Annual Report

2011-12

जैविक खेती पर नेटवर्क परियोजना

Network Project on Organic Farming

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

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

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).

Mandate

- To characterize existing farming systems to know the productivity, viability and constraints
- To develop resource efficient, economically viable and sustainable integrated farming system modules and models for different farming situations
- To undertake basic and strategic research on production technologies for improving agricultural resource use efficiencies in farming system mode
- To develop and standardize package of production practices for emerging cropping/farming concepts and evaluate their long-term sustainability
- To act as repository of information on all aspects of farming systems by creating appropriate databases
- To develop on-farm agro-processing and value addition techniques to enhance farm income and quality of finished products
- To undertake on-farm testing, verification and refinement of system based farm production technologies
- To develop capacity building of stakeholders in Integrated Farming Systems through training

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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NETWORK PROJECT ON ORGANIC FARMING

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

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Important Notes:

- This compilation is a joint contribution of all the scientists involved in Network Project on Organic Farming (NPOF) at 13 centres and PDFSR, Modipuram (report writing, compilation, editing and printing).
- The report is based on experimental data generated during *kharif*, *rabi* and *summer* seasons of 2010-11. The other details are relevant up to 31 March 2012.
- The report includes both processed and semi-processed data, generated in different experiments under NPOF. As such no material/ data should be reproduced in any form without prior written permission of the Project Director, Project Directorate for Farming Systems Research and due credit to the concerned scientist (s).

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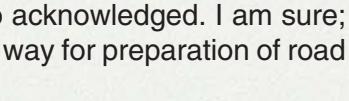
I am highly thankful to all the scientists and research fellows involved in the project at 13 centres for taking the pain to conduct the field experiments, lab analysis and generating data. The sincere efforts put forth by **Dr. N. Ravisankar**, Principal Scientist deserves appreciation for statistical analysis, drafting, editing and proof corrections of the report. Thanks 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**, Technical Officer for his cooperation in compilation of the report and help in checking the proofs.

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 annual report will go in a long way for preparation of road map in organic farming in India.



(B. GANGWAR)
Project Director

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सार

जैविक रासायनिक और एकीकृत प्रबंधन (आईएम) उत्पादन प्रणालियों का मूल्यांकन

- मोदीपुरम में जैविक कृषि के अधीन बासमती चावल, हरे भुटटे की मक्का, जौं और मूंग की अपेक्षाकृत अधिक पैदावार दर्ज की गई जबकि एकीकृत प्रबंधन पद्वति के अधीन अनाज के लिए मक्का, आलू, भिण्डी, सरसों तथा मूली की अपेक्षाकृत अधिक पैदावार प्राप्त की गई ।
- जबलपुर में जैविक और एकीकृत प्रबंधन पद्वति के साथ बासमती चावल की पैदावार में कमी पाई गई जो क्रमशः केवल 41 और 82 किलाग्राम प्रति हैक्टेयर थी जबकि गेहूँ की पैदावार में कमी और भी अधिक (क्रमशः 515 और 138 किलाग्राम प्रति हैक्टेयर) थी। रासायनिक पद्वति की तुलना में जैविक पद्वति के साथ मटर की पैदावार 12.6% अधिक पाई गई।
- कोयम्बाटूर में, रासायनिक पद्वति की तुलना में जैविक पद्वति के साथ 993 किलोग्राम प्रति हैक्टेयर मिर्च की अतिरिक्त पैदावार पाई गई। जबकि एकीकृत प्रबंधन पद्वति की तुलना में जैविक पद्वति के अधीन सूरजमुखी, मक्का, बैंगन और कपास की पैदावार में क्रमशः 24.3, 18%, 17.5 और 11.2% की गिरावट पाई गई थी।
- रायपुर में खरीफ में सोयाबीन की पैदावार जैविक पद्वति के अधीन 1695 किलोग्राम प्रति हैक्टेयर अपेक्षाकृत अधिक पाई गई और उसके बाद रासायनिक पद्वति (1647 किलोग्राम प्रति हैक्टेयर) तथा एकीकृत प्रबंधन पद्वति (1608 किलोग्राम प्रति हैक्टेयर) का स्थान था। रायपुर में, जिन अन्य फसलों का मूल्यांकन किया गया, उनमें एकीकृत प्रबंधन के अधीन बरसीम और प्याज की अधिक पैदावार दर्ज की गई जबकि ईसबगोल और सूरजमुखी की पैदावार रासानिक पद्वति के अधीन अपेक्षाकृत अधिक प्राप्त की गई।
- कालीकट में जैविक पद्वति के अधीन अदरक के प्रकन्द की अपेक्षाकृत अधिक उपज हुई जबकि हल्दी की पैदावार एकीकृत प्रबंधन पद्वति के अधीन अधिक हुई। रासायनिक और एकीकृत प्रबंधन पद्वति की तुलना में जैविक पद्वति के अधीन अदरक की पैदावार क्रमशः 27.2% और 67.2% अधिक पाई गई।
- धारवाड़ में, कपास को छोड़कर जिन सभी फसलों का पांच प्रणालियों में मूल्यांकन किया गया, उनकी जैविक पद्वति के अधीन अधिक पैदावार दर्ज की गई। रासायनिक पद्वति की तुलना में जैविक पद्वति के अधीन मक्का, सफेद चना, ज्वार, मटर, मूँगफली, आलू सोयाबीन और गेहूँ की पैदावार क्रमशः 39, 32, 26.2, 34.8, 27.2, 42. 1, 53 और 17.4 प्रतिशत अधिक पाई गई।
- करजट में खरीफ के मौसम में धान की पैदावार सबसे अधिक रासायनिक पद्वति में दर्ज की गई जिसके बाद एकीकृत प्रबंधन पद्वति के अधीन पैदावार हुई। यहां पर रासायनिक पद्वति की तुलना में जैविक और एकीकृत प्रबंधन में पैदावार में क्रमशः 16 और 3.9% की कमी दर्ज की गई।
- लुधियाना में रासायनिक पद्वति की तुलना में जैविक पद्वति द्वारा कपास और हल्दी की पैदावार में 50% से अधिक की वृद्वि हुई। जबकि बासमती धान की उपज में केवल 5.9% वृद्वि दर्ज की गई। रबी में जैविक पद्वति अपनाने पर चना, प्याज और आलू की पैदावार में रासायनिक पद्वति की तुलना में क्रमशः 19.3, 18.3 और 37. 6 प्रतिशत की वृद्वि हुई।
- बजौरा में एकीकृत प्रबंधन द्वारा टमाटर की पैदावार 2246 किलोग्राम प्रति हैक्टेयर दर्ज की गई जबकि रासायनिक पद्वति के अधीन 2037 किलोग्राम प्रति हैक्टेयर की पैदावार दर्ज की गई। रासायनिक पद्वति की तुलना में जैविक खेत में केवल 44 किलोग्राम प्रति हैक्टेयर की कमी पाई गई।
- भोपाल में एकीकृत प्रबंधन पद्वति के अधीन सफेद चना की सर्वाधिक (2107 किलोग्राम प्रति हैक्टेयर) पैदावार दर्ज की गई रासायनिक तथा जैविक पद्वतियों के अधीन पैदावार की तुलना में 62.8% और 15.7% अधिक थी।

- पंतनगर में खरीफ के दौरान एकीकृत प्रबंधन पद्धति के अधीन बासमती चावल की उल्लेखनीय रूप से अधिक औसत पैदावार 3599 किलोग्राम प्रति हैक्टेयर पाई गई और उसके बाद जैविक पद्धति का स्थान था। रबी फसलों में, एकीकृत प्रबंधन पद्धति के अधीन 4168 किलोग्राम प्रति हैक्टेयर की पैदावार हुई और उसके बाद रासायनिक पद्धति (3770 किलोग्राम प्रति हैक्टेयर) और जैविक पद्धति (3677 किलोग्राम प्रति हैक्टेयर) का स्थान है।
- रॉची में खरीफ धान की जैविक पद्धति के अधीन औसतन 2210 किलोग्राम प्रति हैक्टेयर की पैदावार प्राप्त की गई जो एकीकृत प्रबंधन पद्धति के अधीन हुई पैदावार की तुलना में 28.1% अधिक और रासायनिक पद्धति के अधीन हुई पैदावार से 53.8% अधिक थी, रबी में रासायनिक पद्धति की तुलना में जैविक पद्धति में लगभग 330 किलोग्राम प्रति हैक्टेयर कम पैदावार पाई गई।
- उमियम में यद्यपि रबी के दौरान एकीकृत प्रबंधन पद्धति के अधीन बोई गई गाजर, आलू, फ्रेंचबीन और टमाटर जैसी सब्जियों की बेहतर पैदावार हुई, तथापि जैविक पद्धति द्वारा भी उतनी ही पैदावार हुई जितनी एकीकृत प्रबंधन पद्धति के अधीन पैदावार हुई थी। रासायनिक पद्धति के अधीन काफी कम पैदावार हुई। सब्जियों की फसलों में अजैविक पद्धति के अधीन गाजर और टमाटर की पैदावार की तुलना में जैविक पद्धति के अधीन गाजर और टमाटर की पैदावार में क्रमशः 65.9 और 49.9% की वृद्वि दर्ज की गई।

पोशक तत्वों हेतु विभिन्न जैविक स्रोतों का मूल्यांकन

- जबलपुर में प्रत्येक एक तिहाई नत्रजन की दर पर वीसी एफवाइएम, एनईओसी, पीजी के उपयोग से अनाज की अधिक पैदावार (बासमती चावल, गेहूँ और बरसीम बीज क्रमशः 1652, 1538, और 50 किलोग्राम प्रति हैक्टेयर) हुई, जिसके बाद चावल–गेहूँ–हरी खाद और बासमती चावल बरसीम प्रणालियों में प्रत्येक में एक तिहाई नत्रजन की दर पर वीसी एफवाईएमएनईओएफ का स्थान आता है।
- कोयम्बटूर में प्रत्येक 1/2 एन की दर पर एफवाइएम, एनईओसी, पीजी कपास (1693 किग्रा/है0), मक्का (3159 किग्रा/है0), मिर्च (6266 किग्रा/है0) और सूरजमुखी (1344 किग्रा/है0) की अपेक्षाकृत अधिक पैदावार देने वाला पाया गया जो प्रत्येक 1/2 एन की दर पर एफवाइएम, एनईओसी के कपास मक्का –हरी खाद और मिच–सूरजमुखी–हरी खाद प्रणालियों में सभी फसलों की पैदावार के बराबर थी।
- रायपुर में प्रत्येक एक तिहाई नत्रजन की दर पर बायोडायनामिक पद्वति, ईसी सीडीएमएनईओसी, पीजी के उपयोग से चावल (4284 किग्रा/है0) और सफेद चना (1208 किग्रा/है0) की अधिक पैदावार हुई, तथापि चावल और सफेद चना प्रणालियों की दोनों फसलों में केवल यह प्रत्येक एक तिहाई नत्रजन की दर पर ईसी, सीडीएम, एनईओसी, पीजी और प्रत्येक एक तिहाई नत्रजन की दर पर ईसी, सीडीएम, एनईओसी के उपयोग से प्राप्त पैदावार के बराबर था।
- कालीकट में एफवाइएम, एनसी 2, वीसी, पीजी, बायोडायनामिक, आर पी के साथ अदरक प्रकंद की 23525 किग्रा/है0 की अपेक्षाकृत अधिक पैदावार हुई जो कि नियंत्रित दशा में 88.6% और दूसरे संयोजन (फवाइएमबायोडायनामिक पद्वतियां आरपी) पैदावार से 17% अधिक थी।
- धारवाड़ में मूंगफली–ज्वार मक्का–सफेद चना और मिर्च–प्याज प्रणालियों में पीजी स्पे के साथ 12 ग्राम /हैक्टेयर की दर से ईसी, वीसी, जीएलएम, पीजी स्प्रे अथवा ईसी, वीसी, जीएलएम के साथ बराबर था।
- करजट में खरीफ के दौरान प्रत्येक 1/3 एन की दर पर फवाइएम धान की पुआल ग्लाइरिसीडिया के उपयोग के साथ और रबी के दौरान प्रत्येक 1/3 एन की दर पर फवाइएम नीम की खली वर्मी कम्पोस्ट से पीजी के स्प्रे के उपयोग से चावल–रैड पम्पकिन और धान –खीरा प्रणालियों से अपेक्षाकृत अधिक पैदावार (क्रमशः 3927, 8530 किग्रा/है0) राइस–रैड पम्पकिन और 3757, 6038 किग्रा/है0, धान–खीरा के साथ अपेक्षाकृत अधिक पैदावार प्राप्त की गई।

- लुधियान में फवाइएम़पीजी. बायोडायनामिक पद्वतियों के उपयोग से मक्का की अपेक्षाकृत अधिक पैदावार (6137 किग्रा/है0) दर्ज की गयी जबकि केवल फवाइएम़पीजी के उपयोग से गेहूँ की अधिक पैदावार (2517 किग्रा/है0) दर्ज की गई। लुधियाना में पीजी के साथ एफवाइएम मिलाने अथवा बयोडायनामिक पद्वतियों की तुलना में गर्मियों में मूंग की अधिक पैदावार प्राप्त करने के लिए केवल एफवाइएम पर्याप्त था।
- सोयाबीन–गेहूँ और मक्का–सफेद चना प्रणालियों में केवल जैविक खाद की तुलना में बायोडायनामिक और पीजी पद्वतियों के कारण पैदावार में उल्लेखनीय वृद्वि नहीं पाई गई थी तथापि भोपाल में ओएम. पीजी. बीडी के संयुक्त उपयोग से सभी फसलों में अधिक पैदावार दर्ज की गई और यह सोयाबीन, गेहूँ, मक्का तथा सफेद चना की पैदावार में क्रमशः 117, 1003, 387 और 140 किग्रा/है0 थी।
- पंतनगर में केवल फवाइएम़वीसी़एनसी़ईसी के उपयोग की तुलना में प्रत्येक 1/4 एन की दर पर फवाइएम़वीसी़एनसी़ईसीफवाइएम़वीसी़एनसी़ईसी़बीडी़पीजी के उपयोग से बासमती धान की पैदावार में 300 किग्रा /है0 की वृद्वि पाई गई तथा इसी केन्द्र पर नत्रजन की आवश्यकता को पूरा करने के लिए प्रत्येक 1/2 दर से गोबर की खाद केंचुआ खाद को धान–गेहूँ, धान–सफेद चना और धान–मटर सब्जी प्रणालियों में अधिक पैदावार देने वाला पाया गया। पोषक स्रोत के रूप में प्रत्येक 1/2 की दर पर गोबर की खाद केंचुआ खाद अथवा प्रत्येक 1/4 की दर पर संवर्धित काम्पोस्ट केंचुआ खाद अखाद्य तेल की खली गोबर की खाद के साथ मृदा का जैविक कार्बन तत्व भी बेहतर पाया गया था।
- रांची में केंचुआ खाद केसी बायोडायनामिक प्रिप्रेषन पीजी के साथ सभी फसलों की अधिक पैदावार धान–गेहूं और आलू की क्रमशः 2558, 2411 तथा 17200 किग्रा0/ है0 दर्ज की गई ।
- फवाइएम़वीसी़पीजी के उपयोग से अनाज और हरी गुल्ली (क्रमशः 4153 और 9333 किग्रा/है0) और फ्रेंचबीन (1426 किग्रा/है0) के लिए मक्का की अधिक पैदावार दर्ज की गई, लेकिन केवल फवाइएम़वीसी के उपयोग के साथ भी पैदवार उतनी ही थी। तथापि, उमियम में तोरिया के मामले मे केवल फवाइएम़वीसी की तुलना में पीजी को मिलान से पैदावार में 75 प्रतिशत की वृद्वि हुई।

जैविक खेती में कीट और रोग प्रबंधन

- मोदीपुरम में उन खेतों में जिनमें गर्मियों में जुताई की गयी थी और जिनमें हरी खाद डाली गई थी, बासमती धान (क्रमशः 2755 और 2733 किग्रा/है0), सफेद चना (क्रमशः 1342 और 1303 किग्रा/है0) और सरसों (क्रमशः 1008 और 986 किग्रा/है0) की अपेक्षाकृत अधिक पैदावार दर्ज की गई।
- पूर्ण नियंत्रण की तुलना में अदरक अन्तः पादप जीवाणु (जीईबी 17 और जीईबी 18) और अदरक राइजोबैक्टीरिया (जीआरबी 57) के साथ अदरक में तना बेधक का प्रकोप कम था। कालीकट में प्रकोप में क्रमशः 17.3, 19.7 और 43.7% 6:7% कमी पाई गई।
- बजौरा में खरीफ के दौरान 10% की दर पर ऐससियोअस लीफ एक्सट्रेगोमूत्र (3%) ट वीन–80 (0.05%) कारवी (रॉयलिया सिनेरा) और रबी के दौरान (1.5 और 67.5% मामले) 5% की दर पर गोमूत्र (3%) कारवी के उपयोग में टमाटर में फल बेधक और फल सड़न अपेक्षाकृत कम था।
- मक्का की आरम्भिक अवस्थ में डेरीसोम (3 मि0ली0/लीटर) 10% की दर से पीजी और 3% गोमूत्र के उपयोग से मोनालेप्ट (040%), माइलासिरस (087%) और एप्लिचना (027%) के कम मामले पाए गए जबकि एनोमिन 3 मि0ली0/लीटर या 3% की दर पर पीजी के उपयोग के माध्यम से लीफ फोल्डर में कमी पायी गई थी। उमियम में 3% की दर पर पीजी. 10% की दर पर वर्मीवाश के उपयोग से सोयाबीन किटट 24.5% के स्तर तक नियंति पाया गया।

जैविक खेती पर खरपतवार प्रबंधन

- जबलपुर में खरपतवार मुक्त स्थिति में धान (6753 किग्रा/है0) और गेहूँ (6235 किग्रा/है0) की अपेक्षाकृत अधिक पैदावार हुई, जिसके बाद खरपतवार नियंत्रण हेतु हाथ से दो बार निराई 3.4 पत्ती की अवस्थ पर छिडकाव के संयोजन द्वारा उस खेत की तुलना में जहां खरपतवार नियंत्रण दिया गया है, धान और गेहूं की क्रमशः 44.9% और 41.3% की पैदावार दर्ज की गई।
- कोयम्बटूर में चावल और उड़द दोनों में खरपतवार मुक्त स्थिति में अपेक्षाकृत अधिक पैदावार (क्रमशः 3843 और 773 किग्रा0/है) दर्ज की गई, जिसके बाद हाथ की दो निराइयॉ खरपतवार की 3–4 पत्ती की अवस्था पर ऐक्विअस पत्ती के सत्त के स्प्रे के संयोजन द्वारा उस खेत की तुलना में, जहाँ खरपतवार नियंत्रित नहीं गई, में चावल और उड़द की पैदावार में 113% और 9% की वृद्वि दर्ज की गई।
- रायपुर में चावल में वर्ग रोपण के साथ कोनोवीडर के उपयोग से 68% कमी हुई जबकि सरसों के स्टेल सीड बैड के परिणामस्वरूप खरपतवारों की कुल संख्या में 71% की कमी हुई।
- आपात–पूर्व के रूप में 25% पर परथेनियम का जलीय आपात–पूर्व छिड़काव (ऐक्टिअस स्प्रे)। धारवाड में ऐक्विअस स्प्रे में, परथेनियम के उपरान्त अनुपयोग की तुलना में आपात–उपरान्त के रूप में कैसिया और प्रोसोपिस ज्यूलीफलोरा के स्प्रे अधिक प्रभावी पाए गए।
- करजट में हाथ द्वारा दो गुड़ाई क्रोमोलाइना ओडोरेटा से उस खेत की तुलना में जहां खरपतवार नियंति नहीं गई, में खरपतवार के कुल शुष्क वजन (72.7%) में अपेक्षाकृत कमी दर्ज की गई।
- अधिक घनत्व वाले रोपण 25.30 डीएटी पर हाथ से निराई से खरपतवार के कुल शुष्क वजन (8.3 ग्राम मी^{2}) में अधिकतम कमी दर्ज की गई जो 25–30 डीएटी पर हाथ से निराई, 25–30 और 45–50 डीएटी पर हाथ से निराई और वर्ग रोपण चावल में वीडर पर बराबर थी।
- पंतनगर में खरीफ के दौरान घास और प्रतृण (सेज) काउंट और रबी के दौरान चौडी पत्ती वाले खरपतवार सभी तीनो प्रणालियों– खरीफ के दौरान 25–30 डीएटी पर हाथ की एक निराई और रबी के दौरान 25–30 और 45–50 डीएएस पर हाथ की दो निराई अत्यधिक कम पाई गई।
- केवल ऐक्विअस पत्ती के सत्त के स्प्रे से पैदावार में धान में 68%, गेहूँ में 30.6% और अलसी में 51.4% की कमी दर्ज की गई। रांची में खेत को खरपतवार से मुक्त रखने पर धान की अधिकतम पैदावार 7 गुणा पायी गयी ।
- मक्का (हरी गुल्लियां) और सरसों , दोनों में 10 टन /हैक्टेयर की दर से ताजे यूपैटोरियम एमब्रोसिया के साथ (भू संयोजन के बाद) पलवारने (मल्च बनाने) से अपेक्षाकृत अधिक पैदावार दर्ज की गई जिसके बाद लेन्टाना के ऐक्विअस पत्ती सत्त स्प्रे और खरपतवार की 3–4 पत्ती की अवस्था पर चीड (पाइन) प्रजाति से अधिक पैदावार दर्ज की गई। उमियम में, ताजे यूपैटोरियम/एमब्रोसिया के साथ पलवारने से पैदावार में, खरपतवार मुक्त और उस खेत की तुलना में जहां खरपतवार नियंत्रित नहीं किया गया, में क्रमशः मक्का में 29.4% तथा 47.2% और सरसों में 73% तथा 93% की वृद्वि पाई गई।

ABSTRACT

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

- Basmati rice, maize for cob, barley and greengram have recorded higher yield under organic system while maize for grain, potato, okra, mustard and radish have recorded higher yield under IM practice at **Modipuram.**

- At **Jabalpur**, the yield reduction observed in basmati rice with organic and IM practice was found to be only 41 and 82 kg ha^{-1} respectively while, the reduction was much higher for wheat (515 and 138 kg ha^{-1} respectively). The yield increase in vegetable pea with organic nutrient practice was found to be 12.6% compared to inorganic practice.

- At **Coimbatore**, the additional chilli yield obtained with organic practice was found to be 993 kg ha^{-1} compared to inorganic practice. The drop in yield under organic practice over IM was found to be 24.3,18, 17.5 and 11.2% for sunflower, maize, brinjal and cotton respectively**.**

- Mean yield of soybean in *kharif* was found to be higher under organic practice (1695 kg ha^{-1}) followed by inorganic (1647 kg ha^{-1}) and IM (1608 kgha^{-1}). Among the other crops evaluated, berseem and onion registered higher yield under IM, while Isabgol and safflower performed better under inorganic practice at **Raipur**.

- Ginger recorded higher rhizome yield under organic practice while turmeric performed better under IM. The yield increase in ginger was found to be 27.5% and 67.2% under organic practice compared to inorganic and IM respectively at **Calicut**.

- At Dharwad, all the crops except cotton evaluated in five systems recorded higher yield with organic practice. The yield increase over inorganic was found to be 39, 32, 26.2, 34.8, 27.2, 42.1, 53 and 17.4% for maize, chickpea, pea, groundnut, sorghum, potato, soybean and wheat respectively.

- Rice during *kharif* registered significantly higher yield under inorganic practice followed by IM. The yield drop observed with organic and IM practice was found to be 16 and 3.9% respectively over inorganic practice at **Karjat**.

- More than 50% increase in yield under organic over inorganic was observed in cotton and turmeric during *kharif* at **Ludhiana**. Basmati rice recorded only 5.9% increase. In *rabi*, the results revealed that an increase in yield of gram, onion and potato by 19.3, 18.3 and 37.6% under organic over inorganic practice**.**

- Tomato recorded higher yield under IM (2246 kg ha^{-1}) followed by inorganic (2037 kg ha^{-1}). Organic practice in tomato recorded yield drop of only 44 kg ha^{-1} over inorganic and 253 kg ha^{-1} over IM at **Bajaura**.

- Chickpea registered significantly higher yield of 2107 kg ha^{-1} with IM and the yield increase was found to be 62.8 and 15.7% over inorganic and organic practices at **Bhopal.**

- Significantly higher mean yield of basmati rice, during *kharif* was observed with IM as it recorded higher grain yield of 3599 kg ha^{-1} followed by organic. The yield drop was 13.5%. Among *rabi* crops, wheat recorded significantly higher yield of 4168 kg ha^{-1} under IM followed by inorganic (3770 kg ha^{-1}) and organic (3677 kg ha^{-1}) at **Pantnagar.**

- Rice recorded significantly higher mean grain yield of 2210 kg ha^{-1} during *kharif* which is 28.1% higher than IM and 53.8% higher than inorganic practice. In *rabi*, it was observed that wheat recorded around 330 kg ha^{-1} lesser yield with organic compared to inorganic practice at **Ranchi**.

- All the vegetables like carrot, potato, french bean and tomato grown during *rabi* though performed better under IM, the yield obtained with organic was at par with IM practice. Inorganic practice recorded significantly lower yield. Among the vegetable crops, carrot and tomato have recorded 65.9 and 49.9% higher yield with organic over inorganic practice at **Umiam**.

Evaluation of various sources of organics for nutrient source

- Application of VC + FYM + NEOC @ 1/3 N each + PG recorded higher grain yield (1652, 1538 and 50kg of basmati rice, wheat and berseem seed ha^{-1}) followed by VC + FYM + NEOF @ 1/3 N each in rice- wheat-green manure and basmati rice-berseem sytems at **Jabalpur**.

- FYM + NEOC @ ½ N each + PG was found to give higher yield of cotton (1693 kg ha^{-1}), maize (3159kgha^{-1}), chillies (6266kg ha^{-1}) and sunflower (1344kg ha^{-1}) which was on par with FYM + NEOC @ ½ N each alone for all the crops in cotton-maize-green manure and chillies-sunflower-green manure systems at **Coimbatore**.

- At **Raipur**, though application of biodynamic practice + EC + CDM + NEOC @ 1/3 N each + PG recorded higher yield of rice (4284 kg ha^{-1}) and chickpea (1208 kg ha^{-1}), it was at par with application of + EC + CDM + NEOC @ 1/3 N each + PG and EC + CDM + NEOC @ 1/3 N each alone in both the crops of rice-chickpea system.

- Higher ginger rhizome yield of 23525 kg ha^{-1} was observed with FYM + NC + 2VC + PG + biodynamic + RP which is 88.6% higher than absolute control and 17% higher than the next best combination (FYM + Biodynamic practices + RP) at **Calicut**.

- EC + VC + GLM + biodynamic spray @ 12 g/ha with PG spray was found to be better, but it is on par with EC+ VC + GLM + PG spray or EC + VC + GLM in groundnut-sorghum, maize-chickpea and chilli + onion systems at **Dharwad**.

- Rice-red pumpkin and rice-cucumber systems have recorded higher yield with application of FYM + rice straw + gliricidia @ 1/3rd each of N during *kharif* and FYM + neem cake + vermicompost @ 1/3 each of N during *rabi* along with spray of PG (3927, 8530 kg ha^{-1} of rice-red pumpkin and 3757, 6038 kg ha^{-1} of rice-cucumber respectively) at **Karjat** .

- At **Ludhiana**, application of FYM + PG + biodynamic practices recorded higher grain yield of maize (6137 kg ha^{-1}), while in wheat FYM + PG alone recorded higher yield (2517 kg ha^{-1}). Application of only FYM was sufficient in summer moong to realize higher yield compared to combining FYM with PG or biodynamic practices at **Ludhiana**.

- The yield increase due to biodynamic and PG practices over organic manure alone was found to be not significant in soybean-wheat and maize-chickpea systems. However, combined application of OM+PG + BD registered higher yield in all crops and the yield increase was found to be 117, 1003, 387 and 140 kg ha^{-1} in soybean, wheat, maize and chickpea respectively at **Bhopal**.

- Application of FYM + VC + NC + EC @ ¼ N each + BD + PG recorded an increase in yield to the tune of 300 kg ha^{-1} in basmati rice compared to application of FYM + VC + NC + EC alone at **Pantnagar**.

- 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**, all the crops recorded higher yield with Vermicompost + KC + biodynamic peparration + PG (2558, 2411 and 17200 kg ha^{-1} in rice, wheat potato respectively).

- Application of FYM + VC + PG recorded numerically higher yield in maize for grain and green cobs (4153 and 9333 kg ha^{-1} respectively and French bean (1426 kg ha^{-1}) but the same was on par with application of FYM + VC alone. However, in case of toria addition of PG resulted in 75% yield increase over FYM + VC alone at Umiam.

Pest and disease management under organic farming

- At **Modipuram**, summer ploughing and green manure treated plots recorded higher grain yield of basmati rice (2755 and 2733 kg ha^{-1}respectively) chick pea (1342 and 1303kg ha^{-1}) and mustard (1008 and 986 kg ha^{-1}) at **Modipuram**.

- Shoot borer infestation in ginger was lower with ginger endophytic bacteria (GEB 17 and GEB 18) and ginger rhizobacteria (GRB 57) compared to absolute control. The reduction in infestation was observed to be 17.3, 19.7 and 43.7% respectively at **Calicut**.

- Fruit borer and fruit rot in tomato was lower in application of Karvi (*Roylea cinerea*) @ 10% asceous leaf extract + cow urine (3%) + tween-80 (0.05%) as emulsifier during *kharif* and karvi @ 5% +cow urine (3%) during *rabi* (1.5 and 67.5% incidence) at **Bajaura**.

- Application of Derisom (3 ml/l) + PG @ 10% and cow urine 3% recorded lower incidence of Monolapta (0.40%), mylloceros (0.87%) and Epilechna (0.27%) in early stage of maize while leaf folder incidence was found to be reduced through application of Anomin 3 ml/litre or PG @ 3%. Soybean rust was found to be controlled to the level of 24.5% with the application of PG @ 3% + lantana @ 10% + vermiwash @ 10% at **Umiam**.

Weed management under organic farming

- weed free recorded higher grain yield of rice (6753 kg ha^{-1}) and wheat (6235 kg ha^{-1}) followed by combination of two hand weeding + spray at 3-4 leaf stage of weeds which recorded 44.9 and 41.3% higher grain yield of rice and wheat respectively compared to unweeded check at **Jabalpur**.

- In both rice and blackgram at **Coimbatore**, weed free condition recorded higher yield (3843 and 773 kg ha^{-1} respectively) followed by combination of two hand weeding + spray of aqueous leaf extract at 3-4 leaf stage of weeds which recorded 113 and 9% increase yield of rice and blackgram over unweeded control.

- Use of conoweeder with square planting in rice contributed for 68% reduction while stale seed bed to mustard resulted in 71% reduction in total weed count at **Raipur**.

- Aqueous spray of Parthenium at 25% as pre emergent. Among the aqueous sprays, spray of cassia and *Prosppis juliflora* as post emergent was found to be more effective than pre or post emergence application of parthenium at **Dharwad**.

- Two hand hoeing + spray of *Chromolaena odorata* recorded the higher reduction in total dry weight of weeds (72.7%) over unweeded control at **Karjat**.

- High density planting + hand weeding at 25-30 DAT recorded maximum reduction of total dry weight of weeds (8.3 gm^{-2}) which was on par with hand weeding at 25-30 DAT, hand weeding at 25-30 and 45-50 DAT and square planting + weeder in rice at **Ludhiana**.

- Grasses and sedges count during *kharif* and broad leaved weeds count during *rabi* was found to be significantly lower in all the three systems with one hand weeding at 25-30 DAT during *kharif*and 2 hand weeding at 25-30 and 45-50 DAS during *rabi* at **Pantnagar**.

- Spray of aqueous leaf extract alone recorded reduction in yield to the tune of 68% in rice, 30.6% in wheat and 51.4% in linseed. Keeping the field free from weeds gave maximum yield advantage of 7 times in rice at **Ranchi.**

- In both maize (green cobs) and mustard, mulching with fresh eupatorium ambrosia @ 10 t/ha (after earthing up) recorded higher yield followed by aqueous leaf extract spray of lantana and pine spp. at 3-4 leaf stage of weed. The increase in yield under mulching with fresh *Eupatorium/Ambrosia* was found to be 29.4 and 47.2% in maize and 73 and 93% in mustard over weed free and weedy checks respectively at **Umiam**.

1. INTRODUCTION

Organic agriculture is intended to produce high quality, nutritious food that contributes to preventive health care and well-being in an environmental friendly manner. The principles underlying traditional agriculture are also part of the organic farming concepts. 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 and 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. The researchable issues such as identifying the appropriate production systems that involves natural manuring in the form of recycling and plant protection has got greater value in the organic food production systems.

In order to develop a technological package of organic farming including plant protection for different crops in system mode, a Network Project on Organic Farming (NPOF) was initiated during 2004-05 by Indian Council of Agricultural Research (ICAR), New Delhi with Project Directorate for Farming Systems Research (PDFSR) as nodal institute. In order to address, issues of 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 (Fig 1). The objectives along with significant findings of all the experiments are presented in the subsequent sections.

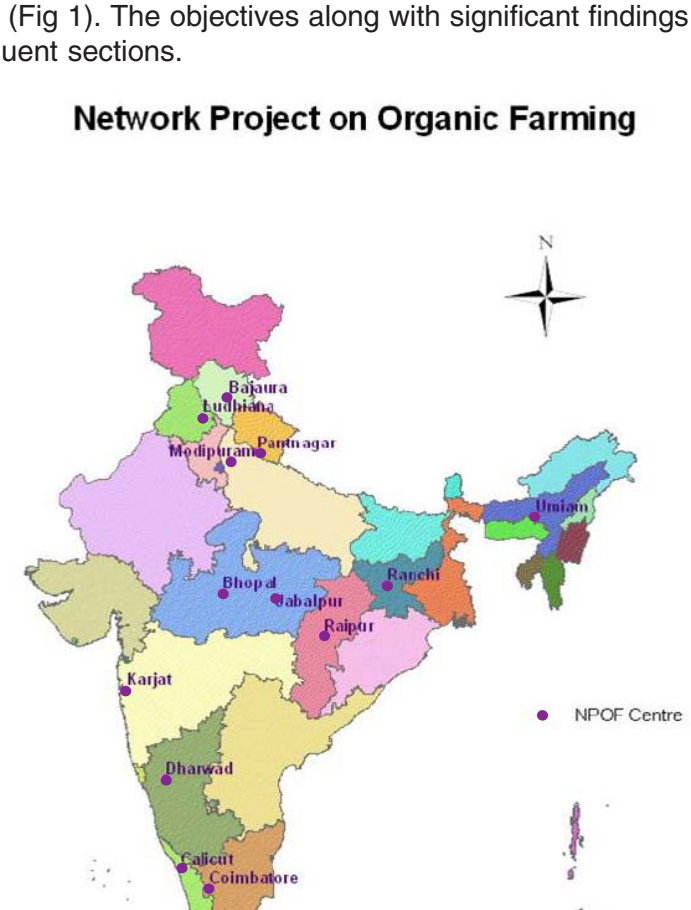


Fig. 1. Experimental locations of Network Project

2. OBJECTIVES AND METHODOLOGY

Objectives

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

Methodology

The experiments in the project have been designed mainly to evaluate the relative performance of location-specific, important cropping systems under organic and conventional (chemical) farming, and assess agronomic efficiency of different organic inputs, especially organic manures and bio-agents. Cropping systems, which are under evaluation, involve cereal crops (mainly basmati rice, *durum* and *aestivum* wheats, sorghum and maize), pulses and oilseeds (chickpea, lentil, green gram, soybean, mustard, and groundnut), spices (black pepper, ginger, turmeric, chillies, onion, and garlic), fruits (papaya, and mango), vegetables (potato, okra, baby corn, cowpea, pea, tomato, and cauliflower), cotton, fodder crops (sorghum, maize, pearl millet, oat, cow pea and berseem), and medicinal plants (Isabgol and mentha). The details of varieties used in the experimentation at each centre is given in appendix. During 2010-11, following four experiments were undertaken at different centers:

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

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

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

IV. Weed management in cropping system under organic farming

The treatment details of each experiment at various locations are presented in chapter 7 at respective tables. General guidelines and standards for organic production, as suggested under National Standards for Organic Production (NSOP), formed as the basis for raising the experimental crops in the project. A compact block of land has been earmarked at each of the cooperating centres for experimental purpose, as far as possible. The plot identified was in general, free from hazards of erosion, sediments, chemical pollutants and contaminants. Shelterbelts have been developed by planting multi-purpose trees/shrubs etc. such as *Subabul*, *Sesbania* spp. etc. around the field. The individual centre has been advised to select organic sources of nutrients depending upon the local availability and also in suitable combination(s) to fulfill the entire requirement of nitrogen and 80-90% requirement of phosphorus and potassium for each cropping system. Cooperating centers have also been advised that each centre should select only those crops for organic farming research in which effective organic (non-chemical) measures are available for plant protection to avoid failure of crops at later stages. Bulky manure were prepared within the premises of cooperating centres under the project itself or under any other project going on at university/institute/centre in order to ensure proper quality of inputs. Inputs related to plant protection, bio-fertilizers etc are procured from reliable sources only. Adequate care has also been taken by the centres that seeds purchased from outside are not treated with any chemical seed dresser.

3. LOCATION

Multi-location experiments were conducted during 2010-11 at 13 research centers of SAUs/ ICAR Institutes. The details of centres are given below in the order of results presented in the chapter 7.

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

4. SOIL AND CLIMATE

Soil type, weather 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.	Min.			
1.	Modipuram	Alluvium soil Typic ustochrept	862	41.2	16.8	75-85	29°4'	77°46'
2.	Jabalpur	Vertisoils, Chromusterts	1669	32.72	18.56	75.94	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	4436	33.65	21.07	88.67	18°33'	77°03'
5.	Raipur	Ochraquals association, deep black soil	982	32.95	21.13	79.87	21°16'	81°36'
6.	Bhopal	Vertisols, Clayey Montmo-rillonite/smectite type	1080	32.0	22.0	70-80	23°18'	77°24'
7.	Ranchi	Ultic Palesustalfs, very deep soils	1614.5	29.54	16.45	54.21	23°17'	85°19'
8.	Ludhiana	Ustochrepts-Ustic pramments association, alluvial, sandy & sandy loam	618.8	29.54	17.40	70.73	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	2100	30.21	17.62	82.09	29°08'	79°05'
11.	Bajaura	Silty loam	1247	24.81	10.37	89.37	31.8°	77°
12.	Dharwad	Vertic inceptisols	1008	30.39	18.76	68.50	15°26'	75°07'
13.	Umiam	Clay loam	2829	20.09	14.33	83.49	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	0.7	264	12.6	282	-	-	-
3.	Coimbatore	0.6	269	17.9	690	-	29.6	4.5
4.	Karjat	1.1	223	18.0	308	-	-	-
5.	Raipur	0.6	237	13.0	274	-	-	-
6.	Bhopal	0.5	154	12.7	530	4.9	5.5	0.7
7.	Ranchi	0.3	-	-	-	-	-	-
8.	Ludhiana	0.3	278	36.3	134	-	-	-
9.	Calicut	2.0	120	6.80	164	-	46.0	0.5
10.	Pantnagar	0.6	238	16.7	156	29.3	30.2	0.8
11.	Bajaura	0.5	146	43.3	-	-	-	-
12.	Dharwad	0.4	250	23.0	330	20.0	7.5	0.8
13.	Umiam	2.4	150	2.96	245	-	-	-
Experiment 2								
1.	Modipuram	-	-	-	-	-	-	-
2.	Jabalpur	0.6	256	11. 8	273	-	-	-
3.	Coimbatore	0.6	258	22.9	698	-	31.6	3.5
4.	Karjat	1.1	194	15.0	346	-	-	-
5.	Raipur	0.6	248	16.2	252	-	-	-
6.	Bhopal	-	-	-	-	-	-	-
7.	Ranchi	0.4	-	-	-	-	-	-
8.	Ludhiana	-	-	-	-	-	-	-
9.	Calicut	2.0	120	6.80	164		46.0	0.54
10.	Pantnagar	0.6	238	16.7	156	29.3	-	-
11.	Bajaura	-	-	-	-	-	-	-
12.	Dharwad	0.41	250	23.0	330	20.0	7.5	0.8
13.	Umiam	1.3	185	10.36	165	-	-	-
Experiment 3								
1.	Jabalpur	6.5	249	12.1	285	-	-	-
2.	Karjat	0.8	220	23.0	379	-	-	-
3.	Calicut	2.0	120	6.80	164	-	46.0	0.54
4.	Umiam	2.4	232	-	230	-	-	-
Experiment 4								
1.	Coimbatore	0.4	258	15.2	568	-	23.2	5.2
2.	Raipur	0.6	220	16.2	260	-	-	-
3.	Pantnagar	0.8	314	15.0	190	23.3	-	-
4.	Umiam	1.8	180	9.5	175	-	-	-

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 centre.

6. BUDGET

A total budget of ₹ 100 lakh was released to 13 centres during 2010-11. The centre wise allocation/ utilization of funds are given below.

(₹ in lakhs)

S. No.	Centre	Recurring			Non Recurring	Total
		Contractual services	Travelling allowances	Recurring contingency		
1.	Modipuram	4.46	0.30	4.40	-	9.16
2.	Jabalpur	3.67	0.25	3.65	-	7.57
3.	Coimbatore	3.67	0.25	3.65	-	7.57
4.	Karjat	3.67	0.25	3.65	-	7.57
5.	Raipur	3.67	0.25	3.65	-	7.57
6.	Bhopal	3.67	0.25	3.65	-	7.57
7.	Ranchi	3.67	0.25	3.65	-	7.57
8.	Ludhiana	3.67	0.25	3.65	-	7.57
9.	Calicut	3.67	0.25	3.65	-	7.57
10.	Pantnagar	3.67	0.25	3.65	-	7.57
11.	Bajaura	3.67	0.25	3.65	-	7.57
12.	Dharwad	3.67	0.25	3.65	-	7.57
13.	Umiam	3.67	0.25	3.65	-	7.57
	Total	48.50	3.30	48.20	-	100.00

7. RESEARCH RESULTS

7.1 Evaluation of organic, inorganic & Integrated Management production system

Title of the experiment: Evaluation of different production system in various cropping systems on soil health, crop productivity, quality and profitability in differenent locations.

Objectives

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

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

Year of start: The experiment was originally planned during 2004-05. However, the year of start varied with the centres depending upon the establishment of infrastructure for conducting the experiments. All the centres started the experiment during 2004-05 except in Modipuram and Umiam where it was started during 2005-06.

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

Three input systems such as organic, inorganic and integrated management were assigned to main plots which were common to all the centres, while the centre specific cropping systems has been assigned to sub plots. The number of cropping systems ranged from 3 (Coimbatore and Calicut) to as high as 5 (Ludhiana and Dharwad). The details of treatments are given in Table1 along with experimental results. The organic and IM treatments were formulated based on 100% recommended nitrogen dose of each crop in the system.

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

Eco-System	Centre (State)
Arid	Dharwad (Karnataka), Bajaura (Himachal Pradesh) 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
Coimbatore			
FYM	0.51	0.20	0.50
VC	0.50	0.40	0.98
Neem cake	3.25	0.60	1.10
Karjat			
FYM	0.50	0.25	0.50
Neem cake	5.20	1.00	1.40
VC	2.00	1.00	1.50
Glyricidia green leaves	2.74	0.50	1.15
Paddy straw	1.20	0.16	1.14
Raipur			
Enriched compost	0.35	0.70	0.85
Cow dung manure	0.55	0.45	0.80
Non Edible Oil Cakes (NEOC)	4.5	0.70	1.60
Rock phosphate	-	23	-
Sunhemp	2.25	0.40	1.50
Ranchi			
FYM	0.5	0.3	0.5
VC	1.2	0.45	1.4
KC	4.0	1.0	1.0
Urea	46	-	-
SSP	-	16	-
MOP	-	-	60
Calicut			
FYM	0.67	0.17	0.64
Neem cake	1.67	0.19	1.70
Ash	-	0.23	7.0
VC	0.79	0.20	0.58
Green leaf mulch	2.62	0.09	0.62
Rajphos	-	18.5	-
Urea	46	-	-
MOP	-	-	58
Bajaura			
VC	1.72	0.26	1.31
FYM	2.25	0.28	2.11
Urea	46.00	-	-
SSP	-	16.00	-
MOP	-	-	58.00
Rockphosphate	-	34.00	-
Dharwad			
Enriched compost	0.6	0.55	0.52
VC	1.0	0.69	0.28
Glyricidia	0.5	0.32	1.15
FYM	0.5	0.27	0.41
Umiam			
FYM	1.01	0.56	1.00
VC	1.52	0.62	1.01
Rock phosphate	-	16.0	-
Tephrosia spp	3.31	0.44	1.46

Results

The parameter wise result of 2010-11 for each centre are presented and discussed here.

Grain and straw yield (Table 1-2)

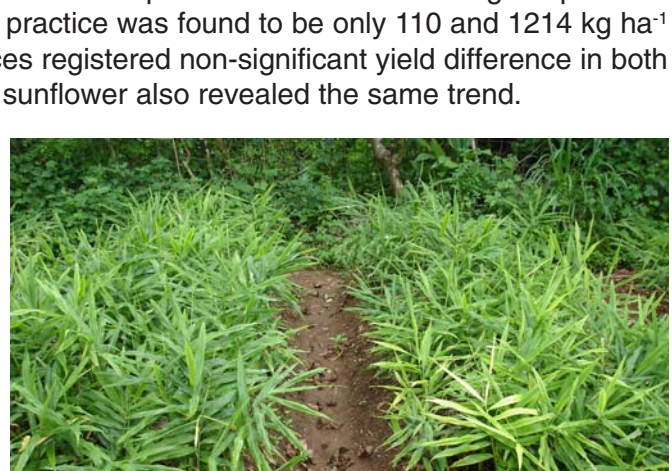
Modipuram: The response of different crops in the systems varied for the type of input practices adopted. Among the various crops in the system, basmati rice, maize for cob, barley and greengram have recorded higher yield under organic system while maize for grain, potato, okra, mustard and radish have recorded higher yield under IM practice. Wheat registered drop in yield to the tune of 30.7% with organic practice while under IM, the drop was found to be only 7.6%. In case of basmati rice, it was observed that 10.8% higher yield under organic system compared to inorganic practice, however, in rice, the yield decreased to the level of only 4.5% in IM practice. Straw yield also exhibited the similar trend.

Jabalpur: Most of the crops in the system have recorded higher yield under inorganic input practice. Basmati rice, chickpea, sesamum and sorghum recorded higher yield under inorganic practice while berseem and vegetable pea registered better yield under organic nutrient management practice. The yield reduction observed in basmati rice with organic and IM practice was found to be only 41 and 82 kg ha^{-1} respectively while, the reduction was much higher for wheat (515 and 138 kg ha^{-1} respectively). The yield increase in vegetable pea with organic nutrient practice was found to be 12.6% compared to inorganic practice. Straw yield of basmati rice and wheat have also exhibited similar trend.

Coimbatore: All the crops evaluated performed better under IM practice except chilli which recorded higher yield under organic practice. The additional yield obtained with organic practice was found to be 993 kg ha^{-1} compared to inorganic practice. However, the yield difference between IM and organic practice was found to be only 203 kg ha^{-1}. The drop in yield under organic practice over IM was found to be 24.3,18, 17.5 and 11.2% for sunflower, maize, brinjal and cotton respectively.

Raipur: Mean yield of soybean in *kharif* was found to be higher under organic practice (1695 kg ha^{-1}) followed by inorganic (1647 kg ha^{-1}) and IM (1608 kgha^{-1}). Among the other crops evaluated berseem and onion registered higher yield under IM, while Isabgol and safflower performed better under inorganic practice. The drop in yield of onion and berseem with organic practice was found to be only 110 and 1214 kg ha^{-1} compared to IM. All the nutrient management practices registered non-significant yield difference in both *kharif* and *rabi* seasons. Straw yield of soybean and sunflower also revealed the same trend.

Calicut: Ginger recorded higher rhizome yield under organic practice while turmeric performed better under IM. The yield increase in ginger was found to be 27.5% and 67.2% under organic practice compared to inorganic and IM respectively. Though the turmeric recorded lower yield with organic practice, the yield drop was found to be only 4.6% over IM.



Ginger under organic management at Calicut

Dharwad: All the crops except cotton evaluated in five systems recorded higher yield with organic practice. The yield increase over inorganic was found to be 39, 32, 26.2, 34.8, 27.2, 42.1, 53 and 17.4% for maize, chickpea, pea, groundnut, sorghum, potato, soybean and wheat respectively. Cotton recorded yield drop of 11.5% with organic compared to inorganic practice. IM was the next best for most of the crops as all the crops registered higher yield in IM than the inorganic practice. Straw yield also exhibited similar trend.

Karjat: Rice during *kharif* registered significantly higher yield under inorganic practice followed by IM. The yield drop observed with organic and IM practice was found to be 16 and 3.9% respectively over inorganic

Table 1. Influence of methods of nutrient application on yield (kg/ha) of crops at various locations

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Modipuram									
Basmati rice-wheat	3333	3000	-	3008	4333	-	3146	4000	-
Rice-barley+mustard-GG	3625	4583 (84)	400	2333	3166 (104)	380	2604	3625 (80)	360
Maize cob-Potato-Okra	5416	13166	3895	3416	15541	4046	5000	16375	4090
Maize -mustard+radish-GG	2583	318 (7500)	680	1833	328 (8000)	590	3333	354 (8250)	640
Jabalpur									
Basmati Rice - D.Wheat - GM	3284	3421	-	3325	3936	-	3243	3798	-
Basmati Rice - Chickpea - Sesamum	3339	611	229	3471	935	312	3341	749	268
Basmati Rice - Berseem	3289	32098	-	3477	31019	-	3283	28422	-
Basmati Rice- Veg.pea - Sorghum	3047	7129	42812	3114	6329	47132	2965	6612	45565
Coimbatore									
Cotton - Maize -Sunhemp	1493	3757	-	1533	4473	-	1683	4583	-
Chillies - Sunflower -Sunhemp	5526	1349	-	4533	1487	-	5323	1672	-
Brinjal - Sunflower - Sunhemp	10825	1256	-	12524	1570	-	13127	1660	-
Raipur									
Soybean-Berseem	1762	36238	-	1703	35428	-	1793	37452	-
Soybean-Isabgol	1701	555	-	1645	563	-	1612	558	-
Soybean-Onion	1656	11780	-	1597	11216	-	1602	11890	-
Soybean-Safflower	1660	1477	-	1641	1604	-	1746	1542	-
							Kharif		*Rabi*	
							SEm±	CD	SEm±	CD
					Input		14	NS	214	NS
					Cropping		11	33	255	738
					Cropping X Input		23	70	438	NS
					Input X Cropping		20	58	441	NS
Calicut										
Ginger	20167	-	-	15819	-	-	12063	-	-	
Turmeric	28700	-	-	28700	-	-	30071	-	-	
							Kharif		*Rabi*	
							SEm±	CD	SEm±	CD
					Input		494	1520	-	-
					Cropping		653	1940	-	-
					Cropping X Input		940	2821	-	-
					Input X Cropping		1132	3361	-	-
Dharwad										
Maize-Chickpea	4280	1534	-	3077	1135	-	3846	1488	-	

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Cotton+Pea	1464	1775	-	1654	1406	-	1382	1481	-
Groundnut-Sorghum	4520	1532	-	3353	1204	-	4174	1450	-
Potato-Chickpea	5665	1410	-	3986	1094	-	5175	1322	-
Soybean-Wheat	2809	1364	-	1835	1162	-	2345	1288	-
Karjat									
Rice-Groundnut	3533	2881	-	4187	3682	-	3757	3495	-
Rice-Maize (Sweet Corn for cob)	2770	10931	-	3100	17104	-	3057	14982	-
Rice-Mustard	3193	527	-	3587	670	-	3453	583	-
Rice-Dolichos Bean (For green pod vegetable)	2703	1904	-	3650	1623	-	3707	2031	-

	Kharif		*Rabi*	
	SEm±	CD	SEm±	CD
Input	50	194	268	1053
Cropping	66	196	267	792
Cropping X Input	111	350	482	1573
Input X Cropping	115	340	462	1372

Ludhiana I									
Cotton-Gram(D)	1610	1820	-	1050	1680	-	1340	1780	-
Maize(PP)-Gram(K)	2490	1590	-	2080	1220	-	3260	1560	-
B.Rice-Wheat-S.moong	4260	3570	1250	4020	3780	1170	4050	4050	1220
Turmeric-Onion	25260	16930	-	6150	14310	-	18980	14890	-
Maize-Potato-S.moong	5320	15280	1330	3640	11100	1080	4500	13500	1100
Ludhiana II									
Sorghum-Berseem	26650	65370	-	20150	54675	-	25350	61520	-
Maize-Berseem-Bajra	23800	66175	24300	25650	55535	22700	24100	63825	25800
Maize-Berseem-Maize+Cowpea	25650	68670	34450	27800	58380	29600	25300	63405	45400
Sorghum+Guar-Oats-Cowpea	39400	38780	22880	32250	43500	17890	36500	39750	19762

	Kharif		*Rabi*		Summer	
	SEm±	CD	SEm±	CD	SEm±	CD
Input	1424	NS	980	3293	2337	NS
Cropping	1583	4595	1447	4199	3517	10204
Cropping X Input	2770	NS	2382	7136	5769	NS
Input X Cropping	2743	NS	2506	7272	6091	NS

Bajaura									
Cauliflower-Pea-Tomato	9523	7420	1993	7436	5531	2037	11972	8389	2246
French bean-Cauliflower-French bean	8420	9340	8523	7065	7558	6580	8107	20092	9350
Cauliflower-Pea-Cauliflower	7049	8556	8310	5391	5481	4790	9057	6858	8260
Maize-Garlic	6018	8664	-	5125	6717	-	7357	8152	-

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Bhopal									
Soybean-Wheat	1072	3605	-	769	3355	-	850	3628	-
Soybean-Mustard	1226	1142	-	747	934	-	962	1270	-
Soybean-Chickpea	1208	1821	-	1085	1294	-	1046	2107	-
Soybean-Linseed	906	*	-	1003	-	-	947	*	-
							Kharif		***Rabi***
							SEm±	CD	SEm±	CD
					Input		28	108	33	128
					Cropping		27	80	52	154
					Cropping X Input		49	160	84	263
					Input X Cropping		47	138	90	267
Pantnagar									
Basmati rice-wheat-*Sesbania*	3002	3677	-	2783	3770	-	3607	4168	-
Basmati rice-lentil-*Sesbania*	3348	1234	-	2956	1209	-	4021	1227	-
Basmati rice-vegetable pea-*Sesbania*	3156	5534	-	2838	4718	-	3640	4896	-
Basmati rice-*Brassica napus*-*Sesbania*	2945	1158	-	2521	1217	-	3129	1233	-
							Kharif		***Rabi***
							SEm±	CD	SEm±	CD
					Input		85	333	65	NS
					Cropping		95	282	66	198
					Cropping X Input		165	NS	120	388
					Input X Cropping		164	NS	115	343
Ranchi									
Rice - Wheat	2150	2241	-	1420	2571	-	1710	2404	-
Rice - Potato	2580	19000	-	1668	15600	-	1920	17700	-
Rice - Linseed	2050	791	-	1311	740	-	1630	725	-
Rice - Lentil	2060	771	-	1350	682	-	1640	833	-
Umiam									
Rice -carrot	3070	11868	-	3051	7153	-	2708	12446	-
Rice -potato	2903	15747	-	2975	14017	-	3097	16298	-
Rice-French bean	3128	8659	-	2859	7487	-	3105	9544	-
Rice-tomato	3040	21309	-	3095	14213	-	2880	21627	-
							Kharif		***Rabi***
							SEm±	CD	SEm±	CD
					Input		46	160	165	574
					Cropping		36	NS	173	505
					Cropping X Input		77	241	343	1044
					Input X Cropping		71	209	347	1011

( ) Figures in parenthesis are yield of inter crops

Table 2. Influence of methods of nutrient application on straw yield (kg/ha) of crops at various locations

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Modipuram									
Basmati rice-wheat	14792	7246	-	9792	9965	-	17063	9128	-
Rice-barley+mustard-GG	7875	-	-	4750	-	-	5708	-	-
Jabalpur									
Basmati Rice - D.Wheat - GM	5758	6250	-	5747	6913	-	5884	6987	-
Basmati Rice - Chickpea - Sesamum	5757	-	-	6544	-	-	5885	-	-
Basmati Rice - Berseem	5759	-	-	6085	-	-	5884	-	-
Basmati Rice- Veg.pea - Sorghum	5885	-	-	5759	-	-	5307	-	-
Coimbatore									
Cotton - Maize -Sunhemp	-	4568	-	-	5103	-	-	5361	-
Chillies - Sunflower -Sunhemp	-	3050	-	-	3750	-	-	3640	-
Brinjal - Sunflower - Sunhemp	9519	3250	-	11178	3440	-	11604	3750	-
Raipur									
Soybean-Berseem	3345	0	-	3462	0	-	3440	0	-
Soybean-Isabgol	3317	0	-	3352	0	-	3406	0	-
Soybean-Onion	3220	-	-	3152	-	-	3184	-	-
Soybean-Safflower	3271	3457	-	3338	3714	-	3515	3626	-

	Kharif		Rabi	
	SEm±	CD	SEm±	CD
Input	42	NS	39	NS
Cropping	45	129	37	109
Cropping X Input	79	NS	69	NS
Input X Cropping	77	NS	65	NS

Karjat									
Rice-Groundnut	3913	4739	-	3790	5736	-	3790	5393	-
Rice-Maize (Sweet Corn for cob)	3667	23148	-	4643	33436	-	4117	28549	-
Rice-Mustard	3727	973	-	4520	1011	-	4217	881	-
Rice-Dolichos Bean (For green pod vegetable)	4097	11093	-	4523	10905	-	3880	13784	-

	Kharif		Rabi	
	SEm±	CD	SEm±	CD
Input	85	334	481	1888
Cropping	96	NS	871	2589
Cropping X Input	167	538	1393	4296
Input X Cropping	166	494	1509	4483

Ludhiana I									
Cotton-Gram(D)	11000	3620	-	9100	3410	-	10120	2570	-
Maize(PP)-Gram(K)	7640	3490	-	6390	3010	-	9170	2980	-

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
B.Rice-Wheat-S.moong	10840	5280	-	10980	5390	-	10550	6090	-
Turmeric-Onion	6670	-	-	1430	-	-	5690	-	-
Maize-Potato-S.moong	15830	3560	-	7780	2000	-	11670	2250	-
Dharwad									
Maize-Chickpea	-	1405	-	-	1111	-	-	1326	-
Cotton+Pea	-	-	-	-	-	-	-	-	-
Groundnut-Sorghum	-	6004	-	-	4942	-	-	5960	-
Potato-Chickpea	-	1334	-	-	1156	-	-	1283	-
Soybean-Wheat	-	2208	-	-	1844	-	-	1948	-
Bajaura									
French bean-Cauliflower-French bean	2500	-	1680	1950	-	1560	2750	-	1720
Maize-Garlic	8050	-	-	10000	-	-	10580	-	-
Bhopal									
Soybean-Wheat	2805	-	-	2468	-	-	2776	-	-
Soybean-Mustard	3544	-	-	2356	-	-	3170	-	-
Soybean-Chickpea	3287	-	-	2799	-	-	2801	-	-
Soybean-Linseed	2711	-	-	2791	-	-	2504	-	-

	Kharif	
	SEm±	CD
Input	86	338
Cropping	122	NS
Cropping X Input	202	NS
Input X Cropping	211	NS

Pantnagar									
Basmati rice-wheat-*Sesbania*	4922	4756	-	4021	5526	-	4842	3879	-
Basmati rice-lentil-*Sesbania*	5051	4257	-	4300	3482	-	5014	3168	-
Basmati rice-vegetable pea-*Sesbania*	4826	1126	-	4141	5173	-	4999	4950	-
Basmati rice-*Brassica napus*-*Sesbania*	4548	3448	-	4546	2629	-	4711	3127	-

	Kharif		Rabi	
	SEm±	CD	SEm±	CD
Input	92	362	123	482
Cropping	111	NS	308	913
Cropping X Input	191	NS	477	1448
Input X Cropping	193	NS	533	1582

Ranchi									
Rice - Wheat	3230	3669	-	2100	4086	-	2600	3846	-
Rice - Potato	3900	-	-	2490	-	-	2810	-	-
Rice - Linseed	3050	1520	-	2070	1426	-	2440	1421	-
Rice - Lentil	3090	2221	-	2000	1990	-	2480	2400	-

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
Umiam									
Rice -potato	-	5025	-	-	4798	-	-	5349	-
Rice-F.B	-	1650	-	-	1447	-	-	1633	-
Rice-tomato	-	1681	-	-	1266	-	-	1704	-

	Kharif		Rabi	
	SEm±	CD	SEm±	CD
Input	-	-	74	257
Cropping	-	-	81	234
Cropping X Input	-	-	158	479
Input X Cropping	-	-	161	469

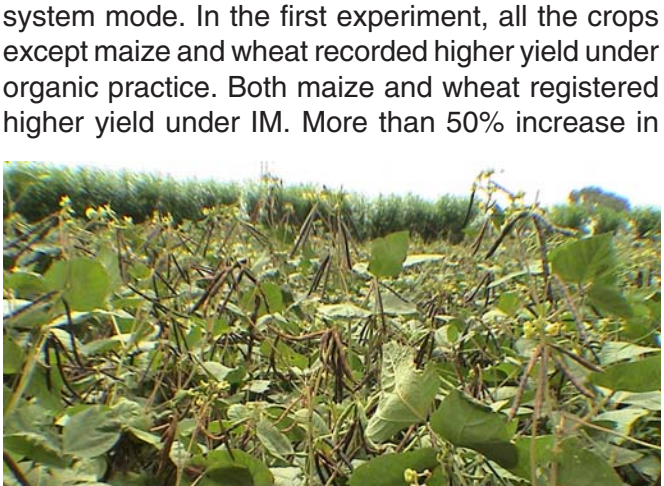
( ) Figures in parenthesis are straw yield of inter crops

Soybean under organic management at Dharwad

yield under organic over inorganic was observed in cotton and turmeric during *kharif*. Basmati rice recorded only 5.9% increase. In *rabi*, the results revealed that, an increase in yield of gram, onion and potato by 19.3, 18.3 and 37.6% under organic over inorganic practice. Similarly, in summer moong, it was found that 14.7% increase in yield under organic practice. Straw yield also exhibited similar trend. In the second set of experiments, the different input practices did not significantly influence on the yield of crops during *kharif* and summer seasons implying suitability of organic nutrient management practice especially for sorghum, maize, pearlmillet and cowpea. In *rabi*, berseem recorded higher yield under organic practice (66738 kg ha^{-1}) while oats performed better under inorganic practice (43500 kgha^{-1}). The yield drop in oats due to organic nutrient system was found to be 10.9%.

practice. During *rabi*, it was observed that except dolichos bean, all the other crops (groundnut, maize for cob and mustard) have recorded significantly higher yield under inorganic practice. Though the yield of dolichous bean is higher with organic practice (1904 kg ha^{-1}) compared to inorganic (1623 kgha^{-1}) the increase was lesser than that of IM (25.1% increase over inorganic). Straw yield also recorded similar trend.

Ludhiana: Two set of experiments were conducted by including various combinations of crops in the system mode. In the first experiment, all the crops except maize and wheat recorded higher yield under organic practice. Both maize and wheat registered higher yield under IM. More than 50% increase in



Summer greengram under organic management at Ludhiana

Bajaura: The general trend of cauliflower, pea, french bean and maize was found to be better under IM followed by organic practice. Tomato recorded higher yield under IM (2246 kg ha^{-1}) followed by inorganic (2037 kg ha^{-1}). Organic practice in tomato recorded yield drop of only 44 kg ha^{-1} over inorganic and 253 kg ha^{-1} over IM. Garlic registered 28.9 and 6.3% higher yield under organic practice over inorganic and IM respectively. Straw yield also registered similar trend.

Bhopal: In *kharif*, soybean recorded 22.4 and 15.9% higher grain yield under organic practice over inorganic and IM respectively. Among the *kharif,* though IM recorded higher yield of wheat and mustard, it was at par with organic practice. However, chickpea registered significantly higher yield of 2107 kg ha^{-1} with IM and the yield increase was found to be 62.8 and 15.7% over inorganic and organic practices. Residues yield of soybean also exhibited similar trend.

Pantnagar: Significantly higher mean yield of basmati rice, during *kharif* was observed with IM as it recorded higher grain yield of 3599 kg ha^{-1} followed by organic. The yield drop was 13.5% under organic farming. Among *rabi* crops, wheat recorded significantly higher yield of 4168 kg ha^{-1} under IM followed by inorganic (3770 kg ha^{-1}) and organic (3677 kg ha^{-1}). Though lentil and *Brassica napus* recorded numerically higher yield under organic, the same was at par with that of IM and inorganic practices. Vegetable pea produced better performance under organic (5534 kg ha^{-1}) followed by IM (4896 kg ha^{-1}) and inorganic (4718 kg ha^{-1}) which were at par. The straw yield of both *kharif* and *rabi* crops have resulted in similar trend.

Basmati rice under INM at Pantnagar

Ranchi: Rice recorded significantly higher mean grain yield of 2210 kg ha^{-1} during *kharif* which is 28.1% higher than IM and 53.8% higher than inorganic practice. In *rabi*, it was observed that wheat recorded around 330 kg ha^{-1} lesser yield with organic compared to inorganic practice. Though lentil recorded numerically higher yield under IM (833 kg ha^{-1}), the yield difference between IM and organic practice was found to be only 62 kg ha^{-1}. Potato and linseed recorded 21.8 and 6.9% increase in yield under organic over inorganic practice. Similar trend was also obtained for straw yield of all the crops.

Umiam: Rice grown during *kharif* recorded numerically higher mean grain yield of 3035 kg ha^{-1} with organic practice, but the same was at par with inorganic (2995 kg ha^{-1}) and IM (2948 kg ha^{-1}). All the vegetables like carrot, potato, french bean and tomato grown during *rabi* though performed better under IM, the yield obtained with organic was at par with IM practice. Inorganic practice recorded significantly lower yield. Among the vegetable crops, carrot and tomato have recorded 65.9 and 49.9% higher yield with organic over inorganic practice. Residues yield of vegetables have also given same trend.

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

Except Bhopal and Ranchi, all the centres have reported soil parameters

Modipuram: Soil EC, PH, OC, available N, P, K, Mn, Zn, Cu and Fe were estimated. The result reveals that not much variation in EC and PH was observed among various input practices and cropping systems. However, the soil quality under inorganic practice deteriorated as it is evidenced through reduction in organic carbon by 60.9% under inorganic over organic practice. Among the different cropping systems, maize for cob-potato-okra recorded higher organic carbon (8.05%) followed by maize-mustard + radish-greengram (7.62%). Considerable increase in organic carbon content of soil was also observed under IM practice. At the end of cropping cycle, it was observed that, the available P and K were higher with organic practice followed by IM. However, in case of available N, IM registered 5% higher N compared to organic practice. The residual soil N, P and K was higher in maize-mustard + radish-greengram (165, 30 and 393

Table 3. Influence of methods of nutrient application on soil bulk density, electrical conductivity, pH and organic carbon at the end of cropping cycle at various locations

Cropping/Input system	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Modipuram																
Basmati rice-wheat	-	-	-	-	0.22	0.19	0.26	0.22	7.71	7.82	7.62	7.72	8.85	3.30	7.75	6.63
Rice-barley+mustard-GG	-	-	-	-	0.23	0.17	0.22	0.21	7.39	7.62	7.56	7.52	7.95	1.80	8.70	6.15
Maize cob-Potato-Okra	-	-	-	-	0.17	0.29	0.27	0.24	7.59	7.64	7.28	7.50	11.10	4.80	8.25	8.05
Maize -mustard+radish-GG	-	-	-	-	0.20	0.23	0.22	0.22	7.70	7.08	7.65	7.48	10.10	4.95	7.80	7.62
Mean	-	-	-	-	0.20	0.22	0.24		7.60	7.54	7.53		9.50	3.71	8.13	
Jabalpur																
Basmati Rice - D.Wheat - GM	1.31	1.38	1.32	1.34	0.47	0.51	0.52	0.50	7.29	7.35	7.40	7.35	0.79	0.70	0.76	0.75
Basmati Rice - Chickpea - Sesamum	1.33	1.38	1.34	1.35	0.46	0.48	0.47	0.47	7.28	7.40	7.44	7.37	0.76	0.68	0.72	0.72
Basmati Rice - Berseem	1.32	1.39	1.34	1.35	0.45	0.46	0.44	0.45	7.30	7.42	7.45	7.39	0.76	0.68	0.75	0.73
Basmati Rice- Veg.pea - Sorghum	1.30	1.35	1.32	1.32	0.50	0.44	0.48	0.47	7.35	7.49	7.38	7.41	0.79	0.69	0.75	0.74
Mean	1.32	1.38	1.33	-	0.47	0.47	0.48	-	7.31	7.42	7.42	-	0.78	0.69	0.75	-
Coimbatore																
Cotton - Maize -Sunhemp	-	-	-	-	-	-	-	-	-	-	-	-	0.70	0.61	0.67	0.66
Chillies - Sunflower -Sunhemp	-	-	-	-	-	-	-	-	-	-	-	-	0.68	0.60	0.65	0.64
Brinjal - Sunflower - Sunhemp	-	-	-	-	-	-	-	-	-	-	-	-	0.63	0.60	0.63	0.62
Mean	-	-	-	-	-	-	-	-	-	-	-		0.67	0.60	0.65	
Raipur																
Soybean-Berseem	1.28	1.31	1.29	1.29	-	-	-	-	-	-	-	-	0.70	0.60	0.63	0.65
Soybean-Isabgol	1.29	1.30	1.29	1.30	-	-	-	-	-	-	-	-	0.69	0.64	0.67	0.66
Soybean-Onion	1.30	1.33	1.31	1.31	-	-	-	-	-	-	-	-	0.68	0.63	0.64	0.65
Soybean-Safflower	1.33	1.35	1.34	1.34	-	-	-	-	-	-	-	-	0.69	0.62	0.65	0.65
Mean	1.30	1.32	1.31	-	-	-	-	-	-	-	-	-	0.69	0.62	0.65	-

Cropping/Input system	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
		SEm±	CD	-	-	-	-	-	-	-	-	-	-	SEm±	CD	-
Input		0.01	0.02	-	-	-	-	-	-	-	-	-	-	0.01	0.03	-
Cropping		0.01	0.01	-	-	-	-	-	-	-	-	-	-	0.01	NS	-
Cropping X Input		0.01	NS	-	-	-	-	-	-	-	-	-	-	0.01	NS	-
Input X Cropping		0.01	NS	-	-	-	-	-	-	-	-	-	-	0.01	NS	-
Calicut																
Ginger	-	-	-	-	-	-	-	-	-	-	-	-	1.79	1.71	1.59	1.70
Turmeric	-	-	-	-	-	-	-	-	-	-	-	-	1.46	1.36	1.57	1.46
Mean	-	-	-	-	-	-	-	-	-	-	-	-	1.62	1.54	1.58	
														SEm±	CD	
Input														0.04	NS	
Cropping	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.07	-
Cropping X Input	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04	0.14	-
Input X Cropping	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04	0.11	-
Dharwad																
Maize-Chickpea	1.21	1.29	1.23	1.24	0.18	0.21	0.21	0.20	7.25	7.55	7.32	7.37	0.60	0.50	0.56	0.55
Cotton+Pea	1.22	1.29	1.25	1.25	0.20	0.22	0.21	0.21	7.20	7.50	7.30	7.33	0.60	0.49	0.54	0.54
Groundnut-Sorghum	1.21	1.28	1.26	1.25	0.21	0.20	0.20	0.20	7.34	7.54	7.36	7.41	0.62	0.51	0.59	0.57
Potato-Chickpea	1.22	1.29	1.24	1.25	0.18	0.20	0.17	0.18	7.29	7.51	7.40	7.40	0.61	0.47	0.54	0.54
Soybean-Wheat	1.21	1.29	1.22	1.24	0.19	0.21	0.18	0.19	7.22	7.58	7.30	7.37	0.62	0.49	0.56	0.56
Mean	1.21	1.29	1.24	-	0.19	0.21	0.19	-	7.26	7.54	7.34	-	0.61	0.49	0.56	-
Karjat																
Rice-Groundnut	-	-	-	-	0.37	0.38	0.51	0.42	6.67	6.71	6.76	6.71	1.19	1.11	1.20	1.17
Rice-Maize(Sweet Corn for cob)	-	-	-	-	0.49	0.37	0.39	0.42	6.58	6.50	6.71	6.60	1.06	1.07	1.07	1.06
Rice-Mustard	-	-	-	-	0.67	0.37	0.47	0.50	6.53	6.49	6.54	6.52	1.17	1.09	1.12	1.13
Rice-Dolichos Bean (For green pod vegetable)	-	-	-	-	0.32	0.47	0.52	0.44	6.62	6.65	6.65	6.64	1.22	1.13	1.20	1.18

Cropping/Input system	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Mean	-	-	-	-	0.46	0.40	0.47		6.60	6.59	6.67		1.16	1.10	1.14	
						SEm±	CD			SEm±	CD			SEm±	CD	
Input						-	-			-	-			0.00	0.02	
Cropping						-	-			-	-			0.01	0.04	
Cropping X Input					-	-			-	-				0.02	NS	
Input X Cropping					-	-			-	-				0.02	NS	
Ludhiana II																
Sorghum-Berseem	-	-	-	-	0.28	0.26	0.27	0.27	7.51	7.56	7.40	7.49	0.56	0.46	0.56	0.53
Maize-Berseem-Bajra	-	-	-	-	0.26	0.24	0.26	0.25	7.45	7.44	7.53	7.47	0.59	0.43	0.52	0.51
Maize-Berseem-Maize+Cowpea	-	-	-	-	0.30	0.27	0.25	0.27	7.48	7.45	7.48	7.47	0.57	0.45	0.57	0.53
Sorghum+Guar-Oats-Cowpea	-	-	-	-	0.26	0.26	0.27	0.27	7.55	7.44	7.53	7.51	0.59	0.52	0.55	0.55
Mean	-	-	-	-	0.28	0.26	0.26	-	7.50	7.47	7.48	-	0.57	0.466	0.552	-
						SEm±	CD			SEm±	CD			SEm±	CD	
Input						-	-			-	-			0.02	0.06	
Cropping						-	-			-	-			0.01	NS	
Cropping X Input					-	-			-	-				0.02	NS	
Input X Cropping					-	-			-	-				0.02	NS	
Bajaura																
Cauliflower-Pea-Tomato	-	-	-	-	-	-	-	-	-	-	-	-	0.97	0.51	0.85	0.78
French bean-Cauliflower-French bean	-	-	-	-	-	-	-	-	-	-	-	-	0.95	0.56	0.90	0.80
Cauliflower-Pea-Cauliflower	-	-	-	-	-	-	-	-	-	-	-	-	1.00	0.60	0.85	0.82
Maize-Garlic	-	-	-	-	-	-	-	-	-	-	-	-	0.98	0.59	0.87	0.81
Mean	-	-	-	-	-	-	-	-	-	-	-	-	0.98	0.57	0.87	-
Pantnagar																
Basmati rice-wheat-*Sesbania*	-	-	-	-	-	-	-	-	-	-	-	-	0.96	0.83	0.95	0.91

Cropping/Input system	Bulk density (g/cc)				Electrical conductivity (dS/m)				pH				Organic carbon (%)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Basmati rice-lentil-*Sesbania*	-	-	-	-	-	-	-	-	-	-	-	-	0.96	0.86	0.94	0.92
Basmati rice-vegetable pea-*Sesbania*	-	-	-	-	-	-	-	-	-	-	-	-	0.96	0.86	0.93	0.92
Basmati rice-Brassica napus-*Sesbania*	-	-	-	-	-	-	-	-	-	-	-	-	0.94	0.81	0.91	0.89
Mean	-	-	-	-	-	-	-	-	-	-	-	-	0.95	0.83	0.93	
														SEm±	CD	
Input														0.01	0.02	
Cropping														0.01	NS	
Cropping X Input														0.02	NS	
Input X Cropping														0.02	NS	
Umiam																
Rice -carrot	1.10	1.23	1.13	1.15	-	-	-	-	5.12	5.02	5.14	5.09	3.19	2.80	2.81	2.93
Rice -potato	1.09	1.20	1.12	1.14	-	-	-	-	5.07	4.97	5.06	5.03	3.08	3.00	3.09	3.06
Rice-F.B	1.09	1.21	1.15	1.15	-	-	-	-	5.08	5.03	5.06	5.06	3.11	2.65	3.39	3.05
Rice-tomato	1.10	1.21	1.14	1.15	-	-	-	-	5.11	5.02	5.06	5.06	3.07	2.91	3.24	3.07
Mean	1.10	1.21	1.13	-	-	-	-	-	5.10	5.01	5.08	-	3.11	2.84	3.13	-
		SEm±	CD							SEm±	CD			SEm±	CD	
Input		0.01	0.04											0.08	0.27	
Cropping		0.01	NS											0.08	NS	
Cropping X Input		0.02	NS											0.16	NS	
Input X Cropping		0.03	NS											0.16	NS	

Table 4. Influence of methods of nutrient application on soil available nitrogen, phosphorus and potassium at the end of cropping cycle at various locations

Cropping/Input system	N (kg/ha)				P (kg/ha)				K (kg/ha)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Modipuram												
Basmati rice-wheat	132	132	157	140	29.8	20.1	25.4	25.1	314	197	239	250
Rice-barley+mustard-GG	132	138	188	153	25.1	19.6	36.8	27.2	290	198	332	273
Maize cob-Potato-Okra	163	139	132	145	40.4	18.2	30.4	29.7	461	235	351	349
Maize -mustard+radish-GG	182	157	157	165	38.7	16.4	34.9	30.0	424	374	381	393
Mean	152	142	159	-	33.5	18.6	31.9	-	372	251	326	-
Jabalpur												
Basmati Rice - D.Wheat - GM	285	275	277	279	14.2	13.3	14.0	13.8	269	259	268	265
Basmati Rice - Chickpea - Sesamum	271	276	276	274	14.0	12.5	13.0	13.2	272	251	261	261
Basmati Rice - Berseem	288	273	285	282	13.3	13.1	13.8	13.4	269	255	264	263
Basmati Rice- Veg.pea - Sorghum	277	265	271	271	14.0	13.0	14.1	13.7	271	242	265	259
Mean	280	272	277	-	13.9	13.0	13.7	-	270	252	265	-
Coimbatore												
Cotton - Maize -Sunhemp	230	219	225	225	21.8	19.4	20.5	20.6	684	677	680	680
Chillies - Sunflower -Sunhemp	229	216	224	223	19.9	18.1	18.6	18.9	665	662	666	664
Brinjal - Sunflower - Sunhemp	217	209	214	213	21.7	19.9	20.8	20.8	662	635	648	648
Mean	225	215	221	-	21.1	19.1	20.0	-	670	658	665	-
Raipur												
Soybean-Berseem	247	270	262	259	11.3	14.6	13.4	13.1	240	261	252	251
Soybean-Isabgol	255	301	261	272	12.8	14.2	14.2	13.7	246	266	251	254
Soybean-Onion	247	274	261	261	13.2	18.3	12.9	14.8	245	286	264	265
Soybean-Safflower	256	283	266	268	13.9	16.8	14.6	15.1	242	290	278	270
Mean	251	282	262	-	12.8	16.0	13.8	-	243	276	261	-
		SEm±	CD			SEm±	CD			SEm±	CD	
Input		4	16			0.4	1.4			4	12	
Cropping		5	NS			0.5	1.5			3	9	
Cropping X Input		8	NS			0.9	NS			6	NS	
Input X Cropping		8	NS			0.9	NS			6	NS	
Calicut												
Ginger	161	148	147	152	0.0	0.1	0.1	0.1	419	304	258	327
Turmeric	197	197	206	200	32.0	66.5	31.3	43.2	206	266	275	249
Mean	179	172	177	-	16.0	33.3	15.7	-	313	285	267	-
		SEm±	CD			SEm±	CD			SEm±	CD	
Input		4	NS			1.1	3.4			9	28	
Cropping		4	10			1.0	3.0			11	34	
Cropping X Input		6	NS			1.6	5.0			16	50	
Input X Cropping		6	NS			1.7	5.2			20	58	

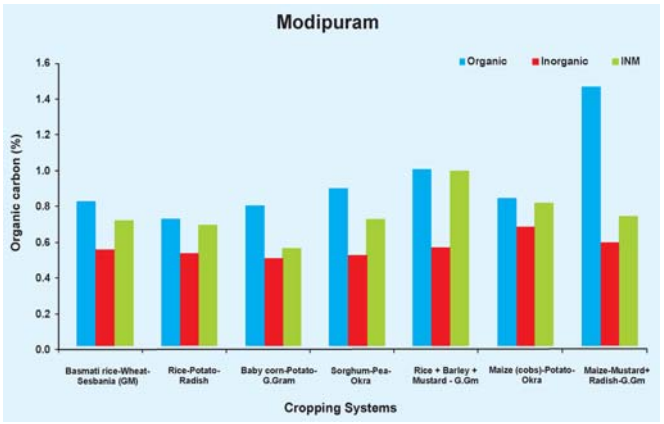
Cropping/Input system	N (kg/ha)				P (kg/ha)				K (kg/ha)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Dharwad												
Maize-Chickpea	280	250	252	261	28.3	25.8	28.4	27.5	383	327	370	360
Cotton+Pea	276	262	270	269	28.9	25.0	27.0	27.0	376	325	352	351
Groundnut-Sorghum	274	252	265	264	29.5	26.8	28.6	28.3	365	330	356	350
Potato-Chickpea	262	249	258	256	29.0	26.9	28.1	28.0	387	330	378	365
Soybean-Wheat	265	254	268	262	28.8	25.2	27.4	27.1	367	321	357	348
Mean	271	253	263	-	28.9	25.9	27.9	-	375	327	362	-
Karjat												
Rice-Groundnut	236	225	237	232	28.3	28.6	29.5	28.8	341	344	339	341
Rice-Maize (Sweet Corn for cob)	209	208	209	209	25.8	27.9	28.0	27.6	317	321	323	320
Rice-Mustard	234	220	226	227	28.9	29.5	27.8	28.7	315	326	339	327
Rice-Dolichos Bean (For green pod vegetable)	238	229	237	235	28.5	29.0	28.1	28.6	329	338	331	333
Mean	229	220	227	-	27.9	28.8	28.36	-	325	332	333	-
		SEm±	CD			SEm±	CD			SEm±	CD	
Input		5	NS			0.1	0.5			6	NS	
Cropping		4	10			0.3	0.9			5	15	
Cropping X Input		7	NS			0.5	NS			10	NS	
Input X Cropping		6	NS			0.5	NS			8	NS	
Ludhiana II												
Sorghum-Berseem	262	255	288	268	72.2	72.1	41.2	61.9	167	167	165	166
Maize-Berseem-Bajra	302	273	265	280	70.7	60.8	58.7	63.4	155	155	159	156
Maize-Berseem-Maize+Cowpea	313	271	270	285	79.2	54.1	75.5	69.6	166	163	152	160
Sorghum+Guar-Oats-Cowpea	288	271	302	287	73.9	59.1	62.6	65.2	165	153	176	165
Mean	291	268	281	-	74.0	61.5	59.5	-	163	160	163	-
		SEm±	CD			SEm±	CD			SEm±	CD	
Input		6	NS			3.8	NS			2	NS	
Cropping		6	NS			7.0	NS			3	NS	
Cropping X Input		11	33			11.1	NS			6	NS	
Input X Cropping		10	30			12.1	NS			6	NS	
Bajaura												
Cauliflower-Pea-Tomato	165	189	174	176	28.0	41.0	34.0	34.0	111	127	119	119
French bean-Cauliflower-French bean	160	195	185	180	32.0	43.0	37.0	37.0	96	119	103	106
Cauliflower-Pea-Cauliflower	171	196	181	183	33.0	41.0	36.0	37.0	89	123	111	108
Maize-Garlic	176	193	180	183	31.0	40.0	36.0	36.0	101	120	107	109
Mean	168	193	180	-	31.0	41.0	36.0	-	99	122	110	-

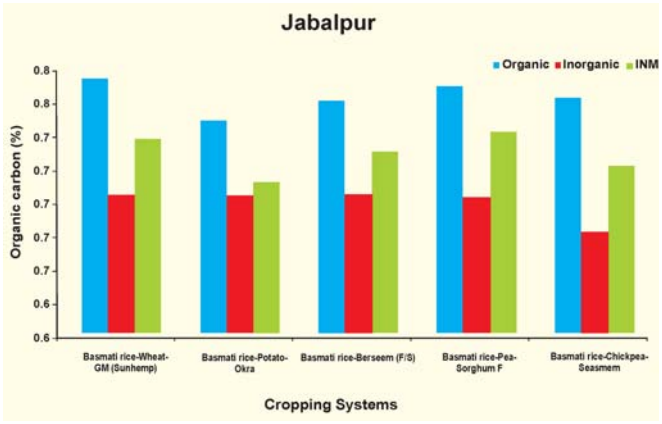
Cropping/Input system	N (kg/ha)				P (kg/ha)				K (kg/ha)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Pantnagar												
Basmati rice-wheat-*Sesbania*	333	391	385	370	27.1	36.0	34.8	32.7	188	297	290	258
Basmati rice-lentil-*Sesbania*	337	383	350	357	27.2	32.6	37.3	32.4	295	249	242	262
Basmati rice-vegetable pea-*Sesbania*	342	378	334	351	37.5	30.1	28.1	31.9	273	289	247	270
Basmati rice-Brassica napus-*Sesbania*	338	315	376	343	28.5	36.9	33.6	33.0	241	259	238	246
Mean	338	366	361	-	30.1	33.9	33.4	-	249	273	254	-
		SEm±	CD			SEm±	CD			SEm±	CD	
Input		1	5			0.5	2.0			1	4	
Cropping		1	3			0.8	NS			2	5	
Cropping X Input		2	6			1.3	4.1			3	9	
Input X Cropping		2	5			1.4	4.2			3	10	
Umiam												
Rice -carrot	230	226	233	230	18.3	14.0	19.0	17.1	265	257	281	268
Rice -potato	231	227	230	229	18.3	14.1	19.6	17.3	268	261	284	271
Rice-F.B	231	227	229	229	17.7	15.4	19.1	17.4	272	261	283	272
Rice-tomato	234	228	234	232	18.4	15.4	19.5	17.8	270	261	284	272
Mean	232	227	231	-	18.1	14.7	19.3	-	269	260	283	-
		SEm±	CD			SEm±	CD			SEm±	CD	
Input		1	5			0.2	0.9			1	3	
Cropping		2	NS			0.5	NS			1	3	
Cropping X Input		4	NS			0.9	NS			2	NS	
Input X Cropping		4	NS			0.9	NS			2	NS	

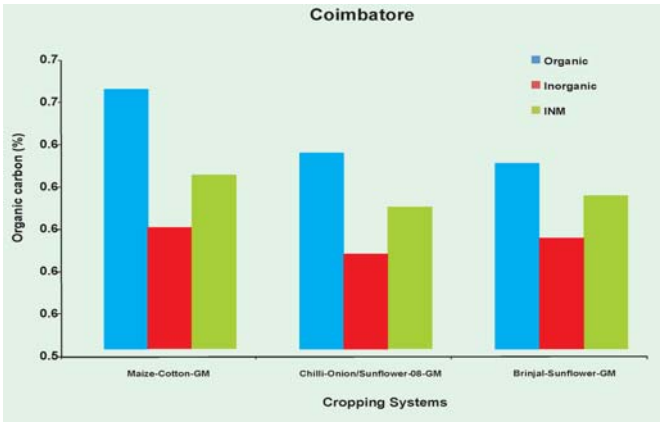
Table 5. Influence of methods of nutrient application on soil micronutrients at the end of cropping cycle at various locations

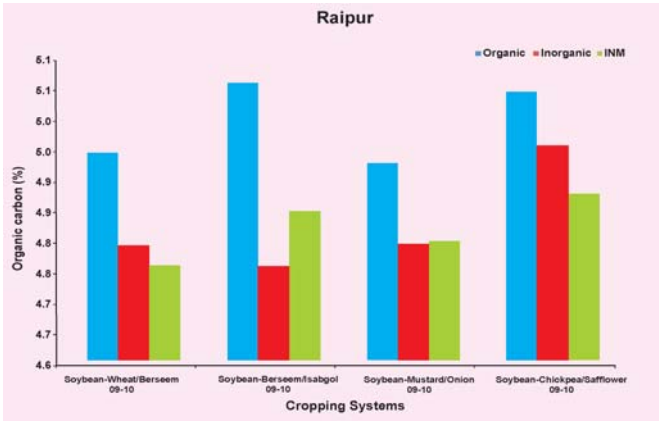
Cropping/Input system	Mn (ppm)				Zn (ppm)				Cu (ppm)				Fe (ppm)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Modipuram																
Basmati rice-wheat	12.4	9.0	11.1	10.8	2.3	1.4	2.0	1.9	4.5	3.0	3.9	3.8	36.0	18.4	32.8	29.1
Rice-barley+mustard-GG	9.9	8.3	10.3	9.5	2.0	1.5	2.4	2.0	4.1	3.1	4.6	3.9	29.3	23.2	29.7	27.4
Maize cob-Potato-Okra	14.3	9.4	12.4	12.0	2.7	1.5	2.6	2.3	4.2	2.6	3.3	3.4	19.8	13.7	17.3	16.9
Maize -mustard+radish-GG	8.1	7.5	10.0	8.5	2.4	1.1	1.5	1.7	3.6	2.9	3.0	3.2	15.5	15.4	16.4	15.8
Mean	11.2	8.5	10.9	-	2.3	1.4	2.1	-	4.1	2.9	3.7	-	25.1	17.7	24.0	-
Coimbatore																
Brinjal - Sunflower - Sunhemp	11.3	9.2	10.6	10.4	4.8	4.0	4.6	4.5	3.4	2.8	3.0	3.1	30.6	28.9	29.0	29.5
Calicut																
Ginger	5.9	21.3	14.4	13.9	1.2	1.5	1.2	1.3	16.0	16.0	16.0	16.0	28.5	40.9	39.8	36.4
Turmeric	13.7	12.0	4.7	10.1	1.5	0.5	0.7	0.9	12.7	0.8	1.4	5.0	33.5	20.3	17.6	23.8
Mean	9.8	16.7	9.6	-	1.4	1.0	0.9	-	14.4	8.4	8.7	-	31.0	30.6	28.7	-
		SEm±	CD			SEm±	CD			SEm±	CD			SEm±	CD	
Input		0.6	2.0			0.1	0.2			0.2	0.5			0.7	NS	
Cropping		0.5	1.5			0.1	0.2			0.1	0.4			0.6	1.6	
Cropping X Input		0.9	0.9			0.1	0.1			0.2	0.6			1.0	1.0	
Input X Cropping		0.9	0.9			0.1	0.1			0.2	0.6			1.0	1.0	
Dharwad																
Maize-Chickpea	10.7	8.8	10.2	9.9	1.0	0.8	0.8	0.9	1.4	1.1	1.5	1.3	8.3	7.3	8.1	7.9
Cotton+Pea	10.5	9.2	10.1	9.9	0.9	0.7	0.8	0.8	1.3	2.0	1.3	1.5	8.8	7.5	8.5	8.3
Groundnut-Sorghum	10.5	9.2	9.8	9.8	0.8	0.8	0.9	0.8	1.3	1.2	1.4	1.3	8.7	7.3	8.6	8.2
Potato-Chickpea	10.0	8.8	9.8	9.5	1.0	0.8	0.9	0.9	1.4	1.0	1.4	1.3	8.6	7.3	8.4	8.1
Soybean-Wheat	10.5	9.0	9.7	9.7	0.9	0.7	0.8	0.8	1.5	1.3	1.4	1.4	8.0	7.0	7.8	7.6
Mean	10.4	9.0	9.9	-	0.9	0.8	0.8	-	1.4	1.3	1.4	-	8.5	7.3	8.3	-

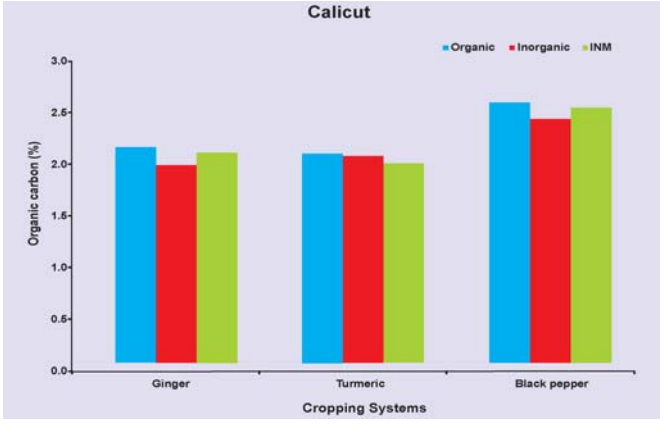
Cropping/Input system	Mn (ppm)				Zn (ppm)				Cu (ppm)				Fe (ppm)			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mea
Bajaura																
Cauliflower-Pea-Tomato	23.5	10.4	19.2	17.7	7.2	1.4	5.8	4.8	6.0	1.2	5.1	4.1	70.5	35.6	45.8	50.6
French bean-Cauliflower-French bean	21.4	12.4	20.3	18.0	8.0	1.5	7.0	5.5	6.6	1.3	5.8	4.6	68.9	30.8	52.4	50.7
Cauliflower-Pea-Cauliflower	28.1	10.6	22.2	20.3	7.9	1.3	7.0	5.4	7.2	1.0	6.7	5.0	76.2	31.4	55.1	54.2
Maize-Garlic	25.4	13.2	19.6	19.4	8.2	1.9	6.5	5.5	8.6	1.3	7.0	5.7	64.1	33.7	54.8	50.9
Mean	24.6	11.6	20.3	-	7.8	1.5	6.6	-	7.1	1.2	6.1	-	69.9	32.9	52.0	-
Pantnagar																
Basmati rice-wheat-*Sesbania*	8.9	7.7	8.4	8.3	0.6	0.6	0.7	0.6	1.5	1.0	1.2	1.2	29.1	21.3	24.5	25.0
Basmati rice-lentil-*Sesbania*	12.4	6.4	7.7	8.8	0.7	0.6	0.8	0.7	1.6	1.3	1.3	1.4	26.6	21.9	24.9	24.5
Basmati rice-vegetable pea-*Sesbania*	11.9	5.8	7.6	8.4	0.7	0.7	0.3	0.6	1.6	0.8	1.3	1.2	22.8	18.7	23.7	21.7
Basmati rice-Brassica napus-*Sesbania*	8.0	6.2	11.5	8.6	0.8	0.7	0.8	0.8	1.3	0.7	0.7	0.9	25.3	23.1	24.3	24.0
Mean	10.3	6.5	8.8	-	0.7	0.6	0.7	-	1.5	0.9	1.1	-	25.0	21.2	24.3	-
		SEm±	CD			SEm±	CD			SEm±	CD			SEm±	CD	
Input		0.1	0.5			0.0	NS			0.0	0.2			0.4	1.7	
Cropping		0.2	NS			0.0	0.0			0.0	0.2			0.4	1.3	
Cropping X Input		0.3	0.9			0.0	0.1			0.1	NS			0.8	2.6	
Input X Cropping		0.3	0.9			0.0	0.1			0.1	NS			0.8	2.3	

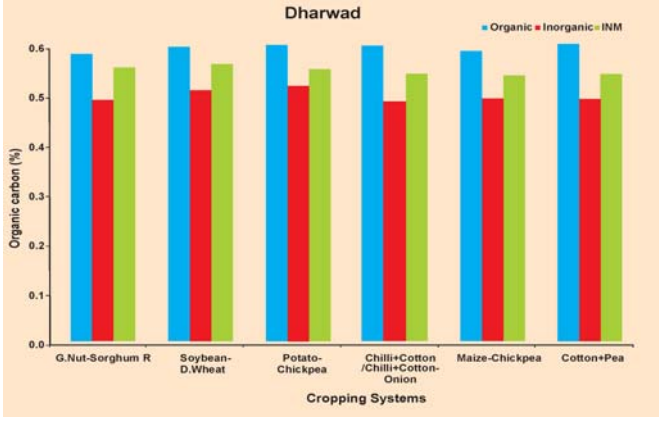

Modipuram
Organic
Inorganic
INM
Organic carbon (%)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Basmati rice-Wheat-Sesbania (GM)
Rice-Potato-Radish
Baby corn-Potato-G.Gram
Sorghum-Pea-Okra
Rice + Barley + Mustard - G.Gm
Maize (cobs)-Potato-Okra
Maize-Mustard+ Radish-G.Gm
Cropping Systems

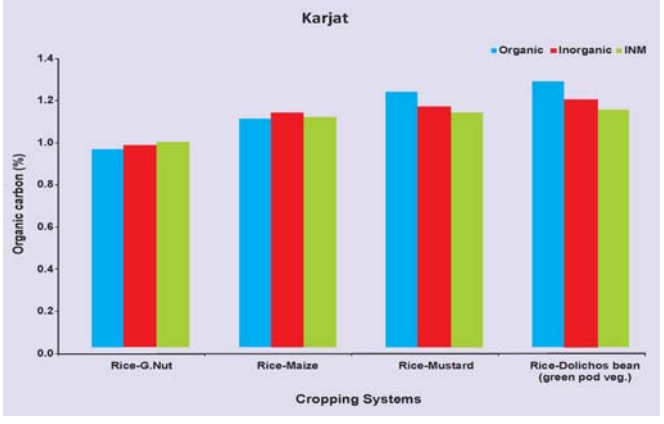

Jabalpur
Organic
Inorganic
INM
Organic carbon (%)
0.8
0.8
0.7
0.7
0.7
0.7
0.6
0.6
Basmati rice-Wheat-GM (Sunhemp)
Basmati rice-Potato-Okra
Basmati rice-Berseem (F/S)
Basmati rice-Pea-Sorghum F
Basmati rice-Chickpea-Seasmem
Cropping Systems

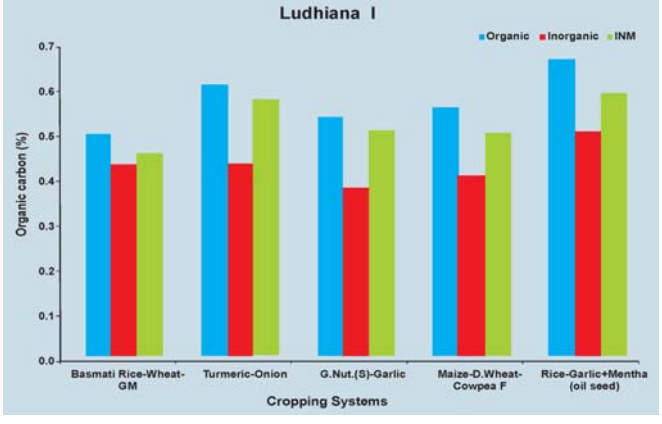

Coimbatore
Organic
Inorganic
INM
Organic carbon (%)
0.7
0.7
0.6
0.6
0.6
0.6
0.5
Maize-Cotton-GM
Chilli-Onion/Sunflower-08-GM
Brinjal-Sunflower-GM
Cropping Systems


Raipur
Organic
Inorganic
INM
Organic carbon (%)
5.1
5.1
5.0
5.0
4.9
4.8
4.8
4.7
4.7
4.6
Soybean-Wheat/Berseem 09-10
Soybean-Berseem/Isabgol 09-10
Soybean-Mustard/Onion 09-10
Soybean-Chickpea/Safflower 09-10
Cropping Systems


Calicut
Organic
Inorganic
INM
Organic carbon (%)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Ginger
Turmeric
Black pepper
Cropping Systems


Dharwad
Organic
Inorganic
INM
Organic carbon (%)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
G.Nut-Sorghum R
Soybean-D.Wheat
Potato-Chickpea
Chilli+Cotton /Chilli+Cotton-Onion
Maize-Chickpea
Cotton+Pea
Cropping Systems


Karjat
Organic
Inorganic
INM
Organic carbon (%)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Rice-G.Nut
Rice-Maize
Rice-Mustard
Rice-Dolichos bean (green pod veg.)
Cropping Systems


Ludhiana I
Organic
Inorganic
INM
Organic carbon (%)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Basmati Rice-Wheat-GM
Turmeric-Onion
G.Nut.(S)-Garlic
Maize-D.Wheat-Cowpea F
Rice-Garlic+Mentha (oil seed)
Cropping Systems

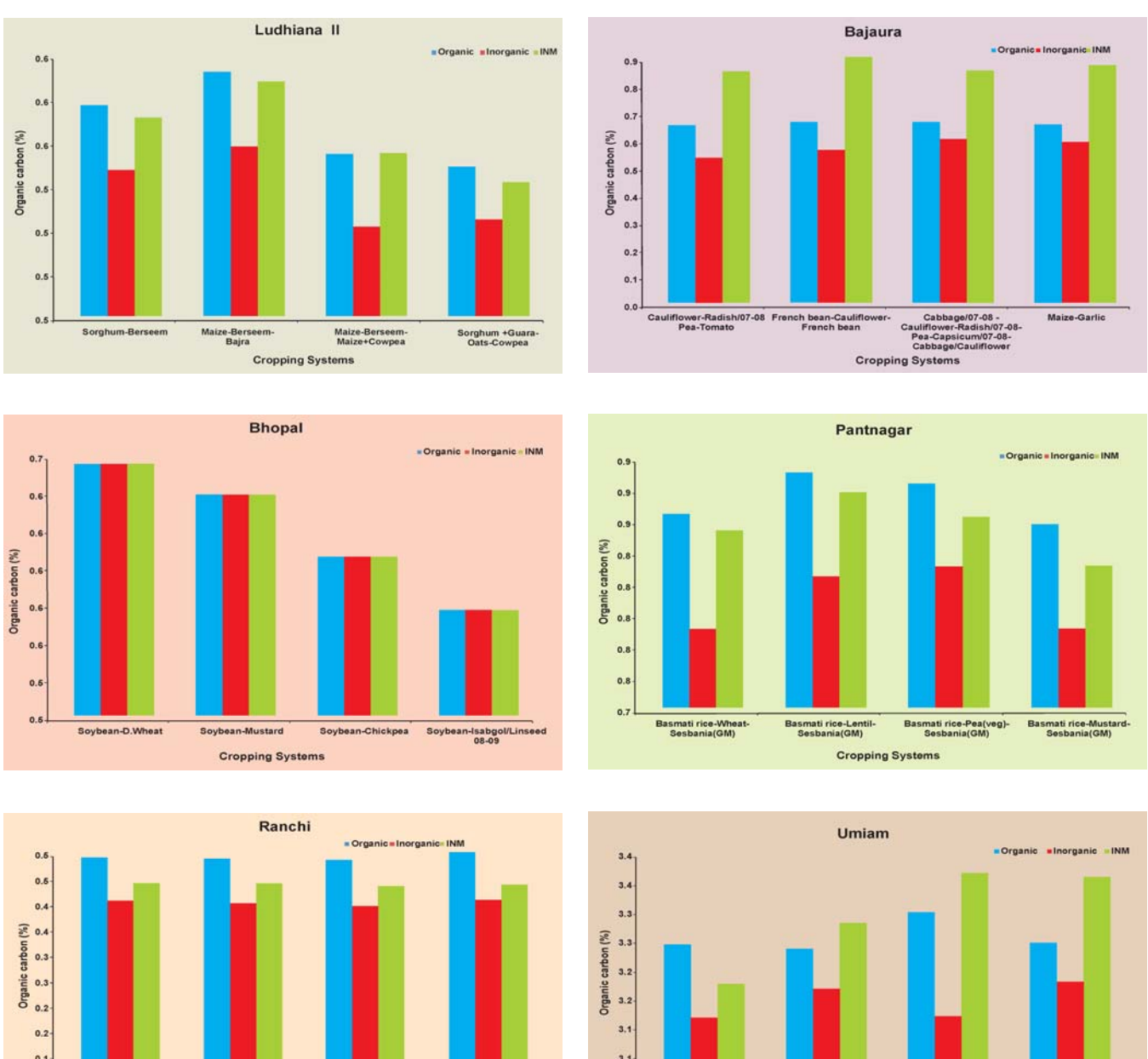


Fig 2. Influence of organic, inorganic and INM practices on organic carbon content of soils (mean of 7 years)

kg/ha) system. Micronutrients such as Mn, Zn, Cu and Fe was found to be 30.9, 70.2, 40.8 and 42.2% higher with organic than inorganic practices. Among the systems, maize for cob-potato and okra recorded higher residual Mn and Zn while Cu was higher in rice-barley + mustard-greengram. Basmati rice-wheat recorded higher Fe availability (29.07 ppm) in soil after the cropping cycle.

Jabalpur: Physical and chemical characteristics of soil in terms of bulk density, electrical conductivity and pH were estimated and it was found that bulk density was lower with organic (1.32 g/cc) and IM (1.33 g/cc) compared to inorganic (1.38 g/cc) practices. No significant variation in bulk density was observed among the cropping systems. EC and pH of soil was not influenced either by nutrient input practice or cropping systems. Irrespective of the cropping systems, organic and IM input practice recorded 13 and

8.6% higher organic carbon respectively compared to inorganic inputs. Among the various systems, basmati rice-wheat–GM recorded higher organic carbon (0.75%) followed by Basmati rice-vegetable pea-sorghum (0.74%). Marginal improvement in available N (2.9%) and considerable residual P (6.9%) and K (7.1%) was observed with organic input over inorganic practice. The residual soil available N was found to be better in basmati rice-berseem (282 kg ha^{-1}) system while P and K was found to be higher in basmati rice-wheat-green manure system (13.8 and 265 kg ha^{-1}) due to presence of green manure crop in the systems.

Coimbatore: Residual organic carbon, available soil N, P and K was estimated for all the three cropping systems under three input practices while soil residual Mn, Zn, Cu and Fe were estimated for only brinjal-sunflower-green manure system. Irrespective of the cropping systems, organic and IM practice resulted in 11.7 and 8.3% improvement in organic carbon compared to inorganic practice. Cotton-maize-green manure system recorded higher organic carbon (0.66%) compared to all other systems. As expected the residual available NPK was found to be higher with organic practice (225, 21.1, 670 kg NPK ha^{-1}). Cotton-maize-green manure recorded higher available N and K (225 and 680 kg ha^{-1} respectively) while brinjal-sunflower-green manure systems left 20.8 kg ha^{-1} of soil available P at the end of cropping cycle. Micronutrient status of the same system indicates higher Mn (11.30 ppm), Zn (4.80 ppm), Cu (3.40 ppm) and Fe (30.60 ppm) with organic input practice.

Cotton under organic system at Coimbatore

Dr B. Gangwar, Project Director reviewing the NPOF experiment at Coimbatore

Brinjal under integrated nutrient management at Coimbatore

Raipur: Soil bulk density, organic carbon, available N, P and K were estimated at the end of cropping cycle. The soil bulk density was lower with organic (1.30 g/cc) followed by IM (1.31 g/cc) and inorganic (1.32 g/cc). Considerably higher bulk density of 1.34 g/cc was observed with soybean-safflower system. Around 11.2% higher organic carbon content was observed under organic than inorganic practice. No significant variation in residual organic carbon was observed among different cropping system. Significantly lower available N, P and K was observed under organic practice compared to inorganic irrespective of cropping systems. Though available N did not differ significantly among systems, soybean-onion systems resulted in higher residual P (14.8 kg ha^{-1}) while soybean-safflower recorded higher K (270 kg ha^{-1}). The reverse trend of lower available N, P and K under organic input practice can be attributed to presence of

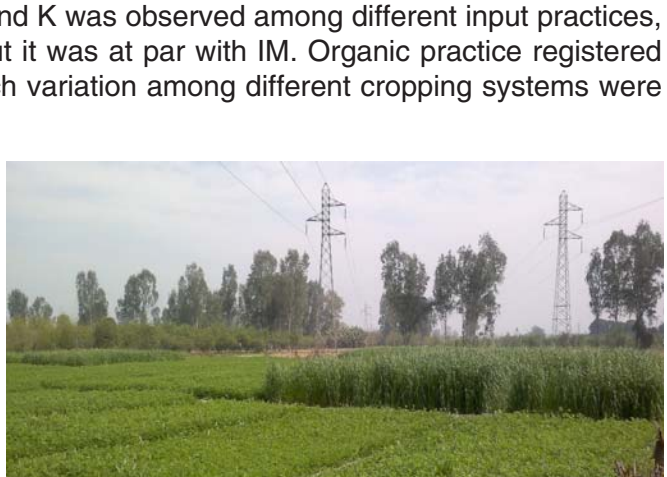
fodder crops like berseem and vegetable like onion which requires more nutrients for their biomass accumulation.

Calicut: Soil organic carbon, available N, P and K along with micronutrient such as Mn, Zn, Cu and Fe were estimated for both turmeric and ginger. Irrespective of crops marginal improvement was observed in organic carbon with organic practice (5.2%) compared to inorganic input use. Ginger recorded significantly higher soil organic carbon content (1.70%) than turmeric (1.46%). No significant difference in available N was observed among various types of input practices. However, residual P was found to be higher with inorganic (33.3 kg ha^{-1}) while K was higher with organic (313kg ha^{-1}) input system. Turmeric recorded higher residual soil N and P while K was higher in plots grown with ginger. Except Mn, all the other micronutrients such as Zn, Cu, Fe were higher under organic practice. Among the two crops, ginger recorded higher availability of micronutrients (13.97, 1.29, 16.02 and 36.40 ppm of Mn, Zn, Cu and Fe respectively).

Dharwad: Lower bulk density (1.21 g/cc), EC (0.19 ds/m) and pH (7.26) were recorded under organic input practice compared to inorganic and IM. No significant variation in these parameters was observed among different cropping systems. A significantly higher increase (24.5%) in organic carbon content was observed with organic practice compared to inorganic and the increase was reduced to only 8.9% over IM. Variation in organic carbon among various cropping systems was found to be only 0.03%. Marginal increase of 6.6% was observed in available N under organic practice over inorganic while significant improvement in residual P (11.4%) and K (14.7%) was noticed. Cotton + pea recorded higher residual N of 269 kg ha^{-1} while P was higher in groundnut-sorghum. Available K was found to be higher with potato-chickpea system. The variation in residual N, P and K among different cropping systems was found to be 13, 1.3 and 17 kg ha^{-1} respectively. Higher residual availability of Mn, Zn, Cu and Fe were observed under organic practice compared to inorganic and IM. Not much variation in availability of micronutrient was observed among different cropping systems.

Karjat: No much variation in EC and pH of soil was observed in different cropping as well as input practice. Soil organic carbon content was higher under organic (1.16%) followed by IM (1.14%) and inorganic (1.10%) practices. Both rice-groundnut and rice-dolichos bean (for green pod) owing to their higher drop of dry matter to the soil, organic carbon was higher (1.17 and 1.18% respectively) compared to other systems. No significant variation in soil available N and K was observed among different input practices, however, higher P was observed under inorganic but it was at par with IM. Organic practice registered significantly lower residual P (27.9 kg ha^{-1}). Not much variation among different cropping systems were observed in terms of residual effect.

Ludhiana: Soil EC, pH, OC available N, P and K was estimated for second set of experiment. Though there was not much variation in EC and pH was observed, soil organic carbon was found to increase by 23.8% under organic compared to inorganic practice. Sorghum + guar-oats-cowpea registered higher OC of 0.56% compared to other systems. Though available N, P and K was observed to be higher with organic input system, but the difference with inorganic and IM was statistically non-significant. Similar is the result for different cropping systems also. Sorghum + gaur-oats-cowpea recorded higher residual N while Maize-berseem-maize+cowpea registered higher residual P (69.6 kg ha^{-1}). Available K was higher under sorghum-berseem (166 kg ha^{-1}) system.



Performance of berseem under different management systems at Ludhiana

Bajaura: Organic carbon, soil available N, P, K and all the micronutrients were estimated. An increase of 71.9% in organic carbon was observed with organic over inorganic practice. IM registered an increase of 52.6%. Variation of only 0.04% was observed among different vegetable based systems. Availability of residual N,P,K was higher with inorganic (193, 41, 122 kg ha^{-1} respectively) irrespective of cropping systems. Cauliflower-pea-tomato system recorded lower soil available N (176 kg ha^{-1}) and P (34kg ha^{-1}) while french bean-cauliflower-french bean recorded lower K (106 kg ha^{-1}) among the various cropping systems.All the micro nutrient were higher with organic (24.6, 7.83, 7.11 and 69.93 ppm of Mn, Zn, Cu and Fe respectively) practice irrespective of cropping systems.Mn and Fe availability was found to be higher at the end of cauliflower-pea-cauliflower system while Zn and Cu were higher under maize-garlic system.

Pantnagar: Soil OC was found to be 13.9 and 11% higher with organic and IM over inorganic practice. Among the various cropping systems, basmati rice-lentil-sesbania green manuring system resulted in higher OC (0.92%) followed by basmati rice-vegetable pea-sesbania green manure (0.92%). Available N, P, K at the end of cropping cycle was significantly influenced by both input and cropping system practices. Drop in residual N, P and K was observed to the level of 7, 11.3 and 8.8% respectively with organic inputs over inorganic practice. Significantly higher available N was recorded with basmati rice-wheat-*sesbania* system (370kg ha^{-1}). Basmati rice-vegetable pea-*sesbania* recorded higher residual K (270kg ha^{-1}) compared to other systems. Available P did not differ significantly among the system. Available Mn, Cu and Fe were significantly influenced by different input practices. Residual Mn and Cu was found to increase by > 50% with organic over inorganic practice while in Fe, the increase was observed to be 22.3% only. Among the various systems, basmati rice-brassica napus-*sesbania* registered higher residual availability of Zn. Basmati rice-wheat- sesbania and basmati rice-lentil-*sesbania* was found to increase the residual Fe and Cu in soil compared to other systems. Availability Mn did not differ significantly among the cropping systems.

Umiam: Soil pH was in acidic range (5.01 to 5.10). Bulk density and organic carbon was found to be significantly influenced with different input practice but not with various cropping systems. Bulk density was lowered by 9.1%, but organic carbon increased by 9.5% with organic over inorganic practice. Around 5 kg increase in available N was observed with organic nutrient inputs. Though IM recorded higher available P and K, the increase with organic practice was found to be 3.42 and 9 kg ha^{-1} over inorganic nutrient inputs. Cropping system influenced only the soil available K and it was observed that rice-tomato and rice-french bean have recorded higher K (272 kg ha^{-1}) which was on par with rice-potato system.

Vegetables in raised& sunken beds under organic farming at Umiam

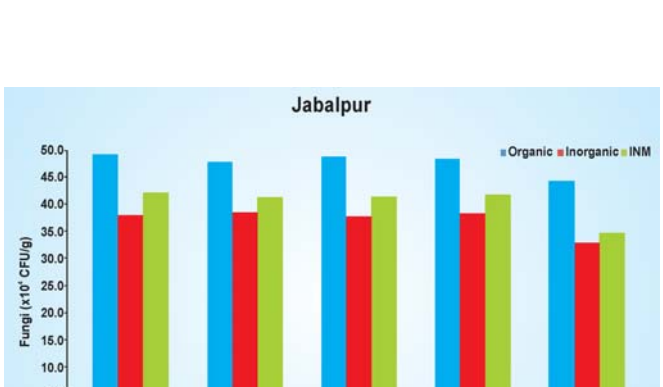
Carrot in raised beds under organic production at Umiam

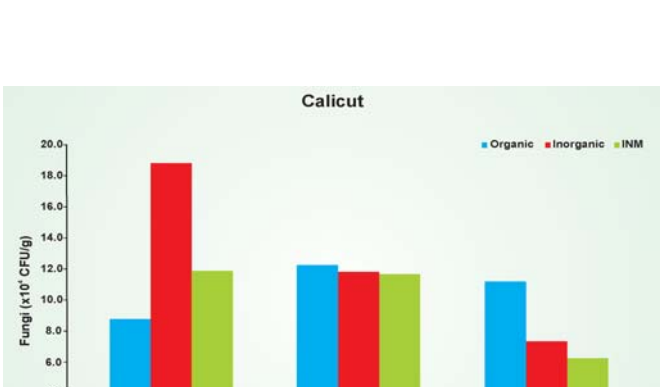
Soil microbial count (Table 6 & Fig. 3)

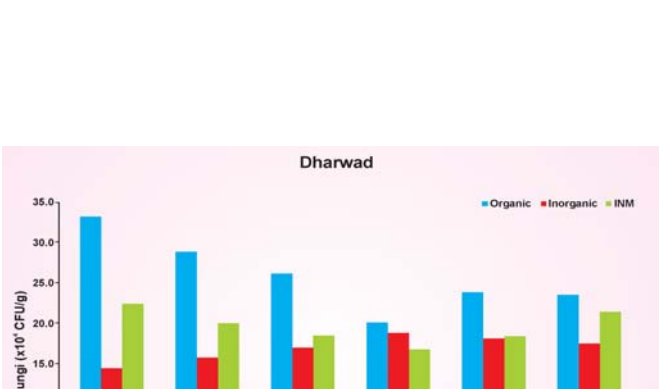
Soil microbial count was estimated at Jabalpur and Dharwad only.

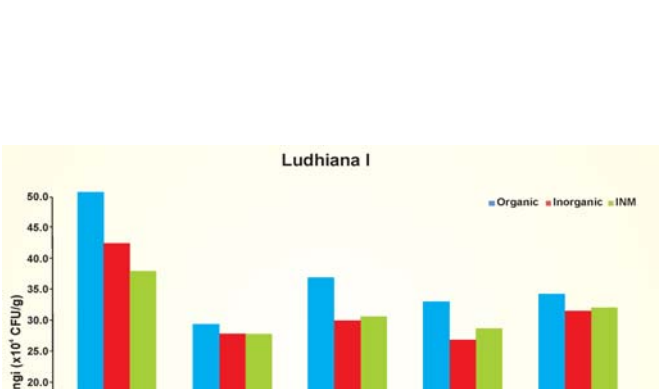
Jabalpur: Microbial count of *azotobacter*, fungi, bacteria and actinomycetes were higher with organic practice and the increase over inorganic practice was found to be 27.4, 37.4, 36.3 and 69.6% respectively. The increase over IM was found to be also considerable (23.1, 20.8, 26.7 and 18.3% respectively for *azotobacter*, fungi, bacteria and actinomycetes). Among the different cropping systems, basmati rice-wheat-green manure recorded 28.5, 39.7 and 11.8 (x10^4 CFU/g) count of *azatobacter*, fungi, and actinomycetes, respectively which is higher compared to other system. Basmati rice-vegetable pea-sorghum registered higher bacterial count of 47.4x10^4 CFU/g of soil.

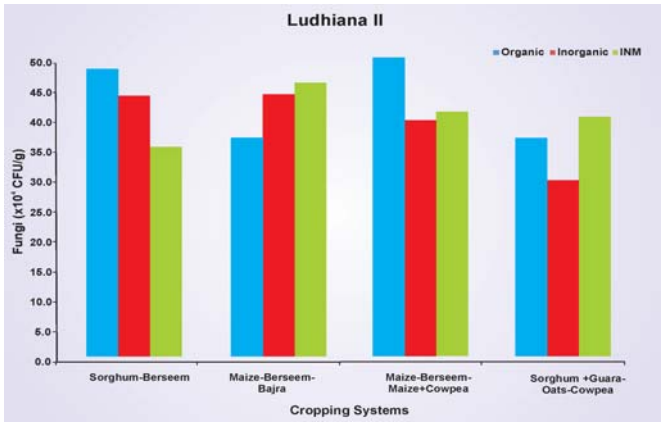
Dharwad: The increase in fungi, bacteria and actinomycetes was found to be 73.2, 27.5 and 58.3% with organic inputs over inorganic practice. IM registered 45, 11.4 and 17.3% increase only. Considerably higher count of fungi (21x10^4 CFU/g), bacteria (89x10^4 CFU/g) and actinomycetes (48x10^4CFU/g) was observed with potato-chickpea, maize-chickpea and groundnut-sorghum systems.

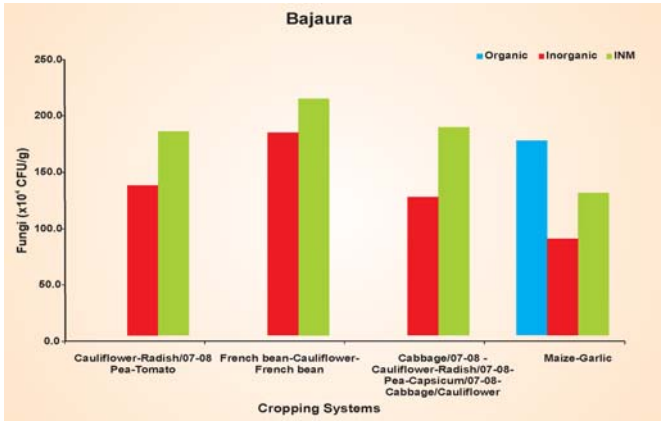


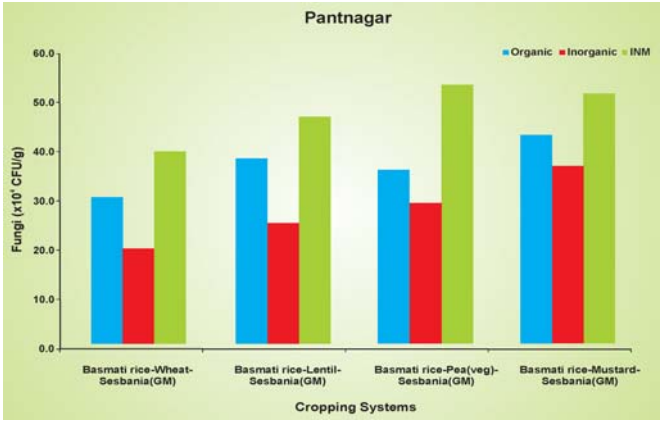


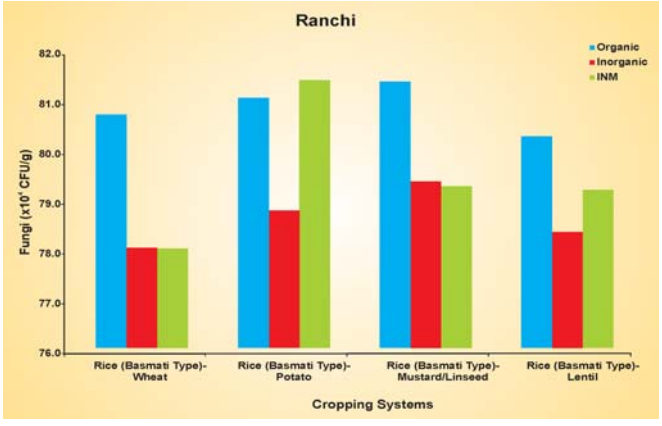












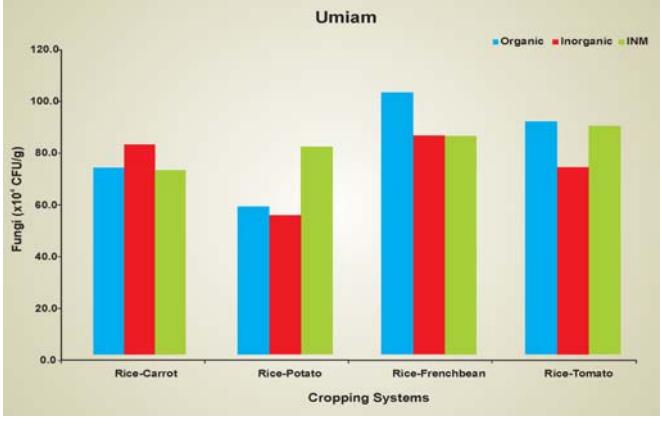


Fig 3. Fungal population (mean of 7 years)

Table 6. Influence of methods of nutrient application on soil microbial count (x10⁴ CFU/g) at the end of cropping cycle at various locations

Cropping/ Input	Azotobacter				Fungi				Bacteria				Actinomycetes			
	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean	Org	Inorg	INM	Mean
Jabalpur																
Basmati Rice - D.Wheat - GM	31.6	27.3	26.6	28.5	46.0	32.9	40.2	39.7	53.1	39.9	43.6	45.5	15.5	7.1	12.9	11.8
Basmati Rice - Chickpea - Sesauem	25.4	20.3	23.1	22.9	43.3	31.8	33.6	36.2	50.9	35.8	39.3	42.0	12.3	8.4	12.6	11.1
Basmati Rice - Berseem	27.8	23.2	20.5	23.8	45.4	32.3	38.1	38.6	50.7	38.2	41.9	43.6	14.6	8.9	10.9	11.5
Basmati Rice- Veg.pea - Sorghum	31.6	20.6	24.3	25.5	44.8	33.4	36.6	38.3	57.6	41.8	42.7	47.4	10.7	6.9	8.5	8.7
Mean	29.1	22.8	23.6	-	44.9	32.6	37.1	-	53.1	38.9	41.9	-	13.3	7.8	11.2	-
Dharwad																
Maize-Chickpea	-	-	-	-	22.0	15.0	22.0	19.7	91.0	83.0	93.0	89.0	45.0	25.0	35.0	35.0
Cotton+Pea	-	-	-	-	23.0	17.0	21.0	20.3	94.0	73.0	85.0	84.0	52.0	32.0	33.0	39.0
Groundnut-Sorghum	-	-	-	-	25.0	13.0	22.0	20.0	95.0	68.0	54.0	72.3	61.0	32.0	51.0	48.0
Potato-Chickpea	-	-	-	-	26.0	14.0	23.0	21.0	82.0	63.0	79.0	74.7	43.0	33.0	26.0	34.0
Soybean-Wheat	-	-	-	-	27.0	12.0	15.0	18.0	73.0	54.0	69.0	65.3	46.0	34.0	38.0	39.3
Mean	-	-	-	-	24.6	14.20	20.6	-	87.0	68.20	76.0	-	49.4	31.20	36.6	-

Economics (Table 7)

Modipuram: Application of organic and IM practice increased the gross returns by 13.2 and 7.3% over inorganic practice irrespective of cropping systems. However, due to enhanced cost of cultivation of 21.9% under organic and 15.2% with IM, the net returns dropped by 3.8% and 8.1% with organic and IM compared to inorganic practices. Among the different systems, basmati rice-wheat recorded higher gross returns (₹ 1,29,019 ha^{-1}), net returns (₹ 74548 ha^{-1}) and B: C ratio (1.4). The cost of cultivation was also lower (₹ 54470 ha^{-1}) for this system. Among the systems, rice-barley + mustard-greengram recorded higher net returns (₹ 38234 ha^{-1}) with organic while maize-mustard + radish-greengram registered better net returns (₹ 27482 ha^{-1}) with IM practice. All the other systems recorded higher net returns with inorganic practice.

Jabalpur: Organic nutrient input recorded 15.5% increase in net returns, 2% reduction in cost of cultivation and 50.7% increase in net returns. The B: C ratio was also higher (1.76) compared to inorganic and IM practices. No difference in net return of inorganic and IM was observed. Among the cropping systems, basmati rice-vegetable pea-sorghum registered higher gross (₹ 1, 19,188 ha^{-1}), net returns (₹ 60147 ha^{-1}) and B: C ratio (2.02). Invariably, all the system recorded higher net returns and B: C ratio with organic input management.

Coimbatore: IM practice outperformed the organic and inorganic practices for all the systems evaluated. An increase in cost of cultivation due to organic and IM practice was observed (20.7 and 8% respectively). Further, the gross return was less by 7.3% with organic but it got increase by 7.9% with IM over inorganic practices. Consequence of this, reduced net returns (21.6%) was observed with organic while it increased by 7.2% with IM. Among the systems, brinjal-sunflower-greenmanure recorded higher net return of ₹ 1, 18,266 ha^{-1}. All the system performed better with IM in terms economics.

Raipur: The cost of cultivation with organic and IM practice was found to increase by 14.6 and 4.4% over inorganic while net returns increased only 6.5% with organic and very negligible difference with inorganic and IM practice was observed. Though higher gross return of 9.7% and 1.9% was observed with organic and IM, owing to higher cost of cultivation, higher B: C ratio of 3.09 was observed with inorganic practice. Though soybean-onion system recorded higher gross returns of ₹ 1,22,342 ha^{-1}, due to high cost of cultivation (₹ 54, 052 ha^{-1}), the net returns and B: C ratio was higher with soybean-isabgol system (₹ 69, 520 ha^{-1} and 3.83) B: C ratio of soybean-berseem (2.45) and soybean-onion (2.59) was found to be higher with organic inputs compared to inorganic and IM.

Dharwad: Organic input practice resulted in 8.9% increase in gross returns over inorganic while IM recorded decrease to the level of 21.4%. The same trend was also reflected in cost of cultivation as organic practice resulted in 8.6% increased cost while IM recorded 13.8% decreased cost of cultivation. Net returns rose by 9.1% with organic and fell by 23.5% with IM over inorganic practices B: C ratio was found to be higher with organic input (3.69). Among the cropping systems, groundnut-sorghum recorded higher B: C ratio of 5.64. The same system and soybean-wheat recorded higher B: C ratio with organic practice while for maize-chickpea, IM was found to be more effective. Cotton + pea and potato-chickpea systems registered higher B: C ratio of 3.72 and 2.46 respectively with inorganic practice.

Chilli under organic management at Dharwad

Table 7. Influence of methods of nutrient application on economics of different cropping systems at various locations

Cropping/Input system	Gross returns (₹/ha)				Cost of cultivation (₹/ha)				Net returns (₹/ha)				B:C ratio			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Modipuram																
Basmati rice-wheat	111493	138297	137266	129019	49427	52847	61137	54470	62066	85450	76129	74548	1.3	1.6	1.2	1.4
Rice-barley+mustard-GG	110158	77228	82339	89908	71924	59651	67418	66331	38234	17577	14921	23577	0.5	0.3	0.2	0.3
Maize cob-Potato-Okra	141861	114162	125023	127015	134594	103043	118818	118818	7267	11119	6205	8197	0.1	0.1	0.1	0.1
Maize -mustard+radish-GG	93385	73746	88580	85237	70178	52019	61098	61098	23207	21727	27482	24139	0.3	0.4	0.4	0.4
Mean	114224	100858	108302	-	81531	66890	77118	-	32694	33968	31184	-	0.5	0.6	0.5	-
Jabalpur																
Basmati Rice - D.Wheat - GM	118193	98019	95940	104051	57026	59918	53222	56722	61168	38101	42717	47329	2.1	1.6	1.8	1.8
Basmati Rice - Chickpea - *Sesamum*	66237	62521	56327	61695	56196	57289	53389	55625	10042	5332	2939	6104	1.2	1.1	1.1	1.1
Basmati Rice - Berseem	92151	76494	71671	80105	57908	58128	54758	56931	34243	18366	16914	23174	1.6	1.3	1.3	1.4
Basmati Rice- Veg.pea - Sorghum	129323	114422	113819	119188	59178	59708	58238	59041	70145	54714	55581	60147	2.2	1.9	1.9	2.0
Mean	101476	87864	84439	-	57577	58761	54902	-	43900	29128	29538	-	1.8	1.5	1.5	-
Coimbatore																
Chillies - Sunflower -Sunhemp	108561	119469	126899	118310	40230	32140	35880	36083	68331	89429	91019	82926	1.7	2.8	2.5	2.3
Brinjal - Sunflower - Sunhemp	102735	94548	109023	102102	49662	41736	44945	45448	53073	52812	64078	56654	1.1	1.3	1.4	1.3
Mean	142162	167630	176090	161961	57252	47986	50845	52028	90910	128644	135245	118266	1.6	2.7	2.7	2.3
	117819	127216	137337	-	49048	40621	43890	-	70771	90295	96781	-	1.5	2.2	2.2	-
Raipur																
Soybean-Berseem	80288	69489	73312	74363	36022	32349	34314	34228	44266	37140	38998	40135	2.5	2.3	2.3	2.3
Soybean-Isabgol	111924	103277	102037	105746	40469	33277	34932	36226	71455	70000	67105	69520	3.5	4.2	3.8	3.8
Soybean-Onion	129754	116054	121218	122342	55807	52724	53625	54052	73947	63330	67593	68290	2.6	2.3	2.3	2.4
Soybean-Safflower	96915	92985	92750	94217	41300	33086	35252	36546	55615	59899	57498	57671	2.7	3.6	3.3	3.2
Mean	104720	95451	97329	-	43400	37859	39531	-	61321	57592	57799	-	2.8	3.1	2.9	-

Cropping/Input system	Gross returns (₹/ha)				Cost of cultivation (₹/ha)				Net returns (₹/ha)				B:C ratio			
	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Dharwad																
Maize-Chickpea	81479	76268	59487	72411	19551	17818	18968	18779	54829	51018	40519	48789	3.1	3.0	3.1	3.1
Cotton+Pea	108678	98727	75719	94375	30425	29182	26939	28849	78253	72177	51969	67466	3.6	3.7	3.2	3.5
Groundnut-Sorghum	168640	156478	126543	150554	29521	27960	20074	25852	139119	128518	103993	123877	5.7	5.6	5.6	5.6
Potato-Chickpea	107441	99106	78459	95002	46077	40321	36448	40949	62364	58785	42011	54387	2.3	2.5	2.2	2.3
Soybean-Wheat	100737	89926	68819	86494	29994	27901	20918	26271	74082	64076	47901	62020	3.8	3.5	3.3	3.5
Mean	113395	104101	81805	-	31114	28636	24669	-	81729	74915	57279	-	3.7	3.7	3.5	-
Karjat																
Rice-Groundnut	123888	140837	131742	132156	135517	112652	124435	124201	-11629	28185	7307	7954	0.9	1.3	1.1	1.1
Rice-Maize (Sweet Corn for cob)	127809	244871	222500	198393	164964	137225	157958	153382	-37155	107646	64542	45011	0.8	1.8	1.4	1.3
Rice-Mustard	58070	63253	58781	60035	114145	76983	95625	95584	-56075	-13730	-36844	-35550	0.5	0.8	0.6	0.7
Rice-Dolichos Bean (For green pod vegetable)	84902	83975	93997	87625	184216	143255	165649	164373	-99314	-59280	-71652	-76749	0.5	0.6	0.6	0 . 5
Mean	98667	133234	126755	-	149711	117529	135917	-	-51043	15705	-9162	-	0.7	1.1	0.9	-
Ludhiana I																
Cotton-Gram(D)	126550	82943	93329	100941	55646	41471	49841	48986	70904	41472	43488	51955	1.3	1.0	0.9	1.1
Maize(PP)-Gram(K)	134641	88557	144611	122603	56552	44832	53951	51778	78089	43725	90660	70825	1.4	1.0	1.7	1.4
B.Rice-Wheat-S.moong	218291	172485	178610	189795	71770	60232	70132	67378	143521	112253	108478	121417	2.0	1.9	1.6	1.8
Turmeric-Onion	316425	122760	203220	214135	73459	58277	65657	65798	242966	64483	137563	148337	3.3	1.1	2.1	2.2
Maize-Potato-S.moong	228316	143934	203206	191819	128379	107601	118897	118292	99937	36333	54309	63526	0.8	0.3	0.7	0.6
Mean	204845	122136	164595	-	77161	62483	71696	-	127083	59653	86900	-	1.8	1.1	1.4	-

Cropping/Input system	Gross returns (₹/ha)				Cost of cultivation (₹/ha)				Net returns (₹/ha)				B:C ratio			
	Org	Inor	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean	Org	Inorg	IM	Mean
Ludhiana II																
Sorghum-Berseem	60542	48928	57192	55554	18875	20481	20183	19846	41667	28447	37009	35708	2.2	1.4	1.8	1.8
Maize-Berseem-Bajra	74518	68747	74263	72509	26488	27526	27341	27118	48030	41221	46922	45391	1.8	1.5	1.7	1.7
Maize-Berseem-Maize+Cowpea	92288	83818	80249	85452	30525	32095	31810	31477	61763	51723	48439	53975	2.0	1.6	1.5	1.7
Sorghum+Guar-Oats-Cowpea	68498	62430	64906	65278	24950	24776	23305	24344	43548	37654	41601	40934	1.8	1.5	1.8	1.7
Mean	73962	65981	69153	-	25210	26220	25660	-	48752	39761	43493	-	2.0	1.5	1.7	-
Bajaura																
Cauliflower-Pea-Tomato	295531	187880	279245	254219	142608	147977	145285	145290	152923	39903	133960	108929	1.1	0.3	0.9	0.8
French bean-Cauliflower-French bean	206626	133305	222659	187530	146993	154826	154092	151970	59633	-21521	68567	35560	0.4	-0.1	0.4	0.2
Cauliflower-Pea-Cauliflower	352413	184025	276040	270826	137591	145061	143841	142164	214822	38964	132199	128662	1.6	0.3	0.9	0.9
Maize-Garlic	323408	203800	255299	260836	86090	89292	87691	87691	237318	114508	167608	173145	2.8	1.3	1.9	2.0
Mean	294495	177253	258311	-	128321	134289	132727	-	166174	42964	125584	-	1.5	0.4	1.0	-
Pantnagar																
Basmati rice-wheat-*Sesbania*	135192	107436	126227	122952	-	-	-	-	-	-	-	-	2.4	2.2	2.4	2.3
Basmati rice-lentil-*Sesbania*	118618	86653	108687	104653	-	-	-	-	-	-	-	-	2.3	1.9	2.5	2.2
Basmati rice-vegetable pea-*Sesbania*	120062	82419	99786	100756	-	-	-	-	-	-	-	-	2.6	2.0	1.7	2.1
Basmati rice-Brassica napus-*Sesbania*	102317	74971	87500	88262	-	-	-	-	-	-	-	-	1.9	1.4	1.7	1.7
Mean	119047	87869	105550	-	-	-	-	-	-	-	-	-	2.3	1.9	2.1	-
Ranchi																
Rice - Wheat	86824	63593	65385	71934	53597	29363	41480	41480	33227	34230	23905	30454	1.3	2.2	1.1	1.5
Rice - Potato	190950	118596	134860	148135	81923	56149	69036	69036	109027	62447	65824	79099	2.5	2.1	1.7	2.1
Rice - Linseed	52400	30521	34874	39265	37940	21859	29900	29900	14459	8662	4975	9366	0.6	0.7	0.2	0.5
Rice - Lentil	73824	45210	55065	58033	35537	23048	29293	29293	38286	22162	25772	28740	2.6	2.0	2.1	2.2
Mean	100999	64480	72546	-	52250	32605	42427	-	48750	31875	30119	-	1.7	1.8	1.3	-

Karjat: Organic and IM based nutrient management resulted in reduction of gross returns by 25.9 and 4.9% respectively irrespective cropping system. Owing to higher cost of cultivation in organic (27.3%) and IM (15.6%), there was a loss to the tune of ₹ 51043 $ha^{-1}$with organic and ₹ 9162 ha^{-1} with IM practice. Higher B: C ratio of 1.11 was observed under inorganic input system. Among the systems, rice-maize for cobs resulted in B: C ratio of 1.32. All the systems recorded better B: C ratio with inorganic nutrient management compared to organic and IM.

Ludhiana: In the first set of experiment, though the cost of cultivation was higher under organic (23.5%) and IM (14.7%), due to the higher gross returns (67.7 and 34.7% respectively), significantly higher increase in net returns was recorded with organic (113%) and IM (45.6%) over inorganic practice. The same trend was observed with B: C ratio as organic nutrient input resulted in B: C ratio of 1.76. Among the systems, turmeric-onion recorded higher B: C ratio. All the systems except maize-gram recorded higher B: C ratio with organic practice. IM was found to give better B: C ratio for maize-gram system. Similar trend was observed with second set of experiment also. Higher net returns (₹ 48752 ha^{-1}) and B: C ratio (1.95) was recorded with organic practice. Sorghum-berseem registered higher B: C ratio of 1.81. All the systems except sorghum + guar-oats-cowpea registered higher B: C ratio with organic inputs. The sorghum + guar-oats-cowpea recorded better B: C ratio with IM.

Bajaura: Gross returns was significantly higher (66.1%) with organic followed by IM (45.7%) over in organic practice. Due to the lower cost of cultivation under these treatment, the increase in net returns was 287 and 192% higher with organic and IM over inorganic practices. Higher B: C ratio of 1.46 was recorded with organic input system. All the systems registered higher B: C ratio with organic practice and among the systems, maize-garlic recorded higher B: C ratio of 1.98.

Pantnagar: Increase in gross returns with organic and IM was found to be 35.4 and 20.1% over inorganic practice. The B: C ratio also followed the same trend with organic practice recording 2.29 followed by IM (2.08). Among the systems, basmati rice-wheat-*sesbania* green manuring resulted in higher B: C ratio of 2.32. Interaction between cropping system and input practices indicates that basmati rice-wheat-*sesbania* and basmati rice-lentil-*sesbania* registered better B: C ratio under IM while basmati rice-vegetable pea-*sesbania* and basmati rice-brassica napus-*sesbania* recorded better B: C ratio under organic input system.

Ranchi: Organic and IM practice recorded increase in gross returns by 56.6 and 12.5% respectively over inorganic practice. The cost of cultivation also found to be 60.3 and 30% higher with these treatments. Owing to higher gross returns, an increase in net return by 52.9% was recorded with organic while under IM, net returns dropped by 5.5%. Though inorganic practice recorded higher B: C ratio of 1.77, organic also registered closer (1.74). Among the systems, rice-lentil recorded higher B: C ratio (2.24). Interaction effect reveals that rice-potato and rice-lentil are suited for organic condition while rice-wheat and rice-linsed produced better B: C ratio under inorganic condition.

Soybean under organic management at Bhopal

Linseed in soybean-linseed system with organic management at Bhopal

Nutrient uptake (Table 8 to 14)

Six centres have estimated uptake of nutrient for all the crops evaluated under different input systems.

Raipur: No significant difference in N uptake in both *kharif* and *rabi* due to various input management practices was observed. However, among the different crops, uptake was higher in berseem under IM (882 kgha^{-1}) followed by soybean (132.5 kgha^{-1}). P uptake was highly influenced by input practices especially for soybean. IM recorded higher uptake of P (24.59 kg ha^{-1}) followed by inorganic (23.68 kg ha^{-1}). Similar trend was observed for K uptake also.

Karjat: NPK uptake in all the crop were significantly influenced by both input and cropping system practice. Uptake of N by rice under organic practice was very low (58.75 kg ha^{-1}) compared to inorganic (75.09 kg ha^{-1}) and IM (74.53 kg ha^{-1}). In the *rabi* crops, groundnut and maize recorded higher N uptake under inorganic while mustard and dolichos bean registered higher uptake of N with IM. Significantly higher P and K uptake of rice (16.79 and 73.23 kg ha^{-1}) was observed under inorganic practice. All the *rabi* crops except dolichos bean recorded higher P uptake with inorganic practice. However, K uptake of groundnut, maize and dolichos bean was higher under IM. Mustard recorded higher uptake with inorganic nutrient supply.

Ludhiana: In the second set of experiment involving fodder crops, uptake of nutrients were assessed. The result reveals that uptake of N was found to be better under organic for sorghum (112.47 kg ha^{-1}) maize (61.05 kg ha^{-1}) and sorghum + gaur (129.85 kgha^{-1}). The P uptake was also found to be in the same trend for all the crops. The uptake of P increased by 128% in sorghum, 51.3% in maize and 18.1% in sorghum + gaur under organic over inorganic practice. K uptake was also observed in the same trend with sorghum + gaur recording higher uptake of132.2 kgha^{-1} under organic practice.

Bajaura: Crops like cauliflower, pea, french bean and maize have recorded higher N uptake under IM whereas, tomato and garlic have took higher N under organic practice. Higher P uptake of pea (46.75 kg ha^{-1}), tomato (33.03 kg ha^{-1}), french bean (28.63 kg ha^{-1}), cauliflower (44.04 kg ha^{-1}) and garlic (32.92 kg ha^{-1}) was observed with organic practice. K uptake was found to be better under IM practice for almost all the crops grown in the system. Fe uptake was higher either under organic or IM practice. Among the different crops, higher uptake of 7.7 kg ha^{-1} was observed with cauliflower under IM. Cu, Mn and Zn uptake also followed the similar trend for various vegetable crops grown in the sequence.

Pantnagar: N uptake of basmati rice was significantly influence by both input and cropping system practices. Significantly higher N uptake in basmati rice was observed with IM (77.34 kg ha^{-1}) followed by organic (69.9 kg ha^{-1}) input practice. In general, all the *rabi* crops recorded higher uptake under organic system. Though P uptake of basmati rice was not influence by various input practices, it did influence on P uptake of *rabi* crops significantly. Lentil and *Brassica napus* recorded higher P uptake with organic while wheat recorded P uptake of 25.18 kg ha^{-1} with inorganic practice. K uptake of basmati rice was significantly higher (71.48 kg ha^{-1}) with IM followed by organic (69.67kg ha^{-1}). Lentil and *Brassica napus* recorded higher K with organic while wheat registered uptake of 87.28 kgha^{-1} under inorganic input system.

Ranchi: Rice recorded N uptake of 56.5 kg ha^{-1} with organic followed by IM (43.3 kg ha^{-1}) and inorganic (35.3 kg ha^{-1}). N uptake of potato and linseed was found to be higher (61.3 and 44.6 kg ha^{-1} respectively) with organic while wheat and lentil, it was higher under inorganic and IM practice respectively. P uptake of rice was also higher under organic practice (10.8 kg ha^{-1}) followed by IM (7.7 kg ha^{-1}). Wheat and linseed recorded higher uptake with inorganic while P uptake of potato (44.40 kg ha^{-1}) was higher under organic. Typically, lentil registered P uptake of 8 kg ha^{-1} under IM. Like N and P, K uptake also registered similar trend of higher uptake in rice with organic (40 kg ha^{-1}) practice followed by IM (30.2 kg ha^{-1}). Higher K uptake in wheat and linseed was observed with inorganic while uptake of potato was found to be better under organic (184.80 kg ha^{-1}) practice. IM resulted in higher uptake of K in lentil.

Table 8. Influence of methods of nutrient application on N uptake (kg/ha) of different crops at various locations

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
Raipur									
Soybean-Berseem	135.0	814.0	-	133.0	854.0	-	139.0	882.0	-
Soybean-Isabgol	131.0	12.0	-	129.0	14.0	-	128.0	13.0	-
Soybean-Onion	128.0	23.0	-	125.0	24.0	-	126.0	25.0	-
Soybean-Safflower	128.0	48.0	-	129.0	54.0	-	137.0	50.0	-
							Kharif		*Rabi*
							SEm±	CD	SEm±	CD
						Input	1.0	NS	6.0	NS
						Cropping	1.0	3.0	6.0	16.0
						Cropping X Input	1.0	5.0	11.0	32.0
						Input X Cropping	1.0	4.0	10.0	29.0
Karjat									
Rice-Groundnut	71.9	117.0	-	74.7	154.0	-	79.1	151.0	-
Rice-Maize (Sweet Corn for cob)	53.4	174.0	-	78.9	254.0	-	76.9	241.0	-
Rice-Mustard	54.0	23.7	-	65.5	26.7	-	63.7	27.1	-
Rice-Dolichos Bean (For green pod vegetable)	55.6	86.8	-	81.4	70.6	-	78.4	115.0	-
							Kharif		*Rabi*
							SEm±	CD	SEm±	CD
						Input	1.9	7.2	4.6	18.2
						Cropping	2.4	7.2	9.1	27.1
						Cropping X Input	4.1	NS	14.5	NS
						Input X Cropping	4.2	NS	15.8	NS
Ludhiana II									
Sorghum-Berseem	112.5	-	-	54.1	-	-	89.4	-	-
Maize-Berseem-Bajra	61.1	-	-	28.1	-	-	40.6	-	-
Maize-Berseem-Maize+ Cowpea	43.8	-	-	47.5	-	-	52.1	-	-
Sorghum+Guar-Oats-Cowpea	129.9	-	-	84.3	-	-	76.8	-	-

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
				Kharif		*Rabi*		Summer	
				SEm±	CD	SEm±	CD	SEm±	CD
		Input		6.9	23.8	-	-	-	-
		Cropping		9.0	26.1	-	-	-	-
		Cropping X Input		15.2	NS	-	-	-	-
		Input X Cropping		15.6	NS	-	-	-	-
Bajaura									
Cauliflower-Pea-Tomato	67.6	341.3	118.0	49.8	196.9	100.6	89.8	352.3	117.0
French bean-Cauliflower-French bean	128.0	60.7	119.3	96.8	43.1	72.4	130.5	120.6	121.6
Cauliflower-Pea-Cauliflower	57.8	290.9	67.3	42.1	170.5	34.5	77.0	221.5	64.4
Maize-Garlic	33.7	51.1	-	25.6	30.2	-	43.4	41.6	-
Pantnagar									
Basmati rice-wheat-*Sesbania*	65.9	86.1	-	60.8	73.8	-	69.8	76.4	-
Basmati rice-lentil-*Sesbania*	77.7	46.2	-	70.2	36.2	-	88.1	42.2	-
Basmati rice-vegetable pea-*Sesbania*	63.6	0.0	-	67.8	0.0	-	77.6	0.0	-
Basmati rice-*Brassica napus*-*Sesbania*	72.6	45.2	-	63.7	42.8	-	73.8	40.1	-
						Kharif		*Rabi*	
						SEm±	CD	SEm±	CD
				Input		1.0	3.9	1.4	NS
				Cropping		1.5	4.5	1.9	5.6
				Cropping X Input		2.5	NS	3.2	NS
				Input X Cropping		2.6	NS	3.3	NS
Ranchi									
Rice - Wheat	54.7	57.9	-	34.6	69.0		43.1	62.9	-
Rice - Potato	67.7	61.3	-	41.6	53.7		49.0	60.9	-
Rice - Linseed	52.4	44.6	-	33.0	43.5		40.2	42.4	-
Rice - Lentil	51.4	44.7	-	31.8	42.2		40.8	49.2	-

Table 9. Influence of methods of nutrient application on P uptake (kg/ha) of different crops at various locations

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
Raipur									
Soybean-Berseem	21.9	107.0	-	24.5	113.0	-	25.4	112.0	-
Soybean-Isabgol	21.2	1.3	-	23.6	1.7	-	23.9	1.5	-
Soybean-Onion	21.3	4.4	-	22.3	5.1	-	23.4	4.5	-
Soybean-Safflower	21.0	12.0	-	24.3	13.9	-	25.6	12.9	-
							Kharif		*Rabi*
							SEm±	CD	SEm±	CD
					Input		0.3	1.0	2.3	NS
					Cropping		0.4	1.1	2.1	6.2
					Cropping X Input		0.6	NS	3.9	NS
					Input X Cropping		0.6	NS	3.7	NS
Karjat									
Rice-Groundnut	15.8	18.3	-	17.7	25.2	-	17.2	21.5	-
Rice-Maize (Sweet Corn for cob)	11.9	18.7	-	15.3	28.6	-	14..1	23.4	-
Rice-Mustard	12.8	2.0	-	16.1	2.8	-	14.9	2.3	-
Rice-Dolichos Bean (For green pod vegetable)	13.8	7.5	-	18.1	8.3	-	16.8	9.7	-
							Kharif		*Rabi*	
							SEm±	CD	SEm±	CD
					Input		0.2	0.6	0.5	2.2
					Cropping		0.3	0.8	0.9	2.8
					Cropping X Input		0.4	NS	1.5	NS
					Input X Cropping		0.4	NS	1.6	NS
Ludhiana II									
Sorghum-Berseem	26.2	-	-	11.5	-	-	19.2	-	-
Maize-Berseem-Bajra	16.5	-	-	10.9	-	-	11.4	-	-
Maize-Berseem-Maize+Cowpea	16.9	-	-	12.3	-	-	15.7	-	-
Sorghum+Guar-Oats-Cowpea	30.9	-	-	26.1	-	-	17.4	-	-

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
								Kharif	
								SEm±	CD
							Input	0.4	1.4
							Cropping	1.9	5.5
							Cropping X Input	2.9	NS
							Input X Cropping	3.3	NS
Bajaura									
Cauliflower-Pea-Tomato	34.3	46.8	33.0	22.3	22.7	21.6	37.1	46.1	29.3
French bean-Cauliflower-French bean	28.6	34.6	28.1	21.2	19.7	17.1	25.9	58.3	28.9
Cauliflower-Pea-Cauliflower	26.1	47.9	44.0	16.7	24.7	19.6	30.8	35.0	41.3
Maize-Garlic	17.5	32.9	-	11.8	18.8	-	19.1	26.9	-
Pantnagar									
Basmati rice-wheat-*Sesbania*	13.8	24.6	-	14.1	25.9	-	12.6	17.1	-
Basmati rice-lentil-*Sesbania*	15.2	18.4	-	12.7	11.4	-	14.9	10.5	-
Basmati rice-vegetable pea-*Sesbania*	12.9	0.0	-	12.3	0.0	-	13.0	0.0	-
Basmati rice-*Brassica napus*-*Sesbania*	14.4	14.8	-	13.2	9.1	-	10.5	11.4	-
							Kharif		*Rabi*
							SEm±	CD	SEm±	CD
						Input	0.5	NS	0.4	1.6
						Cropping	0.4	NS	1.0	3.1
						Cropping X Input	0.8	2.6	1.6	NS
						Input X Cropping	0.8	2.2	1.8	NS
Ranchi									
Rice - Wheat	10.2	9.6	-	5.9	12.5	-	7.6	10.9	-
Rice - Potato	13.2	44.4	-	7.3	40.2	-	8.9	43.6	-
Rice - Linseed	9.7	2.5	-	5.6	2.8	-	7.2	2.5	-
Rice - Lentil	10.0	6.9	-	5.3	7.3	-	7.1	8.0	-

Table 10. Influence of methods of nutrient application on K uptake (kg/ha) of different crops at various locations

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
Raipur									
Soybean-Berseem	65.9	818.0	-	70.6	855.0	-	70.3	891.0	-
Soybean-Isabgol	64.4	4.5	-	69.1	4.9	-	68.5	4.5	-
Soybean-Onion	63.6	7.7	-	65.1	8.4	-	64.3	8.3	-
Soybean-Safflower	63.3	13.3	-	69.2	15.0	-	72.2	13.6	-
							Kharif		*Rabi*
							SEm±	CD	SEm±	CD
					Input		0.7	2.4	5.0	NS
					Cropping		0.8	2.2	4.6	13.2
					Cropping X Input		1.3	NS	8.5	26.3
					Input X Cropping		1.3	NS	7.9	22.9
Karjat									
Rice-Groundnut	57.4	40.7	-	63.9	40.2	-	59.9	45.8	-
Rice-Maize (Sweet Corn for cob)	54.8	52.5	-	77.4	67.6	-	66.1	72.5	-
Rice-Mustard	56.5	16.3	-	74.0	17.7	-	66.2	15.6	-
Rice-Dolichos Bean (For green pod vegetable)	63.6	51.0	-	77.6	54.2	-	67.4	70.4	-
							Kharif		*Rabi*
							SEm±	CD	SEm±	CD
					Input		1.2	4.8	1.5	6.0
					Cropping		1.7	5.0	2.6	7.6
					Cropping X Input		2.8	NS	4.1	NS
					Input X Cropping		2.9	NS	4.4	NS
Ludhiana II									
Sorghum-Berseem	80.1	-	-	51.5	-	-	69.8	-	-
Maize-Berseem-Bajra	47.3	-	-	17.8	-	-	40.5	-	-
Maize-Berseem-Maize+Cowpea	53.4	-	-	30.8	-	-	38.7	-	-
Sorghum+Guar-Oats-Cowpea	132.2	-	-	73.1	-	-	71.1	-	-

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
								Kharif	
								SEm±	CD
							Input	4.8	16.6
							Cropping	6.8	19.7
							Cropping X Input	11.2	NS
							Input X Cropping	11.8	NS
Bajaura									
Cauliflower-Pea-Tomato	61.9	55.7	96.0	44.6	33.2	84.8	75.4	55.4	105.6
French bean-Cauliflower-French bean	69.0	66.3	59.7	53.7	42.3	44.7	64.9	130.6	68.3
Cauliflower-Pea-Cauliflower	47.2	66.7	43.2	32.4	34.0	24.0	56.2	45.3	45.4
Maize-Garlic	40.9	47.7	-	29.7	50.4	-	44.1	48.1	-
Pantnagar									
Basmati rice-wheat-*Sesbania*	71.5	75.1	-	46.1	87.3	-	76.9	62.2	-
Basmati rice-lentil-*Sesbania*	72.6	55.2	-	51.2	49.6	-	66.0	45.2	-
Basmati rice-vegetable pea-*Sesbania*	68.7	0.0	-	62.3	0.0	-	67.2	0.00	-
Basmati rice-*Brassica napus*-*Sesbania*	66.0	45.8	-	53.3	37.9	-	75.8	42.5	-
							Kharif		*Rabi*
							SEm±	CD	SEm±	CD
						Input	1.3	5.0	1.3	5.2
						Cropping	1.5	NS	3.3	9.8
						Cropping X Input	2.6	4.5	5.1	NS
						Input X Cropping	2.6	8.3	5.7	NS
Ranchi									
Rice - Wheat	38.7	35.2	-	24.2	40.6	-	30.4	36.9	-
Rice - Potato	48.1	184.8	-	29.0	154.2	-	33.7	174.0	-
Rice - Linseed	36.2	21.5	-	23.5	24.9	-	28.3	20.1	-
Rice - Lentil	37.1	26.1	-	22.9	25.7	-	28.7	29.0	-

Table 11. Influence of methods of nutrient application on Fe, Cu, Mn & Zn uptake (g/ha) of different crops at Bajaura

Cropping / Input system	Organic			Inorganic			IM		
	Kharif	Rabi	Summer	Kharif	Rabi	Summer	Kharif	Rabi	Summer
Fe uptake									
Cauliflower-Pea-Tomato	4006	2861	4252	2697	1938	3156	4856	3127	3781
French bean-Cauliflower-French bean	3448	3782	3358	2018	2742	2473	2893	7743	3667
Cauliflower-Pea-Cauliflower	3155	3327	2171	1685	1933	1022	3715	2561	1846
Cu uptake									
Maize-Garlic	2424	2556	-	1479	1828	-	2743	2301	-
Cauliflower-Pea-Tomato	305	173	396	76	86	161	339	176	338
French bean-Cauliflower-French bean	201	234	139	80	100	56	179	430	141
Cauliflower-Pea-Cauliflower	174	227	161	53	62	36	193	144	135
Maize-Garlic	153	222	-	51	91	-	170	183	-
Mn uptake									
Cauliflower-Pea-Tomato	833	501	983	384	263	592	997	513	970
French bean-Cauliflower-French bean	576	658	532	253	317	213	467	1316	425
Cauliflower-Pea-Cauliflower	550	542	481	277	231	146	657	413	386
Zn uptake									
Maize-Garlic	250	626	-	151	373	-	274	537	-
Cauliflower-Pea-Tomato	330	263	562	84	143	323	279	252	514
French bean-Cauliflower-French bean	385	267	367	131	77	165	273	440	311
Cauliflower-Pea-Cauliflower	250	299	321	82	107	103	270	207	271
Maize-Garlic	197	334	-	64	142	-	191	271	-

Quality parameters (Table 12)

Protein, oil and methionine content in soybean was estimated at Bhopal while protein content was estimated for all the *rabi* crops at Karjat.

Bhopal: Though numerically higher protein content (35.6%) was observed under organic practice, but it was on par with inorganic and IM. No significant difference in oil content was observed among various input practices. Marginal increase in methionine content was observed under organic (1.72%) compared to inorganic (1.64%) and IM (1.67%). Soybean grown in soybean-wheat system resulted in higher oil (18.42%) and methionine (1.75%). Soybean in soybean-linseed recorded higher protein (35.59%).

Karjat: Groundnut and maize for cob recorded higher protein (22.5 and 19.7% respectively) under organic practice while mustard and dolichos bean recorded higher protein with IM (18.7 and 19.4% respectively). Irrespective of nutrient input practices, groundnut recorded higher content of protein (21%) followed by mustard (18.2%), doliches bean (18.1%) and maize for cob (17.9%).

Table 12. Influence of methods of nutrient application on quality parameters

Cropping / Input system	Protein (%)				Oil (%)				Methionine (%)			
	Organic	Inorganic	IM	Mean	Organic	Inorganic	IM	Mean	Organic	Inorganic	IM	Mean
Bhopal												
Soybean-Wheat	35.6	35.4	35.4	35.5	18.4	18.5	18.4	18.4	1.7	1.8	1.72	1.8
Soybean-Mustard	35.6	35.5	35.5	35.5	18.3	18.4	18.3	18.3	1.7	1.7	1.7	1.7
Soybean-Chickpea	35.6	35.4	35.5	35.5	18.2	18.2	18.2	18.2	1.8	1.6	1.8	1.7
Soybean-Linseed	35.7	35.5	35.5	35.6	18.1	18.1	18.2	18.1	1.7	1.5	1.5	1.6
Mean	35.6	35.5	35.5		18.2	18.3	18.3		1.7	1.6	1.7	
		SEm±	CD			SEm±	CD			SEm±	CD	
Input		0.0	NS			0.0	NS			0.0	0.0	
Cropping		0.0	0.1			0.1	0.2			0.0	0.1	
Cropping X Input		0.1	NS			0.1	NS			0.0	0.1	
Input X Cropping		0.0	NS			0.1	NS			0.0	0.1	
Karjat (only *rabi*)												
Rice-Groundnut	22.5	19.5	21.0	21.0								
Rice-Maize (Sweet Corn for cob)	19.7	16.0	18.1	17.9								
Rice-Mustard	18.2	17.7	18.7	18.2								
Rice-Dolichos Bean (For green pod vegetable)	18.7	16.3	19.4	18.1								
Mean	19.8	17.4	19.3									
		SEm±	CD									
		0.7	NS									
		0.7	NS									
		1.3	NS									
		1.3	NS									

7.2 Evaluation of various sources of organic inputs

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

Objectives:

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

Treatment: There are no common treatments for all the centres as cropping system and inputs for nutrients are varying from location to locations. The details of treatments are given in Table 16 along with experimental results.

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

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

RESULTS

Grain and straw yield (Table 13)

Jabalpur: Two cropping systems namely basmati rice- wheat-green manure and basmati rice-berseem were evaluated with five different combinations of nutrient sources. In both the cropping systems, application of nutrients through VC + FYM + N EOF @ 1/3 N each + Panchgavya recorded higher grain yield (1652, 1538 and 50kg of basmati rice, wheat and berseem seed ha^{-1}) followed by VC + FYM + NEOF @ 1/3 N each. Biodynamic and panchgavya practices recorded lower yield than that of combination of organic nutrient inputs. Among the systems, grain yield of basmati rice obtained with basmati rice- wheat-green manure was found to be higher (1427 kg ha^{-1}) compared to basmati rice-berseem (1412 kg ha^{-1}). Though no significant difference in straw yield was noticed among the different sources, VC + FYM + NEOF @ 1/3 N each recorded 17.8% higher straw yield in basmati rice compared to biodynamic practices.

Experiment on organic input evaluation at Jabalpur

Coimbatore: Two systems namely cotton-maize-green manure and chillies-sunflower-green manure were evaluated with five different combinations of nutrient sources. In both the systems, it was observed that application of nutrient through FYM + NEOC @ ½ N each + panchgavya was found to give higher yield of cotton (1693 kg ha^{-1}), maize (3159 $kgha^{-1}$), chillies (6266kg ha^{-1}) and sunflower (1344kg ha^{-1}) which was on par with FYM + NEOC @ ½ N each alone for all the crops. The yield reduction due to application of either biodynamic practices alone or biodynamic with panchagavya was found to be 10 to 35% in various crops compared to combination of organic inputs (FYM + NEOC) with panchgavya alone. Lowest yield in all the crops were observed with application of either biodynamic practices or panchagavya alone.

Table 13. Influence of source of nutrients on grain and straw yield (kg/ha) of crops at various locations

Cropping system	Source of nutrient	Grain Yield		Straw Yield	
		Kharif	*Rabi*	*Kharif*	*Rabi*
Jabalpur					
Basmati Rice - D.Wheat - GM	VC+FYM+NEOF @ 1/3 N each	3363	3079	6431	4786
	Panchgavya alone	2814	2246	5998	5175
	VC+FYM+NEOF + Panchgavya @1/3 N each	3622	3328	6952	5460
	Biodynamic practices	2649	2245	5898	4185
	Biodynamic practices+ Panchgavya	2993	2618	7326	5087
	Mean	3088	2703	6521	4939
Basmati Rice - Berseem	VC+FYM+NEOF @ 1/3 N each	3298	115	6471	13353
	Panchgavya alone	2898	92	6023	10924
	VC+FYM+NEOF + Panchgavya @1/3N each	3530	108	7300	14120
	Biodynamic practices	2560	92	5447	10158
	Biodynamic practices+ Panchgavya	2991	97	5424	11457
	Mean	3055	101	6133	12002
Coimbatore					
Cotton - Maize - Sunhemp	FYM + NEOC* (1/2+1/2)	1643	3111	-	-
	Panchagavya alone	1054	2238	-	-
	FYM+NEOC*(1/2+1/2)+ Panchagavya	1693	3159	-	-
	Biodynamic practices	1089	2635	-	-
	Biodynamic practices+ Panchagavya	1208	2889	-	-
	Mean	1337	2806	-	-
Chillies-Sunflower - Sunhemp	FYM + NEOC* (1/2+1/2)	6019	1227	-	-
	Panchagavya alone	4962	1057	-	-
	FYM+NEOC*(1/2+1/2)+ panchagavya	6266	1344	-	-
	Biodynamic practices	4638	1008	-	-

Cropping system	Source of nutrient	Grain Yield		Straw Yield	
		Kharif	*Rabi*	*Kharif*	*Rabi*
	Biodynamic practices+ panchagavya	5666	1150	-	-
	Mean	5510	1157	-	-
		Kharif (GY)		*Rabi* (GY)	
		SEm±	CD	SEm±	CD
	Cropping	54	326	13	83
	Method	95	287	45	136
	Cropping X Method	132	464	59	187
	Method X Cropping	135	406	64	193
Raipur					
Rice-Chickpea	EC+CDM+NEOC @ 1/3 N each	3894	1011	5814	2289
	Bio dynamic practice	3373	750	5397	1866
	EC+CDM+NEOC@ 1/3Neach+Panchagavya	4063	1109	5882	2302
	EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice	3297	1042	5743	2364
	Biodynamic practice+ EC+CDM+NEOC@ 1/3N each+panchagavya	4284	1208	6309	2586
	Mean	3908	1024	5829	2281
Rice- Mustard+lentil (alternate row)	EC+CDM+NEOC @ 1/3 N each	3688	975	5480	3227
	Biodynamic practice	3229	729	5057	2549
	EC+CDM+NEOC@1/3 N each+panchagavya	3844	1146	5532	3463
	EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice	3865	1021	5823	3087
	Biodynamic practice+ EC+CDM+NEOC@1/3 N each+panchagavya	4140	1177	6164	3923
	Mean	3753	1008	5611	3250

Cropping system	Source of nutrient	Grain Yield		Straw Yield	
		Kharif	*Rabi*	*Kharif*	*Rabi*
		Kharif (GY)	*Rabi* (GY)	*Kharif* (SY)	Rabi(SY)
		SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	197 NS	24 NS	242 NS	84 513
	Method	145 434	60 180	136 409	125 375
	Cropping X Method	269 NS	80 NS	298 NS	179 NS
	Method X Cropping	204 NS	85 NS	193 NS	177 NS
Calicut					
Ginger	FYM+BD+PG+RP	19870	-	-	-
	FYM+PG+RP	11025	-	-	-
	FYM+BD+RP	19975	-	-	-
	FYM+NC+2VC+PG+BD+RP	23525	-	-	-
	FYM+NC+2VC+RP	15425	-	-	-
	Absolute control	12475	-	-	-
	Mean	17049	-	-	-
Turmeric	FYM+BD+PG+RP	27100	-	-	-
	FYM+PG+RP	20600	-	-	-
	FYM+BD+RP	23450	-	-	-
	FYM+NC+2VC+PG+BD+RP	26200	-	-	-
	FYM+NC+2VC+RP	32100	-	-	-
	Absolute control	17900	-	-	-
	Mean	24558	-	-	-
		Kharif			
		SEm±	CD		
	Cropping	540	2429		
	Method	967	2793		
	Cropping X Method	1361	4274		
	Method X Cropping	1368	3950		
Dharwad					
Groundnut-Sorghum	EC+VC+GLM	4098	1901	-	12616
	Panchagavya spray	3743	1654	-	11763
	EC+VC+GLM +	4107	1877	-	11474

Cropping system	Source of nutrient	Grain Yield		Straw Yield	
		Kharif	*Rabi*	*Kharif*	*Rabi*
	Panchagavya spray				
	EC+VC+GLM+ Biodynamic spray @5g/ac	4096	1704	-	11761
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	4230	1852	-	11468
	FYM+VC+GLM	3960	1655	-	12118
	Control	3510	1432	-	10477
	Mean	3963	1725	-	11668
Maize-Chickpea	EC+VC+GLM	5590	1779	6431	1311
	Panchagavya spray	4579	1549	5152	1202
	EC+VC+GLM + Panchagavya spray	5859	1763	6936	1366
	EC+VC+GLM+ Biodynamic spray @5g/ac	5724	1717	6497	1175
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	6196	1768	6701	1120
	FYM+VC+GLM	5421	1634	5758	1284
	Control	3905	1246	5354	1039
	Mean	5325	1636	6119	1214
Chilli+onion	EC+VC+GLM	848	3106	-	-
	Panchagavya spray	759	2289	-	-
	EC+VC+GLM + Panchagavya spray	881	3498	-	-
	EC+VC+GLM+ Biodynamic spray @5g/ac	931	2761	-	-
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	906	3121	-	-
	FYM+VC+GLM	832	2761	-	-
	Control	517	2042	-	-
	Mean	810	2797	-	-

Cropping system	Source of nutrient	Grain Yield		Straw Yield	
		Kharif	***Rabi***	***Kharif***	***Rabi***
		Kharif	*Rabi*	*Kharif*	*Rabi*
		SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	113 443	58 228	101 397	122 477
	Method	86 245	98 282	97 278	120 346
	Cropping X Method	178 585	168 NS	185 590	228 724
	Method X Cropping	148 424	170 NS	168 482	209 590
Karjat					
Rice- Red pumpkin	Kh. FYM + rice straw + glyricidia leaves @1/3rd N each Rb. FYM +NC +VC @1/3rd N each	3677	8450	6353	3419
	Panchagavya alone	3310	6375	5147	3362
	Kh. FYM + rice straw + glyricidia leaves @ 1/3rd N each Rb. FYM + NC +VC @1/3rd N each + panchagavya	3927	8530	6143	3852
	Biodynamic practices	3177	6774	4833	3085
	Panchagavya + Biodynamic practices	3413	7111	5147	3770
	Mean	3501	7448	5525	3497
Rice- Cucumber	Kh. FYM + rice straw + glyricidia leaves @ 1/3rd N each Rb. FYM + NC +VC @1/3rd N each	3727	5919	5673	1283
	Panchagavya alone	3463	4244	5147	1240
	Kh. FYM + rice straw + glyricidia leaves @ 1/3rd N each Rb. FYM+ NC +VC @1/3rd N each + panchagavya	3757	6038	6197	1325
	Biodynamic practices	3403	4187	4883	1215
	Panchagavya + Biodynamic practices	3413	4447	5303	1267
	Mean	3553	4967	5441	1266

Cropping system	Source of nutrient		Grain Yield			Straw Yield	
			Kharif		*Rabi*	*Kharif*	*Rabi*
			Kharif (GY)		Rabi(GY)	*Kharif*(SY)	*Rabi* (SY)
			SEm±	CD	SEm± CD	SEm± CD	SEm± CD
	Cropping		23	NS	294 1790	168 NS	13 81
	Method		97	289	466 1396	219 656	105 NS
	Cropping X Method		124	NS	658 NS	323 NS	133 NS
	Method X Cropping		136	NS	658 NS	310 NS	148 NS
Ludhiana							
Maize-Wheat+ Gram-S.moong	B.Rice	Other crops	*Kharif*		*Rabi* Summer	*Kharif*	*Rabi*
	GM	FYM	5833		2380 883	14960	4047
	GM+PG	FYM+PG	6043		2517 730	15540	3917
	GM+BD	BD	3583		1510 657	11043	2543
	GM+BD+FYM	FYM+BD	5820		2293 647	15127	3027
	GM+PG+BD	FYM+PG+BD	6137		2497 780	14167	3680
	Control	Control	2017		1187 227	8597	2143
	Mean		4905		2064 654	13239	3226
B.Rice- Wheat-Greenmanure(GM)	GM	FYM	3897		2537 0	10110	3920
	GM+PG	FYM+PG	3923		2470 0	9517	3397
	GM+BD	BD	3797		1720 0	10240	3387
	GM+BD+FYM	FYM+BD	3927		2403 0	10003	3670
	GM+PG+BD	FYM+PG+BD	4007		2540 0	8580	3870
	Control	Control	3320		1253 0	8120	2500
	Mean		3812		2153 0	9428	3457
			Kharif		*Rabi* *Kharif*		*Kharif*
			SEm±	CD	SEm± CD SEm± CD		SEm± CD
	Cropping		136	829	80 NS 57 343		57 NS
	Method		186	549	127 375 54 159		335 989
	Cropping X Method		277	1025	182 NS 89 375		437 NS
	Method X Cropping		263	777	180 NS 76 224		475 NS

Cropping system	Source of nutrient	Grain Yield			Straw Yield	
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*
Bhopal		*Kharif*		*Rabi*	*Kharif*	*Rabi*
Soybean-Wheat	OM	859		2967	2183	6228
	BD	439		2920	1420	3765
	OM+PG	948		3593	1871	5340
	OM+BD	868		3124	1861	5968
	OM+PG+BD	976		3970	2261	5904
	Control	554		2718	1293	4021
	Mean	774		3215	1815	5205
Maize-Chickpea	OM	4068		1715	8008	3333
	BD	2963		1501	7130	2584
	OM+PG	4260		1726	8179	3052
	OM+BD	4097		1787	6864	3250
	OM+PG+BD	4455		1855	8847	3623
	Control	2565		1711	4198	3155
		Kharif		*Rabi*	*Kharif*	*Rabi*
		SEm±	CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	97	308	163 520	315 1003	347 1103
	Method	121	248	156 318	752 1556	378 772
	Cropping X Method	184	434	259 647	1021 NS	599 NS
	Method X Cropping	172	351	220 450	1064 NS	535 NS
Pantnagar						
Basmati rice – Chickpea–*Sesbania*	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)	3122		1338	5311	4922
	Biodynamic (BD)	2633		993	4944	5051
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ Panchgavya	3209		1342	5336	4826
	FYM+VC+NC+EC 1/4+ 1/4+1/4+1/4)+BD	3133		1199	5511	4548
	FYM+VC+NC+EC (1/4+ 1/4+1/4+1/4)+BD+ Panchgavya	3422		1335	5200	4021
	Control	2650		1054	4761	4300
	Mean	3028		1210	5177	4611

Cropping system	Source of nutrient	Grain Yield		Straw Yield	
		Kharif	*Rabi*	*Kharif*	*Rabi*
Basmati rice – Vegetable pea – Maize+ Moong (moong residues incoporation)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)	2700	10302	4523	-
	Biodynamic (BD)	1722	6214	4111	-
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ Panchgavya	2655	12445	4511	-
	FYM+VC+NC+EC 1/4+ 1/4+1/4+1/4)+BD	2744	10532	4678	-
	FYM+VC+NC+EC (1/4+ 1/4+1/4+1/4)+BD+ Panchgavya	2866	11688	4600	-
	Control	1754	6706	4061	-
		Kharif		*Rabi*		*Kharif*		*Rabi*	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	62	377	99	605	64	393	44	266
	Method	103	303	344	1015	110	325	94	277
	Cropping X Method	146	NS	455	1410	156	NS	129	427
	Method X Cropping	145	NS	487	1435	156	NS	133	392
Ranchi									
Rice - Wheat	50% VC+50% KC	2293		2099		3293		3487	
	BD Preparation (CPP,BD500 & 501)	1200		1036		1917		2113	
	VC + K.C+Panchagavaya	2303		2154		3457		3513	
	VC + K.C+ BD Prepartion	2420		2246		3627		3600	
	VC + K.C+ BD Prepartion+ Panchagavya	2533		2411		3803		3797	
	Mean	2150		1989		3219		3302	
Rice – Potato	50% VC+50% KC	2330		11567		3500		2890	
	BD Preparation (CPP,BD500 & 501)	1240		7033		1957		1293	
	VC + K.C+Panchagavaya	2380		16867		3667		3100	
	VC + K.C+ BD Prepartion	2483		16933		3827		3117	

Cropping system	Source of nutrient	Grain Yield		Straw Yield	
		Kharif	*Rabi*	*Kharif*	*Rabi*
	VC + K.C+ BD Prepartion + Panchagavya	2583	17200	3973	3183
	Mean	2203	13920	3385	2717
		Kharif	*Rabi*	*Kharif*	*Rabi*
		SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	37 NS	682 4148	62 NS	68 415
	Method	103 308	1129 3385	157 471	151 454
	Cropping X Method	135 NS	1583 5651	209 NS	204 NS
	Method X Cropping	146 NS	1597 4788	222 NS	214 NS
Umiam 2A					
Maize + Soybean (GM) - Toria	FYM+VC	4076	259	9019	-
	Panchagavya(PG)	1344	101	3021	-
	FYM+VC+PG	4153	453	9037	-
	Biodynamic Formulation (BD-501)	1516	132	3403	-
	BD -501 +PG	2380	257	5659	-
	Control	1009	15	2261	-
	Mean	2413	219	5400	-
Maize (green cob)+ Soybean (GM) - Frenchbean (Green pod)	FYM+VC	8934	1393	6657	893
	Panchagavya(PG)	2576	559	1627	277
	FYM+VC+PG	9333	1426	7016	760
	Biodynamic Formulation (BD-501)	3117	514	1874	270
	BD -501 +PG	4323	592	3050	250
	Control	1214	127	834	153
	Mean	4916	768	3510	434
		Kharif	*Rabi*	*Kharif*	Rabi
		SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	269 1640	18 107	293 1780	6 37
	Method	276 813	16 49	282 833	21 63
	Cropping X Method	446 1827	28 117	467 NS	28 87
	Method X Cropping	390 1150	23 69	399 NS	30 89

Cropping system	Source of nutrient	Grain Yield		Straw Yield	
		Kharif	*Rabi*	*Kharif*	*Rabi*
Umiam 2B					
Maize+Soybean-Tomato	FYM	5281	18096	10539	2353
	VC	5086	16838	10238	2170
	FYM+VC	5542	17546	11898	2260
	Control	3011	6264	5208	916
	Mean	4730	14686	9471	1925
Maize+Soybean-Potato	FYM	5277	1938	9432	2280
	VC	5070	2097	10001	2493
	FYM+VC	5277	1891	9713	2277
	Control	2539	803	5477	997
	Mean	4541	1682	8656	2011
Maize+Soybean-Frenchbean	FYM	4704	20968	10270	4210
	VC	4460	20556	10140	3965
	FYM+VC	5102	22075	10417	4437
	Control	2406	17153	6145	2295
	Mean	4168	20188	9243	3727
		Kharif (GY)		*Rabi(GY)*		*Kharif (SY)*		*Rabi*	
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	170	NS	1006	3950	197	NS	149	583
	Method	96	287	408	1213	284	843	84	250
	Cropping X Method	223	NS	1178	4320	469	NS	194	NS
	Method X Cropping	167	NS	707	2101	492	NS	146	NS

Raipur: Two systems namely rice-chickpea and rice-mustard + lentil (alternate row) were evaluated with five combinations of nutrient sources. Though application of biodynamic practice + EC + CDM + NEOC @ 1/3 N each + panchagavya recorded higher yield of rice (4284 kg ha^{-1}) and chickpea (1208 kg ha^{-1}), it was at par with application of EC + CDM + NEOC @ 1/3 N each + panchagavya and EC + CDM + NEOC @ 1/3 N each alone in both the crops of rice-chickpea system. Similar trend was also observed with rice-mustard + lentil (alternate row system). In mustard, no significant difference in yield was observed among the various nutrient sources, even though biodynamic practice + EC + CDM + NEOC @ 1/3 N each + panchagavya recorded numerically higher yield of 1177 kg ha^{-1}. Lowest yield in all the crops were observed under biodynamic practice.

Calicut: Six treatments comprising of five different combinations of nutrient sources along with absolute control were evaluated in ginger and turmeric crops. In case of ginger, higher rhizome yield of 23525 kg ha^{-1} was observed with FYM + NC + 2VC + panchgvaya + biodynamic + RP which is 88.6% higher than absolute control and 17% higher than the next best combination (FYM + Biodynamic practices + RP). Significantly higher rhizome yield of turmeric was observed with FYM+ NC + 2VC + RP (32100 kg ha^{-1}) followed by FYM + BD + PG+ RP (27100 kg ha^{-1}) and FYM+NC+2VC+PG+BD+RP (26200 kg ha^{-1}). The yield increase with best nutrient source combination was found to be 79% over absolute control, 18.5% over FYM + BD + PG + RP and 22.5% over FYM+NC+2BC+PG+BD+RP. Among the different nutrient source combinations, lowest yield in both turmeric and ginger was observed with FYM + PG + RP.

Dharwad: Three systems namely groundnut-sorghum, maize-chickpea and chilli + onion were tested with six different combinations of organic inputs along with control. In all the cropping systems, performance of EC + VC + GLM + biodynamic spray @ 12 g/ha with panchagavya spray was found to be better, but it is on par with EC+ VC + GLM + panchagavya spray or EC + VC + GLM in most of the crops. Spray of panchagavya alone recorded lower yield in all the crops compared to EC+ VC + GLM. The yield increase in EC + VC + GLM + biodynamic + panchgavya spray was found to be 20.5,29.3,58.6 and 41.8% in groundnut, sorghum, maize and chickpea respectively over control. In case of chilli, EC+ VC + GLM + biodynamic spray @ 12g ha^{-1} registered higher yield of 931 kg ha^{-1} while in onion higher bulb yield was obtained with EC + VC + GLM + panchgavya spray (3498 kg ha^{-1}) compared to other treatments. Straw yield of all the crops have also followed the similar trend.

Karjat: Rice-red pumpkin and rice-cucumber systems have recorded higher yield with application of FYM + rice straw + *Gliricidia* @ 1/3rd each of N during *kharif* and FYM + neem cake + vermicompost @ 1/3 each of N during *rabi* along with spray of panchgavya (3927, 8530 kg ha^{-1} of rice-red pumpkin and 3757, 6038 kg ha^{-1} of rice-cucumber respectively). It was at par with application of nutrients through FYM, rice straw and gliricidia during *kharif* and FYM + neemcake and vermicompost during *rabi*. Application of either panchgavya alone or Biodynamic practices or its combination registered significantly lower yield in all the crops. The reduction in yield was found to be 11.1, 16.6 and 26.3% in rice, red pumpkin and cucumber with combination of panchgavya + biodynamic practices compared to organic sources + panchgavya.

Ludhiana: Two systems namely maize-wheat + gram-summer moong and basmati rice-wheat-green manure were evaluated with different organic sources and biodynamic practices. Application of FYM + panchgavya + biodynamic practices recorded higher grain yield of maize (6137 kg ha^{-1}), while in wheat FYM + PG alone recorded higher yield (2517 kg ha^{-1}). Application of only FYM was sufficient in summer moong to realize higher yield compared to combining FYM with panchgavya or biodynamic practices. In case of basmati rice, except control, all the organic sources *viz*., green manure alone or its combination with FYM, biodynamic practices or panchagavya recorded statistically at par yield. Wheat yield was significantly lower in biodynamic practices (1720 kg ha^{-1}) and control (1253 kg ha^{-1}) compared to application of FYM alone or with biodynamic and panchgavya practices. The yield increase due to biodynamic and panchgavya practices were not significant compared to FYM alone.

Bhopal: The yield increase due to biodynamic and panchgavya practices over organic manure alone was found to be not significant in soybean-wheat and maize-chickpea systems. However, combined application of OM+PG + BD registered higher yield in all crops and the yield increase was found to be 117, 1003, 387 and 140 kg ha^{-1} in soybean, wheat, maize and chickpea respectively. Application of biodynamic practices alone recorded only marginal increase in yield of all the crops over control. Straw yield of all the crops also indicated similar trend.

Pantnagar: Application of FYM + VC + NC + EC @ ¼ N each + BD + panchgavya recorded an increase in yield to the tune of 300 kg ha^{-1} in basmati rice compared to application of FYM + VC + NC + EC alone. However in case of chickpea, it was observed that all the treatments except biodynamic practices alone or control was at par. Significantly higher yield of 12445 kg ha^{-1} in frenchbean was recorded with FYM + VC +NC + EC @ ¼ N each + panchagavya compared to other treatments. Residues yield of the crops also responded similarly as that of economic yield.

Ranchi: Two systems namely rice-wheat and rice-potato were evaluated for its response to organic inputs in the form of vermicompost, biodynamic preparation, cow pat pit and panchagavya in various combinations. All the crops recorded higher yield with VC + KC + biodynamic peparration + panchagavya (2558, 2411 and 17200 kg ha^{-1} in rice, wheat, potato respectively) which was at par with without panchagavya in the same treatment. Lowest yield was obtained in all the crops under biodynamic preparation (CPP, BD 500 and 501) alone. The yield increase due to application of panchagavya and biodynamic preparation over and above. The effect of VC + KC @ ½ N each was found to very minimum in rice and wheat (1.38 and 2.6% with panchagavya and 6.1 and 7% with biodynamic preparations in rice and wheat respectively), however, the contribution of panchagavya and biodynamic preparation over and above VC + KC was found to be 45.8 and 46.4% in potato. The residues yield of all the crops have also recorded similar trend as that of economic yield.

Umiam: Two experiments were conducted with different combinations of cropping systems and organic inputs. In the first experiment, two systems namely maize + soybean (green manure) – toria and maize (green cob) + soybean (green manure) –frenchbean (green pod) were evaluated with biodynamic and panchgavya practices apart from vermicompost and FYM. Application of FYM + VC + panchagavya recorded numerically higher yield in maize for grain and green cobs (4153 and 9333 kg ha^{-1} respectively and frenchbean (1426 kg ha^{-1}), but the same was on par with application of FYM + VC alone. However, in case of toria, addition of panchagavya resulted in 75% yield increase over FYM + VC alone. Application of biodynamic preparation or panchagavya alone or its combination resulted in significantly lower yield in all the crops evaluated. In the other experiment, tomato, potato and frenchbean were evaluated as succeeding crop after maize + soybean with FYM and Vermicompost. The response of maize was found to be better with application of FYM + VC @ ½ N each as it recorded significantly higher grain yield compared to FYM or VC alone. In case of vegetable crops, differential response was observed. Though, higher yield of tomato was observed with FYM alone, its increase over FYM+ VC was only 3 %. Potato recorded higher yield under VC application and the increase over FYM was found to be 8.2%. In case of french bean, combined application of FYM + VC resulted in 5.3% increase in yield over FYM alone. The yield of residues also performed in similar manner.

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

Coimbatore: Organic carbon, available N, P, K and microbial count of fungi, bacteria and actinomycetes were analysed at the end of the cropping cycle. In cotton-maize-green manure system, application of FYM + NEOC @ ½ N each + panchagavya recorded higher OC (0.72%), available N (242 kg ha^{-1}), P (21.70 kg ha^{-1}) and K (742 kg ha^{-1}) while FYM + NEOC @ ½ N each was found to be better in chillies-sunflower-green manure system (0.67%, 247, 20.10 and 646 kg ha^{-1} of OC, N, P and K respectively). Among the two systems, cotton-maize-green manure recorded slightly better residual organic carbon and available soil nutrients. Fungi, bacteria and actinomycetes count was higher in FYM + NEOC @ ½ N each + panchagavya in both the systems. Application of panchagavya or biodynamic practices alone does not increase the microbial population compared to addition of the same with FYM + NEOC.

Maize crop under biodynamic farming practices at Coimbatore

Raipur: Bulk density of soil was found to be higher with biodynamic practice in both rice-chickpea and rice-mustard + lentil (alternate row) systems (1.28 and 1.32 g cc^{-1}). No significant variation among different input practices and cropping system was observed in soil pH and EC. However, organic carbon was found to be higher under EC + CDM + NEOC @ 1/3 N each + Panchagavya in rice-chickpea (0.65%)

Table 14. Influence of source of nutrients on physical and chemical properties of soils after the cropping cycle at various locations

Cropping system	Source of nutrient	Bulk density (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
Coimbatore								
Cotton - Maize - Sunhemp	FYM + NEOC* (1/2+1/2)	-	-	-	0.71	250	20.50	725
	Panchagavya alone	-	-	-	0.65	211	18.90	716
	FYM + NEOC* (1/2+1/2) + Panchagavya	-	-	-	0.72	242	21.70	742
	Biodynamic Practices	-	-	-	0.65	217	16.60	709
	Biodynamic Practices + Panchagavya	-	-	-	0.68	228	17.50	721
	Mean	-	-	-	0.68	230	19.04	723
Chillies - Sunflower - Sunhemp	FYM + NEOC* (1/2+1/2)	-	-	-	0.67	247	20.10	646
	Panchagavya alone	-	-	-	0.64	235	17.90	604
	FYM + NEOC* (1/2+1/2) + Panchagavya	-	-	-	0.66	242	19.57	638
	Biodynamic Practices	-	-	-	0.60	228	17.80	585
	Biodynamic Practices + Panchagavya	-	-	-	0.61	209	16.77	597
	Mean	-	-	-	0.64	232	18.43	614
					SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	-	-	-	0.00 0.02	1 NS	0.16 NS	4 24
	Method	-	-	-	0.00 0.01	4 11	0.38 1.14	9 28
	Cropping X Method	-	-	-	0.01 0.03	5 16	0.51 NS	12 NS
	Method X Cropping	-	-	-	0.01 0.02	5 15	0.54 NS	13 NS

Cropping system	Source of nutrient	Bulk density (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
Raipur								
Rice-Chickpea	EC+CDM+NEOC@ 1/3 each	1.25	7.39	0.26	0.63	215	12.53	272
	Bio dynamic practice	1.28	7.45	0.33	0.57	195	11.20	268
	EC+CDM+NEOC@ 1/3 each + Panchagavya	1.25	7.30	0.21	0.65	209	11.93	268
	NS4- EC+CDM+NEOC@ 1/3 each + Bio dynamic practice	1.24	7.34	0.27	0.64	210	11.80	280
	NS5- Bio dynamic practice + EC+CDM+NEOC@ 1/3 each + Panchagavya	1.22	7.28	0.21	0.63	213	13.27	272
	Mean	1.25	7.35	0.26	0.62	209	12.15	272
Rice- Mustard+lentil (alternate row)	EC+CDM+NEOC@ 1/3 each	1.25	7.37	0.27	0.61	205	11.21	268
	Bio dynamic practice	1.32	7.43	0.33	0.56	190	9.50	261
	EC+CDM+NEOC@ 1/3 each + Panchagavya	1.24	7.27	0.26	0.61	210	10.23	258
	NS4- EC+CDM+NEOC@ 1/3 each + Bio dynamic practice	1.25	7.34	0.26	0.63	200	11.93	265
	NS5- Bio dynamic practice + EC+CDM+NEOC@ 1/3 each + Panchagavya	1.23	7.38	0.28	0.62	206	11.57	268
	Mean	1.26	7.36	0.28	0.61	202	10.89	264
		SEm± CD	-	-	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	0.01 NS	-	-	0.00 NS	1 NS	0.46 NS	1 NS
	Method	0.01 0.03	-	-	0.01 0.03	6 NS	0.85 NS	6 NS
	Cropping X Method	0.01 NS	-	-	0.01 NS	7 NS	1.17 NS	7 NS
	Method X Cropping	0.01 NS	-	-	0.01 NS	8 NS	1.20 NS	8 NS

Cropping system	Source of nutrient	Bulk density (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
Calicut								
Ginger	FYM+BD+PG+RP	-	5.47	-	1.87	183	0.00	310
	FYM+PG+RP	-	5.40	-	1.87	222	0.00	364
	FYM+BD+RP	-	5.17	-	1.90	228	0.00	359
	FYM+NC+2VC+PG+BD+RP	-	5.20	-	1.90	238	0.00	331
	FYM+NC+2VC+RP	-	5.03	-	1.37	188	0.00	289
	Absolute control	-	4.90	-	1.50	237	0.00	238
	Mean	-	5.19	-	1.73	216	0.00	315
Turmeric	FYM+BD+PG+RP	-	-	-	1.80	151	33.41	167
	FYM+PG+RP	-	-	-	1.80	175	24.02	136
	FYM+BD+RP	-	-	-	1.87	140	30.65	152
	FYM+NC+2VC+PG+BD+RP	-	-	-	1.93	167	28.62	210
	FYM+NC+2VC+RP	-	-	-	1.93	168	31.39	256
	Absolute control	-	-	-	1.90	167	23.79	162
	Mean	-	-	-	1.87	161	28.64	180
					SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	-	-	-	0.01 0.06	1 3	0.60 2.72	1 6
	Method	-	-	-	0.04 0.10	5 14	1.51 NS	12 34
	Cropping X Method	-	-	-	0.05 0.14	6 19	2.04 NS	16 45
	Method X Cropping		-		0.05 0.14	7 20	2.14 NS	17 49

Cropping system	Source of nutrient	Bulk density (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
Dharwad								
Groundnut-Sorghum	EC+VC+GLM	1.23	7.22	0.18	0.59	273	28.93	361
	Panchagavya spray	1.27	7.37	0.15	0.55	259	28.10	354
	EC+VC+GLM+ Panchagavya spray	1.18	7.25	0.20	0.60	278	29.77	368
	EC+VC+GLM+ Biodynamic spray @5g/ac	1.27	7.27	0.17	0.50	251	28.03	347
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	1.24	7.33	0.16	0.58	261	28.53	356
	FYM+VC+GLM	1.22	7.35	0.19	0.58	264	28.33	358
	Control	1.28	7.39	0.17	0.52	251	25.57	331
	Mean	1.24	7.31	0.17	0.56	263	28.18	354
Maize-Chickpea	EC+VC+GLM	1.21	7.25	0.16	0.59	270	29.47	361
	Panchagavya spray	1.28	7.32	0.17	0.55	263	28.40	346
	EC+VC+GLM+ Panchagavya spray	1.20	7.21	0.18	0.61	276	30.63	366
	EC+VC+GLM+ Biodynamic spray @5g/ac	1.28	7.31	0.19	0.55	261	27.70	340
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	1.26	7.33	0.18	0.59	266	28.30	355
	FYM+VC+GLM	1.24	7.25	0.18	0.54	268	28.70	356
	Control	1.29	7.40	0.16	0.52	248	26.73	324
	Mean	1.25	7.30	0.17	0.56	265	28.56	349
Chilli+onion	EC+VC+GLM	0.20	7.28	0.19	0.61	271	29.20	366
	Panchagavya spray	0.24	7.35	0.17	0.55	262	27.97	357
	EC+VC+GLM+ Panchagavya spray	0.19	7.24	0.19	0.61	276	29.83	369

Cropping system	Source of nutrient	Bulk density (g/cc)		pH	EC (dS/m)	OC (%)		N (kg/ha)		P (kg/ha)		K (kg/ha)	
	EC+VC+GLM+ Biodynamic spray @5g/ac	0.25		7.34	0.15	0.52		262		27.17		352	
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	0.24		7.31	0.18	0.56		264		28.30		360	
	FYM+VC+GLM	0.22		7.32	0.16	0.68		269		29.10		364	
	Control	0.29		7.38	0.18	0.49		246		25.00		334	
	Mean	0.23		7.32	0.17	0.57		264		28.08		358	
		SEm±	CD	-	-	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	0.01	0.06	-	-	0.01	NS	4	NS	0.14	NS	1	5
	Method	0.01	0.04	-	-	0.02	0.04	4	9	0.45	1.27	4	12
	Cropping X Method	0.03	NS	-	-	0.03	NS	6	NS	0.72	NS	6	NS
	Method X Cropping	0.02	NS	-	-	0.03	NS	6	NS	0.76	NS	7	NS
Karjat													
Rice- Red pumpkin	Kh. FYM + rice straw + glyricidia @1/3rd N each Rb. FYM+NC +VC @1/3rd N each			6.79	0.39	1.19		238		29.02		350	
	Panchagavya alone			6.69	0.35	1.18		226		27.59		328	
	Kh. FYM + rice straw + glyricidia @1/3rd N each Rb. FYM+ NC +VC @1/3rd N each + Panchagavya			6.77	0.38	1.20		242		29.32		350	
	Biodynamic practices			6.69	0.41	1.17		217		27.63		331	
	Panchagavya + Biodynamic practices			6.78	0.41	1.17		226		28.22		332	
	Mean			6.74	0.39	1.18		230		28.36		338	
Rice- Cucumber	Kh. FYM + rice straw + *glyricidia* @1/3rd N each Rb. FYM+NC +VC @1/3rd N each			6.77	0.30	1.19		229		28.42		345	

Cropping system	Source of nutrient		Bulk density (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
	Panchagavya alone		-	6.56	0.27	1.16	210	29.11	329
	Kh. FYM + rice straw + glyricidia @1/3rd N each Rb. FYM+NC +VC @1/3rd N each + Panchagavya		-	6.66	0.28	1.21	238	28.32	350
	Biodynamic practices		-	6.64	0.25	1.17	209	27.43	323
	Panchagavya + Biodynamic practices		-	6.58	0.28	1.16	222	28.30	319
	Mean		-	6.64	0.28	1.18	222	28.31	333
						SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping		-	-	-	0.01 NS	7 NS	0.13 NS	11 NS
	Method		-	-	-	0.01 0.02	6 NS	0.27 0.80	7 NS
	Cropping X Method		-	-	-	0.01 NS	11 NS	0.36 1.22	14 NS
	Method X Cropping		-	-	-	0.01 NS	9 NS	0.37 1.13	11 NS
Ludhiana									
Maize-Wheat+ Gram-S.moong	B.Rice	Other crops							
	GM	FYM	-	7.49	0.26	0.62	341	62.37	185
	GM+PG	FYM+PG	-	7.48	0.25	0.61	339	70.07	155
	GM+BD	BD	-	7.54	0.25	0.61	356	62.27	179
	GM+BD+FYM	FYM+BD	-	7.54	0.24	0.61	368	60.37	171
	GM+PG+BD	FYM+PG+BD	-	7.54	0.32	0.61	338	70.73	180
	Control	Control	-	7.53	0.21	0.40	265	36.20	103
	Mean		-	7.52	0.25	0.58	335	60.33	162

Cropping system	Source of nutrient		Bulk density (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
B.Rice- Wheat-Greenmanure(GM)	FYM	GM	-	7.52	0.28	0.61	327	66.37	182
B.Rice- Wheat-	GM+PG	FYM+PG	-	7.63	0.28	0.66	324	48.63	178
	GM+BD	BD	-	7.72	0.30	0.60	321	48.73	166
	GM+BD+FYM	FYM+BD	-	7.67	0.29	0.61	306	60.87	179
	GM+PG+BD	FYM+PG+BD	-	7.55	0.28	0.60	309	51.87	166
	Control	Control	-	7.78	0.26	0.43	205	46.53	82
	Mean		-	7.64	0.28	0.58	299	53.83	159
						SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping		-	-	-	0.00 NS	11 NS	0.32 NS	3 NS
	Method		-	-	-	0.01 0.05	11 31	3.89 17.73	8 22
	Cropping X Method		-	-	-	0.02 NS	18 NS	7.77 NS	11 NS
	Method X Cropping		-	-	-	0.02 NS	15 NS	8.50 NS	11 NS
Bajaura									
Tomato-Coriander-Pea	Rock phosphate enriched FYM + VC (1:1)		-	5.33	-	0.81	181	47.30	186
	FYM *fb* BD		-	5.43	-	0.84	192	44.63	181
	Rock phosphate enriched FYM + VC (1:1) *fb* Panchagvya		-	5.30	-	0.81	187	43.40	177
	FYM *fb* BD *fb* Panchagvya		-	5.37	-	0.81	188	43.97	182
	Control		-	5.27	-	0.71	120	29.37	110
	Control with Panchagavya		-	5.23	-	0.71	120	29.67	108
	Mean		-	5.32	-	0.78	165	39.72	157

Cropping system	Source of nutrient	Bulk density (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
Cauliflower-Cauliflower-Pea	Rock phosphate enriched FYM + VC (1:1)	-	5.33	-	0.81	178	47.77	195
	FYM *fb* BD	-	5.43	-	0.83	190	42.53	193
	Rock phosphate enriched FYM + VC (1:1) *fb* Panchagvya	-	5.30	-	0.81	185	44.43	175
	FYM *fb* BD *fb* Panchagvya	-	5.30	-	0.80	182	40.23	174
	Control	-	5.30	-	0.96	110	31.67	130
	Control with Panchagavya	-	5.17	-	0.69	115	31.60	131
	Mean	-	5.31	-	0.77	160	39.70	166
					SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	-	-	-	0.00 0.01	1 NS	0.28 NS	1 5
	Method	-	-	-	0.01 0.03	2 5	1.05 3.08	1 5
	Cropping X Method	-	-	-	0.01 NS	3 NS	1.38 NS	2 8
	Method X Cropping	-	-	-	0.01 NS	3 NS	1.48 NS	2 6
Pantnagar								
Basmati rice – Chickpea – *Sesbania*	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)	-	-	-	1.02	393	31.10	293
	Biodynamic (BD)	-	-	-	0.86	307	23.10	256
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+Panchgavya	-	-	-	1.04	367	27.75	269
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD	-	-	-	1.02	339	25.77	268
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+Panchgavya	-	-	-	1.05	375	31.97	238
	Control	-	-	-	0.91	303	21.23	214

Cropping system	Source of nutrient	Bulk density (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
	Mean	-	-	-	0.98	347	26.82	256
Basmati rice–Vegetable pea – Maize +Moong (moong residues incoporation)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)	-	-	-	0.96	355	33.50	208
	Biodynamic (BD)	-	-	-	0.85	288	23.53	178
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+Panchgavya	-	-	-	0.96	375	33.50	206
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD	-	-	-	0.97	350	33.40	208
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+Panchgavya	-	-	-	0.96	360	34.33	208
	Control	-	-	-	0.83	279	23.67	181
	Mean	-	-	-	0.92	334	30.32	198
					SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	-	-	-	0.00 0.02	2 NS	0.22 1.34	1 7
	Method	-	-	-	0.02 0.06	4 12	0.82 2.43	4 13
	Cropping X Method	-	-	-	0.03 NS	6 21	1.08 NS	6 17
	Method X Cropping	-	-	-	0.03 NS	6 18	1.17 NS	6 18
Umiam 2A								
Maize + Soybean (GM) - Toria	FYM+VC	1.10	5.07	-	2.29	234	22.51	230
	Panchagavya(PG)	1.12	5.01	-	1.73	202	17.27	197
	FYM+VC+PG	1.09	5.17	-	2.39	237	23.20	235
	Biodynamic formulation(BD-501)	1.14	5.10	-	2.09	212	20.50	218
	BD -501 +PG	1.12	5.03	-	1.95	213	14.02	212

Cropping system	Source of nutrient	Bulk density (g/cc)	pH	EC (dS/m)	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)
	Control	1.15	4.94	-	1.71	195	13.41	198
	Mean	1.12	5.05	-	2.03	215	18.48	215
Maize (green cob) + Soybean (GM) - Frenchbean (Green pod)	FYM+VC	1.13	5.07	-	2.31	238	24.02	233
	Panchagavya(PG)	1.15	5.01	-	1.69	209	18.84	204
	FYM+VC+PG	1.12	5.22	-	2.40	241	26.50	238
	Biodynamic Formulation(BD-501)	1.16	5.10	-	2.11	210	21.13	217
	BD -501 +PG	1.17	5.02	-	2.06	217	16.06	220
	Control	1.19	4.88	-	1.74	198	14.84	198
	Mean	1.15	5.05	-	2.05	219	20.23	218
		SEm± CD	-	-	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	Cropping	0.02 NS	-	-	0.03 NS	1 NS	0.21 1.30	3 NS
	Method	0.02 NS	-	-	0.06 0.18	1 5	0.75 2.22	2 7
	Cropping X Method	0.03 NS	-	-	0.08 NS	3 NS	1.00 NS	4 NS
	Method X Cropping	0.03 NS	-	-	0.08 NS	3 NS	1.06 NS	4 NS
Umiam 2B								
Maize+ Soybean-Tomato	FYM	1.15	5.07	-	2.27	245	30.17	244
	VC	1.10	5.12	-	2.20	232	28.72	240
	FYM+VC	1.07	5.07	-	2.39	242	30.31	245
	Control	1.13	4.80	-	1.98	200	20.71	220
	Mean	1.11	5.01	-	2.21	230	27.48	237
Maize+Soybean-Potato	FYM	1.11	5.02	-	2.35	243	30.02	246

Cropping system	Source of nutrient	Bulk density (g/cc)		pH	EC (dS/m)	OC (%)		N (kg/ha)		P (kg/ha)		K (kg/ha)	
	VC	1.07		5.03	-	2.31		233		28.32		240	
	FYM+VC	1.08		5.07	-	2.13		237		31.28		250	
	Control	1.17		4.72	-	1.90		200		21.01		223	
	Mean	1.10		4.96	-	2.17		228		27.66		240	
Maize+Soybean-Frenchbean	FYM	1.15		5.15	-	2.29		252		30.19		246	
	VC	1.10		5.05	-	2.25		237		29.11		241	
	FYM+VC	1.13		5.13	-	2.46		244		32.13		255	
	Control	1.15		4.74	-	1.91		208		20.97		224	
	Mean	1.13		5.02	-	2.23		235		28.10		242	
		SEm±	CD	-	-	SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	0.01	NS	-	-	0.03	NS	4	NS	0.99	NS	1	NS
	Method	0.01	0.04	-	-	0.05	0.15	4	11	0.84	2.51	1	5
	Cropping X Method	0.03	NS	-	-	0.08	NS	7	NS	1.61	NS	3	NS
	Method X Cropping	0.03	NS	-	-	0.08	NS	6	NS	1.46	NS	3	NS

Table 15. 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

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Fungi	Bacteria	Actinomy-cetes
Coimbatore								
Cotton - Maize - Sunhemp	FYM + NEOC* (1/2+1/2)	-	-	-	-	21.87	116	36.50
	Panchagavya alone	-	-	-	-	19.77	101	32.00
	FYM+NEOC* (1/2+1/2)+ Panchagavya	-	-	-	-	22.37	121	38.57
	Biodynamic Practices	-	-	-	-	19.47	105	31.50
	Biodynamic Practices + Panchagavya	-	-	-	-	22.17	105	32.77
	Mean	-	-	-	-	21.13	110	34.27
Chillies - Sunflower - Sunhemp	FYM + NEOC* (1/2+1/2)	-	-	-	-	21.87	117	35.57
	Panchagavya alone	-	-	-	-	19.77	99	33.47
	FYM+NEOC* (1/2+1/2)+ Panchagavya	-	-	-	-	22.37	118	39.30
	Biodynamic Practices	-	-	-	-	19.47	98	32.97
	Biodynamic Practices + Panchagavya	-	-	-	-	22.17	101	34.97
	Mean	-	-	-	-	21.13	107	35.25
							SEm± CD	SEm± CD
	Cropping	-	-	-	-	-	2 NS	0.54 NS
	Method	-	-	-	-	-	2 6	0.81 2.41
	Cropping X Method	-	-	-	-	-	3 NS	1.15 NS
	Method X Cropping	-	-	-	-	-	3 NS	1.14 NS

Cropping system	Source of nutrient	Mn		Zn		Cu		Fe		Fungi	Bacteria	Actinomy-cetes
Calicut												
Ginger	FYM+BD+PG+RP	4.80		1.20		16.60		28.33		-	-	-
	FYM+PG+RP	6.60		1.53		16.00		27.33		-	-	-
	FYM+BD+RP	7.80		1.57		16.20		28.60		-	-	-
	FYM+NC+2VC+PG+BD+RP	7.47		1.33		16.40		32.67		-	-	-
	FYM+NC+2VC+RP	7.60		1.33		16.00		29.53		-	-	-
	ABSOLUTE CONTROL	10.47		1.13		16.00		30.40		-	-	-
	Mean	7.45		1.35		16.20		29.48		-	-	-
Turmeric	FYM+BD+PG+RP	13.00		1.58		10.86		32.80		-	-	-
	FYM+PG+RP	14.09		1.29		10.39		32.49		-	-	-
	FYM+BD+RP	9.49		1.37		12.36		34.86		-	-	-
	FYM+NC+2VC+PG+BD+RP	12.10		2.15		12.53		35.27		-	-	-
	FYM+NC+2VC+RP	2.17		0.72		6.11		13.47		-	-	-
	ABSOLUTE CONTROL	1.61		0.60		5.90		13.55		-	-	-
	Mean	8.74		1.28		9.69		27.07		-	-	-
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD			
	Cropping	0.20	0.88	0.08	NS	0.25	1.14	0.76	NS	-	-	-
	Method	0.73	2.11	0.11	0.35	0.17	0.48	0.93	2.67	-	-	-
	Cropping X Method	0.96	2.85	0.17	0.33	0.33	1.27	1.41	4.74	-	-	-
	Method X Cropping	1.03	2.99	0.16	0.54	0.24	0.69	1.31	3.78	-	-	-
Dharwad												
Groundnut-Sorghum	EC+VC+GLM	11.63		0.86		1.43		9.40		11.67	66.33	40.33
	Panchagavya spray	9.85		0.77		1.21		8.58		18.00	59.00	31.67

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Fungi	Bacteria	Actinomy-cetes
	EC+VC+GLM + Panchagavya spray	11.74	0.89	1.46	9.94	14.33	76.00	39.00
	EC+VC+GLM+ Biodynamicspray @5g/ac	9.52	0.72	1.16	8.35	15.67	86.67	43.33
	EC+VC+GLM+ Biodynamicspray @5g/ac+ Panchagavya spray	10.10	0.81	1.26	8.70	20.67	72.67	37.33
	FYM+VC+GLM	10.53	0.84	1.31	9.00	25.00	77.67	36.00
	Control	9.35	0.57	1.10	7.25	10.67	54.67	28.67
	Mean	10.39	0.78	1.27	8.75	16.57	70.43	36.62
Maize-Chickpea	EC+VC+GLM	11.43	0.76	1.29	8.97	18.33	69.00	28.67
	Panchagavya spray	9.92	0.72	1.21	7.84	21.67	61.67	30.67
	EC+VC+GLM + Panchagavya spray	11.52	0.83	1.39	9.49	20.33	82.33	32.00
	EC+VC+GLM+ Biodynamicspray @5g/ac	9.38	0.61	1.16	7.63	23.00	89.67	34.33
	EC+VC+GLM+ Biodynamicspray @5g/ac+ Panchagavya spray	10.60	0.59	1.23	8.64	16.67	70.00	33.33
	FYM+VC+GLM	10.65	0.69	1.26	8.90	27.00	77.00	32.00
	Control	8.74	0.62	1.08	7.18	14.33	61.33	22.33
	Mean	10.32	0.69	1.23	8.38	20.19	73.00	30.48
Chilli+onion	EC+VC+GLM	10.57	0.82	1.36	9.07	19.00	49.33	31.67
	Panchagavya spray	10.40	0.73	1.22	8.32	23.33	44.33	33.67
	EC+VC+GLM + Panchagavya spray	11.78	0.86	1.40	9.25	20.00	57.67	39.33
	EC+VC+GLM+ Biodynamicspray @5g/ac	9.92	0.74	1.21	7.84	27.00	67.67	49.00

Cropping system	Source of nutrient	Mn	Zn	Cu	Fe	Fungi		Bacteria		Actinomy-cetes	
	EC+VC+GLM+ Biodynamicspray @5g/ac+ Panchagavya spray	10.47	0.77	1.26	8.39	26.00		56.00		35.33	
	FYM+VC+GLM	10.73	0.78	1.28	8.65	24.67		45.67		40.33	
	Control	9.40	0.56	1.06	7.31	14.67		34.67		29.67	
	Mean	10.47	0.75	1.26	8.40	22.09		50.76		37.00	
						SEm±	CD	SEm±	CD	SEm±	CD
	Cropping	-	-	-	-	0.59	2.30	0.35	1.40	0.66	2.62
	Method	-	-	-	-	1.07	3.08	1.39	3.97	1.40	4.01
	Cropping X Method	-	-	-	-	1.82	5.42	2.25	6.51	2.34	NS
	Method X Cropping	-	-	-	-	1.86	5.34	2.40	6.87	2.43	NS
Bajaura											
Tomato-Coriander-Pea	Rock phosphate enriched FYM + VC (1:1)	31.43	2.14	1.78	77.43	-		-		-	
	FYM fb BD	29.40	1.90	1.75	72.10	-		-		-	
	Rockphosphate enriched FYM + VC (1:1) fb Panchagvya	30.10	1.90	1.78	72.53	-		-		-	
	FYM fb BD fb Panchagvya	27.30	2.03	1.72	74.90	-		-		-	
	Control	19.33	0.65	0.79	35.70	-		-		-	
	Controlwith Panchagavya	19.47	0.64	0.80	35.87	-		-		-	
	Mean	26.17	1.54	1.44	61.42	-		-		-	
Cauliflower-Cauliflower-Pea	Rock phosphate enriched FYM + VC (1:1)	32.67	2.07	1.78	76.40	-		-		-	
	FYM fb BD	30.40	2.00	1.71	72.13	-		-		-	

Cropping system	Source of nutrient	Mn		Zn		Cu		Fe		Fungi	Bacteria	Actinomy-cetes
	Rockphosphate enriched FYM + VC (1:1) fb Panchagvya	29.67		1.90		1.71		70.47		-	-	-
	FYM fb BD fb Panchagvya	27.50		2.00		1.74		74.93		-	-	-
	Control	19.83		0.69		0.71		41.87		-	-	-
	Controlwith Panchagavya	19.50		0.68		0.70		42.23		-	-	-
	Mean	26.59		1.56		1.392		63.00		-	-	-
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD			
	Cropping	0.84	NS	0.02	NS	0.02	NS	0.91	NS	-	-	-
	Method	0.51	1.49	0.03	0.09	0.01	0.04	0.59	1.75	-	-	-
	Cropping X Method	1.07	NS	0.05	NS	0.03	NS	1.18	5.66	-	-	-
	Method X Cropping	0.71	NS	0.04	NS	0.02	NS	0.83	2.47	-	-	-
Pantnagar												
Basmati rice – Chickpea – Sesbania (green manure)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)	6.37		0.68		1.16		33.22		-	-	-
	Biodynamic (BD)	3.88		0.61		0.74		28.26		-	-	-
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+Panchgavya	6.54		0.65		1.11		33.27		-	-	-
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD	5.87		0.95		1.08		32.51		-	-	-
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+ Panchgavya	7.04		0.63		0.82		32.84		-	-	-
	Control	4.06		0.77		1.07		28.57		-	-	-
	Mean	5.63		0.72		1.00		31.44		-	-	-

Cropping system	Source of nutrient	Mn		Zn		Cu		Fe		Fungi	Bacteria	Actinomy-cetes
Basmati rice – Vegetable pea – Maize +Moong (moong residues incoporation)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)	8.37		1.45		0.89		31.23		-	-	-
	Biodynamic (BD)	4.21		0.66		0.66		33.76		-	-	-
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ Panchgavya	5.61		0.85		0.74		31.89		-	-	-
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD	6.17		0.82		0.60		35.07		-	-	-
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+ Panchgavya	6.16		0.84		0.81		33.92		-	-	-
	Control	4.54		0.64		0.75		32.81		-	-	-
	Mean	5.84		0.88		0.74		33.11		-	-	-
		SEm±	CD	SEm±	CD	SEm±	CD	SEm±	CD			
	Cropping	0.00	0.01	0.01	0.04	0.02	0.13	0.42	NS	-	-	-
	Method	0.21	0.62	0.01	0.04	0.04	0.11	0.62	1.82	-	-	-
	Cropping X Method	0.27	0.80	0.01	0.06	0.06	0.19	0.90	3.25	-	-	-
	Method X Cropping	0.30	0.88	0.02	0.05	0.06	0.16	0.87	2.57	-	-	-

and EC + CDM + NEOC@ 1/3 N each + biodynamic practice in rice-mustard + lentil (0.63%) system. Soil available N, P, K was not significantly influenced either by different input practices or cropping systems.

Calicut: Soil pH, OC, available N, P, K, Mn, Zn, Cu and Fe were estimated at the end of the cropping period of ginger and turmeric. No significant change was observed for pH of both the crops and available P of turmeric due to application of various organic input practices. FYM + BD + RP and FYM + NC + 2VC +PG + BD + RP recorded higher OC and available N in ginger, (1.90%) and turmeric (1.93%). Soil available N was found to be higher in the same treatment for ginger, while in turmeric, it was better in FYM + PG + RP. Higher residual K was recorded with FYM + NC + 2VC + RP (256 kg ha^{-1}) in turmeric. Among the two crops, organic carbon content was found to be higher in turmeric (1.87%) compared to ginger (1.73%). In ginger, application of different input practices did not contribute for improvement in soil available micronutrients such as Mn, Zn, Cu and Fe as it is evident that control recorded higher availability of these nutrients at the end of cropping period. However, in case of turmeric, FYM + PG + RP registered higher Mn (14.09 ppm) while Zn, Cu, and Fe was higher under FYM + NC + 2VC + PG + BD + RP (2.15, 12.53 and 35.27 ppm respectively).The improvement over control was found to be 258, 112 and 160% for Zn, Cu and Fe respectively with the combined application of all the inputs.

Dharwad: All the physical and chemical properties of soil along with microbial count was estimated at the end of cropping cycle. Higher bulk density was observed with either panchagavya spray or biodynamic spray @ 12 g ha^{-1} in all the cropping systems. Soil pH and EC did not vary much due to application different sources of nutrients. Groundnut-sorghum, maize-chickpea and chilli + onion systems recorded higher organic carbon, available N, P and K with application of EC + VC + GLM @ 1/3 N each + panchagavya spray compared to other practices. Among the panchagavya and biodynamic practice, combining panchagavya with organic inputs such as EC + VC + GLM was found to be more effective in terms of soil health. Among the three systems, chilli + onion recorded better residual organic carbon and nutrients. All the micronutrients estimated also exhibited similar trend as that of macro nutrients by recording higher residual availability with EC + VC + GLM @ 1/3 N each + panchagavya spray. However, irrespective of the cropping systems, microbial count such as fungi, bacteria and actinomycetes was higher in all the treatments which received biodynamic spray. Among the cropping systems, fungi and actionmyceteswas was higher in chilli + onion (22.9 and 37x10^4 CFU/g of soil) while bacteria was higher in maize-chickpea (73x10^4 cfu/g of soil) systems. In chilli + onion systems, the increase in fungi bacteria and actinomycetes due to EC + VC+ GLM + biodynamic spray @12 g/ha^{-1} was found to be 84, 95 and 65% respectively over control. The difference in the count of fungi, bacteria and actinomycetes between panchagavya and biodynamic was found to be 35, 17.3 and 24.5% respectively in the same system.

Maize in maize-chick pea system with combination of inputs at Dharwad

Chickpea in maize-chickpea system at Dharwad

Karjat: Soil pH, EC, OC, available N, P and K were estimated and results reveals that different sources of nutrients did not significantly influence the soil pH, EC, available N and K. however, in both rice-red

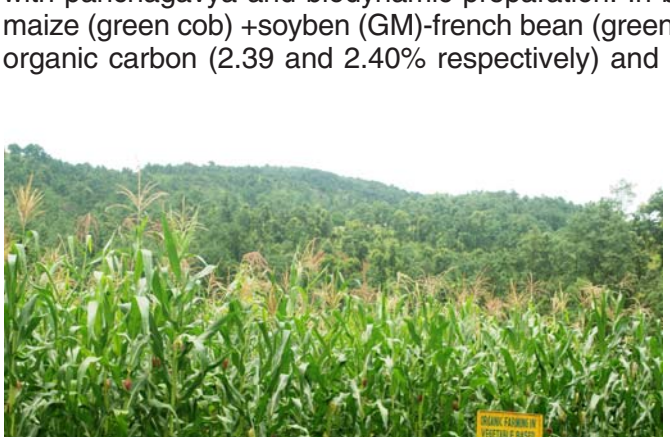
pumpkin and rice-cucumber systems, application of FYM + rice straw + *glyricidia* leaves @ 1/3 N each during *kharif* and FYM + NC + VC @ 1/3 N each during *rabi* with pachagavya during both the seasons recorded higher organic carbon (1.20 and 1.21% respectively) and residual soil P (29.32 and 28.32 kg ha^{-1} respectively). Among the two systems also, no significant change in OC, available N, P and K was observed.

Ludhiana: Soil pH and EC did not vary significantly with different nutrient sources while organic carbon, soil available N, P and K was highly influenced. In maize-wheat + gram-moong (s), application of FYM + BD recorded 55% increase in organic carbon, 38.8% in available N while FYM + PG+ BD recorded 95% increase in available P compared to control. Application of FYM alone recorded higher availability of residual soil K (79%) over control. In basmati rice-wheat-green manure system, an increase of 53 and 58% was observed in organic carbon and available N respectively with application of GM+ PG to rice and FYM + PG to other crops in the system compared to control. Significantly higher residual P (30.8% increase) and K (118% increase) was observed with application of GM+ PG + BD to basmati rice and FYM + PG + BD to other crops in the same system.

Bajaura: Soil pH did not vary among various nutrient sources. Soil organic carbon was found to be higher (0.84%) in FYM + BD in tomato-corinder-pea, system while in cauliflower-cauliflower-pea, it was observed to be higher in control (0.96%). The increase of OC in tomato-corinder-pea was found to be 18.7% over control. Higher available N, P and K was also observed under FYM + BD in the same system. Application of rock phosphate enriched FYM + VC (1:1)+panchagavya recorded higher residual soil P(44.4 Kg ha^{-1}) in cauliflower-cauliflower-pea system. In both the systems,residual availability of Mn,Zn,Cu and Fe was found to be significantly higher with rockphosphate enriched FYM+VC @ ½ N each compared to application of same with panchagavya or biodynamic preparation and FYM. On an average, the increase in availability of micronutrients was found to be more than 50% in both the systems compared to control.

Pantnagar: Marginal increase of organic carbon (5-6%) was observed with FYM + VC + NC + EC @ ¼ N each + panchagavya in basmati rice-chickpea-*sesbania* and same nutrient sources with biodynamic spray in basmati rice-vegetable pea-maize+moong (residues incorporation) system. Available N, P and K was also found to be higher under the same treatments in both the systems. Micronutrients such as Mn, Zn and Cu were found to be 84,26 and 19% higher in FYM + VC +NC + EC @ ¼ N each than control in basmati rice-vegetable pea-maize + moong (residues incorporation). Application of panchagavya or biodynamic preparation had only marginal influence on the soil available micronutrients.

Umiam: Bulk density and soil pH was not significantly influenced by application of nutrient sources along with panchagavya and biodynamic preparation. In both the systems (maize + soybean (GM) –toria and maize (green cob) +soyben (GM)-french bean (green pod)), application of FYM+ VC + PG recorded higher organic carbon (2.39 and 2.40% respectively) and higher available nutrients after the harvest of crops.



Organic farming in vegetable based systems at Umiam

Exposure visit of farmes in Maize + soybean intercropping in vegetables based system at Umiam

Panchagavya spray and biodynamic application did increase the OC and nutrients compared to control, but the increase was lower than the combined application of nutrient inputs with panchagavya and biodynamic practices. In the another experiment, FYM + VC @ ½ N each was found to be better for increasing higher OC and nutrients over control for maize+ soybean-tomato and maize + soybean-french bean systems, while, application of FYM alone was sufficient for maize+ soybean-potato system as it recorded higher OC and residual N, P and K. The increase in OC was found to be 23.6% over control in the system involving potato.

Nutrient uptake (Table 16-18)

Raipur: Uptake of NPK was significantly influenced by nutrient sources in rice -chickpea and rice-mustard + lentil systems. Application of EC + CDM + NEOC @ 1/3 N each + biodynamic spray + panchagavya registered significantly higher N, P and K uptake in all the crops in both the systems (75.8, 14.9 and 125 kg ha^{-1} in rice, 59.2, 15.2 and 26.2 kg ha^{-1} in chickpea and 54.5, 8.4 and 63.1 kg ha^{-1} in mustard). Application of biodynamic and panchagavya practices contributed significantly in nutrient uptake compared to application of nutrients sources in rice with EC+ CDM + NEOC alone.

Karjat: Application of FYM + rice straw + *gliricidia* leaves @ 1/3 N each during *kharif* and FYM + NC + VC @ 1/3 N each during *rabi* with panchagavya spray recorded higher NPK uptake in rice-red pumpkin and rice-cucumber systems. The increase in N uptake over panchagavya and biodynamic practices alone was found to be 32 and 34% in rice, 58 and 55% in red pumpkin, 77 and 69% in cucumber respectively. Combined application of panchagavya and biodynamic preparation was better in enhancing NPK uptake compared to its stand-alone application.

Ludhiana: Estimation of NPK uptake in basmati rice indicates, an increase of 14.7% in N uptake with GM+ PG to basmati rice and FYM + PG to other crops, while GM + PG to basmati rice and FYM + PG + BD to other crops recorded higher P uptake (24.8% increase). The K uptake was found to be better with all the combination of nutrient sources and panchagavya + biodynamic compared to control.

Bajaura: Both tomato-coriander-pea and cauliflower-cauliflower-pea system recorded higher NPK concentration in plants with rock phosphate enriched FYM + VC @ ½ N each as nutrient sources. Application of Panchagavya or biodynamic preparation also improved the concentration of NPK in all the crops compared to control. No significant improvement in panchagavya alone was observed with respect to uptake of all the nutrients compared to control. Fe, Mn, Zn and Cu concentration in plants of tomato, coriander, pea and cauliflower in the respective system have also been found higher with FYM + VC @ ½ N each compared to other sources. The increase in Fe concentration was found to be 23.2, 9.1, 48.3 and 47.8% in tomato, coriander, pea and cauliflower respectively.

Pantnagar: In both the systems, NPK uptake of basmati rice was found to be significantly higher with FYM + VC + NC + EC @ ¼ N each + biodynamic preparation + panchagavya application (70.3, 17.1 and 81.2 kg ha^{-1} of N, P, K uptake respectively) compared to FYM + VC + NC + EC alone (57.6, 13.1 and 70.2 kg ha^{-1} of NPK uptake respectively). In chickpea, application of FYM, VC, NC and EC as nutrient sources along with biodynamic preparation alone recorded higher N uptake (108.2 kg ha^{-1}) while P uptake was found to be higher under organic sources + panchagavya + biodynamic preparation. K uptake in chickpea was found to be higher with application of nutrient sources alone (40.8 kg ha^{-1}) compared to combining the same with either panchagavya or biodynamic preparation.

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

Cropping systems	Treatments	N				P				K			
		Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean
Bajaura (%)													
Tomato-Coriander-Pea	Rock phosphate enriched FYM + VC (1:1)	0.76	3.92	1.30	1.99	0.35	0.57	0.41	0.44	0.56	0.78	1.28	0.87
	FYM fb BD	0.72	3.46	1.20	1.79	0.33	0.47	0.34	0.38	0.53	0.69	1.18	0.80
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya	0.71	3.50	1.21	1.81	0.32	0.45	0.35	0.37	0.53	0.67	1.18	0.79
	FYM fb BDfb Panchagvya	0.70	3.43	3.02	2.38	0.31	0.43	0.37	0.37	0.51	0.66	1.19	0.79
	Control	0.65	3.29	0.93	1.62	0.29	0.38	0.30	0.32	0.50	0.61	1.00	0.70
	Control with Panchagavya	0.65	3.29	0.94	1.63	0.29	0.38	0.30	0.32	0.50	0.61	1.00	0.70
	Mean	0.70	3.48	1.43		0.32	0.45	0.35		0.52	0.67	1.14	
Cauliflower-Cauliflower-Pea	Rock phosphate enriched FYM + VC (1:1)	1.65	3.55	1.32	2.17	0.42	0.56	0.57	0.52	0.65	0.77	1.16	0.86
	FYM fb BD	1.59	3.45	1.23	2.09	0.39	0.43	0.50	0.44	0.63	0.69	1.07	0.80
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya	1.61	3.36	1.23	2.07	0.38	0.42	0.51	0.44	0.61	0.70	1.05	0.79
	FYM fb BDfb Panchagvya	1.59	3.44	1.29	2.11	0.37	0.42	0.52	0.44	0.61	0.67	1.08	0.79
	Control	1.48	3.34	1.01	1.94	0.34	0.36	0.42	0.37	0.58	0.64	0.86	0.69
	Control with Panchagavya	1.48	3.33	1.00	1.94	0.33	0.35	0.43	0.37	0.57	0.62	0.87	0.69
	Mean	1.57	3.41	1.18		0.37	0.42	0.49		0.61	0.68	1.02	
		SEm CD	SEm CD	SEm CD		SEm CD	SEm CD	SEm CD		SEm CD	SEm CD	SEm CD	
	Cropping	0.01 0.03	0.05 NS	0.21 NS		0.00 0.02	0.01 NS	0.01 0.05		0.00 0.02	0.01 NS	0.00 0.02	

Cropping systems	Treatments	N				P				K			
		Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean
	Method	0.01 0.03	0.08 0.23	0.37 NS		0.01 0.02	0.01 0.04	0.01 0.02		0.01 0.01	0.01 0.03	0.01 0.03	
	Cropping X Method	0.01 0.04	0.11 NS	0.53 NS		0.01 NS	0.01 NS	0.01 0.05		0.01 NS	0.02 NS	0.01 NS	
	Method X Cropping	0.01 0.04	0.11 NS	0.53 NS		0.01 NS	0.02 NS	0.01 0.03		0.01 NS	0.01 NS	0.01 NS	
Karjat (kg.ha)													
Rice-Red pumpkin	Kh. FYM + rice straw + glyricidia leaves @ 1/3rd N each Rb. FYM+NC + VC @ 1/3rd N each	92.6	49.4	-	71.00	15.8	14.7	-	15.25	88.4	26.5	-	57.45
	Panchagavya alone	72.7	35.1	-	53.90	12.4	11.1	-	11.75	68.8	19.3	-	44.05
	Kh. FYM + rice straw + glyricidia leaves @ 1/3rd N each Rb. FYM+NC + VC @ 1/3rd N each + Panchagavya	96.2	55.3	-	75.75	16.7	15.6	-	16.15	89.8	27.7	-	58.75
	Biodynamic practices	71.7	35.7	-	53.70	12.2	11.5	-	11.85	66.7	20.2	-	43.45
	Panchagavya+ Biodynamic practices	77.2	41.9	-	59.55	13.3	12.6	-	12.95	72.3	22.0	-	47.15
	Mean	82.08	43.48	-		14.08	13.10	-		77.20	23.14	-	
Rice- Cucumber	Kh. FYM + rice straw + glyricidia leaves @ 1/3rd N each Rb. FYM+ NC +VC @ 1/3rd N each	92.8	58.8	-	75.80	15.4	9.3	-	12.35	88.2	20.8	-	54.50
	Panchagavya alone	79.5	36.6	-	58.05	13.5	6.5	-	10.00	72.4	14.7	-	43.55
	Kh. FYM + rice straw + glyricidia leaves @ 1/3rd N each Rb. FYM+NC + VC @ 1/3rd N each + Panchagavya	101.1	64.9	-	83.00	16.3	9.6	-	12.95	98.2	21.4	-	59.80

Cropping systems	Treatments		N				P				K			
			Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean
	Biodynamic practices		78.1	38.3	-	58.20	13.1	6.5	-	9.80	68.5	13.9	-	41.20
	Panchagavya+Biodynamic practices		82.1	41.3	-	61.70	13.9	6.9	-	10.40	78.8	15.7	-	47.25
	Mean		86.72	47.98	-	-	14.44	7.76	-	-	81.22	17.3		
			SEm CD	SEm CD			SEm CD	SEm CD			SEm CD	SEm CD	-	-
	Cropping		3.2 NS	1.3 NS	-	-	0.1 NS	0.5 2.9	-	-	2.8 NS	1.0 5.9	-	-
	Method		3.0 9.2	2.9 8.7	-	-	0.4 1.3	0.6 2.0	-	-	3.7 11.1	1.4 4.3	-	-
	Cropping X Method		5.0 NS	3.9 NS	-	-	0.6 NS	1.0 NS	-	-	5.4 NS	2.1 NS	-	-
	Method X Cropping		4.3 NS	4.1 NS	-	-	0.6 NS	0.9 NS	-	-	5.2 NS	2.1 NS	-	-
Ludhiana (kg/ha)														
	B.Rice	Other crops												
B.Rice- Wheat-	GM	FYM	106	-	-	106	16.8	-	-	16.8	155	-	-	155
GM														
	GM+PG	FYM+PG	117	-	-	117	17.7	-	-	17.7	173	-	-	173
	GM+BD	BD	110	-	-	110	17.6	-	-	17.6	176	-	-	176
	GM+BD+FYM	FYM+BD	108	-	-	108	16.4	-	-	16.4	172	-	-	172
	GM+PG+BD	FYM+PG+BD	111	-	-	111	18.6	-	-	18.6	165	-	-	165
	Control	Control	102	-	-	102	14.9	-	-	14.9	157	-	-	157
	Mean		109	-	-	-	17.00	-	-	-	166	-	-	
			SEm	CD				SEm	CD	-	-		SEm	CD
	Cropping		1	6	-	-	-	0.0	0.2	-	-	-	1	10
	Method		2	NS	-	-	-	0.4	1.0	-	-	-	6	NS

Cropping systems	Treatments	N				P				K			
		Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean
	Cropping X Method	3	NS	-	-	-	0.4	1.3	-	-	-	7	NS
	Method X Cropping	4	NS				0.5	1.4				8	NS
Pantnagar (kg/ha)													
Basmati rice – Chickpea – Sesbania	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)	61.5	102.5	-	82.00	13.7	12.0	-	12.85	77.0	40.8	-	43.55
	Biodynamic (BD)	56.3	80.6	-	68.45	11.9	9.2	-	10.55	65.8	35.5	-	37.28
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ Panchgavya	61.0	88.5	-	74.75	15.4	9.5	-	12.45	84.6	35.5	-	44.18
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD	69.2	108.2	-	88.70	14.8	9.6	-	12.20	79.2	37.4	-	42.93
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+ Panchgavya	77.0	88.9	-	82.95	18.5	13.5	-	16.00	86.2	28.3	-	43.50
	Control	46.3	89.7	-	68.00	12.1	11.1	-	11.60	51.5	33.5	-	32.20
	Mean	61.88	93.07	-	-	14.40	10.82	-	-	74.05	35.17	-	
Basmati rice – Vegetable pea – Maize +Moong (moong residues incoporation)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)	53.7	0.0	-	26.85	12.5	0.0	-	6.25	63.4	0.0	-	23.22
	Biodynamic (BD)	36.2	0.0	-	18.10	8.8	0.0	-	4.40	52.8	0.0	-	19.07
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+ Panchgavya	56.7	0.0	-	28.35	13.9	0.0	-	6.95	72.1	0.0	-	26.35
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD	55.7	0.0	-	27.85	13.9	0.0	-	6.95	66.3	0.0	-	24.42

Cropping systems	Treatments	N				P				K			
		Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+ Panchgavya	63.7	0.0	-	31.85	15.6	0.0		7.80	76.2	0.0	-	28.00
	Control	45.8	0.0	-	22.90	8.4	0.0		4.20	43.6	0.0	-	15.93
	Mean	51.97	0.00	-	-	12.18	0.00		-	62.40	0.00	-	-
		SEm CD	SEm CD			SEm CD	SEm CD			SEm CD	SEm CD		
	Cropping	0.9 5.5	0.4 2.7		-	0.1 0.8	0.2 1.4		-	0.7 4.4	0.4 2.5	-	-
	Method	1.6 4.8	1.9 5.7		-	0.4 1.2	0.4 1.2		-	1.5 4.3	0.8 2.3	-	-
	Cropping X Method	2.3 7.9	2.5 7.7		-	0.6 NS	0.6 1.9		-	2.1 NS	1.1 3.7	-	-
	Method X Cropping	2.3 6.9	2.8 8.0		-	0.6 NS	0.6 1.7		-	2.1 NS	1.1 3.2	-	-
Raipur (kg/ha)													
Rice-Chickpea	EC+CDM+NEOC @ 1/3 N each	68.1	49.1	-	58.60	13.6	12.5	-	13.05	115	22.5	-	68.75
	Bio dynamic practice	57.0	36.4	-	46.70	10.6	9.2	-	9.90	102	17.0	-	59.50
	EC+CDM+NEOC @ 1/3 N each + Panchagavya	73.0	52.9	-	62.95	15.2	13.8	-	14.50	119	23.7	-	71.35
	EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice	67.4	50.4	-	58.90	13.9	14.0	-	13.95	116	23.3	-	69.65
	Bio dynamic practice + EC+CDM+NEOC @ 1/3 N each + Panchagavya	79.9	59.2	-	69.55	15.5	15.2	-	15.35	125	26.2	-	75.60
	Mean	69.08	49.6	-	-	13.76	12.94	-		115.4	22.54	-	
Rice- Mustard+lentil (alternate row)	EC+CDM+NEOC @ 1/3 N each	62.5	42.2	-	52.35	12.6	7.0	-	9.80	108	48.0	-	78.00
	Bio dynamic practice	52.0	29.7	-	40.85	10.1	4.9	-	7.50	94	36.3	-	65.15

Cropping systems	Treatments	N				P				K			
		Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean
	EC+CDM+NEOC @ 1/3 N each + Panchagavya	65.8	48.3	-	57.05	12.9	7.8	-	10.35	111	53.3	-	82.15
	EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice	66.9	50.0	-	58.45	14.3	8.0	-	11.15	117	58.9	-	87.95
	Bio dynamic practice + EC+CDM+NEOC @ 1/3 N each + Panchagavya	71.8	54.5	-	63.15	14.2	8.4	-	11.30	125	63.1	-	94.05
	Mean	63.8	44.94	-	-	12.82	7.22	-	-	111	51.92	-	-
		SEm CD	SEm CD			SEm CD	SEm CD			SEm CD	SEm CD		
	Cropping	3.9 NS	1.3 NS	-	-	0.8 NS	0.9 5.6	-	-	5 NS	1.7 10.4	-	-
	Method	2.2 6.6	2.1 6.1	-	-	0.7 2.2	0.4 1.2	-	-	3 9	2.3 6.7	-	-
	Cropping X Method	4.7 NS	2.9 NS	-	-	1.2 NS	1.1 NS	-	-	6 NS	3.3 NS	-	-
	Method X Cropping	3.1 NS	2.9 NS	-	-	1.0 NS	0.6 NS	-	-	4 NS	3.2 NS	-	-

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

Cropping systems	Treatments	Fe			Mn		
		Kharif	Rabi	Summer	Kharif	Rabi	Summer
Tomato-Coriander-Pea	Rock phosphate enriched FYM + VC (1:1)	435	275	399	81.7	79.7	140
	FYM fb BD	434	271	386	80.0	74.0	137
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya	428	269	381	79.7	72.0	135
	FYM fb BD fb Panchagvya	425	268	380	80.7	71.0	135
	Control	353	252	270	54.8	64.0	89
	Control with Panchagavya	352	252	269	55.4	63.3	89
Cauliflower-Cauliflower-Pea	Rock phosphate enriched FYM + VC (1:1)	541	275	344	77.9	82.7	138
	FYM fb BD	533	271	336	71.1	75.3	132
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya	536	272	336	70.9	72.0	131
	FYM fb BD fb Panchagvya	530	272	333	70.2	71.3	131
	Control	366	255	231	47.9	65.3	86
	Control with Panchagavya	365	254	231	49.4	64.7	87
		SEm CD	SEm CD	SEm CD	SEm CD	SEm CD	SEm CD
	Cropping	1 7	1 NS	1 3	0.7 4.5	0.7 NS	1 NS
	Method	1 5	1 4	1 5	0.9 2.8	0.8 2.6	3 8
	Cropping X Method	2 8	2 NS	2 7	1.4 NS	1.3 NS	4 NS
	Method X Cropping	2 7	2 NS	2 7	1.3 NS	1.3 NS	4 NS

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

Cropping systems	Treatments	Zn			Cu		
		Kharif	Rabi	Summer	Kharif	Rabi	Summer
Tomato-Coriander-Pea	Rock phosphate enriched FYM + VC (1:1)	31.7	35.7	71.7	29.8	26.0	42.3
	FYM *fb* BD	27.5	29.8	64.7	25.2	21.2	36.7
	Rock phosphate enriched FYM + VC (1:1) *fb* Panchagvya	26.4	31.4	60.3	24.9	22.1	35.3
	FYM *fb* BD *fb* Panchagvya	24.0	32.0	63.3	23.3	20.8	36.0

Cropping systems	Treatments	Zn			Cu		
		Kharif	Rabi	Summer	Kharif	Rabi	Summer
Cauliflower-Cauliflower-Pea	Control	17.6	28.1	45.0	14.4	16.6	27.3
	Control with Panchagavya	16.7	27.6	46.7	13.9	16.2	27.7
	Rock phosphate enriched FYM + VC (1:1)	33.5	38.3	73.3	31.9	29.7	42.0
	FYM *fb* BD	27.6	35.1	68.0	26.5	23.5	35.7
	Rock phosphate enriched FYM + VC (1:1) *fb* Panchagvya	26.9	34.0	68.0	26.2	24.3	36.0
	FYM *fb* BD *fb* Panchagvya	24.5	32.0	66.0	23.4	21.8	34.3
	Control	17.1	28.6	41.7	13.1	20.5	26.3
	Control with Panchagavya	17.3	26.4	42.3	13.6	20.3	24.7
		SEm CD	SEm CD	SEm CD	SEm CD	SEm CD	SEm CD
	Cropping	1.5 NS	0.7 NS	1.0 NS	0.1 0.5	0.6 NS	0.7 NS
	Method	0.5 1.5	1.2 3.5	0.9 2.8	0.8 2.3	0.7 2.0	1.0 2.9
	Cropping X Method	1.6 NS	1.7 NS	1.6 6.5	1.0 NS	1.1 NS	1.4 NS
	Method X Cropping	0.7 NS	1.6 NS	1.3 3.9	1.1 NS	1.0 NS	1.3 NS

Quality parameters (Table 19)

Bhopal: Protein, oil and methionine content of soybean was estimated with different nutrient sources and was observed that marginal improvement in protein and oil content was observed with application of organic nutrient sources. Considerable improvement in methionine content was observed with application of OM + PG + BD compared to control and the increase was found to be 24.8%. All the other treatments *viz*., OM + PG, OM + BD, OM and BD alone have also improved the methionine content, but the rate of increase was lesser than that of combined application of OM + PG+ BD.

Calicut: Starch, oleoresin and curcumin content was estimated for turmeric while only oleoresin was observed for ginger. All the treatments improved the oleoresin content of ginger compared to control and higher increase of 27.5% was observed with FYM + BD + PG + RP followed by 20% in FYM + NC + 2VC + RP. In turmeric, starch content decreased in all the treatments except FYM + PG + RP compared to control while in FYM + BD + PG + RP, the content of curcumin increased by 25%. The oleoresin content of turmeric was increased by 27.6% with the same treatments compared to FYM + BD + RP. In general it was observed that, quality parameters of turmeric and ginger was found to be better with different nutrient sources along with biodynamic and panchagavya sprays.

Table 19. Influence of source of nutrients on quality parameters of different crops at various locations

Cropping systems	Treatments	Protein (%)		Oil (%)		Methionine (%)	
		Kharif		Kharif		Kharif	
Bhopal							
Soybean-Wheat	OM	35.5		18.3		1.60	
	BD	35.4		18.3		1.55	
	OM+PG	35.6		18.4		1.71	
	OM+BD	35.5		18.4		1.67	
	OM+PG+BD	35.6		18.5		1.86	
	Control	35.4		18.2		1.49	
		SEm	CD	SEm	CD	SEm	CD
	Cropping	0.0	0.1	0.0	0.0	0.01	0.04
	Method	0.0	0.1	0.0	0.1	0.01	0.04
	Cropping X Method	0.0	0.1	0.0	0.1	0.02	0.07
	Method X Cropping	0.0	0.1	0.0	0.1	0.02	0.06
		Starch (%)		Oleoresin (%)		Curcumin (%)	
Calicut							
Ginger	FYM+BD+PG+RP	-		5.1		-	
	FYM+PG+RP	-		4.1		-	
	FYM+BD+RP	-		4.0		-	
	FYM+NC+2VC+PG+BD+RP	-		3.7		-	
	FYM+NC+2VC+RP	-		4.8		-	
	Absolute control	-		4.0		-	
Turmeric	FYM+BD+PG+RP	38.7		14.3		6.0	
	FYM+PG+RP	50.0		11.5		5.4	
	FYM+BD+RP	34.3		11.2		4.1	
	FYM+NC+2VC+PG+BD+RP	34.0		12.2		5.4	
	FYM+NC+2VC+RP	31.0		13.1		4.4	
	Absolute control	50.0		0.0		4.8	
		SEm	CD	SEm	CD	SEm	CD
	Cropping	0.6	2.7	0.1	0.4	0.1	1.1
	Method	0.7	2.0	0.4	1.0	0.1	0.5
	Cropping X Method	1.1	3.7	0.5	1.4	0.2	1.2
	Method X Cropping	1.0	2.9	0.5	1.4	0.2	0.7

Economics of nutrient sources (Table 20)

Jabalpur: Among the various sources of nutrients, application of VC+ FYM+ NEOF @ 1/3 N each was found to give higher net returns (₹ 55594 and 69473 ha^{-1}) and B: C ratio (2.25 and 2.75) in basmati rice-wheat-green manure and basmati rice-berseem systems. Though marginal increase in cost of cultivation due to panchagavya was observed in this treatment, due to increase in yield and net returns, B: C ratio was better. Additional cost of ₹ 1214 ha^{-1} is required for panchagavya. Among the two systems, basmati rice-berseem recorded higher net returns (₹ 58509 ha^{-1}) and B: C ratio (2.57). The net returns and B: C ratio was lower in application of panchagavya or biodynamic practices alone to both the systems.

Coimbatore: Application of FYM+ NEOC @ ½ N each with panchagavya to cotton-maize-green manure and chilli-sunflower-green manure recorded higher net returns and B: C ratio (₹ 61751 ha^{-1}, 1.28, ₹ 63707 ha^{-1} and 1.33 in both the systems respectively) though this treatment recorded 6.7% higher cost than FYM + NEOC@ ½ N each alone. Among the two systems, chilli-sunflower-green manure recorded 13.3% higher net returns than other systems. Application of biodynamic practice alone recorded lower net returns among all the treatments.

Pheromone trap to manage brinjal shoot borer at Coimbatore

Release of *Trichogramma* parasitoides for rice leaf folder control at Coimbatore

Dharwad: Application of EC + VC+ GLM + biodynamic spray @ 12 g/ha + panchagavya spray resulted in higher gross and net returns with B:C ratio due to lower cost of cultivation in groundnut-sorghum and

Cotton with FYM+VC+GLM at Dharwad

Groundnut with EC+VC+GLM at Dharwad

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

Cropping system	Source of nutrient	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
Jabalpur					
Basmati Rice - D. Wheat - GM	VC+FYM+NEOF @ 1/3 N each	92664	42843	49821	2.16
	Panchgavya alone	78252	39384	38868	1.99
	VC+FYM+NEOF@1/3Neach+ Panchgavya	99912	44318	55594	2.25
	Biodynamic practices	69936	38275	31661	1.83
	Biodynamic practices + Panchgavya	86052	39936	46116	2.15
	Mean	85191	40951	43986	2.06
Basmati Rice - Berseem	VC+FYM+NEOF @ 1/3 N each	103980	38597	65383	2.69
	Panchgavya alone	90288	36850	53438	2.45
	VC+FYM+NEOF@1/3Neach+ Panchgavya	109284	39811	69473	2.75
	Biodynamic practices	80544	33475	47069	2.41
	Biodynamic practices + Panchgavya	93576	36394	57182	2.57
	Mean	93423	37025	58509	2.57
Coimbatore					
Cotton - Maize - Sunhemp	FYM + NEOC* (1/2+1/2)	106163	45290	60873	1.34
	Panchagavya alone	69934	31980	37954	1.19
	FYM + NEOC* (1/2+1/2) + Panchagavya	110087	48336	61751	1.28
	Biodynamic Practices	77815	34780	43035	1.24
	Biodynamic Practices + Panchagavya	85877	36580	49297	1.35
	Mean	89975	39393	50582	1.28
Chillies - Sunflower-Sunhemp	FYM + NEOC* (1/2+1/2)	105357	45175	60182	1.33
	Panchagavya alone	92079	35489	56590	1.59
	FYM + NEOC* (1/2+1/2) + Panchagavya	111480	47773	63707	1.33
	Biodynamic Practices	82872	35730	47142	1.32

Cropping system	Source of nutrient	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
	Biodynamic Practices + Panchagavya	99042	40140	58902	1.47
	Mean	98166	40861	57305	1.40
Dharwad					
Groundnut-Sorghum	EC+VC+GLM	174850	33933	139417	5.90
	Panchagavya spray	157818	33466	122852	4.84
	EC+VC+GLM + Panchagavya spray	174565	32453	140612	6.38
	EC+VC+GLM+ Biodynamic spray @5g/ac	170256	31643	137113	6.06
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	177942	30914	145528	6.11
	FYM+VC+GLM	164769	33224	130045	5.20
	Control	145262	27437	116325	4.97
	Mean	166495	31867	133127	5.64
Maize-Chickpea	EC+VC+GLM	100117	15796	82821	5.79
	Panchagavya spray	84579	16404	66675	4.72
	EC+VC+GLM + Panchagavya spray	102085	16495	84090	5.67
	EC+VC+GLM+ Biodynamic spray @5g/ac	99596	14190	83906	6.35
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	105255	13107	90648	7.21
	FYM+VC+GLM	94532	15443	77589	5.58
	Control	70034	14016	54518	4.51
	Mean	93743	15064	77178	5.69
Chilli+onion	EC+VC+GLM	125707	19812	104395	5.90
	Panchagavya spray	102736	19737	81499	4.84
	EC+VC+GLM + Panchagavya spray	136002	19822	114680	6.38
	EC+VC+GLM+ Biodynamic spray @5g/ac	125081	19147	104434	6.06
	EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray	130372	19823	109049	6.11
	FYM+VC+GLM	117618	21112	95006	5.20

Cropping system	Source of nutrient		Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
	Control		79579	14496	63583	4.97
	Mean		116728	19136	96092	5.64
Karjat						
Rice- Red pumpkin	Kh. FYM + rice + glyricidia leaves @1/3rd N Each Rb. FYM+NC +VC @1/3rd N Each		176714	120751	55963	1.46
	Panchagavya alone		139733	72630	67104	1.92
	FYM + rice + glyricidia leaves @1/3rd N Each Rb. FYM+NC + VC @1/3rd N Each + Panchagavya		180366	123844	56522	1.46
	Biodynamic practices		143807	73039	70768	1.97
	Panchagavya + Biodynamic practices		151934	74538	77395	2.04
	Mean		158511	92960	65550	1.77
Rice- Cucumber	Kh. FYM + rice + glyricidia leaves @1/3rd N Each Rb. FYM+ NC +VC @1/3rd N Each		167906	129890	38016	1.29
	Panchagavya alone		130717	69426	61291	1.88
	FYM + rice + glyricidia leaves @1/3rd N Each Rb. FYM+NC + VC @1/3rd N Each + Panchagavya		171362	130920	40442	1.31
	Biodynamic practices		128499	68648	59851	1.87
	Panchagavya + Biodynamic practices		134440	70171	64269	1.92
	Mean		146585	93811	52774	1.65
Ludhiana						
	B.Rice	Other crops				
Maize-Wheat+ Gram-S.moong	GM	FYM	150016	58475	91541	1.57
	GM+PG	FYM+PG	146774	63231	83543	1.32
	GM+BD	BD	99672	58025	41647	0.72
	GM+BD+FYM	FYM+BD	136841	62305	74536	1.2
	GM+PG+BD	FYM+PG+BD	149698	66901	82797	1.24
	Control	Control				
	Mean		136600	61787	74813	1.21

Cropping system	Source of nutrient		Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
B.Rice- Wheat-GM	GM	FYM	138348	43518	94830	2.18
	GM+PG	FYM+PG	136918	46624	90294	1.94
	GM+BD	BD	124090	43018	81072	1.88
	GM+BD+FYM	FYM+BD	136843	47058	89785	1.91
	GM+PG+BD	FYM+PG+BD	140258	49044	91214	1.86
	Control	Control				
	Mean		135291	45852	89439	1.95
Bajaura						
Tomato-Coriander-Pea	Rock phosphate enriched FYM + VC (1:1)		125002	75384	49618	0.66
	FYM fb BD		138568	71684	66884	0.93
	Rock phosphate enriched FYM + VC (1:1) fb Panchagvya		128915	82087	46828	0.57
	FYM fb BD fb Panchagvya		131423	78387	53037	0.68
	Control		33864	29450	4414	0.15
	Control with Panchagavya		49147	36153	12994	0.36
	Mean		101153	62191	38962	0.63
Pantnagar						
Basmati rice – Chickpea–*Sesbania*	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)		117509	58915	58594	1.99
	Biodynamic (BD)		95604	45410	50194	2.10
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+Panchgavya		119781	60213	59568	1.99
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD		114137	60052	54085	1.90
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+ Panchgavya		124862	61350	63512	2.03
	Control		97625	44273	53352	2.21
	Mean		111586	55036	56551	2.04
Basmati rice – Vegetable pea – Maize +Moong (moong residues incoporation)	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)		231323	80280	151043	2.88

Cropping system	Source of nutrient	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
	Biodynamic (BD)	144582	66776	77806	2.16
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+Panchgavya	245467	81579	163888	3.01
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD	231429	81417	150012	2.84
	FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+ Panchgavya	248990	82716	166274	3.01
	Control	156816	65639	91177	2.39
	Mean	209768	76401	133367	2.72
Ranchi					
Rice - Wheat	50% VC+50% KC	86346	61080	25266	0.86
	BD Preparation (CPP, BD500 & 501)	45591	26930	18662	1.43
	VC + K.C+Panchagavaya	87848	65080	22767	0.73
	VC + K.C+ BD Prepartion	91726	63680	28046	0.91
	VC + K.C+ BD Prepartion + Panchagavya	97061	67680	29381	0.89
	Mean	81714	56890	24824	0.96
Rice – Potato	50% VC+50% KC	168700	90219	78481	1.60
	BD Preparation (CPP, BD500 & 501)	76242	51987	24255	1.29
	VC + K.C+Panchagavaya	171367	94219	77147	1.49
	VC + K.C+ BD Prepartion	173817	92819	80997	1.63
	VC + K.C+ BD Prepartion + Panchagavya	177683	96819	80864	1.55
	Mean	153562	85213	68349	1.51

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maize-chickpea system while EC+ VC+ GLM + panchagavya spray alone recorded better returns and B:C ratio of chilli +onion (₹ 114680 ha^{-1} and 6.38 respectively). The increase in net returns over control was found to be 25 and 66% in groundnut-sorghum and maize-chickpea respectively due to combined application of panchagavya and biodynamic spray along with other organic inputs such as EC, VC and GLM. Among the three cropping systems, groundnut-sorghum registered 72 and 38.5% higher net returns over maize-chickpea and chilli+ onion systems.

Karjat: The gross returns was higher with application of FYM + rice straw + gliricidia leaves @ 1/3 N each during *kharif* and FYM + NC + VC @ 1/3 N each during *rabi* along with panchagavya in both rice-red pumpkin and rice-cucumber systems. However, due to higher cost of cultivation, net returns and B:C ratio was lower with this particular combination compared to panchagavya + biodynamic practices combination which recorded 37 and 59% higher net returns than organic inputs+ panchagavya in rice-red pumpkin and rice-cucumber systems respectively. In both the systems, application of panchagavya or biodynamic practices alone also recorded better net returns and B: C ratio compared to application of FYM, rice straw, *gliricidia* etc. Among the two systems, rice-red pumpkin registered 24 and 7% higher net returns and B: C ratio respectively over rice-cucumber systems.

Ludhiana: Application of green manure to basmati rice and FYM to other crops in the maize-wheat+ gram-summer moong and basmati-wheat-green manure system was found to be better in terms of gross returns, net returns and B: C ratio compared to application of panchagavya and biodynamic practices along with green manure and FYM. The increase in net returns was found to be 11 and 4% over control in these systems respectively. Although gross returns of basmati rice-wheat-green manure system was higher in GM +PG +BD for basmati rice and FYM +PG +BD for other crops, it was closely followed by GM+ FYM combination. Among the systems, basmati rice-wheat-green manure recorded 20 and 61% higher net returns and B: C ratio than maize-wheat+ gram-summer moong.

Bajaura: Application of FYM followed by biodynamic spray to tomato-coriander-pea system recorded higher gross returns of ₹ 138568 ha^{-1} which is 182% higher than control (panchagavya alone). Net returns (₹ 66884 ha^{-1}) and B: C ratio (0.93) was also higher in the same treatment thought cost of cultivation was 98% higher compared to panchagavya alone. Application of panchagavya in combination with rock phosphate enriched FYM + vermicompost @ 1:1 ratio recorded lower returns and B: C ratio compared to FYM + panchagavya combination. Around 200% increase in net returns and 77% increase in B:C ratio of tomato-coriander-pea system was observed with application of panchagavya alone over absolute control (without panchagavya).

Pantnagar: Application of biodynamic practice and panchagavya along with FYM +VC +NC +EC @ ¼ N each registered 6 and 7.6% higher gross returns in basmati rice-chickpea-*sesbania* (green manure) and basmati rice-vegetable pea-maize+ moong (residues in corporation) systems respectively compared to FYM +VC +NC +EC alone. In the first system, B:C ratio was higher (2.21) in control owing to lower cost of cultivation (Rs. 44273 ha^{-1}) which was closely followed by biodynamic spray alone (₹ 45,410 ha^{-1} and 2.10 respectively). However, in the later system, FYM +VC +NC +EC either with panchagavya alone or

Visitors to NPOF experiment at Pantnagar

panchagavya + biodynamic practice recorded the higher B: C ratio (3.01 in each) compared to control and biodynamic practice alone. Basmati rice-vegetable pea-maize + moong (moong residues incorporation) was found to be better by 88, 136 and 33% in terms of gross, net returns and B: C ratio respectively compared to basmati rice-chickpea-*sesbania* (green manure). Application of panchagavya alone contributed 4.9% towards increase in B: C ratio in the later system.

Ranchi: The gross and net returns (₹ 97061 and 29381 ha^{-1} respectively) were higher with VC+ KG + BD preparation + panchagavya in rice-wheat system. However, higher B: C ratio 1.43 was recorded with BD preparation (CPP, BD 500 &501) alone owing to its lower cost of cultivation (₹ 26930 ha^{-1}). In rice-potato system, though VC + KC +BD preparation + panchagavya recorded higher gross returns of ₹ 177683 ha^{-1}, net returns and B: C ratio was better in VC + KC +BD preparation (₹ 80997 ha^{-1} and 1.63 respectively) even though cost of cultivation was lower in application of BD preparation alone. Among the systems, rice-potato recorded 88, 175 and 57% higher gross, net returns and B: C ratio, though cost of cultivation was 50% more compared to rice-wheat system.

7.3 Pest and disease management under organic farming

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

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

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

Treatments: There are no common treatments for all the centres. The number of cropping system tested varied from 1 to 2. The details of treatments are given in Table 21-25 along with experimental results. Under the experiment 3 on pest and disease management, two set of treatments were evaluated by the centres for various cropping system. The first set of treatments with summer ploughing and green manures were evaluated in only at Modipuram. The centre wise data on yield, pest and disease infestation, soil properties and economics are presented in Table 21-25 and results are given below.

RESULTS

Experiment set 1: Modipuram (Table 21)

Four management practices viz., summer ploughing treated and untreated, green manure treated and untreated were evaluated in basmati rice-chickpea and basmati rice-mustard systems. Observations on grain yield, straw yield were taken. The results revealed that summer ploughing and green manure treated plots recorded higher grain yield of basmati rice (2755 and 2733 kg ha^{-1}respectively), chick pea (1342 and 1303kg ha^{-1}) and mustard (1008 and 986 kg ha^{-1}) compared to untreated plots of summer ploughing and green manure. Net returns of basmati rice-chickpea system was higher in summer ploughing treated (₹ 68213 ha^{-1}) followed by untreated (₹ 63757 ha^{-1}). The green manure treated and untreated plots recorded lower net returns. However, in case of basmati rice-mustard system, summer ploughing and green manure treated plots recorded 25.6 and 60.3% higher net returns compared to respective untreated plots.

Table 21. Influence of pest and disease management practices under organic farming on grain and straw yield (kg/ha) of crops at Modipuram

Cropping system	Pest and disease management	Grain Yield		Straw Yield		Net returns (₹/ha)
		Kharif	*Rabi*	*Kharif*	*Rabi*	
Basmati rice- Chick pea	Summer Ploughing-Untreated	2469	1263	6069	-	63757
	Summer Ploughing-Treated	2755	1342	7135	-	68213
	Green Manure-Treated	2733	1303	7025	-	54977
	Green Manure-Untreated	2204	1236	5731	-	44577
Basmati rice -Mustard	Summer Ploughing-Untreated	2469	967	6069	-	30245
	Summer Ploughing-Treated	2755	1008	7135	-	37998
	Green Manure-Treated	2733	986	7025	-	39600
	Green Manure-Untreated	2204	926	5731	-	24694

Experiment set 2

In the second set of treatments, other applications of pest and disease management combinations were studied at four centres. The data on pest and disease infestation level, grain, straw yield and economics are presented in Table 25-28 and centre wise results are given below.

Modipuram (Table 24 and 25)

Six treatments comprising of organic inputs such as FYM, vermicompost along with biodynamic preparation and panchagavya spray was evaluated besides control in basmati rice-wheat and maize+ cowpea-wheat +mustard system. The results reveals that application of FYM + vermicompost alone with biodynamic preparation and panchagavya recorded higher increase (29.7%) of yield in basmati rice over control followed by addition of BD and panchagavya preparation with FYM and vermicompost (24.3%). However, in chickpea, it was observed that later combination (FYM+ vermicompost +BD + panchagavya) registered15% increase over control followed by FYM+vermicompost alone (10.5%). In the maize+ cowpea-wheat +mustard system application of BD preparation + FYM + vermicompost +panchagavya recorded 9.8 and 18.2% increase in yield of maize and wheat respectively over FYM + vermicompost alone indicating the usefulness of biodynamic and panchagavya preparations. Straw yield of all the crops have also followed the similar trend. Economic analysis of various treatments indicates both FYM +vermicompost +biodynamic preparation +panchagavya and FYM+ vermicompost recorded net return of ₹ 101078 and 102494 ha^{-1} respectively. In basmati rice-wheat system,however, higher net return and B: C ratio was observed with FYM + vermicompost alone. In maize+ cowpea-wheat +mustard system, application of BD preparation alone or FYM+ vermicompost+ BD recorded higher net returns (₹ 60597 and 60105 ha^{-1} respectively) even though FYM + vermicompost + BD + panchagavya combination recorded higher gross returns (₹ 111341 ha^{-1}). The cost of cultivation was higher under this combination (₹ 52358 ha^{-1}) compared to BD alone (₹ 39358 ha^{-1}) and FYM + VC + BD (₹ 47358 ha^{-1}).

Calicut (Table 22 and 24)

Pest and Disease infestation percent and yield in ginger and turmeric were recorded with six treatments comprising of IISR 6, 51,853, P621 and P1AR6 cultures, ginger entophytic bacteria and rhizobacteria along with absolute control. Shoot borer infestation in ginger was lower with ginger endophytic bacteria (GEB 17 and GEB 18) and ginger rhizobacteria (GRB 57) compared to absolute control. The reduction in infestation was observed to be 17.3, 19.7 and 43.7% respectively. In case of turmeric, various treatments did not able to reduce the shoot borer rather it increased the infestation compared to absolute control. In case of rhizome rot in ginger and turmeric, application of ginger endophytic bacteria (GEB 17) reduced the infestation by 10% in ginger and 21.7% in turmeric. However, application of GEB 18 was found to be better for turmeric to control rhizome rot as it reduced the infestation by 42% then absolute control. The effect of ginger rhizobacteria (GRB 57) on rhizome rot of turmeric was found to be only 8.7% over absolute control. Leaf spot in both the crops can be effectively managed with application of either culture combination of IISR 6, 51,853, Pb 21 and P1 AR 6 or GEB 17. GRB 57 was also found to be effective in ginger in reducing the infestation of leaf spot. Maximum reduction in infestation of leaf spot in ginger and turmeric was observed with GEB 17application (39 and 12.6% in ginger and turmeric). Significantly higher rhizome yield of ginger and turmeric was observed with GEB 17 application (20300 and 27400 kg ha^{-1} respectively) which was at par with GEB 18 and GRB 58 application in ginger. Owing to higher infestation of shoot

Treatment vs control in turmeric at Calicut

borer and rhizome rot in ginger with GRB 57 application, lower yield of 16667 kg ha^{-1} was recorded which is 5.7% lower than absolute control. However, in turmeric absolute control recorded the lower yield (20733 kg ha^{-1}).

Bajaura (Table 22, 24 and 25)

Cauliflower-pea-tomato system was tested under different pest and disease management practices involving leaf extracts, natural products and bio control agents like *Bacillus thuringiensis* under different combinations. Infestation of pest and diseases like fruit borer, fruit rot and other factors were assessed in tomato apart from recording yield loss due to these factors in different treatments. Yield of all the crops in the system have also been recorded. Fruit borer and fruit rot in tomato was lower in application of karvi (*Roylea cinerea*) @ 10% aqueous leaf extract + cow urine (3%) + tween-80 (0.05%) as emulsifier during *kharif* and karvi @ 5% +cow urine (3%) during *rabi* (1.5 and 67.5% incidence). Incidence of other factors (pests and diseases) was lower in margosum (Azadoractin @ 1%) applied during *rabi*. The same trend was observed in yield loss in tomato also. Lower yield loss due to fruit borer was observed with application of karvi+ cow urine + tween during *kharif* and karvi + cow urine during *rabi* (1.4%). The yield loss due to fruit rot ranged from 65.2 to 72% in various treatments and no significant variation was observed among the different treatments. Lower yield loss of 12.8% was observed with other pest and disease factors under margosom (Azadoractin, 1%) applied during *rabi*. Though fruit borer and fruit rot of tomato was lower with karvi + cow urine + tween combination, yield loss due to other factors of pest and diseases was more (20.3%) as a consequence of higher incidence (20.6%) of other pest & disease causing factors. No significant difference in yield of pea was observed among the different treatments as the yield difference between best performing treatment (Margersom (Azadaractin 1% @ 1 ml/l) (7044 kg ha^{-1}) and least performing treatment (Nomurearileyi (No lep) + tween during *kharif* and darek + kaner +cow urine (3%) during *rabi* (6036 kg ha^{-1}) was only 1008 kg ha^{-1}. Compared to control, all the treatments recorded significantly higher yield. Higher tomato yield of 14139 kg ha^{-1} was realized with application of margosom (Azedaractin 1% EC) @ 1 ml/l during *kharif* and karvi (*Roylea cinerea*) @ 2.5% aqueous leaf extract + kaner (*Nerium* sp.) @ 2.5% aqueous leaf extract + cow urine (3%) as this particular treatment recorded lower incidence of all (fruit borer: 2.8%, other factors 14.9%) and yield loss due to fruit borer, fruit rot and other factors were less. Karvi + cow urine + tween application also recorded better tomato yield of 13623 kg ha^{-1} compared to other combinations of pest and diseases management practices. Cost of cultivation of various treatments for the cauliflower-pea-tomato systems ranged from ₹ 62660 to 67244 ha^{-1} indicating variation of only ₹ 4584 ha^{-1} in various treatments. Higher gross return of ₹ 110802 ha^{-1} and net return of ₹ 42573 ha^{-1} was recorded with application of margosom (Azodarachtin 1%) @ 1ml/l during *rabi* which is 35.8 and 125% higher respectively than gross and net returns obtained from absolute control. Performance of mixture of derisom (2% EC) @ 2 ml/l and Ha NPV (Helicide) @ 0.5ml/l during *kharif* and Darek (Melia azedarach) @ 5% ASE + cow urine (3%) was also found to be better as it also recorded increase in gross and net returns to the tune of 35.4 and 127% respectively over untreated check (control).

Umiam (Table 23 and 24)

Various pest and disease management practices were studied in maize+ soybean-tomato system and observations on incidence of Monolepta, Mylloceros, Epilechna, leaf fodder and soybean rust was observed in two stages in maize +soybean while fruit borer and early blight incidence in tomato was observed in one stage. Yield of all the crops were also recorded. Application of Derisom (3 ml/l) + panchagavya @ 10% and cow urine 3% recorded

Pest and disease management in tomato at Umiam

lower incidence of monolapta (0.40%), mylloceros (0.87%) and epilechna (0.27%) in early stage of maize while leaf folder incidence was found to be reduced through application of Anomin 3 ml/litre or panchagavya @ 3%. Soybean rust was found to be controlled to the level of 24.5% with the application of panchagavya @ 3% + lantana @ 10% + vermiwash @ 10%. In tomato, fruit borer incidence can be reduced to the level of 25.6% with application of either Anonin @ 3ml/lit or Derisom + panchagavya. Similarly, application of panchagavya @ 3% or panchagavya @ 3%+ lantana @ 10% + vermiwash @ 10% recorded 32.2 and 28.6% less incidence of early blight compared to control (untreated check). Though application of Derisom (3 ml/l) + panchagavya @ 10% + cow urine @ 3% recorded higher maize grain yield of 3743 kg ha^{-1}, it is not significantly different with other treatments. Untreated check recorded lower yield of 2885 kg ha^{-1} of maize. Although application of panchagavya @ 3% + lantana @ 10% + vermiwash @ 10% recorded 30% higher tomato yield (20669kg ha^{-1}) than control (15845 kg ha^{-1}), it is on par with neem oil @ 3 ml/l, Anonin @3 ml/lit, Derisom @ 3ml/lit, panchagavya @ 3% and Trichoderma @ 5g/l. Application of botanicals alone recorded significantly lower yield (17079 kg ha^{-1}).

Table 22. Influence of pest and disease management practices under organic farming on pest, disease infestation and yield loss in tomato, ginger and turmeric

Treatments	Infestation (%)			Yield loss (%)		
	Fruit borer	Fruit rot	Other factors	Fruit borer	Fruit rot	Other factors
Bajaura (Tomato)						
Mixture of Derisom (2% EC) @ 2ml/L and Ha NPV (Helicide) @ 0.5 ml/L	2.6	71.9	14.8	2.6	68.9	14.8
Bhang (*Cannabis sativa*)10% ALE + Cow Urine (3%)+ Tween -80 (0.05%) as emulsifier	3.3	69.6	14.6	3.3	66.8	15.2
Karvi (*Roylea cinerea*) @ 10% ALE + Cow Urine (3%)+ Tween -80 (0.05%) as emulsifier	1.5	67.5	20.6	1.4	65.8	20.3
Metarhizium anisopliae @ 2g per litre of water + Tween -80 (0.05%) as emulsifier	4.1	70.9	13.3	4.0	66.2	14.3
Nomurea rileyi (Nolep) @ 2 gm per litre of water + Tween -80 (0.05%) as emulsifier	2.1	69.6	17.1	1.5	65.2	18.2
Margosom (Azedarachtin 1.0% EC) @ 1ml/L	2.8	70.3	14.9	2.5	68.2	14.7
Lipel (*Bacillus thuringiensis sub sp. kurstaki*) @ 1.0 kg/ha	1.5	73.6	16.2	1.3	72.0	15.1
Control (untreated check)	8.3	72.5	12.4	8.0	70.1	12.8
	Infestation in Ginger (%)			Infestation in Turmeric (%)		
	Rhizome rot	Shoot borer	Leaf spot	Rhizome rot	Shoot borer	Leaf spot
Calicut						
Absolute control	15.0	21.3	20.0	6.9	2.6	10.3
IISR 6, 51, 853, Pb21 and P1AR6	28.5	25.7	17.1	11.2	14.3	9.2
Ginger endophytic bacteria (GEB) 17	13.5	17.6	12.2	5.4	9.9	9.0
Ginger endophytic bacteria (GEB) 18	26.8	17.1	24.4	4.0	10.0	12.0
Ginger rhizobacteria (GRB) 57	17.3	12.0	17.3	6.3	9.5	11.6
Ginger rhizobacteria (GRB) 58	42.4	23.5	21.2	17.9	15.1	20.8

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

Treatments	Kharif (Maize + Soybean)									Rabi (Tomato)	
	Early stage				Late stage						
	Monolepta	Mylloceros	Epilechna	Leaf folder	Monolepta	Mylloceros	Epilechna	Leaf	Soybean folder	Fruit rust	Early borer blight
Control	0.67	2.20	0.40	0.40	0.13	0.43	0.10	0.60	37.00	1.44	48.19
Neem oil @3ml/lit	0.47	2.40	0.20	0.47	0.13	0.40	0.10	0.37	32.30	1.35	33.70
Anonin 3 ml/lit	0.60	1.67	0.20	0.40	0.27	0.43	0.10	0.40	35.10	1.07	51.39
Derisom@3ml/lit	0.53	1.33	0.27	0.43	0.27	0.60	0.07	0.40	38.30	1.33	49.46
Panchagavya 3 %	0.47	1.27	0.33	0.40	0.13	0.40	0.10	0.43	30.90	1.33	32.67
Panch. 3 %+Lantana 10 %+V.wash 10 %	0.47	1.40	0.20	0.47	0.13	0.40	0.07	0.33	27.90	1.03	34.39
Trichoderma 5g/lit	0.47	1.33	0.33	0.57	0.10	0.40	0.10	0.33	34.40	1.19	48.19
Botanicals	0.53	1.87	0.33	0.53	0.17	0.43	0.07	0.40	35.70	1.60	46.92
Derisom+panchgabaya	0.53	1.27	0.33	0.53	0.13	0.57	0.13	0.30	32.30	1.07	38.02
Derisom (3ml/lit)+ panch. 10 %+ cowurine 3 %	0.40	0.87	0.27	0.43	0.10	0.43	0.10	0.40	30.90	1.27	36.72

Table 24. Influence of pest and disease management practices under organic farming on grain & straw yield (kg/ha) of crops at various locations

Cropping system	Pest and disease management	Grain Yield		Straw yield	
		Kharif	*Rabi*	*Kharif*	*Rabi*
Modipuram					
Basmati rice-Wheat	Fym+Vermi Compost	3077	2338	12821	3205
	BD Preparation	2628	2276	10577	3333
	Fym+Vermi Compost+Panchgavya	2885	2275	11731	3450
	Fym+Vermi Compost+BD Preparation	2756	2275	12128	3013
	BD Preparation+Fym+Vermicompost+Panchgavya	2949	2433	12244	3686
	Control	2372	2115	9615	3429
Maize+Cowpea-Wheat+Mustard	Fym+Vermi Compost	6147	2372		3272
	BD Preparation	5936	2276		3429
	Fym+Vermi Compost+Panchgavya	6545	2342		3750
	Fym+Vermi Compost+BD Preparation	6385	2315		3333
	BD Preparation+Fym+Vermicompost+Panchgavya	6753	2500		3752
	Control	5154	2275		3213
Calicut					
Ginger	Absolute control	17667	-	-	-
	IISR 6, 51, 853, Pb21 and P1AR6	17433	-	-	-
	Ginger endophytic bacteria (GEB) 17	20300	-	-	-
	Ginger endophytic bacteria (GEB) 18	19233	-	-	-
	Ginger rhizobacteria (GRB) 57	16667	-	-	-
	Ginger rhizobacteria (GRB) 58	18300	-	-	-
Turmeric	Absolute control	20733	-	-	-
	IISR 6, 51, 853, Pb21 and P1AR6	23533	-	-	-
	Ginger endophytic bacteria (GEB) 17	27400	-	-	-
	Ginger endophytic bacteria (GEB) 18	25867	-	-	-
	Ginger rhizobacteria (GRB) 57	22933	-	-	-
	Ginger rhizobacteria (GRB) 58	25333	-	-	-
		SEm±	CD		
		472	2874		
		1117	NS		
		1517	NS		
		NS	1579		

Cropping system	Pest and disease management	Grain Yield		Straw yield	
		Kharif	*Rabi*	*Kharif*	*Rabi*
Bajaura					
Cauliflower - peas-Tomato	*Kharif* : Mixture of Derisom (2% EC) @ 2ml/L and Ha NPV (Helicide) @ 0.5 ml/L *Rabi*: Darek (*Melia azedarach*) @ 5% ASE + Cow Urine (3.0%)	7023	12944		
	Kharif: Bhang (*Cannabis sativa*)10% ALE + Cow Urine (3%)+ Tween -80 (0.05%) as emulsifier *Rabi*: Kaner (*Nerium sp.*) (5%)+ Cow Urine (3.0%)	6241	12762		
	Kharif: Karvi (*Roylea cinerea*) @ 10% ALE + Cow Urine (3%)+ Tween -80 (0.05%) as emulsifier *Rabi*: Karvi (*Roylea cinerea*) @ 5%+ Cow Urine (3.0%)	6036	13623		
	Kharif: *Metarhizium anisopliae* @ 2g per litre of water + Tween -80 (0.05%) as emulsifier *Rabi*: Darek (*M. azedarach*) (5% ALE) + Cow Urine (3%)	6420	13144		
	Kharif : Nomurea rileyi (Nolep) @ 2 gm per litre of water + Tween -80 (0.05%) as emulsifier *Rabi*: Darek (*M. azedarach*) @ 2.5% ASE + Kaner (*Nerium* sp.) @ 2.5% ALE + Cow Urine (3%)	6036	12554		
	Kharif : Margosom (Azedarachtin 1.0% EC) @ 1ml/L *Rabi*: Karvi (*Roylea cinerea*) @ 2.5% ALE + Kaner (Nerium sp.) @ 2.5% ALE + Cow Urine (3%)	6104	14139		
	Kharif : Lipel (*Bacillus thuringiensis* sub sp. kurstaki) @ 1.0 kg/ha, *Rabi*: Darek (*M. azedarach* (2.5% ALE) + Karvi (*Roylea cinerea*) @ 2.5% ALE + Cow Urine (3%)	6612	13289		
	Kharif: Control (untreated check), *Rabi*: Margosom (Azedarachtin 1%) @ 0.5ml/ L	6118	13607		
	Rabi: Margosom (*Azedarachtin* 1%) @ 0.75 ml/ L	6804			
	Rabi: Margosom (*Azedarachtin* 1%) @ 1.0 ml/ L	7044			
	Rabi: Control (untreated check)	5185			
		SEm± CD	SEm± CD		
		249 735	1550 NS		
Umiam					
Maize+soybean – tomato	Control	2885	15845		973
	Neem oil @3ml/lit	3430	18909		860
	Anonin 3 ml/lit	3550	19129		960
	Derisom@3ml/lit	3645	18825		1083
	Panchagavya 3 %	3175	19025		1067
	Panchagavya 3 %+Lantana 10 %+V.wash 10 %	3413	20669		1063
	Trichoderma 5g/lit	3245	19288		972
	Botanicals	3145	17079		1085
	Derisom+panchgabaya	3508	18431		1024
	Derisom (3ml/lit)+panch. 10 %+cowurine 3 %	3743	17524		1117
		SEm± CD	SEm± CD	SEm±	CD
		247 NS	639 1899	81	NS

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

Cropping system	Pest and disease management	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
Modipuram					
Basmati rice-Wheat	FYM+VC	102494	51654	50840	0.98
	BD Preparation	91691	45594	46097	1.01
	FYM+VC+Panchgavya	97320	56654	40666	0.72
	FYM+VC+BD Preparation	94482	53154	41328	0.78
	BD Preparation+FYM+VC+Panchgavya	101078	58154	42924	0.74
	Control	83659	44094	39565	0.90
Maize+Cowpea-Wheat+Mustard	FYM+VC	102637	45858	56779	1.24
	BD Preparation	99955	39358	60597	1.54
	FYM+VC+Panchgavya	107021	50858	56163	1.10
	FYM+VC+BD Preparation	107463	47358	60105	1.27
	BD Preparation+FYM+VC+Panchgavya	111341	52358	58983	1.13
	Control	91274	37858	53916	1.42
Bajaura					
Cauliflower - peas- Tomato	*Kharif* : Mixture of Derisom (2% EC) @ 2ml/L and Ha NPV (Helicide) @ 0.5 ml/L Rabi: Darek (Melia azedarach) @ 5% ASE + Cow Urine (3.0%)	110472	67476	42996	0.64
	Kharif: Bhang (*Cannabis sativa*)10% ALE + Cow Urine (3%)+ Tween -80 (0.05%) as emulsifier *Rabi*: Kaner (*Nerium* sp.) (5%)+ Cow Urine (3.0%)	98171	67479	30692	0.45
	Kharif: Karvi (*Roylea cinerea*) @ 10% ALE + Cow Urine (3%)+ Tween -80 (0.05%) as emulsifier *Rabi*: Karvi (*Roylea cinerea*) @ 5%+ Cow Urine (3.0%)	94946	67479	27467	0.41
	Kharif: *Metarhizium anisopliae* @ 2g per litre of water + Tween -80 (0.05%) as emulsifier *Rabi*: Darek (*M. azedarach*) (5% ALE) + Cow Urine (3%)	100987	67479	33508	0.50
	Kharif : *Nomurea rileyi* (Nolep) @ 2 gm per litre of water + Tween -80 (0.05%) as emulsifier *Rabi*: Darek (*M. azedarach*) @ 2.5% ASE + Kaner (*Nerium* sp.) @ 2.5% ALE + Cow Urine (3%	94946	67479	27467	0.41
	Kharif : Margosom (Azedarachtin 1.0% EC) @ 1ml/L *Rabi*: Karvi (*Roylea cinerea*) @ 2.5% ALE + Kaner (*Nerium* sp.) @ 2.5% ALE + Cow Urine (3%)	96016	67479	28537	0.42
	Kharif : Lipel (*Bacillus thuringiensis* sub sp. kurstaki) @ 1.0 kg/ha,	104007	67479	36528	0.54

Cropping system	Pest and disease management	Gross returns (₹/ha)	Cost of cultivation (₹/ha)	Net returns (₹/ha)	B:C ratio
	Rabi: Darek (*M. azedarach* (2.5% ALE) + Karvi (*Roylea cinerea*) @ 2.5% ALE + Cow Urine (3%)				
	Kharif: Control (untreated check), *Rabi*: Margosom (Azedarachtin 1%) @ 0.5ml/ L	96236	67244	28992	0.43
	Rabi: Margosom (Azedarachtin 1%) @ 0.75 ml/l	107892	67737	40155	0.59
	Rabi: Margosom (Azedarachtin 1%) @ 1.0 ml/l	110802	68229	42573	0.62
	Rabi: Control (untreated check)	81560	62660	18900	0.30

7.4 Weed management under organic farming

Title: Weed management in cropping systems under organic farming

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

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

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

Locations: The experiment has been conducted at 9 centres namely Jabalpur, Coimbatore, Raipur, Dharwad, Karjat, Ludhiana, Pantnagar, Ranchi and Umiam.

RESULTS

Jabalpur (Table 28 and 32)

Three weed management practices viz., two hand/ mechanical weeding, spray at 3-4 leaf stage of weeds and its combination along with weed free and unweeded control were experimented in rice-wheat system. The result reveals that weed free recorded higher grain yield of rice (6753 kg ha^{-1}) and wheat (6235 kg ha^{-1}) followed by combination of two hand weeding + spray at 3-4 leaf stage of weeds which recorded 44.9 and 41.3% higher grain yield of rice and wheat respectively compared to unwedded check. However, the yield obtained with spray at 3-4 leaf stage of weeds remained at par with unweeded control. Straw yield of both the crops also exhibited the similar trend. Higher gross (₹ 98727 ha^{-1}), net return (₹ 57405 ha^{-1}) and B: C ratio (2.39) was recorded with weed free condition in rice-wheat system even though high cost of cultivation (₹ 41322 ha^{-1}) was noticed in weed free condition. The next best treatment in terms of gross, net returns and B: C ratio was two hand/mechanical weeding +spray at 3-4 leaf stage of weeds (₹ 87888, 49185 ha^{-1} and 2.27 respectively).

Weed management experiment at Jabalpur

Coimbatore (Table 28, 29, 31 and 32)

Five treatments comprising of unweeded check, two hand weeding, spray of aqueous leaf extract at 3-4 leaf stage of weeds, hand weeding + aqueous leaf extract spray and weed free check was evaluated in rice-blackgram-green manure system and observations on yield, soil properties, microbial count and economics were taken. In both rice and blackgram, weed free condition recorded higher yield (3843 and 773 kg ha^{-1} respectively) followed by combination of two hand wedding + spray of aqueous leaf extract at 3-4 leaf stage of weeds which recorded 113 and 9% increase in yield of rice and blackgram over unweeded control. Spray of aqueous leaf extract alone was not effective in controlling of weeds in both the crops as it recorded the reduction in yield to the tune of 52 and 10.7% in rice and blackgram compared to weed free check. Straw yield of rice also exhibited the similar trend. Soil analysis indicated higher organic carbon with weed free check and two hand weeding + spray of aqueous leaf extract combination (0.61 and 0.60%

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

Cropping system/ weed management practices		Kharif			Rabi
		Grasses	Sedges	Total	BLW's
Raipur (Rice-mustard)					
Weedy check		-	-	27.5	387.3
Kh. Use of cono weeder with square planting **Rb**.Stale seed bed		-	-	8.8	112.3
1 HW at 25-30 DAT		-	-	13.2	183.7
2 HW at 25-30 and 45-50 DAT		-	-	3.4	38.3
Aquious spray at 15-20 DAT + 1 HW at 40-50 DAT		-	-	7.1	217.3
				SEm± CD	SEm± CD
				1.1 3.6	16.7 54.3
Pantnagar					
Basmati rice-wheat-*sesbania*					
Kh. Weedy check	Rb. Weedy check	61.7	97.3		238.7
Kh. Use of conoweeder	Rb. One HW at 25-30 DAS	26.3	39.3		110.7
Kh. One hand weeding at 25-30 DAT	Rb. Two HW at 25-30& 45-50 DAS	14.7	27.0		34.0
Kh. Two hand weeding at 25 & 45-50 DAT	Rb. Stale seed bed + 1HW at 30-35 DAS	28.7	34.3		95.3
Basmati rice-lentil-*sesbania*					
Kh. Weedy check	Rb. Weedy check	49.0	88.0		346.0
Kh. Use of conoweeder	Rb. One HW at 25-30 DAS	27.0	54.7		196.0
Kh. One hand weeding at 25-30 DAT	Rb. Two HW at 25-30& 45-50 DAS	17.0	12.7		34.7
Kh. Two hand weeding at 25 & 45-50 DAT	Rb. Stale seed bed + 1HW at 30-35 DAS	17.0	52.7		127.3
Basmati rice-*Brassica napus*-*sesbania*					
Kh. Weedy check	Rb. Weedy check	37.7	90.7		244.7
Kh. Use of conoweeder	Rb. One HW at 25-30 DAS	29.3	55.0		102.3
Kh. One hand weeding at 25-30 DAT	Rb. Two HW at 25-30& 45-50 DAS	16.7	11.0		33.7
Kh. Two hand weeding at 25 & 45-50 DAT	Rb. Stale seed bed + 1HW at 30-35 DAS	28.0	39.3		88.0

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

Cropping system/ weed management practices	Kharif		Rabi	
Karjat (Rice-greengram)				
Unweeded control	5.5		-	
2Hand Hoeings – 20 & 40 DAT	1.6		-	
Spraying aqueous leaf extract of Ipomea carnea@ 10 per cent – 10DAT	4.2		-	
2HHs+ Spr. *Ipomea carnea*	1.7		-	
Mulching with *Ipomea carnea*@ 5 t ha^{-1} – 10DAT	2.4		-	
Incorporation of *Ipomea carnea*@ 10 t ha^{-1}	2.2		-	
Spraying aqueous leaf extract of *Chromolaena odorata* @ 10 per cent – 10DAT	4.3		-	
2HHs+ Spr. *Chromolaena odorata*	1.5		-	
Mulching with *Chromolaena odorata*@ 5 t ha^{-1} – 10DAT	2.9		-	
Incorporation of *Chromolaena odorata*@ 10 t ha^{-1}	2.2		-	
2 Hand weedings – 20 & 40 DAT	0.9		-	
	SEm±	CD		
	0.4	0.8	-	
Ludhiana (Rice-wheat)				
Kh. HW @25-30 DAT ***Rb.*** HW @25-30 DAS	8.9		39.0	
Kh. 2 HW @25-30 and 45-50 DAT ***Rb.*** 2 HW @30-35 and 45-50 DAS	9.2		36.0	
Kh. ES@15-30DAT+HW@40-45DAT ***Rb.*** ES@15-30DAS+HW@40-45DAS	11.0		36.8	
Kh. Sq planting+paddy weeder ***Rb.*** Bed sowing+2HW@30-35&45-50DAS	9.0		37.1	
Kh. High density+hw@25-30DAT ***Rb.*** High seed rate (25%)+15cm spacing	8.3		47.7	
Control	15.4		52.7	
	SEm±	CD	SEm±	CD
	1.3	2.7	3.3	6.9

Cropping system/ weed management practices	Kharif	Rabi	SEm±	CD
Pantnagar				
Basmati rice-wheat-*sesbania*				
Kh. Weedy check ***Rb.*** Weedy check	-	88.9		
Kh. Use of conoweeder ***Rb.*** One HW at 25-30 DAS	-	40.7	2.7	7.4
Kh. One hand weeding at 25-30 DAT ***Rb.*** Two HW at 25-30& 45-50 DAS	-	17.9	2.8	5.8
Kh. Two hand weeding at 25 & 45-50 DAT ***Rb.*** Stale seed bed + 1HW at 30-35 DAS	-	34.1	5.0	11.4
Basmati rice-lentil-*sesbania*				
Kh. Weedy check ***Rb.*** Weedy check	-	76.3		
Kh. Use of conoweeder ***Rb.*** One HW at 25-30 DAS	-	61.9	4.8	10.1
Kh. One hand weeding at 25-30 DAT ***Rb.*** Two HW at 25-30& 45-50 DAS	-	16.8		
Kh. Two hand weeding at 25 & 45-50 DAT ***Rb.*** Stale seed bed + 1HW at 30-35 DAS	-	69.9		
Basmati rice-*Brassica napus-sesbania*				
Kh. Weedy check ***Rb.*** Weedy check	-	83.1		
Kh. Use of conoweeder ***Rb.*** One HW at 25-30 DAS	-	54.0		
Kh. One hand weeding at 25-30 DAT ***Rb.*** Two HW at 25-30& 45-50 DAS	-	22.3		
Kh. Two hand weeding at 25 & 45-50 DAT ***Rb.*** Stale seed bed + 1HW at 30-35 DAS	-	37.6		

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

Cropping system/ weed management practices	*Kharif*	*Rabi*	*Kharif*	*Rabi*
Jabalpur	**Rice-Wheat(GY)**		**Rice-Wheat(GY)**	
Unweeded control	4106	3956	7760	6531
Two hand weeding /mechanical weeding	5629	5302	9399	8216
Spray of 3-4 leaf stage of weeds	4356	4732	8232	6861
Two hand weeding /mechanical weeding + Spray of 3-4 leaf stage of weeds	5951	5593	10714	8389
Weed free	6753	6235	11412	9474
	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	0.1 0.5	0.1 0.5	0.1 0.5	0.1 0.5
Coimbatore	**Rice-Black gram-GM**		**Rice-Blackgram-GM (SY)**	
Unweeded control	1568	645	2380	
Two hand weeding	3374	742	4828	
Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree	1843	690	3286	
Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree	3338	705	4320	
Weed free	3843	773	5148	
	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	88 288	31 NS	124 430	
Raipur	**Rice-Mustard (GY)**		**Rice-Mustard (SY)**	
Weedy check	2417	469	3806	1509
Kh. Use of cono weeder with square planting ***Rb.*** Stale seed bed	3677	704	5373	2181
1 HW at 25-30 DAT	3789	713	5917	2236
2 HW at 25-30 and 45-50 DAT	3952	761	5844	2292
Aquious spray at 15-20 DAT + 1 HW at 40-50 DAT	3521	725	5434	2268
	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	84 276	18 59	95 310	62 204

Cropping system/ weed management practices	*Kharif*	*Rabi*	*Kharif*	*Rabi*
Dharwad	**Groundnut(GY)**			
Aqueous spray of *cassia* at 25% as pre-emergent application	2559	-	-	-
Aqueous spray of *cassia* at 25%as post-emergent application	2765	-	-	-
Aqueous spray of *parthenium* at 25% as pre-emergent application	2621	-	-	-
Aqueous spray of *parthenium* at 25% as post-emergent application	2687	-	-	-
Aqueous spray of *Prosopis juliflora* at 25%as pre-emergent application	2683	-	-	-
Aqueous spray of *Prosopis juliflora* at 25%as post-emergent application	2702	-	-	-
One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS	3063	-	-	-
One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS+Aqueous spray of *cassia* at 25%as pre-emergent application	2944	-	-	-
One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS+Aqueous spray of *parthenium* at 25%as pre-emergent application	3174	-	-	-
One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS+Aqueous spray of *Prosopis juliflora* at 25% as pre-emergent application	3008	-	-	-
Sorghum stubble mulch	3131	-	-	-
Wheat straw mulch	3141	-	-	-
Weed free	3403	-	-	-
Weedy check	2356	-	-	-
	SEm± CD			
	118 344			
Karjat		**Rice - Green gram (GY)**		**Rice - Green gram (SY)**
Unweeded control	2130		2500	
2 Hand Hoeings - 20&40 DAT	2637		3733	
Spraying aqueous leaf extract of *Ipomea carnea*@ 10 per cent – 10DAT	2333		3067	
2HHs+ Spr. *Ipomea carnea*	2660		3800	
Mulching with *Ipomea carnea*@ 5 t ha^{-1} – 10DAT	2369		3100	
Incorporation of Ipomea carnea@ 10 t ha^{-1}	2667		3833	
Spraying aqueous leaf extract of *Chromolaena odorata* @ 10 per cent – 10DAT	2337		2967	

Cropping system/ weed management practices	*Kharif*	*Rabi*	*Kharif*	*Rabi*
2HHs+ Spr. Chromolaena odorata	2613		3767	
Mulching with *Chromolaena odorata* @ 5 t ha^{-1} – 10DAT	2452		3200	
Incorporation of *Chromolaena odorata*@10 t ha-1	2650		3800	
Hand weedings -20&40 DAT	2868		4167	
	SEm± CD		SEm± CD	
	104 306		254 749	
Ludhiana	**B.Rice – Wheat (GY)**		**B.Rice – Wheat (SY)**	
Kh. HW @25-30 DAT Rb.HW @25-30 DAS	4416	28.42	13040	4520
Kh. 2 HW @25-30 and 45-50 DAT ***Rb.*** 2 HW @30-35 and 45-50 DAS	4282	27.00	13814	4524
Kh. ES@15-30DAT+HW@40-45DAT ***Rb.*** ES@15-30DAS+HW@40-45DAS	4308	28.70	13624	4334
Kh. Sq planting+paddy weeder ***Rb.*** Bed sowing+2HW@30-35&45-50DAS	4206	26.46	13124	3768
Kh. High density+hw@25-30DAT ***Rb.*** High seed rate (25%)+15cm spacing	4282	20.01	13670	3468
Control	4140	22.14	13522	4006
	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	169 NS	105 309	552 NS	39 NS
Umiam	**Maize (green cob)–mustard (GY)**		**Maize (green cob)– Mustard (SY)**	
Mechanical weeding (20 DAS) + HW once (60 DAS)	3288	452	8021	770
Mulching with fresh *Eupatorium*/ *Ambrossia* @ 10t/ha (After earthing up)	3938	675	9475	1409
Aqueous leaf extract spray of *lantana* & *pine spp.* at 3-4 leaf stage of weed	3642	514	9117	929
HW twice (20 & 40 DAS)	2888	379	7337	570
Aqueous leaf extract spray of *lantana* & *pine* + hand weeding twice	3556	484	8550	822
Soybean green manure incorporation in situ (1:1) + HW once	3144	393	7836	663
Weed free check	3042	389	7849	582
Weedy check	2675	348	5763	538
	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	142 431	69 NS	152 462	156 147

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

	Basmati rice – wheat-*Sesbania* (GY)		Basmati rice– wheat-*Sesbania* (SY)		Basmati rice– lentil-*Sesbania* (GY)		Basmati rice– lentil-*Sesbania* (SY)		Basmati rice– *Brassica napus*-*Sesbania* (GY)		Basmati rice– *Brassica napus*-*Sesbania* (SY)	
	Kharif	***Rabi***	***Kharif***	***Rabi***	***Kharif***	***Rabi***	***Kharif***	***Rabi***	***Kharif***	***Rabi***	***Kharif***	***Rabi***
Pantnagar												
Kh. Weedy check ***Rb.*** Weedy check	2117	2216	3013	3382	2209	379	3486	1392	1971	566	3138	1317
Kh. Use of conoweeder ***Rb.*** One HW at 25-30 DAS	3223	2987	5153	4510	3427	883	5245	1533	3006	825	4991	1696
Kh. One hand weeding at 25-30 DAT ***Rb.*** Two HW at 25-30& 45-50 DAS	2411	3958	3928	5157	2556	972	4143	1947	2207	1165	3461	2603
Kh. Two hand weeding at 25 & 45-50 DAT ***Rb.*** Stale seed bed + 1HW at 30-35 DAS	3063	3329	4743	4842	3110	856	5168	1719	3003	924	4839	1797
	SEm± CD	SEm± CD	SEm± CD	SEm± CD								
	66 NS	54 210	57 223	54 214								
	69 207	36 106	95 281	88 261								
	124 NS	76 262	153 NS	143 444								
	121 NS	62 184	163 NS	152 452								
Ranchi	**Rice – Wheat (GY)**		**Rice – Wheat (SY)**		**Rice – Linseed (GY)**		**Rice – Linseed (SY)**					
Unweeded Control	277	1637	477	2910	233	383	437	843				
Two hand hoeing 25 & 40 DAT/ DAS	1800	2273	2473	3517	1740	723	2407	1177				
Aqueous leaf extract at 3-4 leaf stage of weeds.	640	1700	1000	3090	610	403	1010	970				
Two hand hoeing 25 & 40 DAT/ DAS + Aqueous leaf extract at 3-4 leaf stage of weeds	1893	2333	2567	3700	1863	760	2543	1343				
Weed free (manual).	2013	2453	2777	3849	1953	830	2654	1497				
One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds	1067	2000	1463	3210	977	563	1250	1053				
	SEm± CD	SEm± CD	SEm± CD	SEm± CD								
	25 NS	35 210	83 NS	15 92								
	77 228	76 226	107 314	97 285								
	103 NS	105 NS	161 NS	126 NS								
	110 NS	108 NS	151 NS	136 NS								

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

Cropping system/weed management practices*	Rice-Blackgram-GM						
	Bulk density	pH	EC	OC	N	P	K
1. Coimbatore							
Unweeded control				0.55	238	20.2	621
Two hand weeding				0.59	240	22.9	573
Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree				0.60	235	23.0	540
Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree				0.60	242	23.4	594
Weed free				0.61	250	22.0	557
				SEm± CD	SEm± CD	SEm± CD	SEm± CD
				0.01 0.01	7 NS	0.8 NS	20 NS
Raipur	**(Rice-mustard)**						
Weedy check	1.43	7.6	0.19	0.43	204	9.6	293
Kh. Use of cono weeder with square planting ***Rb.*** Stale seed bed	1.41	7.6	0.18	0.45	213	10.9	297
1 HW at 25-30 DAT	1.39	7.6	0.19	0.47	213	11.2	304
2 HW at 25-30 and 45-50 DAT	1.38	7.6	0.16	0.48	222	14.0	31
Aquious spray at 15-20 DAT+ 1 HW at 40-50 DAT	1.44	7.6	0.20	0.48	216	12.8	307
	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	0.02 NS			0.01 0.03	10 NS	0.9 NS	6 NS
Umiam	**Maize (green cob) - mustard**						
Mechanical weeding (20 DAS) + HW once (60 DAS)	1.31	5.24		2.35	251	22.1	274
Mulching with fresh *Eupatorium/ Ambrossia* @ 10t/ha (After earthing up)	1.19	5.17		2.54	274	31.8	279
Aqueous leaf extract spray of *lantana* & *pine* spp. at 3-4 leaf stage of weed	1.30	5.18		2.31	244	21.7	264
HW twice (20 & 40 DAS)	1.13	5.23		2.35	262	23.9	263
Aqueous leaf extract spray of *lantana* & *pine* + hand weeding twice	1.18	5.09		2.47	253	22.5	266
Soybean green manure incorporation in situ (1:1) + HW once	1.39	5.27		2.74	270	28.0	275
Weed free check	1.29	5.28		2.36	248	20.3	271
Weedy check	1.25	5.32		2.12	226	16.8	249
	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD	SEm± CD
	0.04 0.12			0.10 0.29	3 11	1.85 5.3	3 11

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

Cropping system/weed management practices*	Rice-Blackgram-GM																			
	Bulk density	pH	EC	OC	N	P	K	Bulk density	pH	EC	OC	N	P	K	Bulk density	pH	EC	OC	N	P	K
Pantnagar	**Basmati rice – wheat-*Sesbania***							**Basmati rice – lentil-*Sesbania***							**Basmati rice – *Brassica napus*-*Sesbania***						
Kh. Weedy check Rb. Weedy check				0.95	349	24.6	241				1.02	354	27.5	233				0.96	366	23.8	232
Kh. Use of conoweeder Rb. One HW at 25-30 DAS				0.96	364	26.5	276				1.03	363	27.7	240				0.94	366	23.1	237
Kh. One hand weeding at 25-30 DAT Rb. Two HW at 25-30& 45-50 DAS				0.96	342	27.6	262				1.06	373	24.0	291				0.98	352	26.4	285
Kh. Two hand weeding at 25 & 45-50 DAT Rb. Stale seed bed + 1HW at 30-35 DAS				0.94	338	23.9	233				0.98	357	24.0	258				0.97	362	23.4	283

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

Cropping system/ weed management practices		NPK uptake by crop (kg/ha)								
		Kharif			Rabi			Summer		
		N	P	K	N	P	K	N	P	K
Pantnagar										
Basmati rice – wheat-*Sesbania*										
Kh. Weedy check	***Rb.*** Weedy check	46.5	6.38	50.1	57.3	8.43	61.4	-	-	-
Kh. Use of conoweeder	***Rb.*** One HW at 25-30 DAS	74.2	9.32	71.2	75.7	18.50	79.3	-	-	-
Kh. One hand weeding at 25-30 DAT	***Rb.*** Two HW at 25-30& 45-50 DAS	56.1	7.07	53.1	85.5	17.07	94.9	-	-	-
Kh. Two hand weeding at 25 & 45-50 DAT	***Rb.*** Stale seed bed + 1HW at 30-35 DAS	72.9	8.55	69.8	81.3	14.62	125.3	-	-	-
Basmati rice – lentil-*Sesbania*										
Kh. Weedy check	***Rb.*** Weedy check	50.8	7.14	50.1	41.9	2.50	22.8	-	-	-
Kh. Use of conoweeder	***Rb.*** One HW at 25-30 DAS	79.3	9.02	75.6	61.0	4.16	26.5	-	-	-
Kh. One hand weeding at 25-30 DAT	***Rb.*** Two HW at 25-30& 45-50 DAS	60.3	9.02	59.1	61.5	4.43	31.8	-	-	-
Kh. Two hand weeding at 25 & 45-50 DAT	***Rb.*** Stale seed bed + 1HW at 30-35 DAS	74.2	8.91	66.1	66.5	4.61	34.8	-	-	-
Basmati rice – *Brassica napus-Sesbania*										
Kh. Weedy check	**Rb.** Weedy check	45.4	5.81	44.8	17.2	3.20	22.7	-	-	-
Kh. Use of conoweeder	***Rb.*** One HW at 25-30 DAS	69.5	8.59	71.1	22.9	4.12	30.1	-	-	-
Kh. One hand weeding at 25-30 DAT	***Rb.*** Two HW at 25-30& 45-50 DAS	51.6	5.43	49.1	34.4	7.74	56.7	-	-	-
Kh. Two hand weeding at 25 & 45-50 DAT	***Rb.*** Stale seed bed + 1HW at 30-35 DAS	64.9	8.21	69.9	24.7	10.77	25.6	-	-	-

Cropping system/ weed management practices	NPK uptake by crop (kg/ha)								
	Kharif			Rabi			Summer		
	N	P	K	N	P	K	N	P	K
Ranchi									
Rice-wheat									
Unweeded Control	6.80	1.20	5.30	40.48	9.05	38.44	-	-	-
Two hand hoeing 25 & 40 DAT/ DAS	41.80	5.70	27.30	57.36	12.64	48.40	-	-	-
Aqueous leaf extract at 3-4 leaf stage of weeds.	15.40	2.40	10.70	40.04	9.64	37.04	-	-	-
Two hand hoeing 25 & 40 DAT/ DAS +Aqueous leaf extract at 3-4 leaf stage of weeds.	46.20	7.90	29.70	54.33	13.18	50.07	-	-	-
Weed free (manual).	50.00	8.40	32.80	60.96	12.99	54.29	-	-	-
One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds.	23.60	3.70	16.10	48.22	11.12	47.04	-	-	-
Rice-linseed									
Unweeded Control	5.90	1.00	4.60	11.32	5.13	27.44	-	-	-
Two hand hoeing 25 & 40 DAT/ DAS	41.20	6.10	26.60	18.91	8.54	39.81	-	-	-
Aqueous leaf extract at 3-4 leaf stage of weeds.	14.60	2.60	11.10	12.85	4.95	30.75	-	-	-
Two hand hoeing 25 & 40 DAT/ DAS +Aqueous leaf extract at 3-4 leaf stage of weeds.	45.30	7.60	30.00	20.29	9.00	45.18	-	-	-
Weed free (manual).	48.50	7.30	32.00	24.56	9.94	50.68	-	-	-
One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds.	22.30	3.30	14.00	16.93	7.01	35.24	-	-	-

Table 31. Influence of weed management practices under organic farming on soil microbial population (x10⁴ CFU/g) after the cropping cycle of rice-blackgram-green manure at Coimbatore

Cropping system/ weed management practices	Fungi		Bacteria		Actinomycetes	
Unweeded control	15.5		94		25.6	
Two hand weeding	17.4		99		26.3	
Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree	17.8		104		28.9	
Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree	16.4		107		28.3	
Weed free	18.8		102		29.6	
	SEm±	CD	SEm±	CD	SEm±	CD
	0.5	1.7	2.6	NS	0.9*	NS

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

Cropping system/ weed management practices	Gross returns	Cost of cultivation	Net returns	B:C ratio	Gross returns	Cost of cultivation	Net returns	B:C ratio
Jabalpur	**Rice - Wheat**							
Unweeded control	61517	30943	30574	1.99	-	-	-	-
Two hand weeding / mechanical weeding	83218	37248	45970	2.23	-	-	-	-
Spray of 3-4 leaf stage of weeds	70054	30604	39451	2.29	-	-	-	-
Two hand weeding /mechanical weeding + Spray of 3-4 leaf stage of weeds	87888	38703	49185	2.27	-	-	-	-
Weed free	98727	41322	57405	2.39	-	-	-	-
Coimbatore	**Rice-Blackgram-GM**							
Unweeded control	47498	20950	18873	0.90	-	-	-	-
Two hand weeding	74225	29500	33595	1.14	-	-	-	-
Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree	52773	22700	21723	0.96	-	-	-	-
Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree	71968	29480	31913	1.08	-	-	-	-
Weed free	80923	32120	37208	1.16	-	-	-	-

Cropping system/ weed management practices	Gross returns	Cost of cultivation	Net returns	B:C ratio	Gross returns	Cost of cultivation	Net returns	B:C ratio
Ranchi			**Rice - Wheat**				**Rice - Linseed**	
Unweeded Control	40012	48603	-8591	-0.49	11380	33501	-22121	-1.24
Two hand hoeing 25 & 40 DAT/ DAS	79692	53043	26650	0.98	44871	37386	7485	0.28
Aqueous leaf extract at 3-4 leaf stage of weeds.	48286	49053	-767	-0.14	18874	33951	-15076	-0.88
Two hand hoeing 25 & 40 DAT/ DAS +Aqueous leaf extract at 3-4 leaf stage of weeds.	82842	53493	29349	1.08	47754	37836	9919	0.40
Weed free (manual).	87535	54153	33382	1.22	50625	38274	12351	0.52
One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds.	60958	51273	9685	0.31	27744	35949	-8205	-0.47

respectively). Residual availability of soil N, P and K also followed the similar trend. Compared to unweeded check, hand weeding, hand weeding + leaf extract spray, leaf extract spray alone and weed free check recorded 12.2, 5.8, 14.8 and 21.2% higher fungal population. Though bacteria and actinomycetes population was not significantly influenced by weed management practices, numerically higher bacteria was observed under leaf extract spray while actinomycetes was higher under weed free check. Higher gross and net returns of ₹ 80923 and 37208 ha^{-1} was observed under weed free check in rice-blackgram-green manure system. The next best treatment for weed management in terms of economics was found to be two hand weeding alone to both the crops in the system. A reduction of 35% in net returns was observed under spray of aqueous leaf extract alone compared to two hand weeding practice. Unweeded check recorded 49% reduction in net returns over weed free condition.

Mechanical weeding in cotton under non chemical weed management at Coimbatore

Rice crop under non chemical weed management at Coimbatore

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

	Basmati rice – wheat-*Sesbania*				Basmati rice – lentil-*Sesbania*				Basmati rice – *Brassica napus*-*Sesbania*			
Pantnagar	**GR**	**CC**	**NR**	**B:C**	**GR**	**CC**	**NR**	**B:C**	**GR**	**CC**	**NR**	**B:C**
Kh. Weedy check ***Rb.*** Weedy check	89987	57250	32737	1.57	65837	54567	11270	1.22	63765	55798	7967	1.14
Kh. Use of conoweeder ***Rb.*** One HW at 25-30 DAS	130974	60509	70465	2.16	108942	57326	51616	1.94	96471	58557	37914	1.65
Kh. One hand weeding at 25-30 DAT ***Rb.*** Two HW at 25-30& 45-50 DAS	124405	64087	60318	1.94	88689	60403	28286	1.51	83460	61635	21825	1.35
Kh. Two hand weeding at 25 & 45-50 DAT ***Rb.*** Stale seed bed + 1HW at 30-35 DAS	131997	62525	69472	2.11	100347	59342	41005	1.73	98562	60573	37989	1.63

Raipur (Table 26, 28 and 29)

Weed management practices comprising of conoweeder with square planting in rice, stale seed bed in mustard, aqueous spray and hand weeding along with weedy check was evaluated under rice-mustard system and observations on weed count grain and straw yield along with soil fertility status were recorded. Maximum reduction in total weed count was observed with 2 hand weeding at 25-30 and 45-50 DAT in both the crops (reduction of 87.6% in rice and 90% in mustard compared to weedy check). Aqueous spray at 15-20 DAT + 1HW at 40-50 DAT recorded 74 and 43.8% mustard respectively. Use of conoweeder with square planting in rice contributed for 68% reduction while stale seed bed to mustard resulted in 71% reduction in total weed count. Though 2 hand weeding at 25-30 and 45-50 DAT recorded numerically higher yield of rice and wheat (3952 and 761 kg ha^{-1}), it was on par with use of conoweeder with square planting in rice and stale seed bed to mustard and 1 hand weeding at 25-30 DAT. Aqueous spray and one hand weeding recorded 10.9 and 5% reduction in yield compared to best performing treatment of 2 hand weeding to both the crops. Straw yield also exhibited similar trend as that of grain yield. Post harvest analysis of soil indicates, no significant variation in bulk density, pH, EC and available N, P and K. However organic carbon content was significantly influenced by weed management practices. Weedy check recorded lower organic carbon of 0.43% while 2 hand wedding and aqueous spray + 1 hand weeding practice recorded higher organic carbon content (0.48% in both the treatments).

Dharwad (Table 28)

Weed management practices under organic farming in groundnut was evaluated with 14 treatments comprising of aqueous leaf spray of cassia, parthenium, *Prospis juliflora* in each condition of pre and post emergence of weeds along with hand weeding, hand hoeing, sorghum stubble mulch, wheat straw mulch, weed free and weedy check. Pod yield of groundnut was recorded. The result indicates, weed free recorded higher pod yield of 3403 kg ha^{-1} which was at par with sorghum stubble and wheat straw mulch besides one hand weeding at 20 DAS + two hand hoeing at 20 and 40 DAS or with the aqueous spray of parthenium at 25% as pre emergent. Among the aqueous sprays, spray of cassia and *Prosppis juliflora* as post emergent was found to be more effective than pre or post emergence application of parthenium. Post emergence spray of aqueous leaf extract was found to be better than pre emergence application. On an average, 1 spray of aqueous leaf extracts alone recorded reduction in yield to the tune of 21.5% over weed free condition while the increase over weedy check was found to be 13.3% indicating usefulness of aqueous leaf extract which can be combined with hand weeding practices.

Karjat (Table 27 and 28)

Ten practices of weed control in rice crop was evaluated and observations on total dry weight of weeds, grain and straw yield were recorded. Maximum reduction in total dry weight of weeds was observed with 2 hand weeding at 20 and 40 DAT which recorded 83.6% reduction in total dry weight of weeds compared to unweeded control. Two hand hoeing + spray of *Chromolaena odorata* recorded the next best reduction in total dry weight of weeds (72.7%) over unweeded control. This was on par with 2 hand hoeing at 20 and 40 DAT and 2 hand hoeing + sprays of *Ipomea cornea*. Grain yield of rice indicates, though yield with 2 hand weeding at 20 and 40 DAT recorded higher yield of 2868 kg ha^{-1}, but it was on par with incorporation of *Chromolaena odorata* @ 10 t ha^{-1}, 2 hand hoeing at 20 and 40 DAT, 2 hand hoeing + spray of *Ipomea cornea*, incorporation of *Ipomoea cornea* @ 10 t ha^{-1} and 2 hand hoeing + spray of *Chromolaena odorata*. Unwedded check registered 25.7% reduction in yield compared to 2 hand weeding at 20 and 40 DAT. Straw yield of rice also exhibited the similar trend.

Ludhiana (Table 27 and 28)

Five management practices along with unweeded control was evaluated in basmati rice-wheat system. Observations on total dry weight of weeds, grain and straw yield were recorded. High density planting + hand weeding at 25-30 DAT recorded maximum reduction of total dry weight of weeds (8.3 gm^{-2}) which was on par with hand weeding at 25-30 DAT, hand weeding at 25-30 and 45-50 DAT and square planting

+ weeder in rice. In case of wheat, reduction in total dry weight of weeds was found to be higher (31.6%) in hand weeding at 30-35 and 45-50 DAS, but it was at par with hand weeding at 25-30 DAS, ES at 15-30 DAS+ hand weeding at 40-45 DAS and bed sowing + 2 HW@ 30-35 and 45-50 DAS. Use of high seed rate (25% higher) + 15 cm spacing in wheat could reduce the dry weight of weeds by 9.4% only. Two hand weeding @ 25-30 and 45-50 DAT and high density planting with one hand weeding in rice recorded same yield of 4282 kg ha^{-1} and it was not significantly different with other practices. In case of wheat, except use of high seed rate (25%) + 15 cm spacing and unweeded check, all the other practices recorded on par yield with ES @ 15-30 DAS + HW @ 40-45 DAS recording numerically higher yield (2870 kg ha^{-1}). The increase was found to be 29.6% over unweeded check. The straw yield of rice and wheat also followed the similar trend as that of grain yield.

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

Three weed management practices namely use of conoweeder during *kharif* and one hand weeding at 25-30 DAS, one hand weeding during *kharif* and two hand weeding at 25-30 and 45-50 DAS, two hand weeding at 25 and 45-50 DAT during *kharif* and stale seed bed + 1 hand weeding at 30-35 DAS along with weedy check were evaluated in three cropping systems namely basmati rice-wheat-*sesbania*, basmati rice-lentil-*sesbania* and basmati rice-*brassica napus*-*sesbania*. Observations on weed count, total dry weight, grain, straw yield, soil properties, NPK uptake by crops along with economics were taken. Grasses and sedges count during *kharif* and broad leaved weeds count during *rabi* was found to be significantly lower in all the three systems with one hand weeding at 25-30 DAT during *kharif* and 2 hand weeding at 25-30 and 45-50 DAS during *rabi*. Across the cropping systems, the reduction of grasses, sedges and broad leaved weeds was found to be 65.7, 81.8 and 87.3 % respectively due to 1 hand weeding during *kharif* and 2 hand weeding during *rabi*. Among the three cropping systems, basmati rice-*brassica napus*-*sesbania* recorded lower grasses, sedges and broad leaved weeds compared to other systems. The reduction in total dry weight of weeds during *rabi* was significantly higher in one hand weeding at 25-30 DAT during *kharif* and two hand weeding at 25-30 and 45-50 DAS during *rabi*. The reduction over weedy check was found to be 79.8, 77.9 and 73.1% in basmati rice-wheat-*sesbania*, basmati rice-lentil-*sesbania* and basmati rice-*brassica napus*-*sesbania* respectively. More than 50% reduction was also observed in conoweeder + hand weeding and hand weeding + stale seed bed techniques.

Significantly higher grain yield of basmati rice in all the three systems during *kharif* was recorded with use of conoweeder during *kharif* and one hand weeding at 25-30 DAS during *rabi* which registered on an average 53.2% increase in yield over weedy check. This was closely followed by two hand weeding at 25 & 45-50 DAT in *kharif* and stale seed bed + one hand weeding at 30-35 DAS during *rabi*. The yield of wheat and lentil during *rabi* was found to be significantly higher with one hand weeding at 25-30 DAT in *kharif* and two hand weeding at 25-30 and 45-50 DAS in *rabi*. The increase over weedy check was found to be 78.6 and 156.4% respectively for wheat and lentil. In case of *Brassica napus*, yield obtained with conoweeder + one hand weeding at 25-30 DAS and hand weeding + stale seed bed recorded on par yield. Weedy check registered significantly lower yield in all the three systems. Straw yield of all the crops in the three systems resulted in similar trend as that of grain yield. No significant variation in organic carbon, available soil N, P and K was observed in all the three systems with various weed management practices, although weedy check recorded lower values. Among the three systems residual organic carbon was found to be higher with basmati rice-lentil-*sesbania* system. Uptake of NPK was significantly higher in conoweeder + hand weeding in basmati rice while it was higher in 1 hand weeding during *kharif* and 2 hand weeding in *rabi* for lentil, *brassica napus* and wheat. Weedy check resulted in lower uptake in all the systems. Economic analysis indicates, in all the systems, use of conoweeder during *kharif* and one hand weeding at 25-30 DAS during *rabi* recorded higher gross, net returns and B:C raio in all the three systems. This was closely followed by one hand weeding during *kharif* and stale seed bed + 1 hand weeding during *rabi*. Among the three systems, basmati rice-wheat-*sesbania* recorded higher net return of ₹ 58248 ha^{-1} with B:C ratio of 1.95. In general, use of conoweeder, stale seed bed and hand weeding are found to be suitable weed management techniques under organic farming conditions.

Ranchi (Table 28a, 30, 32)

Four weed management practices involving hand hoeing, use of aqueous leaf extract and hand weeding were evaluated along with weed free and unweeded control in rice-wheat and rice-linseed system. Observations on grain, straw yield, NPK uptake and economics were taken. In all the systems, weed free recorded higher grain yield followed by two hand hoeing at 25 and 40 DAT/DAS with aqueous leaf extract spray at 3-4 leaf stage. Spray of aqueous leaf extract alone recorded reduction in yield to the tune of 68% in rice, 30.6% in wheat and 51.4% in linseed. Keeping the field free from weeds gave maximum yield advantage of 7 times in rice. In wheat and linseed, it was found to be 48 and 116% over unweeded control. Similar trend was observed for straw yield of all the crops. Keeping the field free of weeds through hand weeding recorded higher NPK uptake in all the crops and this was closely followed by two hand hoeing + aqueous leaf extract spray at 3-4 leaf stage of weeds. In both, rice-wheat and rice-linseed system, weed free recorded higher net return of ₹ 33382 and 12351 ha^{-1} and B: C ratio of 1.22 and 0.52 respectively followed by two hand weeding and aqueous leaf extract spray (Net return of ₹ 29349 and 9919 ha^{-1} respectively in rice-wheat and rice-linseed). Unweeded control and spray of aqueous leaf extract resulted in negative net returns and B:C ratio indicating loss, over investment.

Umiam (Table 28a, 29)

Six weed control treatments involving mechanical weeding (20 DAS) + hand weeding once (60 DAS) mulching with fresh *Eupatorium/Ambrosia* @ 10 t ha^{-1} (after earthing up), aqueous leaf extract spray of *lantana* and *pine* spp. at 3-4 leaf stage of weed, hand weeding twice at 20 and 40 DAS, aqueous leaf extract spray of *lantana* and pine+2 hand weeding and soybean green manure incorporation insitu (1:1) + one hand weeding was evaluated along with weed free and weedy checks in maize (green cob)-mustard system. Observations on grain, straw yield and post harvest soil parameters were taken. In both maize (green cobs) and mustard, mulching with fresh *eupatorium ambrosia* @ 10 t/ha (after earthing up) recorded higher yield followed by aqueous leaf extract spray of *lantana* and *pine* spp. at 3-4 leaf stage of weed. The increase in yield under mulching with fresh *Eupatorium/Ambrosia* was found to be 29.4 and 47.2% in maize and 73 and 93% in mustard over weed free and weedy checks respectively. Two hand weeding along with aqueous leaf extract spray of *lantana* and *pine* and mechanical weeding + one hand weeding to both the crops was more effective than two hand weeding (20 and 40 DAS) alone. Insitu incorporation of soybean green manure and hand weeding recorded lower yield compare to mulching or aqueous leaf extract spray. Straw also exhibited the similar trend. Post harvest analysis of soil sample indicates, bulk density was lower in mulching with *Eupatorium/Ambrosia* (1.19 g/cc). Soil was in acidic condition and no significant variation in pH was observed. Organic carbon content of soil ranged from 2.12 to 2.74 in various treatments with insitu incorporation of soybean as green manure + one hand weeding recording the higher organic carbon followed by mulching with fresh *Eupatorium/Ambrosia* @ 10 t ha^{-1} (2.54%). Residual available NPK was higher with mulching (274, 31.8 and 279 kg ha^{-1} of NPK respectively) which was very closely followed by insitu incorporation of soybean as green manure. The other management practices recorded significantly lower available residual NPK in soil.

Mustard in maize-mustard system at Umiam

8. PUBLICATIONS AND HUMAN RESOURCE DEVELOPMENT

8.1 Publications

Papers presented in conferences

Bala, B. (2010). Organic farming: A viable alternative for Sustainable Agriculture (A case study of Himachal Pradesh). Paper presented in *International Conference on Global Warming, Agriculture, Sustainable Development and public Leadership*. Organised by International School for Public Leadership, Indian School for Community Education and Manthan Educational Programme Society, India at Gujrat Vidyapeeth , Ahmedabad on March 11-13, 2010.

Bala, B., Chandel, Poonam, Sharma, K. D. and Rameshwar (2011). Economics of Organic composts: A case study of Organic Research Farm of CSKHPKV, Palampur. Paper presented in *National Symposium cum Brainstorming Workshop on Organic Agriculture*. Organised by Organic Agricultural Society of India, Palampur; ICAR, New Delhi; National Centre of Organic Farming, Ghaziabad (UP) and CSKHPKV, Palampur on April 19-20, 2011 at CSKHPKV, Palampur.

Kumar, Jitender (2011). Transplanting time- an effective cultural practice for production of organic cabbage and cauliflower crops in Kullu valley, Himachal Pradesh. Paper presented in *National Symposium cum Brainstorming Workshop on Organic Agriculture.* Organised by Organic Agricultural Society of India, Palampur; ICAR, New Delhi; National Centre of Organic Farming, Ghaziabad (UP) and CSKHPKV, Palampur on April 19-20, 2011 at CSKHPKV, Palampur

Kumar, Jitender and Parmar, D. K. (2011). Efficacy and economics of some plant extracts in conjunction with light and/or pheromone trapping for the management of fruit borer (Helicoverpa armigera) on tomato in Kullu valley, Himachal Pradesh. Paper presented in *National Symposium cum Brainstorming Workshop on Organic Agriculture*. Organised by Organic Agricultural Society of India, Palampur; ICAR, New Delhi; National Centre of Organic Farming, Ghaziabad (UP) and CSKHPKV, Palampur on April 19-20, 2011 at CSKHPKV, Palampur.

Parmar, D. K., Sharma Jitender Kumar and Singh, Gurudev (2011). Effect of organic vegetable production system on carbon sequestration and climate change mitigation in the Western Himalayas. In: Rang, A *et al.(eds.). Proc. Int. Conf. Preparing Agriculture for Climate Change.* February 6-8, 2011*,* Ludhiana, India: *Crop Improvement* Volume 38 (Spl. Issue), p 13-14.

Parmar, D. K., Thakur, D. R. and Sharma, Jitender Kumar. (2011). Changes in soil properties under different nutrient management practices and cropping systems. Paper presented in *National Symposium cum Brainstorming Workshop on Organic Agriculture*. Organised by Organic Agricultural Society of India, Palampur; ICAR, New Delhi; National Centre of Organic Farming, Ghaziabad (UP) and CSKHPKV, Palampur on April 19-20, 2011 at CSKHPKV, Palampur.

Thakur, D. R., Parmar, D. K. and Sharma, Jitender Kumar. (2011). Comparative efficacy of organic, inorganic and integrated management practices in crop productivity and economics of vegetable based cropping systems under mid- hill conditions of Himachal Pradesh. Paper presented in *National Symposium cum Brainstorming Workshop on Organic Agriculture*. Organised by Organic Agricultural Society of India, Palampur; ICAR, New Delhi; National Centre of Organic Farming, Ghaziabad (UP) and CSKHPKV, Palampur on April 19-20, 2011 at CSKHPKV, Palampur

Technical Bulletin

Dwivedi,B.S., Jain, R., Singh, N. and Tiwari, R.K.(2010). जैविक खेती, Tech. Bull., KVK,Rewa (MP), pp. 1-30.

Kumar, Jitender, Sharma, S. D. and Devlash, R. (2010). Bhartiya kisanon dwara viksit jaivik nashi- jeev prabandhan kee takneekein (a bulletin in Hindi). CSKHPKV, HAREC, Bajaura (Kullu). Courtesy: ICAR (NAIP), New Delhi, pp. 16.

Popular articles

Jain, R. and Dwivedi, B.S. (2010) स्वस्थ मृदा का आधार : केचुआ खाद, कृशक चेतना, (कृषि द्विमासिक पत्रिका) जबलपुर, मई–जून pp. 46 & 47.

Dwivedi, B.S, Jha, A. and Upadhyay, V.B. (2011). जैविक खेती कृषि उत्पादन में टिकाऊपन. कृषक शक्ति (द्विमासिक कृषि पत्रिका), जुलाई–अगस्त, पृष्ठ संख्या 20.

Dwivedi, B.S, and Jha, A. (2011). जैव उर्वरक के उपयोग. कृषक चेतना (द्विमासिक कृषि पत्रिका), जुलाई–अगस्त, पृष्ठ संख्या 22

8.2 Human Resource Development

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

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

2. Participation of Scientists in Seminars/workshops

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

9. APPENDIX

Details of crops and varieties used in experiment at various locations

Crop	Variety	Duration (days)
Jabalpur		
Rice	Pusa Basmati	-
Wheat	HD-4672 /MPO 1106	-
Chickpea	J-322	-
Seasmem	TKG-54	
Barseem	JB-1	-
Vegetable Pea	Arkel	-
Sorghum Fodder	MP Chari	-
Coimbatore		
GM (Sunhemp)	CO 1	48
Cotton	MCU 5	155
Maize	CO 1	110
Chillies	ULKA	159
Sunflower	CO 4	90
Brinjal	CO 2	158
Green manure	Daincha	52
Rice	White Ponni	158
Blackgram	COGG 973	62
Karjat		
Rice	*Karjat - 4*	Early
Groundnut	*SB-XI*	Early
Maize (Sweet corn)	*Sugar-75*	Early
Mustard	*Varuna*	Early
Dolichos bean(Green pod vegetable)	*Konkan Bhushan*	Early
Red pumpkin	*MPH 1*	Medium
Cucumber	*Himangi*	Medium
Green gram	*Vaishali*	
Mango	*Alphonso*	15 years old mango trees
Raipur		
Soybean	JS – 335	Medium
Berseem	JB-2	Medium

Crop	Variety	Duration (days)
Isabgol	GI-2	Medium
Onion	Nasik red	Medium
Safflower	NARI-NH 1	Medium
Rice	Kasturi	Medium
Chickpea	Vaibhav	Medium
Mustard	Pusa bold	Medium
Lentil	JL-1	Medium
Ranchi		
Rice	Birsamati	125 - 135 (Medium)
Wheat	K- 9107	130
Potato	Kufri Ashoka	95
Linseed	Shekhar	140
Lentil	PL 406	115
Calicut		
Ginger	Varada, Rejatha and Mahima	Short
Turmeric	Alleppey Supreme,Prathibha	Short
Black Pepper	Sreekara, Panniyur -1	Long
Pantnagar		
Sesbania	Ses pant - 1	
Rice	Pusa Basmati -1/ Pusa-1121	Medium
Wheat	PBW-343/ PBW-502	Medium
Lentil	Pant Lentil - 406	Medium
Vegetable Pea	Arkel	Early
B. napus	GLS-1	Medium
Chick pea	Pant Kabuli Chana-1	
Maize	PSM-6	
Moong	Pant Moong-5	
Bajaura		
Tomato (Summer)	No.7730	Medium
French bean (Summer)	Falguni	Medium
Cauliflower (Summer)	Megha	Medium
French bean (*Kharif*)	Contender	Medium
Cauliflower (*Kharif*)	Swati	Medium
French bean (*Kharif*)	Royal	Medium
Maize(*Kharif*)	Girija	Medium
Pea (*Rabi*)	Azad P-1	Medium
Cauliflower (*Rabi*)	Swati	Medium
Garlic(*Rabi*)	GHC-1	Long

Crop	Variety	Duration (days)
Coriander (Kharif)	Mediterranea	Medium
Dharwad		
Groundnut	GPBD-4	105-110 days
Rabi sorghum	DSV-4	Medium
Soybean	JS-335	85-90 days
Durum wheat	DWR-2006	85-90 days
Potato	Kufri Jawahar	85-90 days
Chickpea	JG-11	85-90 days
Cotton	DHB-915	175-180 days
Peas	Arka komal	60 days
Maize	Arjun	110-115 days
Chilli+onion	Byadagi dabbi+Arka kalyani	Medium
Sugar Cane	CO86032	
Chickpea	JJ-11	Long
	BGD-103	
	A-1	-
	BG-1105	-
	BG-256	-
	ICCV-10	-
	KAK-2	-
	ICCV-2	-
French bean	Arka Komal	
Umiam		
Maize(green cob/seed)	DA61-A	108 days
Soybean	JS-80-21	142days
Frenchbean	Naga local	129days
Toria	M-27	27 days
Tomato	Avinash-2	140 days
Potato	Kufri jyoti	100 days
Rice	IR-64/Lumpnah/Vivek dham/ Sahsarang-1/Bhalum-1	140/140/135/ 140/125 days
Carrot	New curoda	95 days

10. ANNEXURE

Contact Address of Centres

PDFSR, Modipuram

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ACRONYMS

ALE : Aquous leaf extract

ASE : Aquous seed extract

B:C : Benefit:Cost

BD : Biodynamic

CC : Cost of cultivation

CDM : Cowdung manure

Cu : Copper

EC : Enriched compost

ECe : Electrical conductivity

fb : followed by

Fe : Iron

FYM : Farm yard manure

GLM : Green leaf manure

GM : Green manure

GR : Gross returns

IM : Integrated management

K : Potassium

KC : Karanj cake

Mn : Manganese

MOP : Muriate of potash

N : Nitrogen

NC : Neem coated

NEOC : Non edible oil cakes

NPV : Nuclear Polyhedrosis virus

NR : Net returns

OC : Organic carbon

P : Phosphorus

PG : Panchagavya

pH : Negative logarithum of hydrogen ion concentration

PPM : Parts per million

RP : Rock phosphate

SSP : Single super phosphate

VC : Vermicompost

Zn : Zinc

NOTES

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Dr. B. Gangwar, Project Director, PDFSR reviewing the NPOF experiment at Coimbatore

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