.0	1	1
	Chilli-Onion	22.3	2	2	Rice-G.Nut	-42.8	1	1
	G.Nut -Sorghum	21.5	1	1	Rice-Maize	-86.7	1	1
	Cotton - Wheat	153.3	1	1	Rice-Mustard	-205.8	2	2
	Maize-Gram	34.8	1	1	French bean-Cauliflower-French bean	-25.9	1	1
	Turmeric+ Onion	76.0	2	2	Rice -Mustard-Sesbania (GM)	-40.0	1	1
	Maize -Potato-Moong (S)	96.7	1	1	Rice-Dolichos bean	-33.6	1	1
	Rice -Wheat-Moong (S)	27.6	1	1	-	-	-	-

Range	Increase over inorganic (%)				Decrease over inorganic (%)			
	Cropping system	Mean (%)	No. of locations	No. of times	Cropping system	Mean (%)	No. of locations	No. of times
	Sorghum - Berseem	24.9	1	1	-	-	-	-
	Maize- Berseem-Bajra	46.6	1	1	-	-	-	-
	Maize-Berseem – Maize +Cowpea	42.2	1	1	-	-	-	-
	Sorghum +Guar-Oats-Cowpea	50.4	1	1	-	-	-	-
	Cauliflower-Radish-Tomato	58.4	1	1	-	-	-	-
	Cabbage-Radish-Capsicum	352.8	1	1	-	-	-	-
	Rice-Wheat-Sesbania (GM)	27.3	1	1	-	-	-	-
	Rice -Pea (veg.)-Sesbania(GM)	49.8	1	1	-	-	-	-
	Rice - Carrot	44.0	1	1	-	-	-	-
Integrated Nutrient Management								
0 to 5	Rice – Berseem	0.5	1	1	Rice-Wheat	-2.5	2	2
	Rice - Tomato	0.0	1	1	Rice-Pea-Sorghum F	-2.3	1	1
	-	-	-	-	Maize-Cotton	-3.6	1	1
	-	-	-	-	Turmeric+ Onion	-2.9	2	2
	-	-	-	-	Rice -Lentil-Sesbania (GM)	-3.6	2	2
5 to 10	Soybean-Wheat	7.0	2	2	Rice – potato -Okra	-5.9	1	1
	-	-	-	-	Soybean-Berseem	-7.9	1	1
	-	-	-	-	Soybean-Mustard	-7.6	1	1
	-	-	-	-	Soybean-Chickpea	-5.5	1	1
	-	-	-	-	Rice-G.Nut	-5.2	1	1
10 to 20	G.Nut -Sorghum	11.8	1	1	Maize-Mustard-Radish-Greengram*	-16.1	1	1
	Maize-Gram	16.6	1	1	Cotton - Wheat	-14.7	1	1
	Rice -Wheat-Moong (S)	13.0	1	1	-	-	-	-
	Maize-Berseem – Maize +Cowpea	19.0	1	1	-	-	-	-

Range	Increase over inorganic (%)				Decrease over inorganic (%)			
	Cropping system	Mean (%)	No. of locations	No. of times	Cropping system	Mean (%)	No. of locations	No. of times
	French bean-Cauliflower-French bean	10.8	1	1	-	-	-	-
	Rice -Potato	10.4	2	2	-	-	-	-
	Rice -Pea (veg.)-Sesbania(GM)	15.1	1	1	-	-	-	-
>20	Brinjal-Sunflower	30.2	1	1	Rice-Maize	-36.3	1	1
	Ginger-Ginger-Ginger	27.7	1	1	Rice-Mustard	-92.5	2	2
	Turmeric- Turmeric-Turmeric	54.8	1	1	Rice-Dolichos bean	-30.9	1	1
	Potato-Chickpea	20.2	1	1	Rice -Mustard-Sesbania (GM)	-47.1	1	1
	Maize -Potato-Moong (S)	45.1	1	1	-	-	-	-
	Sorghum - Berseem	22.9	1	1	-	-	-	-
	Maize- Berseem-Bajra	35.5	1	1	-	-	-	-
	Sorghum +Guara-Oats-Cowpea	56.1	1	1	-	-	-	-
	Cauliflower-Radish-Tomato	35.3	1	1	-	-	-	-
	Cabbage-Radish-Capsicum	249.9	1	1	-	-	-	-
	Maize-Garlic	22.5	1	1	-	-	-	-
	Rice-Wheat-Sesbania (GM)	55.1	1	1	-	-	-	-
	Rice - Carrot	62.2	1	1	-	-	-	-
	Rice – French bean	24.9	1	1	-	-	-	-

Appendix VI. Performance of different cropping system in terms of increase or decrease in organic carbon under organic and INM over inorganic system across the locations (Mean of 6 years)

Range	Increase over inorganic (%)				Decrease over inorganic (%)			
(%)	Cropping system	Mean (%)	No. of locations	No. of times	Cropping system	Mean (%)	No. of locations	No. of times
Organic								
0-5	Maize-Cotton	0.1	1	1	Rice-G.Nut	-3.3	1	1
	Soybean-Mustard	2.7	1	1	Rice-Maize	-3.5	1	1
	Soybean-Chickpea	1.6	1	1	-	-	-	-
	Turmeric- Turmeric-Turmeric	1.0	1	1	-	-	-	-
	Sorghum - Berseem	3.6	1	1	-	-	-	-
	Maize- Berseem- Bajra	1.7	1	1	-	-	-	-
	Maize-Berseem – Maize +Cowpea	3.8	1	1	-	-	-	-
	Sorghum +Guara-Oats-Cowpea	3.8	1	1	-	-	-	-
	Rice -Pea (veg.)-Sesbania(GM)	4.8	1	1	-	-	-	-
	Rice - Carrot	1.2	1	1	-	-	-	-
	Rice – French bean	2.8	1	1	-	-	-	-
	Rice - Tomato	1.2	1	1	-	-	-	-
5 to 10	Rice – potato -Okra	7.1	1	1	-	-	-	-
	Rice – Berseem	7.0	1	1	-	-	-	-
	Rice-Pea-Sorghum F	8.6	1	1	-	-	-	-
	Brinjal-Sunflower	6.8	1	1	-	-	-	-
	Soybean-Wheat	9.3	2	2	-	-	-	-
	Soybean-Berseem	6.3	1	1	-	-	-	-
	Black pepper	6.8	1	1	-	-	-	-
	Rice-Dolichos bean	7.6	1	1	-	-	-	-
	Rice-Wheat-Sesbania (GM)	9.0	1	1	-	-	-	-
	Rice -Mustard-Sesbania (GM)	6.3	1	1	-	-	-	-
10 to 20	Chilly-Onion	15.9	2	2	-	-	-	-
	Ginger-Ginger-Ginger	10.3	1	1	-	-	-	-
	G.Nut -Sorghum	18.8	1	1	-	-	-	-
	Potato-Chickpea	15.4	1	1	-	-	-	-
	Maize-Chickpea	18.4	1	1	-	-	-	-

Range	Increase over inorganic (%)				Decrease over inorganic (%)			
(%)	Cropping system	Mean (%)	No. of locations	No. of times	Cropping system	Mean (%)	No. of locations	No. of times
	Rice-Mustard	14.6	2	2	-	-	-	-
	Rice-Wheat-GM	14.0	1	1	-	-	-	-
	Rice -Potato	12.2	2	2	-	-	-	-
	Rice -Lentil-Sesbania (GM)	14.6	2	2	-	-	-	-
>20	Rice-Wheat	27.8	3	3	-	-	-	-
	Maize-Mustard-Radish-Greengram*	152.6	1	1	-	-	-	-
	Rice-Potato-Radish	39.2	1	1	-	-	-	-
	Babycorn-Potato-Greengram	59.2	1	1	-	-	-	-
	Sorghum (F)-Pea-Okra	72.5	1	1	-	-	-	-
	Rice –Barley + mustard-Greengram	78.2	1	1	-	-	-	-
	Maize-Potato-Okra	24.2	1	1	-	-	-	-
	Turmeric+ Onion	39.5	1	1	-	-	-	-
	G.Nut.(S)- Garlic	43.2	1	1	-	-	-	-
	Maize-Wheat-Cowpea(F)	37.5	1	1	-	-	-	-
	Rice-Garlic+ Mentha oil	32.0	1	1	-	-	-	-
	Cotton - Wheat	43.9	1	1	-	-	-	-
	Maize-Gram	27.8	1	1	-	-	-	-
	Maize -Potato-Moong (S)	81.3	1	1	-	-	-	-
	Rice -Wheat-Moong (S)	81.8	1	1	-	-	-	-
Integrated Nutrient Management								
0-5	Rice – potato -Okra	1.4	1	1	Turmeric-Turmeric-Turmeric	-4.3	1	1
	Rice – Berseem	2.8	1	1	Soybean-Chickpea	-1.8	1	1
	Maize-Cotton	3.4	1	1	Rice-G.Nut	-1.1	1	1
	Brinjal-Sunflower	3.4	1	1	Rice-Maize	-2.7	1	1
	Soybean-Wheat	4.4	2	2	-	-	-	-
	Soybean-Berseem	1.8	1	1	-	-	-	-
	Soybean-Mustard	0.2	1	1	-	-	-	-
	Black pepper	4.7	1	1	-	-	-	-
	Rice-Mustard	3.0	2	2	-	-	-	-
	Rice-Wheat-GM	4.7	1	1	-	-	-	-
	Sorghum - Berseem	1.8	1	1	-	-	-	-
	Maize- Berseem- Bajra	3.4	1	1	-	-	-	-

Range	Increase over inorganic (%)				Decrease over inorganic (%)			
(%)	Cropping system	Mean (%)	No. of locations	No. of times	Cropping system	Mean (%)	No. of locations	No. of times
	Maize-Berseem – Maize +Cowpea	3.8	1	1	-	-	-	-
	Sorghum +Guara-Oats-Cowpea	3.8	1	1	-	-	-	-
	Rice -Pea (veg.)-Sesbania(GM)	2.4	1	1	-	-	-	-
	Rice -Mustard-Sesbania (GM)	3.8	1	1	-	-	-	-
	Rice - Carrot	2.2	1	1	-	-	-	-
	Rice – French bean	2.4	1	1	-	-	-	-
	Rice - Tomato	4	1	1	-	-	-	-
5 to 10	Chilly-Onion	7.1	2	2	Rice-Dolichos bean	-6.7	1	1
	Rice-Pea-Sorghum F	5.7	1	1	-	-	-	-
	Ginger-Ginger-Ginger	8.2	1	1	-	-	-	-
	Potato-Chickpea	5.8	1	1	-	-	-	-
	Maize-Chickpea	8.2	1	1	-	-	-	-
	Rice -Potato	6.9	2	2	-	-	-	-
	Rice-Wheat-Sesbania (GM)	7.7	1	1	-	-	-	-
	Rice -Lentil-Sesbania (GM)	6.7	2	2	-	-	-	-
10 to 20	Rice-Wheat	15.5	3	3	-	-	-	-
	Babycorn-Potato-Greengram	12.2	1	1	-	-	-	-
	Maize-Potato-Okra	19.7	1	1	-	-	-	-
	G.Nut -Sorghum	14.6	1	1	-	-	-	-
	Rice-Garlic+Mentha oil	16.0	1	1	-	-	-	-
>20	Maize-Mustard-Radish-Greengram*	28.1	1	1	-	-	-	-
	Rice-Potato-Radish	33.3	1	1	-	-	-	-
	Sorghum (F)-Pea-Okra	39.2	1	1	-	-	-	-
	Rice –Barley + mustard-Greengram	76.4	1	1	-	-	-	-
	Turmeric+ Onion	32.6	1	1	-	-	-	-
	G.Nut.(S)- Garlic	35.1	1	1	-	-	-	-
	Maize-Wheat-Cowpea(F)	25.0	1	1	-	-	-	-
	Cotton - Wheat	34.1	1	1	-	-	-	-
	Maize-Gram	25.0	1	1	-	-	-	-
	Maize -Potato-Moong (S)	59.4	1	1	-	-	-	-
	Rice -Wheat-Moong (S)	75.8	1	1	-	-	-	-

10. ANNEXURES

Annexure I

10.1 Current Contact Address of Centres

PDFSR, Modipuram

Dr B. Gangwar, Project Director, Project Directorate for Farming Systems Research, Modipuram, Meerut-250 110, U.P. Tel: (Off.) 0121-288 8571, 295 6318; (Mob.) 09412202070; (Fax) 0121-288 8546; Email: directorpdfsr@yahoo.com, bgangwar@pdfsr.ernet.in

Dr Kamta Prasad, Pr Scientist & National PI, NPOF, Project Directorate for Farming Systems Research, Modipuram, Meerut-250 110, U.P.Tel: (Off.) 0121-288 8571; (Mob.) 09412207233; (Fax) 0121-288 8546. Email: kamta_pdcsr@rediffmail.com, pfcu_pdfsr@yahoo.in

Dr N. Ravisankar, Principal Scientist & Associate, NPOF, Project Directorate for Farming Systems Research, Modipuram, Meerut-250 110, U.P. Tel: (Off.) 0121-288 8571; (Mob.) 08755195404, (Fax) 0121-288 8546, Email: ifsofr@rediffmail.com, ifsofr@gmail.com

Principal Investigators at Centres

Dr D.K. Singh, Principal Investigator, NPOF, Department of Agronomy, College of Agriculture, GBPUA&T, Pantnagar-263145, District-Udhamsinghnagar 263 145 (Uttarakhand), Tel: (Off.)05944-233625; (Mob.) 09411320066; (Fax) 05944-233608/233473, Email:dhananjayrahul@rediffmail.com

Dr Y.S. Paul, Principal Investigator, NPOF, CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur, Dist. Kangra-176 062 (H.P.), Tel: (Off.) 01894-230402; (Mob.) 09418194078, Email:yspaul@gmail.com

Dr S. K. Sarawgi, Chief Agronomist, AICRP on IFS & PI, NPOF, Indira Gandhi Krishi Vishwa Vidyalaya, Krishak Nagar,Raipur-492 001 (Chhattishgarh), Tel: (Off.) 0771-2442177, (Mob.) 09826147467 , (Fax) 0771-2442131, Email:sarawgi1959@yahoo.co.in, sarawgi1959@gmail.com

Dr V.B. Upadhyay, Chief Agronomist, AICRP-IFS & Principal Investigator NPOF, Department of Agronomy, College of Agriculture, JNKVV, Jabalpur-482 004 (MP), Tel.: (Off.) 0761- 4016922, (Mob.) 09179085067 , (Fax) 0761-2481236, Email: vbujbp1956@rediffmail.com

Dr L.G. Pawar, Chief Agronomist,AICRP-IFS & Principal Investigator, NPOF, Agricultural Research Station Karjat-410 201 Dist. Raigad (Maharashtra), Tel.: (Off.) 02148-222072, (Mob.) 09421142232, (Fax) 02148-222035, Email:jdeva17@gmail.com,

Dr C.S. Aulakh, Sr. Agronomist, PI, NPOF, Department of Agronomy, PAU, Ludhiana-141 004 (Punjab), Tel.: (Off.) 0161-2401960, Ext.-308, (Mob.) 9888350044, (Fax) 0161-2400945, Email: csaulakh@rediffmail.com

Dr K. Siddeswaran, Chief Agronomist, AICRP on IFS & PI, NPOF, Department of Agronomy, TNAU, Coimbatore-641 003 (T.N.), Tel.: (Off.) 0422-6611246, (Mob.) 09443253332, (Fax) 0422-6611246, Email: ksiddeswaran@gmail.com

Dr H.B. Babalad, Senior Scientist & PI-NPOF, Institute of Organic Farming, U.A.S., Yettinagudda Campus, Krishinagar, Dharwad-580 005, Karnataka, Tel.: (Off.) 0836-2448566/2448321*305; (Mob.) 09449809436; (Fax) 0836-2748377/2448349, Email:babaldhb@rediffmail.com

Dr Janardan Prasad, Jr. Scientist cum Asstt. Prof. Department of Agronomy, Birsa Agricultural University, Ranchi-834 006(Jharkhand), Tel.: (Off.) 0651-2450608; (Mob.) 09934148562; (Fax) 0651-2451106, Email:ranifsbau@ymail.com

Dr A.B. Singh, Principal Scientist & PI, NPOF, Indian Institute of Soil Sciences, Nabi, Bagh, Berasia Road, Bhopal-462 038 (M.P.)

Dr V. Srinivasan, Principal Scientist & PI NPOF, Indian Institute of Spices Research, P.B.No.1701, Marikunnu PO, Calicut-673 012 (Kerala), Tel.: (Off.) 0495 - 2731410, (Mob.) 09446163644, (Fax) 0495-2730294, Email: vsrinivasan@iisr.org, vsrinivasan@spices.res.in

Dr Devendra P. Patel, Sr. Scientist (Plant Physiol.) ICAR Research Complex for NEH Region Umroi Road,Umiam-793 103, (Meghalaya), Tel: (Off.) 0364-2570306; (Mob.) 0436108535; (Fax) 0364-2570306, Email:pateldpp2001@yahoo.com

Dr Prem Singh, Principal Scientist, & PI, NPOF, PDFSR, Modipuram, Meerut-250110, U.P., Tel: (Off.) 0121-288 8571; (Mob.) 09412628440; (Fax) 0121-288 8546, Email: psingh@pdfsr.ernet.in

Annexure II

10.2 ACRONYMS

B:C	-	Benefit-Cost ratio
CDM	-	Cow dung manure
DAS	-	Days after sowing
DAT	-	Days after transplanting
EC	-	Enriched compost / Electrical conductivity
FYM	-	Farm Yard Manure
GLM	-	Green leaf manure
GM	-	Green manure
GRT's	-	Green revolution technologies
ICAR	-	Indian Council of Agricultural Research
IFOAM	-	International Federation of Organic Agriculture Movements
INM	-	Integrated Nutrient Management
LC	-	Leaf compost
Max.	-	Maximum
Min.	-	Minimum
NEH	-	North Eastern Hill
NEOC	-	Non Edible Oil Cakes
NPOF	-	Network Project on Organic Farming
NS	-	Nutrient source
NSOP	-	National Standards for Organic Production
OC	-	Organic carbon
PDFSR	-	Project Directorate for Farming Systems Research
PM	-	Poultry manure
PPM	-	Parts per million
PsF	-	*Pseudomanas fluorescence*
RARS	-	Regional Agricultural Research Station
USDA	-	United States Department of Agriculture
VC	-	Vermicompost

NOTES

CONTACT / सम्पर्क सूत्र

Dr. B. Gangwar, Project Director
Project Directorate for Farming Systems Research
Modipuram, Meerut-250 110, Uttar Pradesh, India
Tel: (Off.) 0121-288 8571, 295 6318;
(Mob.) 09412202070;
(Fax) 0121-288 8546
E-mail: directorpdfsr@yahoo.com,
bgangwar@pdfsr.ernet.in

डा0 बी0 गंगवार, परियोजना निदेशक
कृषि प्रणाली अनुसंधान परियोजना निदेशालय
मोदीपुरम, मेरठ–250 110 (उ.प्र.), भारत
फोनः (कार्या0): 0121–288 8571, 295 6318
(मोबा0): 09412202070
(फैक्स): 0121–288 8546
ई–मेलः directorpdfsr@yahoo.com,
bgangwar@pdfsr.ernet.in

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