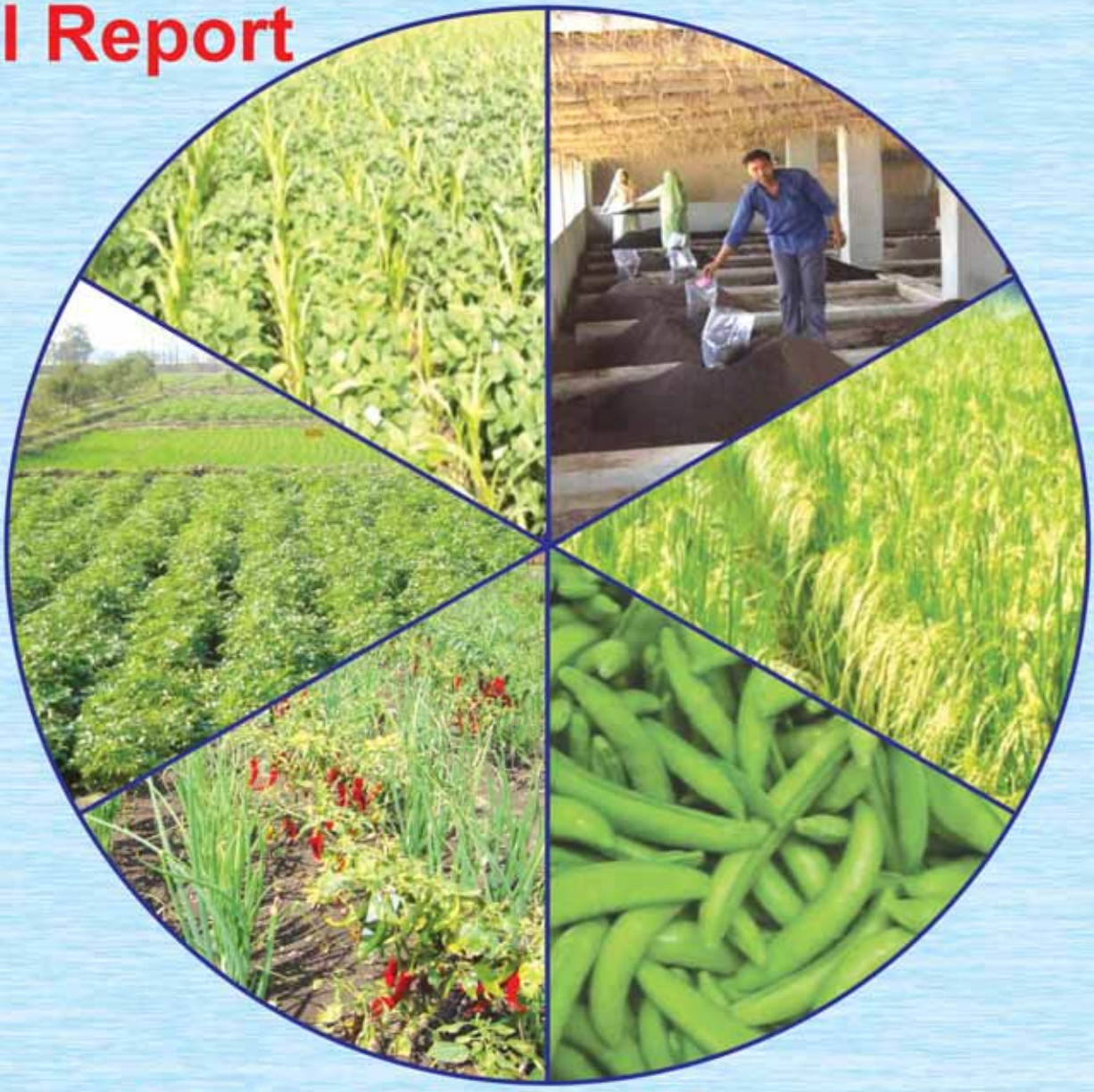
# 2013-14

# वार्षिक प्रतिवेदन
# Annual Report



## जैविक खेती नेटर्वक परियोजना
## Network Project on Organic Farming


भाकृअनुप–भारतीय कृषि प्रणाली अनुसंधान संस्थान
मोदीपुरम, मेरठ –250 110 (उ.प्र.), भारत

ICAR-Indian Institute of Farming Systems Research
Modipuram, Meerut-250 110 (U.P.), India


## *About IIFSR*

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

### Mandate

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

All India Coordinated Research project on Integrated Farming Systems (AICRP on IFS) is an integral part of IIFSR with 75 centres to undertake on-station and on-farm research across length and breadth of the country. The institute is also leading a Network Project on Organic Farming (NPOF) with 20 centres.

# Annual Report
# 2013-14


## NETWORK PROJECT ON ORGANIC FARMING

**ICAR-Indian Institute of Farming Systems 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 ICAR-IIFSR, Modipuram (report writing, compilation, editing and printing).
- The consolidated report is based on experimental data generated during *kharif*, *rabi* and *summer* seasons of 2012-13. The other details are relevant up to 31 March 2014.
- The report includes both processed and semi-processed data, generated in different experiments under NPOF and as such no material/ data should be reproduced in any form without prior written permission of the Director, ICAR-Indian Institute of Farming Systems Research and due credit to the concerned scientist (s).

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# ACKNOWLEDGEMENT

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

I am highly thankful to each and every one of the scientists and research fellows involved in the project at 13 centres for taking the pain to conduct the field experiments, lab analysis and generating data. The sincere efforts put forth by **Dr. N. Ravisankar**, Principal Scientist deserves appreciationfor drafting and editing of the report. Thanks and appreciations are also due to **Dr. Kamta Prasad**, Programme Facilitator (Co-ordination Unit) for extending the cooperation in preparation of report. I extend my appreciation to **Dr. Vipin Kumar**, Assistant Chief Technical Officer for their cooperation in compilation of the data, and its statistical analysis. I sincerely thanks to **Dr. B. Gangwar**, Former Director for guiding the programme till January, 2015.

The contributions of all the other scientific, technical, administrative and skilled supporting staff either directly or indirectly at various levels during preparation of this report are also acknowledged. I am sure; the significant findings obtained from the experiments will go in a long way in preparation of policy guidelines.

**(J.P. SINGH)**
***Director***

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# lkjk'k

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## tfod] vtfod vkj ,dh—r ic/ku mRiknu i.kkfy;k dk eY;kdu

- **ctkjk** e ,dh—r ic/ku d rgr VekVj dh vf/kdre inkokj 7780 fdxk@gŒ nt dh xbA bld vulj.k e tfod i)fr d rgr mit 7600 fdxk@gŒ nt dh xbA vTkfod idt dh ryuk e VekVj dh inkokj tfod vkj lefdr idt d lkFk de'kk 32 vkj 35 ifr'kr vf/kd gkuk ikb xb A QyxkHkh lerY; mit dh Hkk"kk e eDdk$QUpchu&yglu i.kkyh dh mYy[kuh; mit 37177 fdxk@gŒ d lkFk vPNh gkuk ik;h xbA

- **Hkkiky** e vtfod idt dh ryuk e tfod vkj lefdr ic/ku i)fr d v/khu lk;kchu dh mit de'kk 53 vkj 24 ifr'kr vf/kd nt dh xbA vtfod idt dh ryuk e xg] ljlk] puk vkj vylh dh vf/kdre mit tfod idt d vrxr ik;h xb tkfd de'kk 17] 15] 4 vkj 30 ifr'kr vf/kd FkhA

- **dkyhdV** e vdkcfud i)fr dh ryuk e ,dhdr vkj tfod idt d rgr vnjd d idUn dh mit e de'kk 159 vkj 68 ifr'kr dh of) gkuk ik;h xbA gYnh dh fdLe ,yihu vf/kdre idn mit 9200 fdxk@g0 tfod idt d rgr nh tcfd fdLe ifrHkk u vf/kdre mit 10300 fdxk@g0 jklk;fud idt d lkFk ikIr dhA dkyh fepu tfod ic/ku i)fr d lkFk 1513 fdxk@g0 mld ckn vtfod 838 fdxk@g0 vkj ,dhdr d lkFk 744 fdxk@g0 mit nt dhA

- **dk;cVj** e dikl] fep vkj cxu u vfrfjDr mit de'kk 107] 94 vkj 274 fdxk@g0 tfod idt dh ryuk e jklk;fud ic/ku d lkFk ikIr dhA eDdk vkj ljte[kh dh mit e tfod idt d rgr ,dhdr dh ryuk e de'kk 22 vkj 16-6 ifr'kr dh fxjkoV gkuk ik;h x;kA

- **/kkjokM** e vdkcfud dh ryuk e tfod idt d lkFk mit e of) 23-6] 58-1] 19-6] 19-1] 19-3] 17-7] 23-4] vkj 17-7% Øe'kk exQyh] lk;kchu] Tokj] xg] dikl] eVj] eDdk vkj pukd fy; vf/kd gkuk ik;k x;k FkkA vU; i.kkfy;k dh ryuk e eDdk&puk i.kkyh u lcl vf/kd eDdk led{k mit 8560 fdxk@gŒnt dhA

- **tcyijr** e tfod vkj ,dh—r idt d lkFk cklerh /kku e mit e deh Øe'k% 7 vkj 3-4 ifr'kr gkuk ik;k x;h tcfd xg] puk] cjlhe] eVj] fry vkj pkj dh Tokj e deokj 7-9] 3-6] 2] 10-6] 16 vkj 4-3 ifr'kr dh deh vTkfod dh ryuk e tfod idt d lkFk nt dh xbA

- **djtV** e [kjhQ d ekle e /kku dh vf/kdre inkokj ,dhdr ic/ku d vulj.k e jklk;fud idt d v/khu nt dh xbA vdkcfud dh ryuk e /kku dh mit e de'k% 10-4 vkj 5-5 ifr'kr dh deh tfod vkj ,dh—r i)fr d lkFk ik;h x;hA jch lhtu d njE;ku lHkh Qlyk e exQyh] eDdk] ljlk vkj leQyh u mYy[kuh; vf/kd inkokj vtfod idt d lkFk nt dhA jklk;fud dh ryuk e tfod i)fr d lkFk exQyh] eDdk] ljlk vkj leQyh e de'k% 7-8] 24-4] 6-7 vkj 9 ifr'kr dh mit e fxjkoV gkuk ik;h x;hA

- **yf/k;kuk** e [kjhQ d nkjku vtfod dh ryuk e tfod d v/khu cklerh /kku e 7-4 ifr'kr tcfd eDdk e 5-4 ifr'kr dh of) nt dh xbA urht crkr g fd jch d nkjkul;kt vkj vky dh inkokj e of) tfod i)fr d lkFk de'k% 13-8 vkj 37-7 ifr'kr vdkcfud dh ryuk e n[kh xb tcfd pu e 50 ifr'kr dh of) gkuk ik;h xbA blh rjg xh"e ex dh mit e tfod i)fr d rgr 2-1 ifr'kr dh of) nt dh xbA

- **eknhijr** e fofHkUu Qlyk d chpecklerh /kku] /kku] eDdk] ex vkj fHkUMh u tfod idt d rgr vf/kd mit nt dh tcfd xg] tk] ljlk] vky] eyh vkj Hkê¨ d fy; eDdk dh vi{kkdr vf/kd mit ,dhdr idt d rgr nt dh xbA xg dh mit e 29-6 ifr'kr rd dh of) tfod d v/khu ikb xb ;}|fi 40 ifr'kr rd dh of) ,dhdr i)fr d v/khu g¨uk ik;k x;k FkkA vdkcfud dh ryuk e tfod d v/khu cklerh /kku dh mit e 29-4 ifr'kr dh of) nt dh x;hA

- **iruxj** e [kjhQ d nkjku tfod idt d rgr cklerh pkoy dh mit e 20-2 ifr'kr dh mYy[kuh; of) gkuhx;h FkhA lfCt;k e eVj u tfod idt d v/khu ,dhdr vulj.k e Øe'k% 66320 vkj 5880 fdxk@gŒ d lkFk cgrj mit ikIr dhA tfod idt d vulj.k e ,dhdr d vrxr ljlk u de'k% 1917 vkj 1886 fdxk@g0 vf/kdre mit nt dhA

- **jk;ijr** e lk;kchu dh inkokj ,dh—r i)fr d v/khu 1752 fdxk@gŒ vi{kkdr vf/kdre ikb xb bld ckn tfod i)fr ¼1718 fdxk@gŒ½ rFkk vdkcfud ic/ku i)fr ¼1658 fdxk@g0½ dk LFkku FkkA tfod idt d lkFk bloxky vkj l;kt dh inkokj e fxjkoV 44 vkj 714 fdxk@g0 de'k% ik;h xb FkhA vtfod dh ryuk e dle dh inkokj 12-2 ifr'kr ,dh—r idt d v/khu cgrj ikb xbA

- **jkph** e [kjhQ /kku dh tfod i)fr d v/khu vf/kdre mit 4048 fdxk@gŒ ikIr dh xb tk fd ,dhdr vkj vtfod ic/ku dh ryuk e 8-9 vkj 42 ifr'kr vf/kd FkhA vtfod idt dh

ryuk e tfod idt d rgr vky rFkk vylh e 34 ,o 6-5 ifr'kr dh of) nt dh xbA /kku&vky i.kkyh }kjk 12984 fdxk0@gŒ /kku lerY; inkokj dj cgrj gkuk ik;k x;k A

- **mfe;e** e tfod idt d vrxr fofHkUu lfCt;k t l xkt j] vky] vkj VekVj t lh lfCt;k dh cgrj inkokj nt dh xb tk vdkcfud dh ryuk e Øe'k% 69-9] 14-6] 12-7 ifr'kr vf/kd FkhA vU; dh ryuk e /kku&VekVj i.kkyh u 19190 fdxk@gŒ dh nj l mPp /kku cjkcj mit nt dh FkhA

## ik"kd rRok gsrq fofHkUu tfod lkrk dk eY;kdu

- **ctkjk** e xkcj dh [kkn$ck;kMk;ufed d i;kx l /kfu;k dh mYy[kuh; vf/kdre mit 11371 fdxk0@gŒ nt dh xb tcfd jkdQkLQV le) xkcj dh [kkn$oeh dikLV$ipx0; d i;kx l QyxkHkh dh vf/kdre mit 13290 fdxk0@gŒ nt dh xbA
- **Hkkiky** e tfod [kkn$ipx0;$ck;kMk;ufed d l;Dr i;kx l xg dk NkMdj lHkh Qlyk e vf/kd mit nt dh xb rFkk vdy tfod [kkn dh ryuk e 52] 284 ,o 176 fdxk@gŒ l vf/kd mit Øe'k% lk;kchu] eDdk ,o puk e nt dh xbA xg d ekey e tfod [kkn ,o ipx0; d l;DRk i;kx l vf/kdre mit nt dh xbA
- **dk;CkVj** e xkcj dh [kkn$v[kk| [kyh$iR;d vk/kh u=tu dh nj ij$ipx0; d i;kx l eDdk ¼4159 fdxk0@gŒ½ ,o ljte[kh ¼1777 fdxk0@gŒ½ dh vf/kdre mit nt dh xbA tcfd dikl e xkcj dh [kkn$v[kk| [kyh$iR;d vk/kh u=tu d i;kx l vf/kdre mit nt dh xb gA
- **/kkjokM** e le) dikLV$oeh dikLV$gjh ifRr;k dh [kkn$ck;kMk;ufed ,o ipx0; d fNMdko l vf/kdrj Qlyk e cgrj in'ku lkk;k x;kA le) dikLV$oeh dikLV$gjh ifRr;k dh [kkn$ck;kMk;ufed$ipx0; d fNMdko l exQyh] Tokj] eDdk] puk] fep ,o l;kt e Øe'k% 99-3] 100] 69-3] 105-8] 133-9] ,o 82-1 dh mit of) ikb xbA
- **tcyiqj** e oeh dikLV$xkcj dh [kkn$v[kk| [kyh iR;d ,d frgkb u=tu$ipx0; d mi;kx l vf/kdre vuktdh mit 3432] 3785 ,o 214 fdxk@gŒ Øe'k% ckylerh pkoy] xg ,o cjlhe cht e nt dh xbA
- **djtV** e /kku&ykydnn vkj /kku&ddMh i.kkyh u xkcj dh [kkn$/kku dk Hkl k$ykbfjlhfM;k ifRr;k iR;d ,d frgkb u=tu dh nj l mi;kx dju ij [kjhQ e vf/kd mit nt dh vkj jch e xkcj dh [kkn$uhe [kyh$oeh dikLV iR;d ,d frgkb dh nj l d lkFk&lkFk ipx0; fNMdko dk i;kx dju ij /kku vkj ykydnn rFkk /kku vkj ddMh dh mit Øe'k% ¼3381] 13356 fdxk0@gŒ vkj 3541] 12665 fdxk0@gŒ½ nt dh xb FkhA

- **yf/k;kuk** e vdy ck;kMk;ufed dk;ç.kkyh dh ryuk e gjh [kkn ,o ipx0; d i;kx l eDdk ,o xg dh vukt vf/kdre mit Øe'k 5420 ,o 2170 fdxk0@gŒ vi{kkÑr ½2950 vkj 1450 fdxk0@gŒ½ nt dh xbA

- **eknhije** e xkcj dh [kkn$oeh dikLV$ipx0;$ck;kMk;ufed d lk;kx l cklerh /kku ,o xg d vukt mRiknu e Øe'k 4620 ,o 4700 fdxk0@gŒ dh vf/kdre mit nt dh xbA xkcj dh [kkn$oeh dikLV$ipx0;$ck;kMk;ufed d i;kx l EkDdk e Hkh vf/kdre mit 5380 fdxk0@gŒ nt dh xb t¨ fd dUV'y dh ryuk e 26 ifr'kr of) gkuk ikb xbA

- **iruxj** e xkcj dh [kkn$oeh dikLV$,ulh$blh iR;d ,d pkFkkb dh nj l cklerh /kku vukt dh mit 4535 fdxk0@gŒ nt dh xbA ck;kMk;ufed o ipx0;$xkcj dh [kkn$oeh dikLV$,ulh$blh dh iR;d dh ,d pkFkkb dh nj l i;kx dju ij pu dh vf/kdre mit 2440 fdxk0@gŒ ikIr dh xbA

- **jk;ij** e ck;kMk;ufed idt$blh$lhMh,e$v[kk| [kyh iR;d ,d frgkb d u=tu dh nj l$ipx0; d i;kx dju ij /kku ,o pu e Øe'k 4317 ,o 1271 fdxk0@gŒ mit nt dh xbA blh rjg dh iofRr ljlk ,o elj ¼odfYid ifDR i.kkyh½ e Hkh ikb xbA blh$lhM,e$v[kk| [kyh iR;d ,d frgkb d u=tu dh nj l$ck;kMk;ufed idt i;kx dju ij ljlk e 679 fdxk0@gŒ dh mit nt dh xbA

- **jkph** e oeh dikLV$fdjt [kyh$ck;kMk;ufed fofufer inkFk$ipx0; d i;kx l lHkh Qlyk e vf/kd inkokj nt dhA pkoy] xg ,o vky e Øe'k 4665] 2152 ,o 9524 fdxk0@gŒ dh mit nt dh xbA ipx0; ,o ck;kMk;ufed fofufer inkFk d i;kx d dkj.k mit e of) gb] oeh dikLV$fdjt [kyh iR;d vk/kk u=tu dh nj l pkoy ,o xg e U;ure gkuk ik;k x;kA

- **mfe;e** e xkcj dh [kkn$oeh dikLV d i;kx l eDdk ¼5840 fdxk0@gŒ½ VekVj ¼14537 fdxk0@gŒ½ ,o Qpchu ¼20927 fdxk0@gŒ½ dh vf/kdre mit nt dh xbA oeh dikLV vdy d i;kx l vky e Hkh l/kkj ik;k x;k rFkk 17323 fdxk0@gŒ mit nt dh xbA t¨ vdy dh xkcj dh [kkn d i;kx l 5-9 ifr'kr vf/kd FkhA

## tfod [krh e dhV vkj jkx ic/ku

- **ctkjk** e VekVj e Qy Nnd vkj vU; dkjd® ¼dhV vkj j®x® ½ dk idki fyiy ¼clyl Fkutufll 1-0 fdxk@gŒ dh nj l i;kx dju ij fu;U=.k dh ryuk e de FkA fofHkUUk tho dhVuk'kdk d chp e Mkbiy 8 ,y 0-5 yh0@g0 vkj uhecku 0-15 ifr'kr] 2-5 feyh0@yh0 dh nj l feJ.k dk fNMdko dju ij mYy[kuh; iHkko gkuk ik;k x;kA

- **dkyhdV** e vnjd vUr% ikni thok.k lØe.k ¼vkbvkb, lvkj 6]8]13]51]151vkj ihvkb, vkj 6] ihch21 lh dYpj½ vkj vnjd jkbtkcDVhfj;k ¼thvkjch 57½ d lkFk i.k fu;U=.k dh ryuk e de Fkk ble Øe'k% 90-9 vkj 50 ifr'kr dh deh n[kh xbA gYnh vkj idn dh vf/kdre mit **dkyhdV** e vnjd ,MkQk;kfVd thok.k thbch 18 d lkFk 14210 vkj 10900 fdxk@g0 ikIr dh xb A

- **eknhije** e ljlk ,o ckslerh /kku e gjh[kkn ,o to inkFk mipkfjr vkj vuipkfjr Hk[k.Mk e Øe'k% 4070 vkj 3835 fdxk@g0 vf/kdre vukt dhmit nt dh xbA

## tfod [krh d v/khu [kjirokj fu;U=.k

- **dk;cVj** e [kjirokj eDRk fLFkfr e 25&45 fnu jki.k mijkUr [kjirokjk dh l[;k ¼7-2 ,o 9-2 çfr ox eh0½ vkj dy 'k"dotu ¼0-3 ,o 3-9 xke çfr ox eh0½ e vf/kdre deh nt dh xbA mlh rjg pkoy ,o ex nkuk e ml [k.M e ryuk e] tgk [kjirokj fu;f=r ugh dh xb Fkh [kjirokj eDRk fLFkfr e Øe'k% 3829 rFkk 584 fdxk@g0 vf/kdre inkokj nt dh xbA

- **/kkjokM** e ,d fujkb gkFk }kjk 20 fnu cvkÃ mijkUr$nk fujkb g.M g© }kjk 20 RkFkk 40 fnuk ij$vdf'k;k dk tyh; fNMdko 25% mxu d igy dh fLFkfr e tgk [kjirokj fu;f=r ugh fd;k x;k Fkk dh ryuk e [kjirokjk dh l[;k e 43-5 rFkk 28-5% ,o 'k"d Hkkj e 66 rFkk 51-1 ifr'kr dh deh 20 l 60 fnuk ij ikb xb FkhA

- **tcyij** e [kjirokjk d nk fujkb gkFk l$ 3&4 iRrh dh voLFkk ij fNMdko d i;kx l /kku ,o xg dh vf/kdre mit Øe'k% 4724 fdxk@g ,o 4887 fdxk@g tcfd tgk [kjirokj fu;f=r ugh dh xb Fkh [kjirokj eDr voLFkk d lkFk nt dh xbA tk xg ,o /kku Øe'k% 129 ,o 181 ifr'kr vf/kd nt dh xbA

- **djtV** e nk fujkb gkFk d lkFk 20 RkFkk 40 fnuk e dju ij /kku,o ex dh vf/kdre mit ¼3993 rFkk 1542 fdxk@g0½ nt dh xb A mld mijkr vkbikfe;k dkfu;k 10 Vu@g0 d leko'k }kjk /kku ,o ex dh vf/kdre mit ¼3736 rFkk 1463 fdxk@g0½ ikIr gbA tk Øe'k% /kku ,o ex e 24 ,o 36-2 ifr'kr tgk [kjirokj fu;=.k ugh fd; x; Fk fd ryuk e vf/kd nt dh xbA

- **yf/k;kuk** e /kku e [kjirokjk d dy 'k"dotu ¼8-1 xke@oXk eh½ dh vf/kdre deh 25&30 fnu d mPp l?ku jki.k$gkFk fujkb }kjk nt dh xbA /kku e 25&30 fnu ,o 45&50 fnu ij nk fujkb gkFk }kjk dju ij /kku dh vf/kdre mit 3254 fdxk@g0 nt dh xbA xg e D;kjh cvkb$nk fujkb gkFk }kjk 30&35 vkj 45&50 fnu cvkb mijkr dju ij xg dh vf/kdre mit 3450@g0 nt dh xbA tk Øe'k% 25 ifr'kr vf/kd cht nj$15 leh- d vrj vkj dh ryuk e 48-3 vkj 57-8 ifr'kr dh of) gkuk ikb xbA

- **iruxj** e dkukohMj d i;kx l [kjhQ d nkjku lHkh rhuk i)fr;k e cklerh /kku dh mit e mYy[kuh; of) nt dh xbA jch d nkjku 25&30 fnu e ,d fujkb gkFk }kjk dju l vkl ru 34-4 ifr"kr of) nt dh xbA

- **jk;ij** e ljlk ,o /kku e 25&30 vkj 45&50 fnu jki.k d ckndy [kjirokj dh l[;k e nk fujkb gkFk }kjk i;kx l vf/kdre deh nt dh xb rFkk [kjirokj fu;=.k dh ryuk e /kku rFkk ljlk e Øe'kh 73-6 ifr'kr ,o 87-5 ifr'kr dh deh ikb xbA

- **jkph** e [kjhQ ,o jch d nkjku nkuk i.kkfy;k e [kjirokj d 'k"d Hkkj e nk fujkb gkFk l 25 vkj 40 fnu jki.k@cvkb d ckn dju ij rFkk iRrh d lRr d fNMdko d lkFk mYy[kuh; deh nt dh xbA

- **mfe;e** e nk ckj gkFk l fujkb dju ij [kjirokjk dh l[;k e ,o 'k"d Hkkj e mYy[kuh; deh gbA eDdk vkj rkfj;k dh vf/kdre mit] rkt ;iVkfj;e ,eckfl;k 10 Vu@g dh nj l ¼Hkl;k tu d ckn½ d lkFk ikIr dh Fkh mld ckn lk;kchu gjh [kkn d :Ik e i;kx dju ij $ ,d fujkb gkFk d i;kx l ikIr gbA rkt ;iVkfj;e ,eckfl;k dk iyokju l [kjirokj eDr vkj [kjirokj fu;=.k dh ryuk e Øe'kh eDdk e 33-7 ,o 45-3 ifr'kr vkj rkfj;k e 40-9 ,o 67-6 ifr'kr dh of) ikb xbA

# ABSTRACT

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

## Evaluation of organic, inorganic and Integrated Management production system

- Tomato recorded higher yield under integrated (7780 kg $ha^{-1}$) followed by organic (7600 kg $ha^{-1}$). Yield increase was found to be 32% and 35% with organic and integrated management over inorganic package respectively. In term of cauliflower equivalent yield, maize+frenchbean-garlic was found to be better as it registered significantly higher yield of 37177 kg $ha^{-1}$ at **Bajaura.**

- Soybean recorded 53 and 24% higher grain yield under organic and integrated over inorganic respectively. Wheat, mustard, chickpea and linseed recorded significantly higher yield with organic package compared to inorganic and the yield increase was found to be 17, 15, 4 and 30% respectively. Among the systems, soybean-chickpea (2019 kg $ha^{-1}$) and soybean-wheat (1825 kg $ha^{-1}$) was found to be better than other systems at **Bhopal.**

- Yield increase in ginger was found to be 159 and 68% under integrated and organic package compared to inorganic respectively. Turmeric variety Alleppey gave higher rhizome yield (9200 kg $ha^{-1}$) under organic package while Prathibha recorded higher with inorganic package (10300 kg $ha^{-1}$). Black pepper registered higher yield under organic (1513 kg $ha^{-1}$) followed by inorganic (838 kg $ha^{-1}$) and integrated (744 kg $ha^{-1}$) at **Calicut.**

- The additional yield obtained with inorganic package was found to be 107, 94 and 274 kg $ha^{-1}$ compared to organic package of cotton, chilli and brinjal respectively. The drop in yield under organic package over integrated was found to be 22, 16.6% for maize and sunflower at **Coimbatore.**

- The yield increase over inorganic was found to be 23.6, 58.1, 19.6 and 19.1% in groundnut, soybean, sorghum and wheat and 19.3, 17.7, 23.4 and 17.7% for cotton, pea, maize and chickpea respectively. Maize-chickpea registered higher maize equivalent yield (8560 kg $ha^{-}$) than other systems at **Dharwad.**

- The yield reduction observed in basmati rice with organic and integrated package was found to be 7 and 3.4% while, in wheat, chickpea, berseem, vegetable pea, sesamum, and sorghum (fodder) was 7.9, 3.6, 2, 10.6, 16 and 4.3% reduction with organic package compared to inorganic at **Jabalpur.**

- *Kharif* rice registered higher yield under inorganic followed by integrated management package. The reduction in mean yield of rice with organic and integrated package was found to be 10.4 and 5.5% respectively over inorganic. During *rabi* also, all the crops (groundnut, maize for cob, mustard and dolichos bean) have recorded significantly higher yield under inorganic package. The yield drop of groundnut, maize, mustard and dolichous bean was found to be 7.8, 24.4, 6.7 and 9% respectively with organic over inorganic package at **Karjat.**

- Basmati rice recorded 7.4% yield increase whereas maize recorded 5.4% under in *kharif*. In *rabi*, the results revealed that an increase in yield of onion and potato by 13.8 and 37.7% under organic over inorganic package while gram yield increase was found to be 50%. Similarly, in summer moong, it was found that 2.1% in yield under organic package at **Ludhiana.**

- Basmati rice, rice, maize for grains, greengram and okra recorded higher yield under organic system while wheat, barley, mustard, potato, radish and maize for cob have recorded higher yield under integrated package. Wheat registered increase in yield to the tune of 29.6% with organic package

while, the increase was found to be 40% under integrated. In case of basmati rice, it was observed that 29.4% higher yield under organic system at **Modipuram.**

- Significantly higher yield of basmati rice during *kharif* was observed with organic package as it was found to be increase 20.2% over inorganic package. Vegetable pea produced better yield (66320 kg $ha^{-1}$) under organic followed by integrated (5880 kg $ha^{-1}$). *Brassica napus* recorded higher yield (1917 kg $ha^{-1}$) under integrated followed by organic (1886 kg $ha^{-1}$) package at **Pantnagar.**

- Yield of soybean was found to be higher under integrated package (1752 kg $ha^{-1}$) followed by organic (1718 kg $ha^{-1}$) in comparison to inorganic (1658 kg $ha^{-1}$). The drop in yield of isabgol and onion with organic package was found to be 44 and 714 kg $ha^{-1}$ respectively compared to inorganic package. Safflower recorded 12.2% higher with integrated as compared to inorganic at **Raipur.**

- Rice recorded higher yield of 4048 kg $ha^{-1}$ during *kharif* under organic which is 8.9 and 42% higher than integrated and inorganic management practices respectively. Potato and linseed recorded 34 and 6.5% increase in yield under organic over inorganic package. Rice-potato system was found to be better in term of rice equivalent yield (12984 kg $ha^{-1}$) with organic package at **Ranchi.**

- Among the vegetable crops, carrot, potato and tomato have recorded 69.9, 14.6 and 12.7% higher yield with organic over inorganic package. Among the systems, rice-tomato system recorded higher rice equivalent yield (19190 kg $ha^{-1}$) among the systems at **Umiam.**

### Evaluation of sources of nutrients for organic package

- Application of FYM *fb* biodynamic recorded significantly higher yield of coriander (11371 kg $ha^{-1}$) while yield of cauliflower (13290 kg $ha^{-1}$) was recorded with application of rock phosphate enriched FYM + VC (1:1)+ *fb*panchgavya at **Bajaura.**

- Combined application of OM+PG+BD registered higher yield in all crops except wheat and the yield increase over organic manure alone was found to be 52, 284 and 176 kg $ha^{-1}$ in soybean, maize and chickpea respectively. In case of wheat, it recorded higher yield with the combination of organic manure and panchgavya at **Bhopal.**

- Application of nutrients through FYM+NEOC @ ½ N each+ panchgavya recorded higher yield of, maize (4159 kg$ha^{-1}$), chillies (4897 kg $ha^{-1}$) and sunflower (1777 kg $ha^{-1}$). Cotton which recorded higher yield (1422 kg $ha^{-1}$) with the application of FYM+NEOC @ ½ N at **Coimbatore.**

- Performance of EC+VC+GLM+biodynamic @ 12g $ha^{-1}$ with panchgavya spray was found to be better in most of the crops. The yield increase in EC+VC+GLM+biodynamic+Panchgavya spray was found to be 99.3, 100, 69.3, 105.8, 133.9 and 82.1% in groundnut, sorghum, maize, chickpea, chilli and onion respectively over control at **Dharwad.**

- Application of nutrients through VC+FYM+NEOF @ 1/3 N each+panchgavya recorded higher grain yield (3432, 3785 and 214 kg of basmati rice, wheat and berseem seed $ha^{-1}$) at **Jabalpur.**

- Rice, red pumpkin and cucumber recorded higher yield with application of FYM+rice straw+*glyricidia* leaves @ 1/3$^{rd}$ each of N during *kharif* and FYM+ neemcake+vermicompost @ 1/3 each of N during *rabi* along with spray of Panchgavya (3381 and 13356 kg $ha^{-1}$ of rice-red pumpkin and 3541 and 12665 kg $ha^{-1}$ of rice-cucumber respectively) at **Karjat.**

- Significantly higher grain yield of maize and wheat (5420 and 2170 kg $ha^{-1}$respectively) was recorded with green manure and panchgavya than biodynamic practice alone (2950 and 1450 kg $ha^{-1}$) at **Ludhiana.**

- Significantly highergrain yield of basmati rice and wheat (4620 and 4700 kg $ha^{-1}$ respectively) were recorded with application of FYM+vermi compost +panchgavya + BD preparation. Grain yield of maize (5380 kg $ha^{-1}$) was also recorded significantly higher with application of FYM+vermi compost+panchgavya+biodynamic and was found to be 26% increase than control at **Modipuram.**

- Grain yield of basmati rice was significantly higher (4535 kg $ha^{-1}$) with FYM+VC+NC+EC @ ¼ N each+biodynamic and panchgavya preparation than biodynamic preparation alone and control with (green manuring/moog residue only). Significantly higher grain yield (2440 kg $ha^{-1}$) of chickpea were obtained with application of FYM+VC+NC+EC @ ¼ N each along with BD and PG preparation at **Pantnagar.**

- Application of biodynamic package + EC + CDM + NEOC @ 1/3 N each + panchgavya recorded higher yield of rice (4317 kg $ha^{-1}$) and chickpea (1271 kg $ha^{-1}$. Similar trend was also observed for mustard and lentil (alternate row system). EC+CDM+NEOC @ 1/3 N each+biodynamic practice recorded higher yield of mustard 679 kg $ha^{-1}$ at **Raipur.**

- All the crops recorded higher yield with vermicompost + KC + biodynamic peparration + panchgavya (4665, 2152 and 9524 kg $ha^{-1}$ in rice, wheat and potato respectively) at **Ranchi.** The yield increase due to application of panchgavya and biodynamic preparation over and above, the vermicompost + KC @ ½ N each was found to be minimum in rice and wheat.

- Application of FYM + VC recorded significantly higher mean yield of maize (5840 kg $ha^{-1}$), tomato (14537 kg $ha^{-1}$)and frenchbean (green pod 20927 kg $ha^{-1}$). The response of potato was found to be better with application of vermicompost alone which recorded yield of 17323 kg $ha^{-1}$ and the increase over FYM alone was found to be 5.9 % at **Umiam.**

### Pest and disease management under organic farming

- Infestation of fruit borer and other factors (pests and diseases) in tomato was significantly lower with application of Lipel (*Bacillus thuringiensis*sub sp. kurstaki) @ 1 litre/ha. Among different bio-pesticidal treatments, mixture of Dipel 8L @ 0.5 litre/ha and neembaan (*Azedarachtin* 0.15%) @ 2.5 ml/l was found to be the significantly effective at **Bajaura.**

- Rhizome rot infestation in ginger was lower with IISR 6, 8, 13, 51, 151, P1AR6, PB21C cultures and ginger rhizobacteria (GRB 57) compared to absolute control. The reduction in infestation was observed to be 90.9 and 50% respectively. Significantly higher rhizome yield of ginger and turmeric was observed with ginger endophytic bacteria GEB 18 (14210 and 10900 kg $ha^{-1}$ respectively) at **Calicut.**

- Green manure bio agent treated and untreated plots recorded higher grain yield of basmati rice (4070 and 3835 kg $ha^{-1}$respectively) and mustard (1320 and 1130 kg $ha^{-1}$) at **Modipuram.**

## Weed management under organic farming

- Weed free recorded maximum reduction of weed population (7.2 and 9.2 $m^{-2}$) and total dry weight (0.3 and 3.9 g $m^{-2}$) of weeds at 25 and 45 DAT. Similarly, in both rice and green gram, weed free condition recorded higher yield (3829 and 584 kg $ha^{-1}$ respectively) over un-weeded control at **Coimbatore.**

- A reduction of 43.5 and 28.5% in weed population and 66 and 51.1% in dry weight was observed at 20 and 60 days after transplanting with weed management packages of one hand weeding at 20 DAS+two hand hoeing at 20 and 40 DAS+aqueous spray of cassia at 25% as pre-emergent application compared to weedy check at **Dharwad.**

- Weed free recorded higher grain yield of rice (4724 kg $ha^{-1}$) and wheat (4887 kg $ha^{-1}$) followed by combination of two hand weeding + spray at 3-4 leaf stage of weeds which recorded 129 and 181% higher grain yield of rice and wheat respectively compared to un-weeded check at **Jabalpur**.

- Significantly higher yield of rice and green gram recorded with two hand weeding at 20 and 40 DAT/ DAS (3993 and 1542 kg $ha^{-1}$) followed by incorporation of *Ipomea carnea* @ 10 t $ha^{-1}$ (3736 and 1463 kg $ha^{-1}$) which recorded 24 and 36.2% higher grain yield of rice and green gram respectively compared to un-weeded check at **Karjat.**

- High density planting+hand weeding at 25-30 DAT recorded maximum reduction of total dry weight of weeds (8.1 $gm^{-2}$) in rice. Two hand weeding @ 25-30 and 45-50 DAT in rice recorded higher yield of 3254 kg $ha^{-1}$. In case of wheat, bed sowing + two hand weeding at 30-35 and 45-50 DAS recorded higher yield (3450 kg ha-1) which is 48.3 and 57.8% increase over high seed rate (25%)+15 cm spacing and un-weeded check respectively at **Ludhiana.**

- 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 34.4% increase in yield over weedy check at **Pantnagar.**

- Maximum reduction in total weed count was observed with use of 2 hand weeding at 25-30 and 45-50 days after transplanting/sowing in rice and mustard and reduction was found to be 73.6% in rice and 87.5% in mustard compared to weedy check at **Raipur.**

- Two hand hoeing at 25 and 40 DAS/DAT with use of aqueous leaf extract at 3-4 leaf stage registered significantly lower weed dry weight during *kharif* and *rabi* at **Ranchi.**

- Hand weeding twice significantly reduced the weed population and dry weight $m^{-2}$ compared to other treatments. In both maize and toria, mulching with fresh *Eupatorium/ Ambrosia* @ 10 t $ha^{-1}$ (after earthing up) recorded higher yield followed by soybean green manure incorporation insitu (1:1)+one hand weeding. The increase in yield under mulching with fresh *Eupatorium/Ambrosia* was found to be 33.7 and 45.3% in maize and 40.9 and 67.6% in toria over weed free and weedy checks respectively at **Umiam.**

# 1. INTRODUCTION

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

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

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

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

# 2. OBJECTIVES AND METHODOLOGY

## Objectives

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

## Methodology

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

- Evaluation of different nutrient input system in various cropping systems on soil health and crop productivity
- Management of soil fertility using various organic inputs in prominent cropping systems
- Pest and disease management in cropping system under organic farming
- 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 the production of organic production, as suggested under National Standards for Organic Production (NSOP), forms the basis for raising the experimental crops in the project., A compact block of land has been earmarked at each of the cooperating centres for experimental purposes, as far as possible. The plot identified was in general, free from hazards of erosion, sediments, chemical pollutants and contaminants. Shelterbelts have been developed by planting multi-purpose trees/ shrubs etc. such as *Subabul*, *Sesbania* spp. etc. around the field. The individual centre has been advised to select organic sources of nutrients depending upon the local availability and also in suitable combination(s) to fulfill the entire requirement of nitrogen and 80-90% requirement of phosphorus and potassium for each cropping system. Cooperating centers have also been advised that each centre should select only those crops for organic farming research in which effective organic (non-chemical) measures are available for plant protection to avoid failure of crops at later stages. Bulky 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 2012-13 at 13 research centers of SAUs/ ICAR Institutes. Centre details are given below in the order of results presented in the chapter 7.

| Sl. No. | State | Name of SAU/ICAR institute | Location of centre |
|---|---|---|---|
| 1. | Uttar Pradesh | Indian Institute of 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.Pant University of Agriculture Sciences 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. | Bajura | Silty loam | 883.0 | 26.15 | 11.05 | 68.00 | 31.8° | 77° |
| 2. | Bhopal | Vertisols, Clayey Montmorill-onite/smectite type | 1080 | 32.0 | 22.0 | 70-80 | 23°18’ | 77°24’ |
| 3. | Calicut | Clay loam, ustic Humitropept | 4121 | 31.8 | 22.0 | 67-88 | 11°34’ | 75°48’ |
| 4. | Coimbatore | Udic, Rhodustalfs, fine loamy red and sandy soil | 789.30 | 29.83 | 21.31 | 85.56 | 11° | 77° |
| 5. | Dharwad | Vertic inceptisoles | 540.1 | 31.05 | 17.92 | 62.55 | 15°26’ | 75°07’ |
| 6. | Jabalpur | Vertisoils, Chromusterts | 1388.8 | 29.68 | 21.70 | 66.84 | 23°90’ | 79°90’ |
| 7. | Karjat | Haplustults udic-fluvents, red soil | 3295.4 | 34 .00 | 20.96 | 68.98 | 18°33’ | 77°03’ |
| 8. | Ludhiana | Ustochrepts-Ustic pramments association, alluvial, sandy & sandy loam | 465.7 | 29.98 | 17.42 | 64.80 | 30°56’ | 75°52’ |
| 9. | Modipuram | Alluvium soilsTypic ustochrept | 511.20 | 29.89 | 16.31 | 71.30 | 29°4’ | 77°46’ |
| 10. | Pantnagar | Hapludolls, very deep alluvium coarse loomy soils | 2118.6 | 29.39 | 17.03 | 70.68 | 29°08’ | 79°05’ |
| 11. | Raipur | Ochraquals association, deep black soil | 1361.10 | 32.94 | 20.35 | 56.15 | 21°16’ | 81°36’ |
| 12. | Ranchi | Ultic Palesustalfs, very deep soils | 1019.90 | 29.64 | 15.60 | 71.86 | 23°17’ | 85°19’ |
| 13. | Umiam | Clay loam | 3085.2 | 20.86 | 4.60 | 74.75 | 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** | | | | | | | | |
| | Bajaura | 0.45 | 146 | 43.3 | 121 | 22.4 | 30.0 | 1.20 |
| | Bhopal | 0.53 | 154.0 | 12.7 | 530.0 | 4.9 | 5.5 | 1.22 |
| | Calicut | 2.4 | 220.0 | 24.6 | 264.0 | - | 72.0 | 3.80 |
| | Coimbatore | 0.60 | 269 | 17.9 | 690 | - | 29.6kg/ha | 4.5kg/ha |
| | Dharwad | 0.41 | 250 | 23 | 330 | 20Kg/ha | 7.5mg/kg | 0.8mg/kg |
| | Jabalpur | .7 | 264 | 12.6 | 282 | 9.8mg/kg | 2.37mg/kg | 0.32mg/kg |
| | Karjat | 1.14 | 230 | 20 | 327 | | | |
| | Ludhiana | 0.34 | 278.0 | 36.3 | 134.0 | | | |
| | Modipuram | 0.59 | | | | | | |
| | Pantnagar | 0.65 | 238 | 16.7 | 156 | 29.3Kg/ha | 30.24 | 0.84 |
| | Raipur | 0.64 | 237 | 13 | 274 | | | |
| | Ranchi | 0.38 | 220 | 48 | 270 | | | |
| | Umiam | 1.8 | 255.61 | 9.19 | 232.1 | | | |
| **Experiment 2** | | | | | | | | |
| | Bajaura | 0.30 | 126.0 | 31.0 | 110.0 | 17.9 | 44.1 | 0.80 |
| | Bhopal | | | | | | | |
| | Calicut | 2.00 | 120ppm | 6.80ppm | 164ppm | - | 46.0 | 0.54 |
| | Coimbatore | 0.68 | 258 | 22.9 | 698.3 | - | 31.63kg/ha | 3.59kg/ha |
| | Dharwad | 0.41 | 250 | 23 | 330 | 20Kg/ha | 7.5mg/kg | 0.8mg/kg |
| | Jabalpur | 0.68 | 263 | 12.6 | 296 | 9.6mg/kg | 2.39mg/kg | 0.35mg/kg |
| | Karjat | 1.16 | 194 | 15 | 346 | | | |
| | Ludhiana | | | | | | | |
| | Modipuram | | | | | | | |
| | Pantnagar | 0.91 | 238 | 16.7 | 156 | 29.3Kg/ha | | |
| | Raipur | 0.61 | 248 | 16.2 | 252 | | | |
| | Ranchi | 0.38 | 220 | 25 | 185 | | | |
| | Umiam | 2.46 | 150.53 | 2.96 | 245.10 | | | |
| **Experiment 3** | | | | | | | | |
| | Calicut | 2.00 | 120ppm | 6.80ppm | 164ppm | - | 46.0 | 0.54 |
| | Coimbatore | 0.48 | 258 | 15.2 | 568.0 | - | 23.20kg/ha | 8.5kg/ha |
| | Jabalpur | 0.62 | 259 | 12.5 | 265 | 8.9mg/kg | 2.55mg/kg | 0.39mg/kg |
| | Karjat | 0.85 | 220 | 23 | 379 | | | |
| | Pantnagar | 0.86 | 314 | 15.08 | 190 | 23.30 | | |
| | Raipur | 0.66 | 220 | 16.2 | 260 | | | |
| | Ranchi | 0.42 | 230 | 32.25 | 162 | 0.42 | | |
| | Umiam | 1.8 | 180.0 | 9.5 | 175.1 | | | |
| **Experiment 4** | | | | | | | | |
| | Coimbatore | 0.48 | 258 | 15.2 | 568 | - | 23.2/kg/ha | 5.20/kg/ha |
| | Jabalpur | 0.62 | 259 | 12.5 | 265 | 8.9mg/kg | 2.55mg/kg | 0.39mg/kg |
| | Pantnagar | 0.65 | 238 | 16.7 | 156 | 29.3Kg/ha | | |
| | Raipur | 0.66 | 220 | 16.2 | 260 | | | |
| | Umiam | | | | | | | |

# 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. In addition, two senior research fellows (as contractual staff) have been provided at each centre.

# 6. BUDGET

A total budget of ₹ 110 lakh was released to 13 centres during 2012-13. The centre wise allocation/ utilization of funds are given below.

**(₹ in lakhs)**

| Sl. No. | Name of Centre | T. A. | Cont. Service | Other Cont. | TSP general | Total |
|---|---|---|---|---|---|---|
| 1. | ICAR-IIFSR, Modipuram | 0.20 | 6.00 | 2.43 | 0.00 | 8.63 |
| 2. | GBPUA&T, Pantnagar | 0.30 | 6.25 | 3.50 | 0.00 | 10.05 |
| 3. | HAREC, Bajaura | 0.20 | 4.75 | 5.83 | 0.00 | 10.78 |
| 4. | IGKV, Raipur | 0.10 | 1.20 | 0.70 | 1.00 | 3.00 |
| 5. | JNKV, Jabalpur | 0.20 | 5.45 | 3.20 | 1.00 | 9.85 |
| 6. | ARS, Karjat | 0.10 | 1.40 | 0.70 | 1.00 | 3.20 |
| 7. | PAU, Ludhiana | 0.20 | 3.00 | 2.32 | 0.00 | 5.52 |
| 8. | TNAU, Coimbatore | 0.20 | 3.40 | 3.50 | 1.00 | 8.10 |
| 9. | UAS, Dharwad | 0.30 | 3.65 | 1.45 | 7.65 | 13.05 |
| 10. | BAU, Ranchi | 0.10 | 2.40 | 1.20 | 1.00 | 4.70 |
| 11. | ICAR-IISR, Calicut | 0.20 | 4.95 | 2.80 | 0.00 | 7.95 |
| 12. | ICAR-IISS, Bhopal | 0.30 | 4.90 | 3.32 | 0.00 | 8.52 |
| 13. | ICAR-Research Complex, Umiam | 0.30 | 6.00 | 3.00 | 7.35 | 16.65 |
| | **Total** | 2.70 | 53.35 | 33.95 | 20.00 | 110.00 |

# 7. RESEARCH RESULTS

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

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

**Objectives**

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

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

**Year of start:** The experiment was originally planned during 2004-05. However, the year of start varied with the centres depending upon the establishment of infrastructure for conducting the experiments. All the centres started the experiment during 2004-05 except in Modipuram and Umiam where it was started during 2005-06. The cropping system adopted remained almost same for all the years in each centres except Ludhiana where the cropping system was changed during 2008-09 in one set of experiments as Ludhiana centre evaluated two set of cropping systems.

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

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

| Eco-System | Centre (State) |
|---|---|
| Arid | Dharwad (Karnataka)<br>Ludhiana (Punjab) |
| Semi-Arid | Coimbatore (Tamil Nadu) |
| Sub-Arid | Modipuram (Uttar Pradesh)<br>Raipur (Chhattisgarh)<br>Bhopal (Madhya Pradesh)<br>Jabalpur (Madhya Pradesh)<br>Pantnagar (Uttarakhand)<br>Ranchi (Jharkhand) |
| Humid | Bajaura (Himachal Pradesh) |
| Coastal | Umiam (Meghalaya)<br>Calicut (Kerala)<br>Karjat (Maharashtra) |

(Ludhiana and Dharwad) in various centres. The details of cropping systems are given in Table1 along with experimental results. Nutrient package for the organic and integratedmanagement packages were formulated based on recommended nitrogen dose of each system.

**Source of nutrient inputs and their NPK content at various locations**

| Centre | Nutrient Sources | NPK contents on dry weight basis (%) | | |
|---|---|---|---|---|
| | | N | P | K |
| **Bajaura** | Vermi-compost | 1.72 | 0.26 | 1.31 |
| | FYM | 2.25 | 0.28 | 2.11 |
| | Urea | 46.00 | - | - |
| | SSP | - | 16.00 | - |
| | MOP | - | - | 60.00 |
| | Rock-phosphate | - | 34.00 | - |
| **Bhopal** | | | | |
| **Calicut** | Farm Yard Manure | 0.98 | 0.28 | 0.54 |
| | Neem cake | 0.82 | 0.44 | 0.92 |
| | Ash | - | 0.23 | 7.0 |
| | Vermi-compost | 0.79 | 0.20 | 0.58 |
| | Green leaf manure | 2.62 | 0.09 | 0.62 |
| | Rajphos | - | 18.5 | - |
| | Urea | 46 | - | - |
| | MOP | | | 58 |
| **Coimbatore** | FYM | 0.51 | 0.20 | 0.50 |
| | Vermi-compost | 0.62 | 0.38 | 0.96 |
| | Neem cake | 3.90 | 0.63 | 1.20 |
| **Dharwad** | Enriched compost | 0.70 | 0.40 | 0.80 |
| | Vermicompost | 1.00 | 0.86 | 0.98 |
| | Gliricidia | 0.50 | 0.32 | 1.15 |
| | FYM | 0.50 | 0.35 | 0.50 |
| **Jabalpur** | GM (Sunhemp) | 0.66 | 0.13 | 0.50 |
| | FYM | 0.54 | 0.20 | 0.26 |
| | VC | 1.8 | 0.75 | 1.00 |
| | Neem oil Cake | 5.2 | 1.10 | 1.50 |
| | Urea | 46 | - | - |
| | SSP | - | 16 | - |
| | MOP | - | - | 60 |
| | Non-edible oil Cake (NEOC) | 5.20 | 1.10 | 1.50 |
| **Karjat** | F.Y.M. | 0.50 | 0.25 | 0.50 |
| | Neem cake | 5.20 | 1.00 | 1.40 |
| | Vermi-compost | 1.50 | 1.00 | 1.50 |
| | *Glyricidia* green leaves | 2.74 | 0.50 | 1.15 |
| | Paddy straw | 0.61 | 0.16 | 1.14 |
| **Ludhiana** | Urea | 46 | - | - |
| | DAP | 18 | 46 | - |
| | MOP | - | - | 60 |
| **Modipuram** | FYM | 0.56 | 0.33 | 0.61 |
| | VC | 1.24 | 0.43 | 1.43 |
| | *Sesbania* | 2.18 | 0.43 | 3.06 |
| | Urea | 46 | - | - |
| | DAP | 18 | 46 | - |
| | MOP | - | - | 60 |
| | Mungbean | 1.11 | 0.32 | 1.30 |
| | Okra | 1.12 | 0.20 | 1.15 |
| | Neem cake | 4.22 | 0.83 | 1.48 |

| Centre | Nutrient Sources | NPK contents on dry weight basis (%) | | |
|---|---|---|---|---|
| | | N | P | K |
| **Pantnagar** | | | | |
| **Raipur** | Enriched compost | 0.40 | 0.30 | 0.60 |
| | Cow dung manure | 0.60 | 0.30 | 0.70 |
| | Non Edible Oil Cakes (NEOC) | 3.0 | 0.70 | 1.70 |
| | Rock phosphate | | 23 | |
| | Green manure | 2.0 | 0.40 | 1.20 |
| **Ranchi** | FYM | 0.5 | 0.3 | 0.5 |
| | VC | 1.2 | 0.45 | 1.4 |
| | KC | 4 | 1 | 1 |
| | Urea | 46 | - | - |
| | SSP | - | 16 | - |
| | MOP | - | - | 60 |
| **Umiam** | F.Y.M. | 0.72 | 0.29 | 0.61 |
| | Vermicompost | 1.50 | 0.62 | 1.00 |
| | Rock phosphate | - | 18.00 | - |
| | Tephrosia *spp* | 3.31 | 0.44 | 1.46 |

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

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

## Results

The parameter wise result of 2012-13 for each centre are presented and discussed.

### Grain and straw yield (Table 1-2)

**Bajaura:** The general trend of cauliflower, pea, french bean and maize was found to be better under integrated followed by organic management package. Cauliflower recorded yield increase of more than 3.5 times with organic, but under integrated package it was observed 4 times more. Pea yield recorded 66% higher with integrated package while 57% was higher under organic over inorganic conditions. Tomato recorded higher yield under integrated (7780 kg $ha^{-1}$) followed by organic (7600 kg $ha^{-1}$). Tomato recorded


**Performance of cauliflower and maize at Bajaura under organic management**

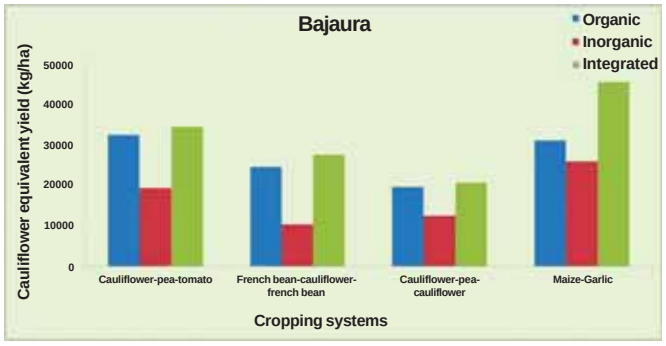
**Table 1. Influence of organic, inorganic and integrated package on yield and equivalent yield of crops at various locations**

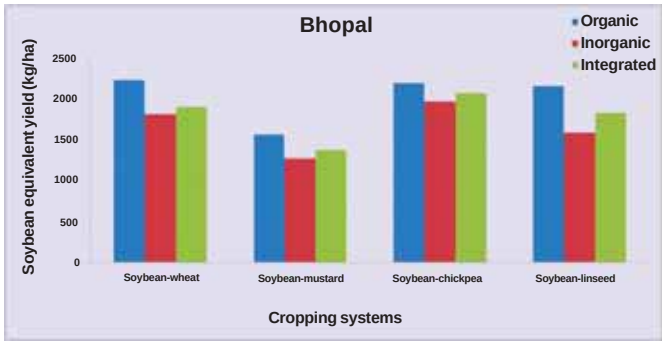
| Cropping system/Package | Grain yield (kg ha$^{-1}$) | | | | | | | | | Systems equivalent yield (kg ha$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | | | Inorganic | | | Integrated | | | | | | |
| | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | Organic | Inorganic | Integrated | Mean |
| **Bajaura** | | | | | | | | | | Cauliflower equivalent yield | | | |
| Cauliflower-pea-tomato | 7360 | 8700 | 7600 | 2041 | 4940 | 5748 | 8396 | 9350 | 7780 | 32480 | 19523 | 34568 | 28857 |
| French bean-cauliflower-frenchbean | 3230 | 8272 | 11500 | 816 | 4090 | 5220 | 3851 | 11600 | 10230 | 24617 | 10534 | 27607 | 20919 |
| Cauliflower-pea-cauliflower | 6842 | 8170 | - | 2023 | 5820 | - | 7567 | 8520 | - | 19761 | 12652 | 20824 | 17745 |
| Maize+frenchbean-garlic | 7440 | 9446 | - | 4762 | 8446 | - | 8334 | 14906 | - | 31055 | 25877 | 45599 | 34177 |
| Mean | | | | | | | | | | 26978 | 17146 | 32149 | |
| **Bhopal** | | | | | | | | | | Soybean equivalent yield | | | |
| Soybean-Duram wheat | 501 | 2891 | - | 326 | 2478 | - | 398 | 2504 | - | 2243 | 1820 | 1907 | 1990 |
| Soybean-mustard | 472 | 985 | - | 321 | 856 | - | 407 | 873 | - | 1572 | 1277 | 1381 | 1410 |
| Soybean-chickpea | 496 | 1368 | - | 322 | 1320 | - | 413 | 1332 | - | 2206 | 1973 | 2078 | 2086 |
| Soybean-linseed | 514 | 1228 | - | 326 | 944 | - | 391 | 1078 | - | 2164 | 1595 | 1839 | 1866 |
| Mean | 496 | | | 324 | | | 402 | | | 2046 | 1666 | 1802 | |
| Calicut | | | | | | | | | | | | | |
| Ginger: Variety- Varda | 11871 | - | - | 7471 | - | - | 19229 | - | - | | | | |
| Rejatha | 8819 | - | - | 4657 | - | - | 15614 | - | - | | | | |
| Mahima | 10000 | - | - | 6357 | - | - | 11671 | - | - | | | | |
| Turmeric: Variety-Alleppey | 9200 | - | - | 8829 | - | - | 7457 | - | - | | | | |
| Prathibha | 5914 | - | - | 10300 | - | - | 8029 | - | - | | | | |
| Black pepper: Variety- Panniyur I (g/vine) | 1513 | - | - | 838 | - | - | 744 | - | - | | | | |
| **Coimbatore** | | | | | | | | | | Cotton equivalent yield | | | |
| Cotton-maize-green manure | 1053 | 4144 | - | 1160 | 4733 | - | 1333 | 5060 | - | 2242 | 2527 | 2795 | 2522 |
| Chillies-sunflower-green manure | 4483 | 1759 | - | 4577 | 1944 | - | 4687 | 2296 | - | 2667 | 2822 | 3093 | 2861 |
| Brinjal-sunflower-green manure | 7974 | 2304 | - | 8248 | 2259 | - | 8518 | 2442 | - | 3677 | 3705 | 3899 | 3761 |
| Mean | | | - | | | - | | | - | 2862 | 3018 | 3262 | |

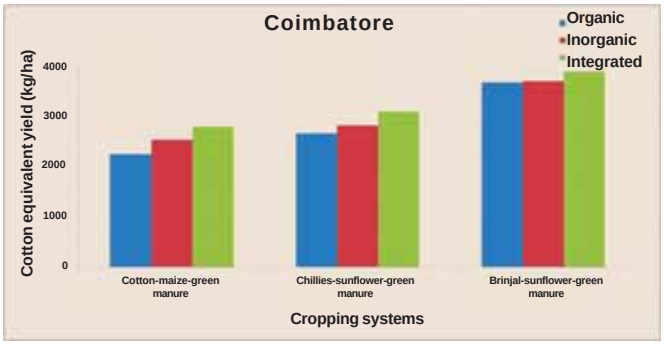
| Cropping system/Package | Grain yield (kg ha$^{-1}$) | | | | | | | | | Systems equivalent yield (kg ha$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | | | Inorganic | | | Integrated | | | | | | |
| | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | Organic | Inorganic | Integrated | Mean |
| **Dharwad** | | | | | | | | | | Maize equivalent yield | | | |
| Groundnut–sorghum | 2705 | 1111 | - | 2189 | 929 | - | 2578 | 1062 | - | 7952 | 6481 | 7583 | 7338 |
| Soybean – durum wheat | 2380 | 1054 | - | 1505 | 885 | - | 2235 | 987 | - | 6604 | 4596 | 6196 | 5799 |
| Soybean+ pigeon pea | 1437(1343) | | - | 1155(1093) | | - | 1213(1463) | | - | 6379 | 5164 | 6272 | 5938 |
| Cotton + peas | 1881(1952) | | - | 1590(1682) | | - | 1897(1979) | | - | 11857 | 10084 | 11977 | 11306 |
| Maize-chickpea | 6460 | 941 | - | 5449 | 773 | - | 6724 | 802 | - | 8487 | 7114 | 8451 | 8017 |
| Mean | | | | | | | | | | 8256 | 6688 | 8096 | |
| **Jabalpur** | | | | | | | | | | Basmati rice equivalent yield | | | |
| Basmati rice-wheat-green manure | 3382 | 3132 | - | 3627 | 3402 | - | 3435 | 3235 | - | 7360 | 6349 | 6023 | 6577 |
| Basmati Rice - chickpea - seasmem | 3333 | 1324 | 186 | 3461 | 1373 | 221 | 3335 | 1358 | 210 | 6020 | 5177 | 5033 | 5410 |
| Basmati rice-berseem (fodder) | 2941 | 74510 | - | 3137 | 75980 | - | 3123 | 75098 | - | 10195 | 9941 | 9805 | 9980 |
| Basmati rice-vegetable pea-sorghum (fodder) | 3039 | 3088 | 34314 | 3431 | 3456 | 35873 | 3301 | 3127 | 34706 | 6938 | 6504 | 6166 | 6536 |
| Mean | 3174 | | | 3414 | | | 3299 | | | 7628 | 6993 | 6757 | |
| **Karjat** | | | | | | | | | | | | | |
| Rice-groundnut | 3842 | 2546 | - | 4237 | 2761 | - | 4029 | 2654 | - | 13884 | 13053 | 12512 | 13150 |
| Rice-maize (sweet corn for cob) | 3147 | 13088 | - | 3552 | 17303 | - | 3364 | 16131 | - | 18598 | 20883 | 19374 | 19618 |
| Rice-mustard | 3325 | 749 | - | 3762 | 803 | - | 3512 | 767 | - | 6111 | 6160 | 5801 | 6024 |
| Rice-dolichos bean (for green pod vegetable) | 3558 | 5627 | - | 3923 | 6181 | - | 3718 | 5872 | - | 17192 | 15926 | 15121 | 16080 |
| Mean | 3468 | | | 3869 | | | 3656 | | | 13946 | 14006 | 13202 | |

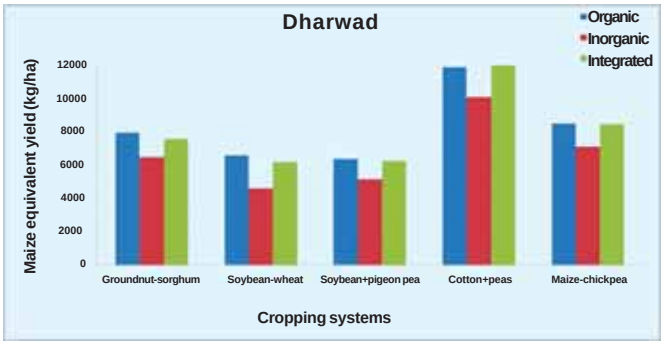
| Cropping system/Package | Grain yield (kg ha$^{-1}$) | | | | | | | | | Systems equivalent yield (kg ha$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | | | Inorganic | | | Integrated | | | | | | |
| | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | Organic | Inorganic | Integrated | Mean |
| **Ludhiana** | | | | | | | | | | Basmati rice equivalent yield | | | |
| Cotton-chickpea | 2140 | 1394 | - | 930 | 1587 | - | 1590 | 1389 | - | 5892 | 4133 | 4766 | 4931 |
| Maize (PP)-chickpea (k) | 2440 | 1087 | - | 2390 | 740 | - | 2050 | 750 | - | 5384 | 4872 | 4427 | 4894 |
| Basmati rice-wheat-summer moong | 3630 | 4159 | 230 | 3380 | 5663 | 180 | 3510 | 4460 | 160 | 7281 | 8098 | 7261 | 7547 |
| Turmeric-onion | 27910 | 14891 | - | 7230 | 13083 | - | 14260 | 14312 | - | 16358 | 8460 | 11432 | 12083 |
| Maize-potato-summer moong | 7110 | 17203 | 1240 | 6670 | 12489 | 1260 | 6890 | 13451 | 1240 | 11804 | 10108 | 10495 | 10802 |
| Mean | | | | | | | | | | 9344 | 7134 | 7676 | |
| **Modipuram** | | | | | | | | | | Basmati rice equivalent yield | | | |
| Basmati rice-wheat-*sesbania*(green manuring) | 3740 | 4330 | | 2890 | 3340 | | 3570 | 4680 | | 8280 | 6390 | 8470 | 7713 |
| Rice-barley+mustard-greengram | 4470 | 2830(395) | 886 | 3730 | 2240(301) | 685 | 4370 | 3010(418) | 864 | 10600 | 8500 | 10610 | 9903 |
| Maize(grain)-potato-okra | 5040 | 22320 | 10530 | 4120 | 18210 | 8270 | 4820 | 22940 | 10240 | 34070 | 27300 | 33740 | 31703 |
| Maize(cob) -mustard+ radish-*sesbania*(green manuring) | 9220 | 711(14620) | | 8230 | 571(11930) | | 9880 | 756(15730) | | 11260 | 9570 | 12080 | 10970 |
| Mean | | | | | | | | | | 16053 | 12940 | 16225 | |
| **Pantnagar** | | | | | | | | | | Basmati rice equivalent yield | | | |
| Basmati rice-wheat-*Sesbania* (green manuring) | 3898 | 4142 | | 3240 | 4202 | | 3573 | 4274 | | 6196 | 5641 | 6011 | 5949 |
| Basmati rice-lentil-*Sesbania* (green manuring) | 4373 | | | 3382 | | | 3716 | | | 4457 | 3485 | 3813 | 3919 |
| Basmati rice-vegetable pea-*Sesbania* (green manuring) | 4033 | 6320 | | 3354 | 5621 | | 3683 | 5880 | | 6373 | 5456 | 5875 | 5901 |
| Basmati rice-Brassica napus-*Sesbania* (green manuring) | 3402 | 1886 | | 3096 | 1725 | | 3420 | 1917 | | 5364 | 4950 | 5485 | 5267 |
| Mean | 3927 | | | 3268 | | | 3598 | | | 5598 | 4883 | 5296 | |

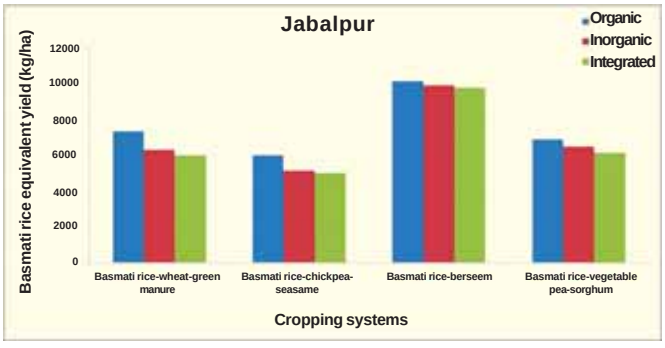
| Cropping system/Package | Grain yield (kg ha$^{-1}$) | | | | | | | | | Systems equivalent yield (kg ha$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | | | Inorganic | | | Integrated | | | | | | |
| | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | Organic | Inorganic | Integrated | Mean |
| **Raipur** | | | | | | | | | | Soybean equivalent yield | | | |
| Soybean-berseem | 1760 | 45952 | - | 1752 | 40619 | - | 1738 | 44690 | - | 3848 | 3598 | 3769 | 3738 |
| Soybean-isabgol | 1750 | 202 | - | 1799 | 246 | - | 1822 | 243 | - | 2668 | 2919 | 2924 | 2837 |
| Soybean-onion | 1574 | 13167 | - | 1593 | 13881 | - | 1757 | 13690 | - | 7559 | 7903 | 7980 | 7814 |
| Soybean-safflower | 1787 | 1137 | - | 1486 | 1258 | - | 1689 | 1412 | - | 3089 | 2916 | 3293 | 3099 |
| Mean | 1718 | | | 1658 | | | 1752 | | - | 4291 | 4334 | 4492 | |
| **Ranchi** | | | | | | | | | | Rice equivalent yield | | | |
| Rice-wheat | 4224 | 2078 | - | 2869 | 2662 | - | 3784 | 2403 | - | 6475 | 5753 | 6387 | 6205 |
| Rice-potato | 4576 | 15368 | - | 3080 | 11472 | - | 4048 | 14069 | - | 13541 | 9772 | 12255 | 11856 |
| Rice-linseed | 3731 | 526 | - | 2816 | 494 | - | 3573 | 515 | - | 4476 | 3516 | 4303 | 4098 |
| Rice-lentil | 3661 | 455 | - | 2640 | 476 | - | 3467 | 498 | - | 4723 | 3751 | 4629 | 4368 |
| Mean | 4048 | | | 2851 | | | 3718 | | - | 7304 | 5698 | 6894 | |
| **Umiam** | | | | | | | | | | Rice equivalent yield | | | |
| Rice-carrot | 3310 | 14100 | - | 3230 | 8300 | - | 3360 | 13850 | - | 11908 | 8299 | 11818 | 10675 |
| Rice-potato | 3360 | 15450 | - | 3320 | 13480 | - | 3360 | 15210 | - | 10426 | 8465 | 9165 | 9352 |
| Rice-french bean | 3570 | 9430 | - | 3420 | 9730 | - | 3570 | 7800 | - | 14351 | 14561 | 12501 | 13805 |
| Rice-tomato | 3470 | 13030 | - | 3320 | 11560 | - | 3470 | 13470 | - | 18367 | 16557 | 18894 | 17939 |
| Mean | 3428 | | | 3323 | | | 3440 | | | 13763 | 11970 | 13095 | |

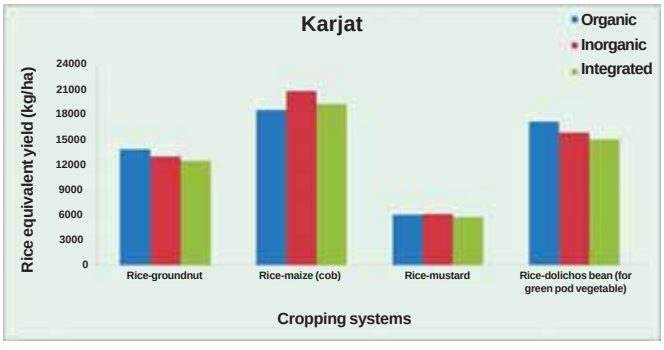

Bajaura
Organic
Inorganic
Integrated
Cauliflower equivalent yield (kg/ha)
50000
40000
30000
20000
10000
0
Cauliflower-pea-tomato
French bean-cauliflower-french bean
Cauliflower-pea-cauliflower
Maize-Garlic
Cropping systems

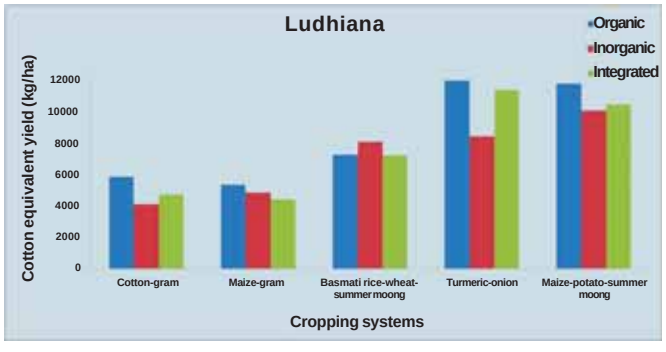

Bhopal
Organic
Inorganic
Integrated
Soybean equivalent yield (kg/ha)
2500
2000
1500
1000
500
0
Soybean-wheat
Soybean-mustard
Soybean-chickpea
Soybean-linseed
Cropping systems

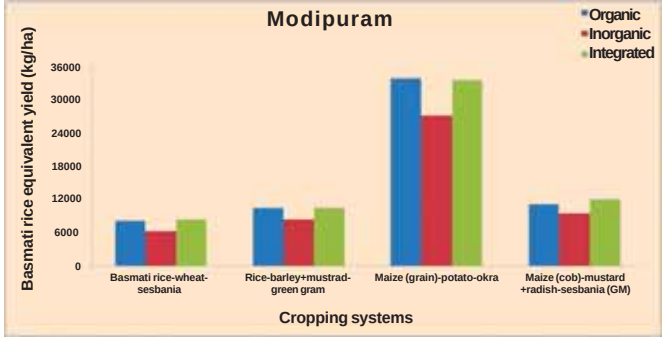

Coimbatore
Organic
Inorganic
Integrated
Cotton equivalent yield (kg/ha)
4000
3000
2000
1000
0
Cotton-maize-green manure
Chillies-sunflower-green manure
Brinjal-sunflower-green manure
Cropping systems

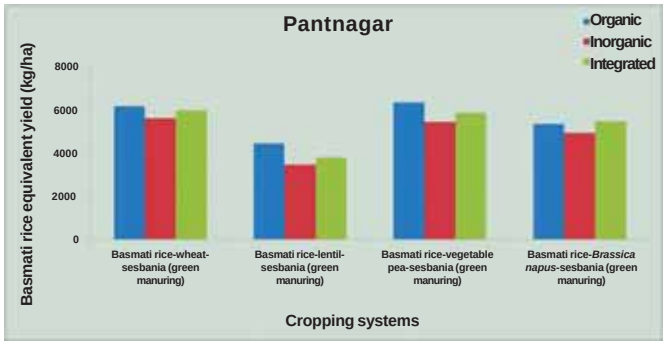

Dharwad
Organic
Inorganic
Integrated
Maize equivalent yield (kg/ha)
12000
10000
8000
6000
4000
2000
0
Groundnut-sorghum
Soybean-wheat
Soybean+pigeon pea
Cotton+peas
Maize-chickpea
Cropping systems

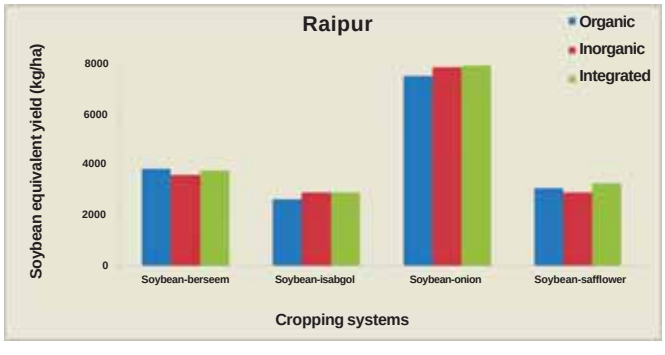

Jabalpur
Organic
Inorganic
Integrated
Basmati rice equivalent yield (kg/ha)
12000
10000
8000
6000
4000
2000
0
Basmati rice-wheat-green manure
Basmati rice-chickpea-seasame
Basmati rice-berseem
Basmati rice-vegetable pea-sorghum
Cropping systems


Karjat
Organic
Inorganic
Integrated
Rice equivalent yield (kg/ha)
24000
21000
18000
15000
12000
9000
6000
3000
0
Rice-groundnut
Rice-maize (cob)
Rice-mustard
Rice-dolichos bean (for green pod vegetable)
Cropping systems


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


Modipuram
Organic
Inorganic
Integrated
Basmati rice equivalent yield (kg/ha)
36000
30000
24000
18000
12000
6000
0
Basmati rice-wheat-sesbania
Rice-barley+mustrad-green gram
Maize (grain)-potato-okra
Maize (cob)-mustard +radish-sesbania (GM)
Cropping systems


Pantnagar
Organic
Inorganic
Integrated
Basmati rice equivalent yield (kg/ha)
8000
6000
4000
2000
0
Basmati rice-wheat-sesbania (green manuring)
Basmati rice-lentil-sesbania (green manuring)
Basmati rice-vegetable pea-sesbania (green manuring)
Basmati rice-Brassica napus-sesbania (green manuring)
Cropping systems


Raipur
Organic
Inorganic
Integrated
Soybean equivalent yield (kg/ha)
8000
6000
4000
2000
0
Soybean-berseem
Soybean-isabgol
Soybean-onion
Soybean-safflower
Cropping systems

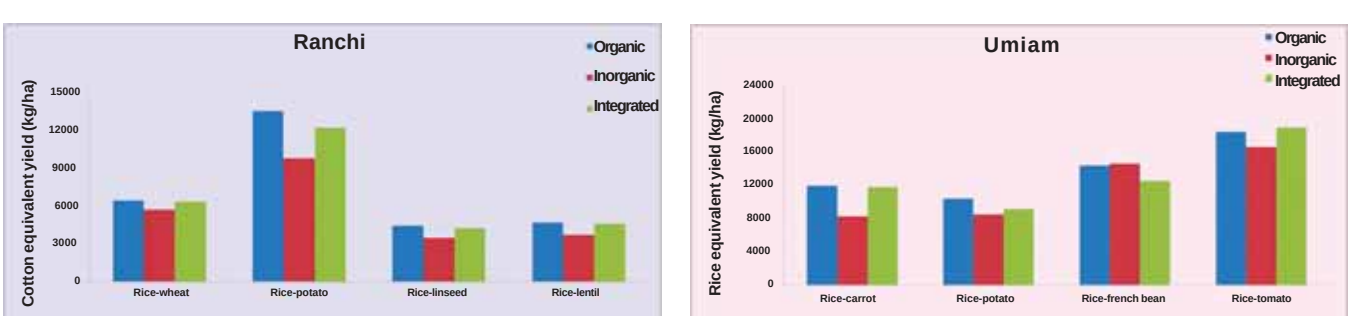



**Fig. 1. Performance of various cropping systems based on system equivalent yield under different management practices**

**Cauliflower under organic management at Bajuara**

**Evaluation of basmati rice-wheat cropping system at Modipuram**

**Green manure in cropping systems at Modipuram**

**Preparation of vermicompost from farm wastes**

**Table 2. Influence of organic, inorganic and integrated packages on straw yield (kg ha$^{-1}$) of crops**

| Cropping systems/package | Organic | | | Inorganic | | | Integrated | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| **Bajaura** | | | | | | | | | |
| Cauliflower-pea-tomato | 6000 | | 2820 | 4580 | | 2200 | 6500 | | 3055 |
| Frenchbean-cauliflower-frenchbean | 1190 | 5060 | 2000 | 520 | 3580 | 1155 | 1250 | 9530 | 2210 |
| Cauliflower-pea-cauliflower | 5030 | | | 4720 | | | 5650 | | |
| Maize+ frenchbean-Garlic | 13360 | | | 12190 | | | 15340 | | |
| **Bhopal** | | | | | | | | | |
| Soybean-duram wheat | 1627 | 6752 | | 1051 | 5853 | | 1341 | 5948 | |
| Soybean-mustard | 1604 | 4433 | | 1171 | 3832 | | 1271 | 3934 | |
| Soybean-chickpea | 1622 | 3728 | | 1151 | 3594 | | 1351 | 3827 | |
| Soybean-linseed | 1729 | 3237 | | 1031 | 2619 | | 1245 | 2894 | |
| **Coimbatore** | | | | | | | | | |
| Cotton - maize -green manure | | 4956 | | | 5318 | | | 5774 | |
| Chillies - sunflower -green manure | | 4298 | | | 4376 | | | 4712 | |
| Brinjal - sunflower - green manure | | 4705 | | | 4511 | | | 4829 | |
| **Dharwad** | | | | | | | | | |
| Maize-Chickpea | | | | | | | | | |
| Cotton+Pea | | | | | | | | | |
| Groundnut-sorghum | | | | | | | | | |
| Potato-Chickpea | | | | | | | | | |
| Soybean-Wheat | | | | | | | | | |
| **Jabalpur** | | | | | | | | | |
| Basmati rice-wheat-green manure | 6426 | 4385 | - | 6964 | 5103 | - | 6527 | 4561 | - |
| Basmati Rice - chickpea - seasmem | 5999 | 1854 | - | 6541 | 1936 | - | 6303 | 1928 | - |
| Basmati rice – berseem (fodder & seed) | 5000 | - | - | 5866 | - | - | 6090 | - | - |
| Basmati rice- vegetable pea – sorghum (fodder) | 5622 | - | - | 6313 | - | - | 6206 | - | - |
| **Karjat** | | | | | | | | | |
| Rice-groundnut | 4534 | | - | 4999 | - | - | 4754 | - | - |
| Rice-maize (sweet corn green fodder) | 3588 | 14767 | - | 4049 | 21805 | - | 3835 | 19408 | - |
| Rice-mustard | 3824 | 801 | - | 4326 | 1102 | - | 4038 | 965 | - |
| Rice-*Dolichos* bean (for green pod vegetable) | 4128 | 807 | - | 4551 | 844 | - | 4313 | 811 | - |

| Cropping systems/package | Organic | | | Inorganic | | | Integrated | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| **Ludhiana** | | | | | | | | | |
| Cotton- chickpea (D) | 7350 | 3359 | - | 1510 | 3469 | - | 3750 | 3507 | - |
| Maize (Pearl popcorn)-chickpea (kabuli) | 5010 | 2873 | - | 4710 | 2534 | - | 4220 | 2665 | - |
| Basmati rice – wheat - summer moong | 5510 | 4745 | - | 5350 | 6110 | - | 5780 | 5338 | - |
| Turmeric - onion | 6600 | - | - | 1290 | | - | 2170 | - | - |
| Maize – potato - summer moong | 13830 | 402 | - | 12890 | 1672 | - | 14130 | 1558 | - |
| **Modipuram** | | | | | | | | | |
| Basmati rice-wheat-*sesbania* GM | 6790 | 6810 | | 4760 | 5970 | | 6410 | 7180 | |
| Rice-barley+mustard-green gram | 7160 | 4390 (1470) | 2870 | 5660 | 3810 (1250) | 2310 | 6800 | 4460 (1530) | 2770 |
| Maize(grains) -Potato-Okra | 6960 | 4250 | | 6030 | 3020 | | 7310 | 4490 | |
| Maize (cobs) -mustard+radish-*sesbania* GM | 11760 | 2920 (5820) | | 9820 | 2030 (4850) | | 12120 | 3080 (6500) | |
| **Pantnagar** | | | | | | | | | |
| Basmati rice-wheat-*Sesbania* (green manuring) | 5651 | 5118 | - | 5177 | 5273 | - | 5073 | 5357 | - |
| Basmati rice-lentil-*Sesbania* (green manuring) | 5903 | - | - | 5789 | - | - | 5447 | - | - |
| Basmati rice-vegetable pea-*Sesbania* (green manuring) | 5797 | - | - | 5304 | - | - | 5159 | - | - |
| Basmati rice-Brassica napus-*Sesbania* (green manuring) | 5463 | 4678 | - | 4900 | 4230 | - | 4868 | 4981 | - |
| **Raipur** | | | | | | | | | |
| Soybean-berseem | 3168 | - | - | 3660 | - | - | 3295 | - | - |
| Soybean-isabgol | 3236 | - | - | 3745 | - | - | 3117 | - | - |
| Soybean-onion | 3050 | - | - | 3245 | - | - | 3005 | - | - |
| Soybean-safflower | 3245 | 2827 | - | 3083 | 2866 | - | 3284 | 3339 | - |
| **Ranchi** | | | | | | | | | |
| Rice-wheat | 6346 | 3217 | - | 4410 | 4042 | - | 5704 | 3682 | - |
| Rice-potato | 6680 | 3074 | - | 4740 | 2362 | - | 6414 | 2743 | - |
| Rice-linseed | 5929 | 1012 | - | 4099 | 935 | - | 5330 | 968 | - |
| Rice-lentil | 5762 | 1277 | - | 3916 | 1342 | - | 5086 | 1364 | - |
| **Umiam** | | | | | | | | | |
| Rice-carrot | 7040 | - | | 6930 | - | | 7710 | - | |
| Rice-potato | 6990 | 5333 | | 6910 | 4390 | | 7260 | 5400 | |
| Rice-french bean | 7520 | 1640 | | 7200 | 1470 | | 8490 | 1610 | |
| Rice-tomato | 6390 | 1400 | | 6670 | 1190 | | 8190 | 1511 | |

yield increase of 32 and 35% with organic and integrated management package over inorganic respectively. Maize (56 and 75%) and garlic (12 and 76%) registered higher yield under organic and integrated packagerespectively over inorganic. Straw yield also registered similar trend. In term of cauliflower equivalent yield, all the systems registered higher yield under integrated package. Among the systems evaluated, maize+frenchbean-garlic was found to be better as it registered significantly higher yield of 34177 kg $ha^{-1}$.

**Bhopal:** In *kharif*, soybean recorded 53 and 24% higher mean yield grain yield under organic and integratedover inorganic respectively. In *rabi,*wheat, mustard, chickpea and linseed recorded significantly higher yield with organic package compared to inorganic and the yield increase was found to be 17, 15, 4 and 30% respectively.Organic package resulted in significantly higher soybean equivalent yield in all the systems followed by integrated package. Among the systems, soybean-chickpea (2086 kg $ha^{-1}$) and soybean-wheat (1990 kg $ha^{-1}$) was found to be better than other systems.

**Performance of wheat at Bhopal under different management conditions**

**Calicut:** Ginger recorded higher rhizome yield under integratedpackage while turmeric and black pepper performed better under organic package. The mean yield increase in ginger was found to be 159% and 68% under integrated and organic package compared to inorganic respectively. Turmeric variety Alleppey gave higher rhizome yield (9200 kg $ha^{-1}$) under organic package while Prathibha recorded higher with


**Performance of ginger and turmeric under organic management at Calicut**

inorganic package (10300 kg ha$^{-1}$).Black pepper registered higher yield under organic (1513 kg ha$^{-1}$) followed by inorganic (838 kg ha$^{-1}$) and integrated (744 kg ha$^{-1}$).

**Coimbatore:** All the crops evaluated performed better under integrated package.The additional yield obtained with inorganic package was found to be 107, 94 and 274 kg ha$^{-1}$ compared to organic packageof cotton, chilli and brinjal respectively. The yield difference between integrated and organic package was found to be 280, 204 and 544 kg ha$^{-1}$. The drop in yield under organic package over integrated was found to be 22 and 16.6% for maize and sunflower. All the systems recorded higher cotton equivalent yield under integrated package even after applying premium price of organic produce. Among the systems, brinjal-sunflower-green manure was found to be better (3761 kg ha$^{-1}$).

Performance of cotton under organic management

Incorporation of green manure in cropping systems

Performance of chillies under organic management

Monitoring of experiments by Director, ICAR-IIFSR at Coimbatore

**Dharwad:** All the crops evaluated in five systems recorded higher yield with organic package except cotton, pea and maize which recorded higher yield under integrated. The yield increase over inorganic was found to be 23.6, 58.1, 19.6 and 19.1% in groundnut, soybean, sorghum and wheat and 19.3, 17.7, 23.4 and 17.7% for cotton, pea, maize and chickpea respectively.Straw yield also exhibited similar trend. Organic package resulted in significantly higher maize equivalent yield followed by integrated package.Among the systems,cotton+pea registered higher maize equivalent yield (11306 kg ha$^{-1}$) than other systems.


**Performance of rainfed wheat, cotton, soybean and chilly + onion at Dharwad under organic management**

**Jabalpur:** Basmati rice, wheat, chickpea, sesamum, berseem, vegetable pea and sorghum recorded higher yield under inorganic package. The yield reduction observed in basmati rice with organic and integrated package was found to be 7 and 3.4% while, in wheat, chickpea, berseem, vegetable pea, sesamum, and sorghum fodder was found to be 7.9, 3.6, 2, 10.6, 16 and 4.3% reduction was found with organic package compared to inorganic. Straw yield of basmati rice and wheat have also exhibited similar trend. In term of basmati rice equivalent yield, all the systems recorded higher yield under organic package. Among the systems, basmati rice-berseem (fodder) recorded higher basmati rice equivalent yield 9980 kg $ha^{-1}$ than other systems.

**Karjat:** During *kharif*, rice registered higher yield under inorganic followed by integratedmanagement package. The reduction inmean yield of rice with organic and integrated package was found to be 10.4 and 5.5% respectively over inorganic. During *rabi*, it was also observed that all the crops (groundnut, maize for cob, mustard and dolichos bean) have recorded significantly higher yield under inorganic package. The yield drop of groundnut, maize, mustard and dolichous bean was found to be 7.8, 24.4, 6.7 and 9% respectively with organic over inorganic package. Straw yield also recorded similar trend.In term of equivalent yield inorganic package resulted in higher rice equivalent yield (14006 kg $ha^{-1}$) followed by organic (13946 kg $ha^{-1}$) and, among the systems, rice-maize (sweet corn for cob) system(19618 kg $ha^{-1}$) was found to be significantly higher than other systems.


**Monitoring of experiments by Director, ICAR-IIFSR at Karjat**

**Ludhiana:** All the crops in various combinations in system mode except chickpea (kabuli), onion and potato recorded higher yield under organic package. Chickpea (kabuli), onion and potato registered higher yield under integrated package. More than 2 and 3 times increase in yield under organic over inorganic was observed in cotton and turmeric during *kharif*. Basmati rice recorded only 7.4% increase whereas maize recorded 5.4%. In *rabi*, the results revealed that an increase in yield of onion and potato by 13.8 and 37.7% under organic over inorganic package while gram yield increase was found to be 50%. Similarly, in summer moong, it was found to be2.1% in yield under organic package. Straw yield also exhibited similar trend. In term of basmati rice equivalent yield, turmeric-onion (12083 kg $ha^{-1}$) and maize-potato-summer moong (10802 kg $ha^{-1}$) was found to be better than other systems. Similarly, all the systems showed better performance with organic package.


**Monitoring of experiments by Director (Acting), ICAR-IIFSR at Ludhiana**

**Modipuram:** Among the various crops in the systems, basmati rice, rice, maize for grains, greengramand okra recorded higher yield under organic system while wheat, barley, mustard, potato, radish and maize for cob have recorded higher yield under integrated package. Wheat registered increase in yield to the tune of 29.6 and 40% with organic and integrated package over inorganic. In case of basmati rice, it was observed that 29.4% higher yield under organic system and 23.5% in integrated compared to inorganic package, whereasin rice,the yield was increased 19.8 and 17.2% under organic and integrated package, respectively.Straw yield also exhibited the similar trend. Among the various systems, maize-potato-okra

Evaluation of rice-potato-radish system under different management practices at Modipuram

recorded higher basmati rice equivalent yield of 31703 kg ha$^{-1}$. Organic and integrated package resulted in on par basmati rice equivalent yield.

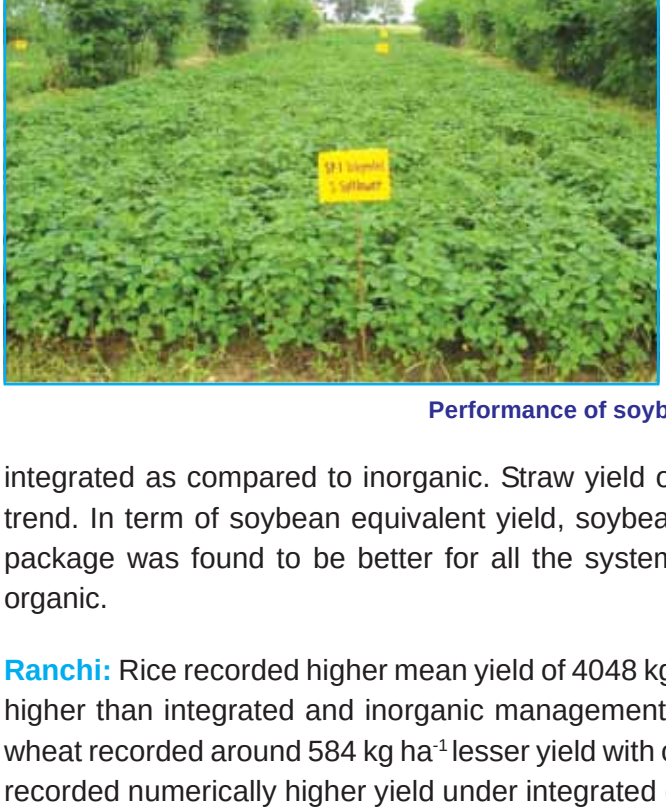
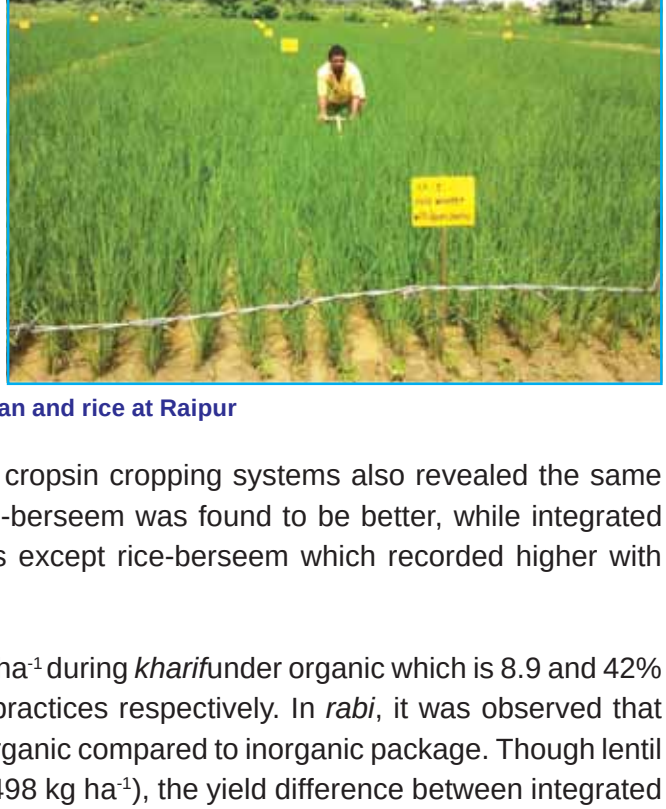
**Pantnagar:** Significantly higher mean yield of basmati rice during *kharif* was observed with organic package as it recorded 3927kg ha$^{-1}$ followed by integrated package 3598 kg ha$^{-1}$. The yield increase under organic was 20.2% over inorganic package. Among *rabi* crops, wheat recorded numerically higher yield under integrated package (4274 kg ha$^{-1}$) but, the same was at par with inorganic (4202 kg ha$^{-1}$). Vegetable pea produced better yield (6320 kg ha$^{-1}$) under organic followed by integrated (5880 kg ha$^{-1}$). *Brassica napus*recorded higher yield (1917 kg ha$^{-1}$) under integrated followed by organic (1886 kg ha$^{-1}$) package. The straw yield of both *kharif* and *rabi* crops have resulted in similar trend. In term of basmati rice equivalent yield, all the systems recorded higher yield under organic package management. Among the systems, basmati rice-wheat-sesbania (green manuring) and basmati rice-vegetable pea-sesbania (green manuring) recorded higher basmati rice equivalent yield (5949 and 5901 kg ha$^{-1}$).

Evaluation of basmati rice-chickpea-sesbania system at Pantnagar

Performance of mustard under organic management at Pantnagar

**Raipur:** Mean yield of soybean in *kharif*was found to be higher under integrated package (1752 kg ha$^{-1}$) followed by organic (1718 kg ha$^{-1}$) in comparison to inorganic (1658 kg ha$^{-1}$). Among the other crops evaluated in *rabi*, berseem registered higher yield under organic package, isabgol and onion recorded higher yield under inorganic package, while safflower performed better under integrated package. The drop in yield of isabgol and onion with organic package was found to be 44 and 714 kg ha$^{-1}$respectively compared to inorganic package. Safflower recorded 12.2% higher yield with


Performance of safflower under organic condition at Raipur

**Performance of soybean and rice at Raipur**

integrated as compared to inorganic. Straw yield of cropsin cropping systems also revealed the same trend. In term of soybean equivalent yield, soybean-berseem was found to be better, while integrated package was found to be better for all the systems except rice-berseem which recorded higher with organic.

**Ranchi:** Rice recorded higher mean yield of 4048 kg ha$^{-1}$ during *kharif* under organic which is 8.9 and 42% higher than integrated and inorganic management practices respectively. In *rabi*, it was observed that wheat recorded around 584 kg ha$^{-1}$ lesser yield with organic compared to inorganic package. Though lentil recorded numerically higher yield under integrated (498 kg ha$^{-1}$), the yield difference between integrated and organic package was found to be only 43 kg ha$^{-1}$. Potato and linseed recorded 34 and 6.5% increase in yield under organic over inorganic package. Similar trend was also obtained for straw yield of all the crops. Rice-potato system was found to be better in term of rice equivalent yield (11856 kg ha$^{-1}$) and all the systems performed better with organic package due to the higher premium price received for organic practice.

**Umiam:** Rice grown during *kharif* recorded numerically higher mean grain yield of 3440 kg ha$^{-1}$ with integrated package (3428kg ha$^{-1}$) followed by organic (3428 kg ha$^{-1}$). Vegetable crops like carrot, potato and tomato grown during *rabi* performed better underorganic package. Among the vegetable crops, carrot,potato and tomato have recorded 69.9, 14.6 and 12.7% higher yield with organic over inorganic package. Straw yield of vegetables have also given same trend. Among the systems, rice-tomato system recorded higher rice equivalent yield (17939 kg ha$^{-1}$) andall the systems recorded higher rice equivalent yield under organic package.

### Soil physical and available nutrient status (Table 3-5)

Except Ranchiall the centres have reported soil parameters

**Bajaura:** Organic carbon, soil available N, P, K and micronutrientsMn, Zn, Cu and Fe were estimated. An increase of 42 and 34.5% in organic carbon was observed with organic and integrated packageover inorganic. Variation of 12.6% was observed among different vegetable based systems. Availability of residual N, was higher with integrated (258.5 kg ha$^{-1}$) whereasP and K was higher under organic (85.3 and 241.4 kg ha$^{-1}$ respectively) irrespective of cropping systems. Among the various cropping systems cauliflower-

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

| Cropping systems/ package | Bulk density (g/cc) | | | | Electrical conductivity (ds/m) | | | | pH | | | | Organic carbon (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean |
| **Bajaura** | | | | | | | | | | | | | | | | |
| Cauliflower-pea-tomato | | | | | | | | | 7.10 | 6.40 | 6.40 | 6.63 | 1.09 | 0.83 | 1.12 | 1.01 |
| Frenchbean-cauliflower-french bean | | | | | | | | | 6.80 | 5.60 | 6.40 | 6.27 | 1.05 | 0.76 | 1.05 | 0.95 |
| Cauliflower-pea-cauliflower | | | | | | | | | 7.20 | 5.70 | 6.60 | 6.50 | 1.13 | 0.81 | 1.15 | 1.03 |
| Maize+frenchbean-garlic | | | | | | | | | 7.00 | 5.70 | 6.60 | 6.43 | 1.34 | 0.83 | 1.03 | 1.07 |
| Mean | | | | | | | | | 7.03 | 5.85 | 6.50 | | 1.15 | 0.81 | 1.09 | |
| **Bhopal** | | | | | | | | | | | | | | | | |
| Soybean-wheat | | | | | 0.26 | 0.25 | 0.23 | 0.25 | 7.87 | 7.97 | 8.10 | 7.98 | 1.13 | 0.71 | 0.54 | 0.79 |
| Soybean-mustard | | | | | 0.24 | 0.22 | 0.24 | 0.23 | 7.83 | 7.77 | 7.87 | 7.82 | 0.82 | 0.49 | 0.77 | 0.69 |
| Soybean-chickpea | | | | | 0.24 | 0.24 | 0.22 | 0.24 | 7.80 | 7.83 | 7.83 | 7.82 | 0.83 | 0.66 | 0.76 | 0.75 |
| Soybean-linseed | | | | | 0.24 | 0.22 | 0.24 | 0.23 | 7.97 | 7.67 | 7.80 | 7.81 | 0.78 | 0.68 | 0.71 | 0.72 |
| Mean | | | | | 0.25 | 0.24 | 0.23 | | 7.87 | 7.81 | 7.90 | | 0.89 | 0.63 | 0.70 | |
| **Calicut** | | | | | | | | | | | | | | | | |
| Ginger | | | | | | | | | 5.43 | 5.00 | 5.18 | 5.20 | 1.82 | 1.66 | 1.63 | 1.70 |
| Turmeric | | | | | | | | | 5.23 | 4.99 | 5.19 | 5.14 | 1.83 | 1.60 | 1.65 | 1.69 |
| Black Pepper | | | | | | | | | 6.66 | 5.98 | 6.48 | 6.37 | 2.99 | 2.35 | 3.30 | 2.88 |
| Mean | | | | | | | | | 5.77 | 5.32 | 5.62 | | 2.21 | 1.87 | 2.19 | |
| **Coimbatore** | | | | | | | | | | | | | | | | |
| Cotton-maize-green manure | | | | | | | | | | | | | 0.67 | 0.61 | 0.71 | 0.66 |
| Chillies-sunflower-green manure | | | | | | | | | | | | | 0.71 | 0.63 | 0.70 | 0.68 |
| Brinjal-sunflower-green manure | | | | | | | | | | | | | 0.66 | 0.64 | 0.68 | 0.66 |
| Mean | | | | | | | | | | | | | 0.68 | 0.63 | 0.70 | |

| Cropping systems/ package | Bulk density (g/cc) | | | | Electrical conductivity (ds/m) | | | | pH | | | | Organic carbon (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean |
| **Dharwad** | | | | | | | | | | | | | | | | |
| Groundnut–sorghum | 1.22 | 1.32 | 1.24 | 1.26 | 0.19 | 0.22 | 0.21 | 0.21 | 7.25 | 7.30 | 7.25 | 7.27 | 0.67 | 0.52 | 0.63 | 0.61 |
| Soybean–wheat | 1.21 | 1.31 | 1.24 | 1.25 | 0.18 | 0.18 | 0.19 | 0.18 | 7.22 | 7.19 | 7.15 | 7.19 | 0.64 | 0.52 | 0.60 | 0.59 |
| Soybean+pigeon pea | 1.20 | 1.32 | 1.24 | 1.25 | 0.21 | 0.20 | 0.20 | 0.20 | 7.14 | 7.22 | 7.03 | 7.13 | 0.66 | 0.53 | 0.60 | 0.60 |
| Cotton+peas | 1.22 | 1.29 | 1.26 | 1.26 | 0.17 | 0.18 | 0.21 | 0.19 | 7.14 | 7.22 | 7.19 | 7.18 | 0.63 | 0.51 | 0.58 | 0.57 |
| Maize-chickpea | 1.20 | 1.30 | 1.24 | 1.25 | 0.19 | 0.20 | 0.20 | 0.20 | 7.27 | 7.28 | 7.24 | 7.26 | 0.65 | 0.53 | 0.58 | 0.59 |
| Mean | 1.21 | 1.31 | 1.24 | | 0.19 | 0.20 | 0.20 | | 7.20 | 7.24 | 7.17 | | 0.65 | 0.52 | 0.60 | |
| **Jabalpur** | | | | | | | | | | | | | | | | |
| Basmati rice – durum wheat -green manure- | | | | | 0.44 | 0.55 | 0.51 | 0.50 | 7.27 | 7.36 | 7.35 | 7.33 | 8.00 | 7.00 | 7.90 | 7.63 |
| Basmati rice – chickpea - sesame | | | | | 0.43 | 0.50 | 0.45 | 0.46 | 2.26 | 7.44 | 7.39 | 5.70 | 7.60 | 6.60 | 7.30 | 7.17 |
| Basmati rice – berseem (fodder) | | | | | 0.41 | 0.50 | 0.46 | 0.46 | 7.30 | 7.46 | 7.39 | 7.38 | 7.50 | 6.50 | 7.40 | 7.13 |
| Basmati rice – vegetable pea- sorghum (fodder) | | | | | 0.45 | 0.47 | 0.50 | 0.47 | 7.32 | 7.51 | 7.41 | 7.41 | 7.80 | 6.90 | 7.50 | 7.40 |
| Mean | | | | | 0.43 | 0.51 | 0.48 | | 6.04 | 7.44 | 7.39 | | 7.73 | 6.75 | 7.53 | |
| **Karjat** | | | | | | | | | | | | | | | | |
| Rice-groundnut | | | | | 0.57 | 0.59 | 0.61 | 0.59 | 6.93 | 6.89 | 6.83 | 6.88 | 1.61 | 1.33 | 1.40 | 1.45 |
| Rice-maize (sweet corn for cob) | | | | | 0.60 | 0.58 | 0.60 | 0.59 | 6.89 | 6.83 | 6.80 | 6.84 | 1.47 | 1.13 | 1.32 | 1.31 |
| Rice-mustard | | | | | 0.55 | 0.59 | 0.59 | 0.58 | 6.88 | 6.87 | 6.82 | 6.86 | 1.58 | 1.19 | 1.35 | 1.37 |
| Rice-dolichos bean (for green pod vegetable) | | | | | 0.60 | 0.57 | 0.59 | 0.59 | 6.87 | 6.84 | 6.85 | 6.85 | 1.47 | 1.18 | 1.35 | 1.33 |
| Mean | | | | | 0.58 | 0.58 | 0.60 | | 6.89 | 6.86 | 6.83 | | 1.53 | 1.21 | 1.36 | |
| **Ludhiana** | | | | | | | | | | | | | | | | |
| Cotton- chickpea (D) | | | | | 0.15 | 0.25 | 0.16 | 0.18 | 7.36 | 7.55 | 7.44 | 7.45 | 0.6 | 0.38 | 0.52 | 0.50 |
| Maize (Pearl Popcorn)-chickpea (kabuli) | | | | | 0.18 | 0.21 | 0.21 | 0.20 | 7.42 | 7.6 | 7.4 | 7.47 | 0.61 | 0.42 | 0.54 | 0.52 |
| Basmati rice – wheat - summer moong | | | | | 0.23 | 0.23 | 0.19 | 0.21 | 7.38 | 7.52 | 7.5 | 7.47 | 0.63 | 0.43 | 0.53 | 0.53 |
| Turmeric - onion | | | | | 0.19 | 0.19 | 0.21 | 0.19 | 7.52 | 7.6 | 7.5 | 7.54 | 0.62 | 0.38 | 0.56 | 0.52 |
| Maize – potato - summer moong | | | | | 0.17 | 0.20 | 0.20 | 0.19 | 7.45 | 7.51 | 7.32 | 7.43 | 0.59 | 0.44 | 0.62 | 0.55 |
| Mean | | | | | 0.18 | 0.21 | 0.19 | | 7.43 | 7.56 | 7.43 | | 0.61 | 0.41 | 0.55 | |

| Cropping systems/ package | Bulk density (g/cc) | | | | Electrical conductivity (ds/m) | | | | pH | | | | Organic carbon (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean |
| **Modipuram** | | | | | | | | | | | | | | | | |
| Basmati rice-wheat-*sesbania* GM | | | | | | | | | | | | | 0.70 | 0.38 | 0.58 | 0.56 |
| Rice-barley+mustard-green gram | | | | | | | | | | | | | 0.49 | 0.29 | 0.39 | 0.39 |
| Maize(grains)-potato-okra | | | | | | | | | | | | | 0.76 | 0.37 | 0.70 | 0.61 |
| Maize(cobs) -mustard+ radish-*sesbania* GM | | | | | | | | | | | | | 0.72 | 0.43 | 0.70 | 0.61 |
| Mean | | | | | | | | | | | | | 0.67 | 0.37 | 0.59 | |
| **Pantnagar** | | | | | | | | | | | | | | | | |
| Basmati rice-wheat-Sesbania (green manuring) | | | | | | | | | | | | | 1.02 | 0.85 | 0.94 | 0.94 |
| Basmati rice-lentil-sesbania (green manuring) | | | | | | | | | | | | | 1.05 | 0.83 | 1.04 | 0.97 |
| Basmati rice-vegetable pea-sesbania (green manuring) | | | | | | | | | | | | | 1.09 | 0.88 | 1.03 | 1.00 |
| Basmati rice-brassica napus-sesbania (green manuring) | | | | | | | | | | | | | 0.99 | 0.87 | 0.91 | 0.93 |
| Mean | | | | | | | | | | | | | 1.04 | 0.86 | 0.98 | |
| **Raipur** | | | | | | | | | | | | | | | | |
| Soybean-berseem | 1.28 | 1.34 | 1.27 | 1.30 | | | | | | | | | 0.72 | 0.63 | 0.66 | 0.67 |
| Soybean-isabgol | 1.28 | 1.33 | 1.28 | 1.30 | | | | | | | | | 0.71 | 0.65 | 0.69 | 0.68 |
| Soybean-onion | 1.28 | 1.35 | 1.29 | 1.31 | | | | | | | | | 0.70 | 0.64 | 0.67 | 0.67 |
| Soybean-safflower | 1.30 | 1.37 | 1.31 | 1.33 | | | | | | | | | 0.71 | 0.65 | 0.67 | 0.68 |
| Mean | 1.29 | 1.35 | 1.29 | | | | | | | | | | 0.71 | 0.64 | 0.67 | |
| **Umiam** | | | | | | | | | | | | | | | | |
| Rice-carrot | 1.14 | 1.27 | 1.17 | 1.19 | | | | | 5.17 | 5.06 | 5.32 | 5.18 | 3.03 | 2.62 | 3.04 | 2.90 |
| Rice-potato | 1.13 | 1.25 | 1.16 | 1.18 | | | | | 5.31 | 5.01 | 5.41 | 5.24 | 3.18 | 2.69 | 2.97 | 2.95 |
| Rice-french bean | 1.12 | 1.23 | 1.15 | 1.17 | | | | | 5.34 | 5.02 | 5.21 | 5.19 | 3.21 | 2.66 | 3.11 | 2.99 |
| Rice-tomato | 1.14 | 1.24 | 1.16 | 1.18 | | | | | 5.34 | 5.06 | 5.33 | 5.24 | 3.19 | 2.66 | 3.01 | 2.96 |
| Mean | 1.13 | 1.25 | 1.16 | | | | | | 5.29 | 5.04 | 5.32 | | 3.15 | 2.66 | 3.03 | |

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

| Cropping system/package | N (kg ha$^{-1}$) | | | | P (kg ha$^{-1}$) | | | | K (kg ha$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | Inorganic | Integrated | Mean | Organic | Inorganic | Integrated | Mean | Organic | Inorganic | Integrated | Mean |
| **Bajaura** | | | | | | | | | | | | |
| Cauliflower-pea-tomato | 248.3 | 220.0 | 282.8 | 250.4 | 91.5 | 32.1 | 57.6 | 60.4 | 254.0 | 114.9 | 226.2 | 198.4 |
| Frenchbean-cauliflower-frenchbean | 242.0 | 235.7 | 246.3 | 241.3 | 97.7 | 35.2 | 52.0 | 61.6 | 259.8 | 129.5 | 185.3 | 191.5 |
| Cauliflower-pea-cauliflower | 235.7 | 202.7 | 257.7 | 232.0 | 77.8 | 30.3 | 48.9 | 52.3 | 137.8 | 99.7 | 187.0 | 141.5 |
| Maize+frenchbean-garlic | 257.7 | 216.8 | 267.1 | 247.2 | 74.1 | 31.5 | 69.6 | 58.4 | 314.1 | 114.9 | 333.3 | 254.1 |
| Mean | 245.9 | 218.8 | 258.5 | | 85.3 | 32.3 | 57.0 | | 241.4 | 114.8 | 233.0 | |
| **Bhopal** | | | | | | | | | | | | |
| Soybean-wheat | 283.3 | 229.7 | 241.3 | 251.4 | 120.3 | 33.0 | 64.7 | 72.7 | 680.0 | 696.0 | 606.3 | 660.8 |
| Soybean-mustard | 243.3 | 238.0 | 246.0 | 242.4 | 93.7 | 49.3 | 82.0 | 75.0 | 544.7 | 581.0 | 516.0 | 547.2 |
| Soybean-chickpea | 259.3 | 264.0 | 267.0 | 263.4 | 88.0 | 48.0 | 84.3 | 73.4 | 520.7 | 563.3 | 508.7 | 530.9 |
| Soybean-linseed | 230.0 | 224.3 | 211.0 | 221.8 | 57.3 | 25.0 | 52.3 | 44.9 | 555.0 | 528.3 | 483.0 | 522.1 |
| Mean | 254.0 | 239.0 | 241.3 | | 89.8 | 38.8 | 70.8 | | 575.1 | 592.2 | 528.5 | |
| **Calicut (ppm)** | | | | | | | | | | | | |
| Ginger | 168.6 | 159.6 | 126.4 | 151.5 | 0.56 | 2.21 | 5.29 | 2.7 | 252.2 | 268.2 | 237.4 | 252.6 |
| Turmeric | 164.3 | 150.5 | 161.8 | 158.9 | 2.95 | 14.17 | 14.67 | 10.6 | 219.8 | 275.7 | 290.2 | 261.9 |
| Black pepper | 268.3 | 263.0 | 306.3 | 279.2 | 0.48 | 0.22 | 1.29 | 0.7 | 233.3 | 289.3 | 388.8 | 303.8 |
| Mean | 200.4 | 191.0 | 198.2 | | 1.33 | 5.53 | 7.08 | | 235.1 | 277.7 | 305.5 | |
| **Coimbatore** | | | | | | | | | | | | |
| Cotton -maize - green manure | 268.0 | 266.0 | 262.0 | 265.3 | 22.6 | 21.8 | 20.5 | 21.6 | 672.0 | 688.0 | 684.0 | 681.3 |
| Chillies-sunflower-green manure | 252.0 | 246.0 | 248.0 | 248.7 | 21.4 | 20.6 | 19.7 | 20.6 | 638.0 | 642.0 | 668.0 | 649.3 |
| Brinjal-sunflower-green manure | 228.0 | 212.0 | 209.0 | 216.3 | 21.0 | 19.8 | 18.2 | 19.7 | 624.0 | 616.0 | 639.0 | 626.3 |
| Mean | 249.3 | 241.3 | 239.7 | | 21.7 | 20.7 | 19.5 | | 644.7 | 648.7 | 663.7 | |

| Cropping system/package | N (kg ha$^{-1}$) | | | | P (kg ha$^{-1}$) | | | | K (kg ha$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | Inorganic | Integrated | Mean | Organic | Inorganic | Integrated | Mean | Organic | Inorganic | Integrated | Mean |
| **Dharwad** | | | | | | | | | | | | |
| Maize-chickpea | 279.3 | 266.2 | 276.3 | 273.9 | 34.5 | 25.2 | 30.4 | 30.0 | 376.2 | 270.5 | 362.4 | 279.3 |
| Cotton+pea | 286.6 | 264.1 | 274.0 | 274.9 | 34.1 | 26.8 | 29.4 | 30.1 | 379.5 | 257.8 | 346.7 | 286.6 |
| Groundnut-sorghum | 278.7 | 254.0 | 277.2 | 269.9 | 33.6 | 25.8 | 29.7 | 29.7 | 404.2 | 256.3 | 369.5 | 278.7 |
| Potato-chickpea | 271.2 | 256.3 | 283.6 | 270.3 | 32.8 | 25.9 | 29.9 | 29.5 | 394.6 | 270.7 | 358.0 | 271.2 |
| Soybean-wheat | 290.0 | 257.5 | 282.2 | 276.6 | 33.4 | 23.7 | 28.4 | 28.5 | 366.6 | 255.8 | 331.9 | 290.0 |
| Mean | 281.1 | 259.6 | 278.6 | | 33.7 | 25.5 | 29.5 | | 384.2 | 262.2 | 353.7 | |
| **Jabalpur** | | | | | | | | | | | | |
| Rice-groundnut | 289.0 | 278.0 | 281.0 | 282.7 | 14.6 | 13.5 | 14.2 | 14.1 | 267.0 | 253.0 | 265.0 | 261.7 |
| Rice-maize (sweet corn for cob) | 272.0 | 276.0 | 275.0 | 274.3 | 14.4 | 12.2 | 13.3 | 13.3 | 266.0 | 249.0 | 259.0 | 258.0 |
| Rice-mustard | 286.0 | 277.0 | 288.0 | 283.7 | 13.7 | 13.3 | 14.0 | 13.7 | 266.0 | 250.0 | 262.0 | 259.3 |
| Rice-dolichos bean (For green pod vegetable) | 277.0 | 263.0 | 269.0 | 269.7 | 13.8 | 12.7 | 13.9 | 13.5 | 265.0 | 237.0 | 258.0 | 253.3 |
| Mean | 281.0 | 273.5 | 278.3 | | 14.1 | 12.9 | 13.9 | | 266.0 | 247.3 | 261.0 | |
| **Karjat** | | | | | | | | | | | | |
| Sorghum-berseem | 273.2 | 257.6 | 262.2 | 264.3 | 29.0 | 27.8 | 28.1 | 28.3 | 349.5 | 331.3 | 343.6 | 341.5 |
| Maize-berseem-bajra | 239.7 | 223.5 | 229.7 | 231.0 | 27.8 | 25.1 | 26.6 | 26.5 | 360.3 | 347.0 | 349.8 | 352.4 |
| Maize-berseem-maize + cowpea | 256.4 | 223.5 | 242.0 | 240.7 | 28.1 | 26.9 | 26.9 | 27.3 | 351.9 | 330.6 | 344.9 | 342.5 |
| Sorghum+guar-oats-cowpea | 277.3 | 249.1 | 258.7 | 261.7 | 27.8 | 27.2 | 28.1 | 27.7 | 372.3 | 356.5 | 359.0 | 362.6 |
| Mean | 261.7 | 238.4 | 248.1 | | 28.2 | 26.8 | 27.4 | | 358.5 | 341.3 | 349.3 | |
| **Ludhiana** | | | | | | | | | | | | |
| Cotton- chickpea (D) | 385.2 | 330.1 | 370.1 | 361.8 | 65.2 | 41.2 | 61.2 | 55.9 | 178.5 | 140.2 | 170.1 | 162.9 |
| Maize (Pearl Popcorn)-chickpea (kabuli) | 325.8 | 300.8 | 330.1 | 318.9 | 68.6 | 49.6 | 62.2 | 60.1 | 180.2 | 128.5 | 172.2 | 160.3 |
| Basmati rice – wheat - summer moong | 382.1 | 320.8 | 365.4 | 356.1 | 72.1 | 56.3 | 60.5 | 63.0 | 176.8 | 148.6 | 168.6 | 164.7 |
| Turmeric - onion | 330.8 | 305.2 | 335.6 | 323.9 | 70.1 | 48.6 | 63.4 | 60.7 | 175.2 | 128.2 | 170.1 | 157.8 |
| Maize – potato - summer moong | 378.2 | 285.2 | 360.8 | 341.4 | 68.2 | 60.2 | 68.6 | 65.7 | 170.1 | 130.5 | 158.2 | 152.9 |
| Mean | 360.4 | 308.4 | 352.4 | | 68.8 | 51.2 | 63.2 | | 176.2 | 135.2 | 167.8 | |

| Cropping system/package | N (kg ha$^{-1}$) | | | | P (kg ha$^{-1}$) | | | | K (kg ha$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | Inorganic | Integrated | Mean | Organic | Inorganic | Integrated | Mean | Organic | Inorganic | Integrated | Mean |
| **Modipuram** | | | | | | | | | | | | |
| Basmati rice-wheat-*sesbania* GM | 247.3 | 147.2 | 199.3 | 197.9 | 23.1 | 14.3 | 17.4 | 18.3 | 277.1 | 173.4 | 264.2 | 238.2 |
| Rice-barley+mustard-green gram | 185.1 | 161.1 | 175.6 | 173.9 | 18.2 | 7.5 | 9.9 | 11.9 | 226.7 | 132.1 | 168.8 | 175.9 |
| Maize(grains)-potato-okra | 241.8 | 176.8 | 201.8 | 206.8 | 20.7 | 18.7 | 20.4 | 19.9 | 227 | 138.6 | 217.1 | 194.2 |
| Maize(cobs)-mustard+ radish-*sesbania* GM | 154.4 | 128.3 | 141.3 | 141.3 | 25.7 | 17.6 | 24.3 | 22.5 | 282.1 | 226.6 | 257.1 | 255.3 |
| Mean | 207.2 | 153.4 | 179.5 | | 21.9 | 14.5 | 18.0 | | 253.2 | 167.7 | 226.8 | |
| **Pantnagar** | | | | | | | | | | | | |
| Basmati rice-wheat-*Sesbania* (green manuring) | 424.2 | 390.6 | 411.7 | 408.8 | 39.77 | 35.46 | 37.93 | 37.7 | 200.8 | 292.1 | 290.2 | 261.0 |
| Basmati rice-lentil-*Sesbania* (green manuring) | 413.7 | 407.9 | 429.9 | 417.2 | 34.57 | 37.88 | 34.25 | 35.6 | 296.6 | 259.2 | 258.1 | 271.3 |
| Basmati rice-vegetable pea-*Sesbania* (green manuring) | 422.1 | 393.6 | 402.4 | 406.1 | 39.62 | 39.30 | 36.62 | 38.5 | 274.6 | 293.0 | 274.7 | 280.8 |
| Basmati rice-*Brassica napus-Sesbania* (green manuring) | 422.8 | 347.6 | 406.1 | 392.2 | 35.99 | 37.09 | 38.99 | 37.4 | 250.5 | 278.6 | 272.1 | 267.0 |
| Mean | 420.7 | 384.9 | 412.5 | | 37.49 | 37.43 | 36.95 | | 255.6 | 280.7 | 273.8 | |
| **Raipur** | | | | | | | | | | | | |
| Soybean-berseem | 257.0 | 279.0 | 271.0 | 269.0 | 15.1 | 16.5 | 16.1 | 15.9 | 253.0 | 265.0 | 260.0 | 259.3 |
| Soybean-isabgol | 253.0 | 279.0 | 261.0 | 264.3 | 14.5 | 15.2 | 17.2 | 15.6 | 256.0 | 271.0 | 263.0 | 263.3 |
| Soybean-onion | 266.0 | 288.0 | 280.0 | 278.0 | 16.5 | 19.9 | 16.7 | 17.7 | 255.0 | 291.0 | 275.0 | 273.7 |
| Soybean-safflower | 257.0 | 288.0 | 265.0 | 270.0 | 17.7 | 18.5 | 17.9 | 18.0 | 251.0 | 291.0 | 286.0 | 276.0 |
| Mean | 258.3 | 283.5 | 269.3 | | 16.0 | 17.5 | 17.0 | | 253.8 | 279.5 | 271.0 | |
| **Ranchi** | | | | | | | | | | | | |
| Rice-wheat | 281.0 | 244.0 | 266.0 | 263.7 | 56.1 | 58.4 | 53.8 | 56.1 | 213.0 | 153.0 | 175.0 | 180.3 |
| Rice-potato | 301.0 | 261.0 | 276.0 | 279.3 | 57.4 | 60.2 | 52.6 | 56.7 | 221.4 | 155.0 | 184.5 | 187.0 |
| Rice-linseed | 292.0 | 241.0 | 260.0 | 264.3 | 55.3 | 56.7 | 54.1 | 55.4 | 227.3 | 151.7 | 181.9 | 187.0 |
| Rice-lentil | 295.0 | 246.0 | 274.0 | 271.7 | 50.2 | 55.1 | 53.8 | 53.0 | 216.7 | 148.5 | 173.4 | 179.5 |
| Mean | 292.3 | 248.0 | 269.0 | | 54.8 | 57.6 | 53.6 | | 219.6 | 152.1 | 178.7 | |

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

| Cropping systems/ package | Mn (ppm) | | | | Zn (ppm) | | | | Cu (ppm) | | | | Fe (ppm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean |
| **Bajaura** | | | | | | | | | | | | | | | | |
| Cauliflower-pea-tomato | 5.00 | 6.35 | 8.95 | 6.77 | 2.25 | 1.91 | 2.63 | 2.26 | 1.01 | 1.12 | 1.17 | 1.10 | 6.75 | 11.65 | 9.80 | 9.40 |
| French bean-cauliflower-french bean | 3.95 | 12.30 | 7.55 | 7.93 | 2.66 | 1.58 | 2.58 | 2.27 | 0.92 | 1.17 | 1.00 | 1.03 | 6.25 | 13.95 | 8.65 | 9.62 |
| Cauliflower-pea-cauliflower | 3.60 | 6.70 | 8.30 | 6.20 | 2.32 | 1.83 | 2.35 | 2.17 | 0.96 | 1.03 | 1.22 | 1.07 | 3.40 | 7.55 | 8.35 | 6.43 |
| Maize+frenchbean-garlic | 3.00 | 9.80 | 7.15 | 6.65 | 2.86 | 1.78 | 2.02 | 2.22 | 0.92 | 1.13 | 1.09 | 1.05 | 6.05 | 10.55 | 9.35 | 8.65 |
| Mean | 3.89 | 8.79 | 7.99 | | 2.52 | 1.78 | 2.40 | | 0.95 | 1.11 | 1.12 | | 5.61 | 10.93 | 9.04 | |
| **Calicut** | | | | | | | | | | | | | | | | |
| Ginger | 3.94 | 6.72 | 5.17 | 5.28 | 0.74 | 0.64 | 0.90 | 0.76 | 22.78 | 2.23 | 16.00 | 13.67 | 31.11 | 32.07 | 38.27 | 33.81 |
| Turmeric | 13.57 | 13.83 | 12.68 | 13.36 | 0.67 | 0.63 | 0.76 | 0.69 | 1.92 | 1.80 | 1.78 | 1.83 | 32.00 | 36.00 | 34.40 | 34.13 |
| Black pepper | 33.18 | 35.43 | 32.38 | 33.66 | 11.73 | 3.48 | 5.25 | 6.82 | 24.23 | 17.90 | 12.78 | 18.30 | 55.85 | 66.98 | 65.53 | 62.78 |
| Mean | 16.90 | 18.66 | 16.74 | | 4.38 | 1.58 | 2.30 | | 16.31 | 7.31 | 10.19 | | 39.65 | 45.01 | 46.06 | |
| **Dharwad** | | | | | | | | | | | | | | | | |
| Maize-chickpea | 12.25 | 9.75 | 11.78 | 11.26 | 0.94 | 0.79 | 0.90 | 0.88 | 1.39 | 1.34 | 1.61 | 1.45 | 9.85 | 8.27 | 9.00 | 9.04 |
| Cotton+pea | 11.50 | 10.77 | 10.83 | 11.03 | 0.89 | 0.80 | 0.89 | 0.86 | 1.56 | 1.36 | 1.47 | 1.46 | 9.20 | 8.33 | 9.11 | 8.88 |
| Groundnut-sorghum | 13.30 | 9.14 | 10.86 | 11.10 | 1.22 | 0.76 | 0.83 | 0.94 | 1.67 | 1.35 | 1.69 | 1.57 | 8.93 | 7.85 | 8.60 | 8.46 |
| Potato-chickpea | 11.57 | 9.07 | 10.81 | 10.48 | 0.84 | 0.73 | 1.02 | 0.86 | 1.64 | 1.28 | 1.54 | 1.49 | 9.33 | 7.58 | 9.50 | 8.80 |
| Soybean-wheat | 11.21 | 9.22 | 11.15 | 10.53 | 1.08 | 0.73 | 0.99 | 0.93 | 1.59 | 1.32 | 1.52 | 1.48 | 9.42 | 7.46 | 9.09 | 8.66 |
| Mean | 11.97 | 9.59 | 11.09 | | 0.99 | 0.76 | 0.93 | | 1.57 | 1.33 | 1.57 | | 9.35 | 7.90 | 9.06 | |
| **Pantnagar** | | | | | | | | | | | | | | | | |
| Basmati rice-wheat-*Sesbania* (green manuring) | 10.11 | 7.91 | 9.61 | 9.21 | 1.10 | 0.87 | 0.92 | 0.96 | 3.46 | 2.23 | 3.24 | 2.98 | 47.04 | 32.04 | 41.02 | 40.03 |
| Basmati rice-lentil-*Sesbania* (green manuring) | 9.19 | 7.55 | 15.82 | 10.86 | 1.82 | 0.85 | 0.96 | 1.21 | 3.62 | 2.49 | 3.38 | 3.16 | 53.98 | 30.96 | 45.20 | 43.38 |
| Basmati rice-vegetable pea-*Sesbania* (green manuring) | 13.31 | 8.62 | 18.71 | 13.55 | 1.34 | 0.89 | 1.00 | 1.08 | 3.75 | 2.82 | 3.12 | 3.23 | 59.06 | 28.74 | 54.34 | 47.38 |
| Basmati rice-*Brassica napus*-*Sesbania* (green manuring) | 11.68 | 9.74 | 10.47 | 10.63 | 1.06 | 0.77 | 0.95 | 0.93 | 3.54 | 2.24 | 3.08 | 2.95 | 54.70 | 28.76 | 44.38 | 42.62 |
| Mean | 11.07 | 8.46 | 13.66 | | 1.33 | 0.85 | 0.96 | | 3.59 | 2.45 | 3.21 | | 53.69 | 30.12 | 46.24 | |

pea-tomato system recorded lower soil available N (232 kg $ha^{-1}$), P (52.3 kg $ha^{-1}$) and K (141.5 kg $ha^{-1}$).Micro nutrientsMn and Fe were higher with inorganic (8.79 and 10.93 ppm respectively). Zn (2.52 ppm) was higher with organic but Cu (1.12) was higher under integratedpackage irrespective of cropping systems.Mn, Zn and Fe availability was found to be lower at the end of cauliflower-pea-cauliflower system.Curecorded lower in frenchbean-cauliflower-frenchbean system.

**Bhopal:** Physical and chemical characteristics of soil in terms of electrical conductivity and pH were estimated and no significant variation was found either by nutrient management practices or cropping systems.Electrical conductivity was numerically higher with organic package (0.25 ds/m) compared to inorganic (0.24 ds/m).An increase of 41% in organic carbon was observed with organic package over inorganic. Marginal improvement in available N (6.3%) and residual P of more than 2 times was observed with organic over inorganic packagewhereas availability of K decreased by 2.9%. The residual soil available N in soybean-chickpea system (263.4 kg $ha^{-1}$), P in soybean-mustard (75 kg $ha^{-1}$) was found to be better while K was found to be higher in soybean-wheat system (660.8 kg $ha^{-1}$).

**Calicut:** pH, soil organic carbon, available N, P and K along with micronutrient such as Mn, Zn, Cu and Fe were estimated after harvest of turmeric, ginger and black pepper. Irrespective of crops, improvement was observed in pH and organic carbon with organic package (8.5 and 18.2%) compared to inorganic input use. Black pepper recorded significantly higher pH (22.5 and 18.2%), soil organic carbon (69 and 70%) than ginger and turmeric. Remarkable difference in available N, P and K was observed among various types of input packages. Availability of residual N (200.4 kg $ha^{-1}$) recorded higher with organic package whereas P and K were found to be higher with integrated package7.08 and 305.5 kg $ha^{-1}$ respectively. Black pepper recorded significantly higher residual soil N and P while K was higher in turmeric. Micronutrient Mn, was higher under inorganic package while Zn and Cu was higher with organic condition. Among the crops, availability of all the micronutrients i.e. Mn, Zn, Cu and Fe were recorded higher in black pepper (33.7, 6.82, 18.3 and 62.8 ppm, respectively).

**Coimbatore:** Residual organic carbon, available soil N, P and K was estimated for all the three cropping systems under variousnutrient managementpractices. Irrespective of the cropping systems, organic and integratedpackage resulted in 7.9 and 11.1% improvement in organic carbon compared to inorganic package. Chillies-sunflower-green manuresystem recorded higher organic carbon (0.68%) compared to all other systems. Only 3% variation was observed among different vegetable based systems. The residual available N and P was found to be higher with organic package (249.3 and 21.7 kg $ha^{-1}$), however K was found to be higher in integrated (663.7 kg$ha^{-1}$). Cotton-maize-green manure recorded higher available N,P and K 265.3, 21.6, and 681.3 kg $ha^{-1}$ respectively at the end of cropping cycle.

**Dharwad:** Physical and chemical characteristics of soil along with micronutrient such as Mn, Zn, Cu and Fe were estimated. Lower bulk density (1.21 g/cc) and EC (0.19 ds/m) were recorded under organic package compared to inorganic and integrated,pH (7.17) were recorded under integratedpackage.Soil organic carbon content was recorded higher under organic conditions with increase 25.5%followed by integrated (15.4%) compared to inorganic. No significant variation in these parameters was observed among different cropping systems. Variation in organic carbon among various cropping systems was found to be 7%.The improvement in residual available N (8.2%) P (32.2%) K (46.5%) was found to be higher with organic packageover inorganic.Soybean-wheatsystem recorded higher residual N and K (276.6 kg $ha^{-1}$ and 290 kg $ha^{-1}$ respectively).Available P was found to be higher with cotton+pea system of 30.1 kg $ha^{-1}$. The variation in residual N, P, and K among different cropping systems was found to be 2.5, 5.6 and

6.9 kg $ha^{-1}$ respectively. Higher residual availability of Mn, Zn, Cu and Fe were observed under organic package compared to inorganic and integrated. Variation of 7.4, 9.3, 7.5 and 6.9% in availability of micronutrient Mn, Zn, Cu and Fe were observed among different cropping systems.

**Jabalpur:** Electrical conductivity, pH, organic carbon, available N, P and K in soil was estimated for all the four cropping systems with three nutrient management practices. Lower EC (0.43 ds/m) was recorded under organic package compared to inorganic and integrated, whereas higher pH (7.17) was recorded under integrated package. An increase of 14.5 and 11.6% in organic carbon was observed with organic and integrated package over inorganic. Basmati rice-wheat-greenmanure system recorded higher organic carbon (0.76%) compared to all other systems. Only 7% variation was observed among different cropping systems. The residual available N, P and K was found to be higher with organic package (281,14.1and 266 kg $ha^{-1}$ respectively).Among the cropping systems rice-mustard recorded higher available N (283.7 kg $ha^{-1}$) while P (14.1 kg $ha^{-1}$) and K (261.7 kg $ha^{-1}$) were recorded higher at the end of cropping cycle in rice-groundnutsystems.

**Karjat:** There wasno significant variation in EC, pH and OC of soil was observed in different cropping as well as input package. Soil organic carbon was higher under organic (1.53%) followed by integrated (1.36%) over inorganic (1.21%) packages. Among the cropping systems, rice-groundnut and rice-mustardrecorded higher organic carbon (1.45 and 1.37% respectively) compared to other systems. Significant variation in soil available N and P was observed among different input packages as well as in different cropping systems. Organic packages registered significantly higher residual N,P and K (261.7, 28.2 and 358.5 kg $ha^{-1}$ respectively). Rice-groundnut and rice-dolichos bean (for green pod) recorded significantly higher available N (264.3 and 261.7 kg $ha^{-1}$ respectively) compared to other systems.

**Ludhiana:** Soil EC, pH, OC, available N, P and K was estimated. Though there was not much variation in pH was observed, lower EC was recorded with organic management practice. Soil organic carbon was found to be increased by 48.8% under organic practice irrespective of nutrient management.Maize-potato-summer moong recorded higher OC of 0.55% compared to other systems. Available N, P and K were observed to be higher with organic management package.Among the cropping systems,N was found to be higher in cotton-chickpea system.Maize-potato-summer moong recorded significantly higher residual P (65.7 kg $ha^{-1}$) while K was higher under basmati rice-wheat-summer moong (164.7 kg $ha^{-1}$).

**Modipuram:** Soil organic carbon, available N, P and K were estimated during the year. Result reveals that significant variation in organic carbon among various nutrient management practice and cropping systems were found. However, the soil quality under inorganic package deteriorated as it is evidenced through reduction in organic carbon by 44.8% over organic package. Among the different cropping systems, maize for cob-potato-okra and maize-mustard+radish-sesbania (greenmanure) system recorded higher organic carbon (0.61%). At the end of cropping cycle, it was observed that, the available N, P and K were higher with organic package followed by integrated. The residual soil P and K was higher in maize-mustard+radish-greengram (22.5 and 255.3 kg $ha^{-1}$) system while N was higher in maize for cob-potato-okra system (206.8 kg $ha^{-1}$).

**Pantnagar:** Irrespective of cropping systems,organic carbon was found to be better with organic nutrient management. Soil organic carbon was found to be 20.9 and 14% higher with organic and integrated over inorganic package. Basmati rice–vegetable pea-sesbania (green manure) system resulted in higher OC (0.99%) followed by basmati rice–lentil-sesbania (green manure) (0.97%. at the end of cropping cycle).

Available N was increased to the level of 9.4 and 7.3%while K was drop 9 and 2.5% with organic and integrated respectively over inorganic. Higher available N (417.2 kg $ha^{-1}$) was recorded with basmati rice-lentil-sesbania (green manure). Basmati rice–vegetable pea-sesbania (green manure)recorded higher residual P & K (38.5 and 280.8 kg $ha^{-1}$) compared to other systems. Available Mn, Cu and Fe were significantly influenced by different input packages. Residual Zn, Cu and Fe was found to increase by 38.5, 11.8 and 16.1% with organic over inorganic package while in Mn, the drop was observed to be 19%. Among the various systems, basmati rice-vegetable pea-sesbania (green manure) registered significantly higher residual availability of Mn, Cu and Fe in soil while basmati rice-lentil-sesbania (green manure) recorded higher Zn.

**Raipur:** Bulk density, organic carbon, available N, P and K were estimated at the end of cropping cycle. The soil bulk density was observed significantly lower with organic (1.29 g/cc) over inorganic (1.35 g/cc). Considerably higher bulk density of 1.33 g/cc was observed with soybean-safflower system. Around 11% higher organic carbon was observed under organic than inorganic package. No significant variation in residual organic carbon was observed among different cropping system. Significantly lower available N, P and K was observed under organic package compared to inorganic irrespective of cropping systems. Though available N did not differ significantly among cropping systems, soybean-safflower systems resulted in higher residual P (18 kg $ha^{-1}$) and K (276 kg $ha^{-1}$).

**Ranchi:** Available N, P and K were estimated at the end of cropping cycle. The available N and K were higher with organic package followed by integrated while P was higher under inorganic package. Available K was found to increased by 44.4% with organic as compared to inorganic management package. Rice-potato system recorded higher residual soil N, P and K (279.3, 56.7 and 187 kg $ha^{-1}$ respectively).

**Umiam:** Bulk density, pH, organic carbon, available N, P and K were estimated at the end of cropping cycle. Lower bulk density (1.13 g/cc) was recorded with organic management package. Among the nutrient management practices, organic and integrated management exhibited superiority over inorganic. Increase in soil carbon was found to be higher under organic (18.4%) followed by integrated (13.9 %).

### Soil microbial count (Table 6)

Soil microbial count was estimated at Jabalpur only.The increase in *fungi*, *bacteriaactinomycetes*, *Azitobactor*and *phosphate solubilizing bacteria* (PSB) was found to be 42.5, 41.1, 85.9, 36.2 and 23% with organic over inorganic packageConsiderably higher count of fungi ($40.7x10^4$ CFU/g) and actinomycetes ($11.7x10^4$CFU/g) was observed with basmati rice-wheat systems while basmati rice–vegetable pea sorghum fodder recorded higher bacteria count ($47.4x10^6$CFU/g).

### Economics (Table 7)

**Bajaura:** Gross return was significantly higher (96.7%) with organic followed by integrated (87.5%) over inorganic package. Due to the lower cost of cultivation under these treatments, the increase in net returns was 82.2 and 80.3% with organic and integrated over inorganic package. Higher B: C ratio of 1.81 was recorded with organic management package system. Irrespective of cropping systems all the systems registered higher B: C ratio with organic package. Maize+frenchbean-garlic system recorded higher B: C ratio of 3.2.

**Table 6. Influence of methods of organic, inorganic and integrated on soil microbial count (x$10^4$ CFU/g) in the end of cropping cycle at Jabalpur**

| Cropping system/ package | Fungi ($10^4$/g) | | | | Bacteria ($10^6$/g) | | | | Actinomycities ($10^6$/g) | | | | Azatobactor ($10^6$/g) | | | | Phosphorus solubilizing bacteria ($10^6$/g) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Org | Inorg | Int | Mean | Org | Inorg | Int | Mean | Org | Inorg | Int | Mean | Org | Inorg | Int | Mean | Org | Inorg | Int | Mean |
| Basmati rice – Durum wheat –green manure | 46.9 | 33.5 | 41.6 | 40.7 | 54.8 | 40.2 | 44.2 | 46.4 | 16.0 | 7.5 | 11.5 | 11.7 | 30.7 | 25.8 | 26.3 | 27.6 | 15.5 | 14.6 | 14.8 | 15.0 |
| Basmati rice – chickpea – sesame | 44.8 | 31.5 | 34.6 | 37.0 | 51.2 | 35.0 | 39.2 | 41.8 | 12.8 | 6.9 | 10.0 | 9.9 | 25.9 | 19.5 | 23.2 | 22.9 | 15.3 | 12.3 | 11.2 | 12.9 |
| Basmati rice – berseem (fodder) | 46.1 | 31.2 | 39.0 | 38.8 | 51.1 | 37.2 | 42.1 | 43.5 | 13.1 | 6.9 | 10.0 | 10.0 | 27.5 | 20.0 | 21.0 | 22.8 | 15.0 | 10.5 | 11.0 | 12.2 |
| Basmati rice – vegetable pea–sorghum (fodder) | 45.6 | 32.4 | 36.7 | 38.3 | 58.6 | 40.5 | 43.2 | 47.4 | 11.0 | 7.0 | 10.8 | 9.6 | 32.0 | 20.0 | 24.1 | 25.4 | 14.4 | 11.4 | 13.0 | 12.9 |
| Mean | 45.9 | 32.2 | 38.0 | | 53.9 | 38.2 | 42.2 | | 13.2 | 7.1 | 10.6 | | 29.0 | 21.3 | 23.6 | | 15.0 | 12.2 | 12.5 | |

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

| Cropping systems/ package | Gross returns (Rs ha$^{-1}$) | | | | Cost of cultivation (Rs ha$^{-1}$) | | | | Net returns (Rs ha$^{-1}$) | | | | B:C ratio | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean |
| **Bajaura** | | | | | | | | | | | | | | | | |
| Cauliflower-pea-tomato | 406000 | 195225 | 345680 | 315635 | 142608 | 147977 | 145285 | 145290 | 263392 | 47248 | 200395 | 170345 | 1.85 | 0.32 | 1.38 | 1.18 |
| French bean-cauliflower-french bean | 307713 | 105340 | 276065 | 229706 | 146993 | 154826 | 154092 | 151970 | 160720 | -49486 | 121973 | 77736 | 1.09 | -0.32 | 0.79 | 0.52 |
| Cauliflower-pea-cauliflower | 247013 | 126515 | 208235 | 193921 | 137591 | 145061 | 143841 | 142164 | 109422 | -18546 | 64394 | 51757 | 0.80 | -0.13 | 0.45 | 0.37 |
| Maize+frenchbean-garlic | 388188 | 258770 | 455990 | 367649 | 86090 | 89292 | 87691 | 87691 | 302098 | 169478 | 368299 | 279958 | 3.51 | 1.90 | 4.20 | 3.20 |
| Mean | 337228.5 | 171463 | 321493 | | 128320.5 | 134289 | 132727 | | 208908 | 37174 | 188765 | | 1.81 | 0.44 | 1.71 | |
| **Bhopal** | | | | | | | | | | | | | | | | |
| Soybean-duram wheat | | | | 61158 | | | | 31974 | | | | 29184 | | | | 1.9 |
| Soybean-mustard | | | | 47925 | | | | 27839 | | | | 20086 | | | | 1.7 |
| Soybean-chickpea | | | | 57162 | | | | 28410 | | | | 28752 | | | | 2.0 |
| Soybean-linseed | | | | 54024 | | | | 27731 | | | | 26293 | | | | 1.9 |
| Mean | 69073 | 44614 | 48436 | | 27843 | 30248 | 28874 | | 41230 | 14366 | 19562 | | 2.5 | 1.5 | 1.7 | |
| **Calicut** | | | | | | | | | | | | | | | | |
| Ginger*(as dry) | | | | | 163996 | 125031 | 148564 | | 255000 | 152500 | 387500 | | | 1.55 (1.43) | 1.22 | 2.61 |
| Turmeric | | | | | 148996 | 140402 | 164015 | | 84000 | 106400 | 86240 | | | 0.56 | 0.76 | 0.53 |
| **Coimbatore** | | | | | | | | | | | | | | | | |
| Cotton-maize-green manure | 121094 | 113729 | 125765 | 120196 | 48572 | 39016 | 43434 | 43674 | 72522 | 74713 | 82331 | 76522 | 1.49 | 1.91 | 1.90 | 1.77 |
| Chillies-sunflower-green manure | 144018 | 126975 | 139185 | 136726 | 58664 | 49300 | 53091 | 53685 | 85354 | 77675 | 86094 | 83041 | 1.45 | 1.58 | 1.62 | 1.55 |
| Brinjal-sunflower-green manure | 201567 | 166746 | 175476 | 181263 | 63321 | 54403 | 58503 | 58742 | 70876 | 112343 | 116973 | 100064 | 1.12 | 2.07 | 2.00 | 1.73 |
| Mean | 155560 | 135817 | 146809 | | 56852 | 47573 | 51676 | | 76251 | 88244 | 95133 | | 1.36 | 1.85 | 1.84 | |
| **Dharwad** | | | | | | | | | | | | | | | | |
| Groundnut–sorghum | 158829 | 126973 | 103356 | 129719 | 30002 | 28460 | 27539 | 28667 | 128827 | 98513 | 75817 | 101052 | 5.29 | 4.46 | 3.75 | 4.50 |
| Soybean–wheat | 129724 | 103862 | 79137 | 104241 | 29994 | 27901 | 20918 | 26271 | 99730 | 75961 | 58219 | 77970 | 4.46 | 3.72 | 3.78 | 3.99 |
| Soybean+ pigeon pea | 134415 | 106068 | 92409 | 110964 | 32001 | 28460 | 27539 | 29333 | 102414 | 77608 | 64870 | 81631 | 6.50 | 5.48 | 5.80 | 5.93 |
| Cotton +peas | 146448 | 118328 | 99587 | 121454 | 30425 | 29182 | 26939 | 28849 | 116023 | 89146 | 72648 | 92606 | 4.81 | 4.05 | 3.70 | 4.19 |
| Maize-chickpea | 149880 | 96375 | 80507 | 108921 | 30517 | 24366 | 20910 | 25264 | 119363 | 72009 | 59597 | 83656 | 4.91 | 3.96 | 3.85 | 4.24 |
| Mean | 143859 | 110321 | 90999 | | 30588 | 27674 | 24769 | | 113271 | 82647 | 66230 | | 5.19 | 4.33 | 4.18 | |

| Cropping systems/ package | Gross returns (Rs ha$^{-1}$) | | | | Cost of cultivation (Rs ha$^{-1}$) | | | | Net returns (Rs ha$^{-1}$) | | | | B:C ratio | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean |
| **Jabalpur** | | | | | | | | | | | | | | | | |
| Basmati Rice - D.wheat - GM | 147190 | 126972 | 120460 | 131541 | 53750 | 51324 | 52356 | 52477 | 93440 | 75648 | 68104 | 79064 | 2.74 | 2.47 | 2.30 | 2.50 |
| Basmati Rice - chickpea - seasmum | 120397 | 103545 | 100650 | 108197 | 55991 | 48980 | 51150 | 52040 | 64406 | 54565 | 49500 | 56157 | 2.15 | 2.11 | 1.97 | 2.08 |
| Basmati rice - Berseem | 203890 | 198810 | 196107 | 199602 | 57800 | 53732 | 55700 | 55744 | 146090 | 145078 | 140407 | 143858 | 3.53 | 3.70 | 3.52 | 3.58 |
| Basmati rice- veg.pea - sorghum | 138767 | 130085 | 123320 | 130724 | 55500 | 51251 | 53600 | 53450 | 83267 | 78834 | 69720 | 77274 | 2.50 | 2.54 | 2.30 | 2.45 |
| Mean | 152561 | 139853 | 135134 | | 55760 | 51322 | 53202 | | 96801 | 88531 | 81933 | | 2.73 | 2.71 | 2.52 | |
| **Ludhiana** | | | | | | | | | | | | | | | | |
| Cotton- chickpea (D) | 141432 | 79049 | 50293 | 90258 | 60947 | 46298 | 50293 | 52513 | 80485 | 32751 | 45309 | 52848 | 2.30 | 1.70 | 1.90 | 1.97 |
| Maize (Pearl Popcorn)-chickpea (kabuli) | 133744 | 93769 | 85812 | 104442 | 64300 | 46721 | 55143 | 55388 | 69444 | 47048 | 30669 | 49054 | 2.10 | 2.00 | 1.60 | 1.90 |
| Basmati rice – wheat - summer moong | 172355 | 161889 | 143868 | 159371 | 78767 | 66216 | 73287 | 72757 | 93588 | 95673 | 70581 | 86614 | 2.20 | 2.40 | 2.00 | 2.20 |
| Turmeric - onion | 358220 | 148044 | 200080 | 235448 | 90150 | 77371 | 84551 | 84024 | 268070 | 70673 | 115529 | 151424 | 4.00 | 1.90 | 2.40 | 2.77 |
| Maize – potato - summer moong | 271868 | 189789 | 197680 | 219779 | 147780 | 121199 | 134214 | 134398 | 124088 | 68590 | 63466 | 85381 | 1.80 | 1.60 | 1.50 | 1.63 |
| Mean | 215524 | 134508 | 135547 | | 88389 | 71561 | 79498 | | 127135 | 62947 | 65111 | | 2.48 | 1.92 | 1.88 | |
| **Modipuram** | | | | | | | | | | | | | | | | |
| Basmati rice-wheat-*sesbania* GM | 165027 | 107341 | 140194 | 137521 | 95894 | 73980 | 89123 | 86332 | 69133 | 33361 | 51071 | 51188 | 1.39 | 2.22 | 1.75 | 1.79 |
| Rice-barley+mustard-green gram | 183607 | 122714 | 153204 | 153175 | 104074 | 82244 | 93447 | 93255 | 79533 | 40470 | 59757 | 59920 | 1.31 | 2.03 | 1.56 | 1.63 |
| Maize(grain)-potato-okra | 515280 | 344225 | 425390 | 428298 | 380312 | 261706 | 316138 | 319385 | 134968 | 82519 | 109252 | 108913 | 2.82 | 3.17 | 2.89 | 2.96 |
| Maize(cob) -mustard+ radish-*sesbania* GM | 174490 | 124504 | 155899 | 151631 | 128909 | 99728 | 120877 | 116505 | 45581 | 24776 | 35022 | 35126 | 2.83 | 4.03 | 3.45 | 3.44 |
| Mean | 259601 | 174696 | 218671 | | 177297 | 129414 | 154896 | | 82303 | 45281 | 63775 | | 2.09 | 2.86 | 2.41 | |

| Cropping systems/ package | Gross returns (Rs ha$^{-1}$) | | | | Cost of cultivation (Rs ha$^{-1}$) | | | | Net returns (Rs ha$^{-1}$) | | | | B:C ratio | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean | Organic | In-organic | Integ-rated | Mean |
| **Pantnagar** | | | | | | | | | | | | | | | | |
| Basmati rice-wheat-*Sesbania* (green manuring) | 214873 | 155824 | 166169 | 178955 | 154754 | 104124 | 111203 | 123360 | 60119 | 51700 | 54966 | 55595 | 3.56 | 3.00 | 3.01 | 3.19 |
| Basmati rice-lentil-*Sesbania* (green manuring) | 156013 | 97596 | 106780 | 120130 | 129156 | 76020 | 82104 | 95760 | 26857 | 21576 | 24676 | 24370 | 4.81 | 3.52 | 3.33 | 3.89 |
| Basmati rice-vegetable pea-*Sesbania* (green manuring) | 223588 | 153253 | 165080 | 180640 | 168323 | 102767 | 104559 | 125216 | 55265 | 50486 | 60521 | 55424 | 4.04 | 3.03 | 2.72 | 3.26 |
| Basmati rice-*Brassica napus*-*Sesbania* (green manuring) | 181261 | 132743 | 146588 | 153531 | 124740 | 81321 | 97668 | 101243 | 56521 | 51422 | 48920 | 52288 | 3.20 | 2.57 | 2.99 | 2.92 |
| Mean | 193934 | 134854 | 146154 | | 144243 | 91058 | 98884 | | 49691 | 43796 | 47271 | | 3.90 | 3.03 | 3.01 | |
| **Raipur** | | | | | | | | | | | | | | | | |
| Soybean-berseem | 57440 | 40619 | 44690 | 47583 | 17197 | 15824 | 16919 | 16647 | 40243 | 24795 | 27771 | 30936 | 2.34 | 1.57 | 1.64 | 1.85 |
| Soybean-isabgol | 25250 | 24643 | 24300 | 24731 | 22914 | 17270 | 18605 | 19596 | 2336 | 7373 | 5695 | 5135 | 0.10 | 0.43 | 0.31 | 0.28 |
| Soybean-onion | 164588 | 138810 | 136900 | 146766 | 37686 | 31563 | 34624 | 34624 | 126902 | 107247 | 102276 | 112142 | 3.37 | 3.40 | 2.95 | 3.24 |
| Soybean-safflower | 35521 | 31458 | 35292 | 34090 | 25595 | 18501 | 20547 | 21548 | 9926 | 12957 | 14745 | 12543 | 0.39 | 0.70 | 0.72 | 0.60 |
| Mean | 70700 | 58883 | 60296 | | 25848 | 20790 | 22674 | | 44852 | 38093 | 37622 | | 1.55 | 1.53 | 1.41 | |
| **Ranchi** | | | | | | | | | | | | | | | | |
| Rice - Wheat | 121753 | 86626 | 96058 | 101479 | 68218 | 39554 | 53875 | 53882 | 53535 | 47073 | 42182 | 47597 | 1.73 | 2.48 | 1.71 | 1.97 |
| Rice - Potato | 154172 | 161699 | 145818 | 153897 | 79733 | 84525 | 82097 | 82118 | 74439 | 77175 | 63721 | 71778 | 2.21 | 2.45 | 2.04 | 2.23 |
| Rice - Linseed | 80116 | 49093 | 60936 | 63382 | 48120 | 28794 | 38437 | 38450 | 31995 | 20300 | 22499 | 24931 | 0.86 | 1.08 | 0.77 | 0.90 |
| Rice - Lentil | 89920 | 56780 | 69685 | 72128 | 44291 | 29473 | 36881 | 36882 | 45629 | 27308 | 32804 | 35247 | 1.76 | 1.71 | 1.54 | 1.67 |
| Mean | 111490 | 88550 | 93124 | | 60090 | 45586 | 52823 | | 51399 | 42964 | 40302 | | 1.64 | 1.93 | 1.52 | |

**Calicut:** The cost of cultivation of Rs.1,63,995, 1,25,031, 1,48,564 $ha^{-1}$ of ginger recorded under organic, inorganic and integrated management package respectively. Net return of Rs. 3,87,500 $ha^{-1}$ was high in integrated system with a B:C ratio of 2.61 followed by organic (Net return 2,55,000 and B:C ratio 1.55). Higher net return and B:C ratio (Rs. 1,06,400 $ha^{-1}$ and 0.76) was recorded with inorganic package owing to higher rhizomes yield of turmeric.

**Coimbatore:** Though the gross return was higher by 14.5 and 8.1% with organic and integrated,consequence of high cost of cultivation reduced net return (13.6%)and B:C ratio (26.5%) was observed with organic. Among the systems, brinjal-sunflower-greenmanure recorded higher net return of Rs. 1,00,064 $ha^{-1}$ but higher BC ratio of 1.77 was recorded with cotton-maize-green manure system. All the system performed better with integrated in terms of economics.

**Dharwad:** Organic input package resulted in 30.4% increase in gross returns over inorganic while integrated recorded reductionto the level of 17.5%. The same trend was also reflected in cost of cultivation as organic and integrated package resulted in 10.8% increased and decrease over inorganic.Considerably higher (37.1%) net return with organic was recorded whereas integrated recorded 19.9% dropover inorganic. B: C ratio was found to be higher with organic input (5.19). Among the cropping systems, groundnut-sorghum recorded higher net return of Rs. 1,01,052 $ha^{-1}$ whereas B: C ratio of 5.93 was recorded with soybean+ pigeon pea system.

**Jabalpur:** Organic nutrient input management recorded 9.1% increase in gross returns, 8.6% in case in cost of cultivation and 9.3% increase in net returns. The B: C ratio was also higher (2.73) compared to other managementpackages. Among the cropping systems, basmati rice-berseem registered higher gross return (Rs. 1,99,602$ha^{-1}$), net returns (Rs. 1,43,858 $ha^{-1}$) and B: C ratio (3.58). Invariably, all the system recorded higher net returns and B: C ratio with organic management.

**Ludhiana:** Irrespective of cropping systems, gross return (60.2%), net return (102%) and B:C ratio (29.2%) found to be higher with organic management package.Turmeric-onion gave higher return of Rs. 1,51,424 $ha^{-1}$ and benefit cost ratio of 2.77 as compared to all other cropping systems.

**Modipuram:** Organic and integratedpackage increased the gross returns by 48.6% and 25.2% over inorganic irrespective of cropping systems. Though the cost of cultivation was higher under organic (37%) and integrated (19.7%), significantly higher net returns was recorded with organic (81.8%) and integrated (40.8%) over inorganic mainly due to premium price. Among the different cropping systems, maize for grain-potato-okra recorded higher gross returns (Rs. 4,28,298 $ha^{-1}$), net returns (Rs. 1,08,913 $ha^{-1}$). Higher B:C ratio of 2.86 was observed under inorganic management due to lower cost of cultivation.

**Pantnagar:** Increase in gross returns with organic and integrated was found to be 43.8 and 8.4% over inorganic package. Cost of cultivation, net return and B: C ratio also followed the same trend with organic package recording Rs. 49,691 $ha^{-1}$, Rs. 1,44,243 $ha^{-1}$ and 3.9 followed by integrated Rs. 47,271 $ha^{-1}$, Rs. 98,884 $ha^{-1}$ and 3.03 respectively. Among the systems, net returns was higher with basmati rice-vegetable pea system (Rs. 1, 25, 216 $ha^{-1}$). Basmati rice-lentil-sesbania (green manure) resulted in higher B: C ratio of 3.89. Irrespective of cropping systems organic package recorded higher BC ratio.

**Raipur:** The cost of cultivation with organic and integratedpackage was found to increase by 24.3 and 9.1% over inorganic.Net returns increased only 8.7% with organic and 5.9% with integratedpackage. Though

higher gross return of 20.1% and 2.4% was observed with organic and integrated, owing to higher cost of cultivation, numerical difference was observed inB: C ratio betweenintegratedand inorganic package(0.02). Soybean-onion recorded higher gross returns of Rs. 1,46,766 $ha^{-1}$, cost of cultivation (Rs. 36, 624 $ha^{-1}$), net returns (Rs. 1,12,142 $ha^{-1}$) and B: C ratio (3.24) among the systems.

**Ranchi:** Organic and integratedpackagefound to increase the gross returns by 25.9 and 5.2% respectively over inorganic. The cost of cultivation also found to be 31.8 and 15.9% higher with these packages respectively. Owing to higher gross returns, an increase in net return by 19.6% was recorded with organic while under integrated, net returns dropped by 6.2%. Inorganic package recorded higher B: C ratio of 1.93 followed by organic (1.64). Among the systems, rice-potato recorded higher gross (Rs. 1,53,897 $ha^{-1}$), net return (Rs. 71,778 $ha^{-1}$) and B: C ratio (1.68)

### Nutrient uptake (Table 8 to 11)

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

**Bajaura:** Crops like cauliflower, pea, french bean and maize have recorded higher N uptake under integrated whereas, tomato and garlic have took higher N under organic package. Similarly, higher P uptake of cauliflower (42.9 kg $ha^{-1}$), french bean (14.2 kg $ha^{-1}$), maize (25.0 kg $ha^{-1}$ ) and garlic (56.6 kg $ha^{-1}$) was observed with integrated package while, pea (60.0 kg $ha^{-1}$) and tomato (18.2 kg $ha^{-1}$) was recorded with organic management package. K uptake was also found to be better under integrated package for almost all the crops grown in the system during *kharif* and *rabi* while in summer, organic package recorded higher K. Fe uptake was higher either under organic or integrated package. Among the different crops, higher uptake of 4508 and 4250 g $ha^{-1}$ was observed with cauliflower and garlic respectively in integrated. Cu, Mn and Zn uptake also followed the similar trend for various vegetable crops grown in the sequence.

**Calicut:** Higher N uptake in turmeric and black pepper was observed under organic package while ginger recorded higher N with integrated. Uptake of P was higher under organic in all the three crops. Turmeric and black pepper uptake higher K under organic condition while ginger observed higher K in organic. Micronutrients Fe and Zn was found to be higher in turmeric and black pepper under organic conditions while ginger found to be higher under inorganic condition.

**Dharwad:** N, P and K uptake in all the crops were found to be higher under organic package except potato. Crops like maize (215.2 kg $ha^{-1}$), cotton (264.3 kg $ha^{-1}$), groundnut (149.8) soybean (129.8 kg $ha^{-1}$) and chickpea (95.8 kg $ha^{-1}$) have recorded higher N uptake under organic management whereas potato (242.8 kg $ha^{-1}$) was observed with inorganic. P and K also followed the similar trend for various crops grown in the sequence. Fe, Cu and Mn uptake was higher either under organic or integrated management package. Zn was found to be higher under organic package.

**Modipuram:** The uptake of N was found to be higher under integrated compared to inorganic package. Similar trend for various vegetable crops grown in the sequence was recorded for P and K uptake. Higher nutrients of N (103.9 and 104.4 kg $ha^{-1}$), P (27.5 and 29.5 kg $ha^{-1}$) and K (123.4 and 123.1 kg $ha^{-1}$) were received in rice and maize respectively.

**Pantnagar:** Higher N uptake in basmati rice was observed with organic (89.4 kg $ha^{-1}$) followed by inorganic (73.6 kg $ha^{-1}$) over integrated (70.8 kg $ha^{-1}$) package, around 9.5% higher uptake of N was recorded with

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

| Cropping systems /package | Organic | | | Inorganic | | | Integrated | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| **Bajaura** | | | | | | | | | |
| Cauliflower-pea-tomato | 56.7 | 149.6 | 59.3 | 15.3 | 82.2 | 42.5 | 68.0 | 185.1 | 58.4 |
| Frenchbean-cauliflower-frenchbean | 50.7 | 74.4 | 147.2 | 11.8 | 27.0 | 67.9 | 64.7 | 91.6 | 139.1 |
| Cauliflower-pea-cauliflower | 60.9 | 138.1 | | 16.6 | 94.3 | | 68.1 | 167.8 | |
| Maize+frenchbean-garlic | 46.9 | 64.2 | | 27.6 | 48.1 | | 53.3 | 96.9 | |
| **Calicut** | | | | | | | | | |
| Ginger-fallow | 1.90 | - | - | 1.90 | - | - | 1.99 | - | - |
| Turmeric-fallow | 2.13 | - | - | 1.63 | - | - | 1.79 | - | - |
| Black pepper-fallow | 2.70 | - | - | 2.28 | - | - | 2.43 | - | - |
| **Dharwad** | | | | | | | | | |
| Maize-chickpea | 215.2 | 95.8 | - | 187.0 | 71.2 | - | 206.0 | 68.1 | - |
| Cotton+Pea | 264.2 | 78.1 | - | 213.2 | 47.5 | - | 247.8 | 61.9 | - |
| Groundnut-Sorghum | 149.8 | 106.0 | - | 140.1 | 99.1 | - | 122.8 | 111.8 | - |
| Potato-chickpea | 221.9 | 82.3 | - | 242.8 | 62.2 | - | 220.8 | 77.0 | - |
| Soybean-wheat | 129.8 | 87.4 | - | 35.2 | 64.3 | - | 26.5 | 78.2 | - |
| **Modipuram** | | | | | | | | | |
| Basmati rice-wheat-*sesbania* (green manure) | 89.7 | 91.6 | | 61.5 | 66.4 | | 88.7 | 102.1 | |
| Rice-barley+ mustard-green gram | 103.8 | 56.5 (16.8) | 69.1 | 78.7 | 42.7 (12.7) | 49.9 | 103.9 | 62.3 (18.1) | 65.5 |
| Maize (grain)-potato-okra | 100.7 | 114.5 | 90.5 | 77.1 | 86.8 | 66.2 | 104.4 | 119 | 90.0 |
| Maize (green cobs)-mustard+ radish-*sesbania* (green manure) | 41.2 | 33.1(40.2) | | 33.3 | 23.8(32.3) | | 44.8 | 36.2(44.3) | |
| **Pantnagar** | | | | | | | | | |
| Basmati rice-wheat-sesbania (green manure) | 89.4 | 120.88 | - | 73.6 | 109.31 | - | 70.8 | 91.37 | - |
| Basmati rice-lentil-sesbania (green manure) | 105.8 | - | - | 95.8 | - | - | 84.8 | - | - |
| Basmati rice-vegetable pea-sesbania (green manure) | 95.7 | - | - | 83.4 | - | - | 80.7 | - | - |
| Basmati rice-Brassica napus-sesbania (green manure) | 84.3 | 65.65 | - | 89.9 | 68.53 | - | 89.8 | 55.57 | - |
| **Raipur** | | | | | | | | | |
| Soybean-berseem | 129.3 | 95.1 | - | 131.2 | 73.4 | - | 130.6 | 140.1 | - |
| Soybean-isabgol | 128.3 | 4.0 | - | 134.3 | 5.6 | - | 137.3 | 4.8 | - |
| Soybean-onion | 117.6 | 20.4 | - | 120.8 | 33.6 | - | 132.3 | 29.2 | - |
| Soybean-safflower | 130.9 | 34.0 | - | 112.3 | 2.1 | - | 128.0 | 31.0 | - |
| **Ranchi** | | | | | | | | | |
| Rice-wheat | 109.7 | 59.2 | - | 72.6 | 69.9 | - | 97.0 | 65.4 | - |
| Rice-potato | 120.2 | 54.1 | - | 80.1 | 44.4 | - | 108.0 | 52.5 | - |
| Rice-linseed | 98.1 | 30.4 | - | 70.3 | 29.3 | - | 90.9 | 29.7 | - |
| Rice-lentil | 94.7 | 27.9 | - | 65.8 | 28.7 | - | 86.2 | 29.1 | - |

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

| Cropping systems /package | Organic | | | Inorganic | | | Integrated | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| **Bajaura** | | | | | | | | | |
| Cauliflower-pea-tomato | 29.4 | 60.0 | 18.2 | 2.6 | 22.2 | 11.5 | 31.9 | 54.2 | 16.3 |
| French bean-cauliflower-frenchbean | 12.6 | 34.7 | 38.0 | 2.8 | 11.5 | 16.7 | 14.2 | 42.9 | 32.7 |
| Cauliflower-pea-cauliflower | 28.1 | 49.0 | | 7.3 | 27.9 | | 28.8 | 50.3 | |
| Maize+frenchbean-garlic | 24.6 | 38.7 | | 11.9 | 29.6 | | 25.0 | 56.6 | |
| **Calicut** | | | | | | | | | |
| Ginger | 0.23 | - | - | 0.13 | - | - | 0.17 | - | - |
| Turmeric | 0.19 | - | - | 0.17 | - | - | 0.17 | - | - |
| Black pepper | 0.37 | - | - | 0.32 | - | - | 0.26 | - | - |
| **Dharwad** | | | | | | | | | |
| Maize-chickpea | 21.3 | 21.3 | - | 19.5 | 12.7 | - | 21.1 | 18.2 | - |
| Cotton+Pea | 21.6 | 28.3 | - | 14.2 | 20.8 | - | 21.7 | 26.5 | - |
| Groundnut-sorghum | 18.8 | 24.2 | - | 25.7 | 20.6 | - | 17.4 | 23.3 | - |
| Potato-chickpea | 27.7 | 26.1 | - | 30.7 | 20.4 | - | 26.2 | 23.2 | - |
| Soybean-wheat | 4.8 | 12.5 | - | 2.9 | 10.0 | - | 4.3 | 12.4 | - |
| **Modipuram** | | | | | | | | | |
| Basmati rice-wheat-*sesbania* (green manure) | 16.1 | 19.7 | | 12.6 | 16.1 | | 20.6 | 25.3 | |
| Rice-barley+ mustard-mungbean | 23.2 | 15.1(2.3) | 7.6 | 19.9 | 12.5(1.9) | 6.5 | 27.5 | 19.0(3.0) | 8.7 |
| Maize (grain)-potato-okra | 26.9 | 13.3 | 17.1 | 22.6 | 10.9 | 14.0 | 29.5 | 14.6 | 19.0 |
| Maize (green cobs)-mustard+ radish-*sesbania* (green manure) | 12.2 | 4.0(6.4) | | 11.0 | 3.2(5.3) | | 15.1 | 5.2(7.5) | |
| **Pantnagar** | | | | | | | | | |
| Basmati rice-wheat-sesbania (green manure) | 15.0 | 30.1 | - | 15.2 | 26.6 | - | 14.3 | 34.5 | - |
| Basmati rice-lentil-sesbania (green manure) | 17.1 | | - | 15.8 | | - | 14.8 | | - |
| Basmati rice-vegetable pea-sesbania(green manure) | 15.2 | | - | 15.7 | | - | 15.7 | | - |
| Basmati rice-brassica napus-sesbania (green manure) | 14.5 | 23.7 | - | 14.2 | 21.7 | - | 12.7 | 16.9 | - |
| **Raipur** | | | | | | | | | |
| Soybean-berseem | 19.6 | 16.6 | - | 22.4 | 17.6 | - | 23.4 | 14.5 | - |
| Soybean-isabgol | 19.2 | 0.6 | - | 22.8 | 1.0 | - | 23.6 | 1.4 | - |
| Soybean-onion | 18.3 | 11.5 | - | 20.7 | 15.7 | - | 23.2 | 14.9 | - |
| Soybean-safflower | 19.8 | 11.3 | - | 19.9 | 8.2 | - | 22.6 | 4.7 | - |
| **Ranchi** | | | | | | | | | |
| Rice-wheat | 22.2 | 9.9 | - | 13.5 | 11.1 | - | 18.6 | 10.6 | - |
| Rice-potato | 25.4 | 41.8 | - | 15.2 | 34.2 | - | 21.7 | 140.7 | - |
| Rice-linseed | 20.0 | 2.0 | - | 13.0 | 1.86 | - | 17.5 | 1.93 | - |
| Rice-lentil | 19.6 | 4.3 | - | 12.0 | 5.1 | - | 16.5 | 5.2 | - |

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

| Cropping systems /package | Organic | | | Inorganic | | | Integrated | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| **Bajaura** | | | | | | | | | |
| Cauliflower-pea-tomato | 50.0 | 67.9 | 47.9 | 13.1 | 30.1 | 34.5 | 55.4 | 69.2 | 51.3 |
| French bean-cauliflower-french bean | 28.4 | 62.0 | 85.1 | 6.4 | 25.4 | 36.0 | 32.7 | 81.2 | 76.7 |
| Cauliflower-pea-cauliflower | 49.3 | 67.8 | | 13.1 | 38.4 | | 52.2 | 60.5 | |
| Maize+frenchbean-garlic | 55.1 | 62.3 | | 30.0 | 52.4 | | 55.8 | 95.4 | |
| **Calicut** | | | | | | | | | |
| Ginger | 0.91 | - | - | 0.78 | - | - | 0.82 | - | - |
| Turmeric | 1.12 | - | - | 1.26 | - | - | 1.10 | - | - |
| Black pepper | 1.31 | - | - | 1.53 | - | - | 1.42 | - | - |
| **Dharwad** | | | | | | | | | |
| Maize-chickpea | 74.3 | 75.3 | - | 62.5 | 58.4 | - | 62.7 | 63.3 | - |
| Cotton+pea | 123.9 | 73.0 | - | 103.8 | 33.6 | - | 108.5 | 38.6 | - |
| Groundnut-sorghum | 120.0 | 120.8 | - | 94.2 | 95.7 | - | 107.1 | 105.3 | - |
| Potato-chickpea | 165.2 | 101.1 | - | 181.3 | 74.2 | - | 170.3 | 79.9 | - |
| Soybean-wheat | 22.2 | 94.4 | - | 15.1 | 63.9 | - | 20.8 | 85.3 | - |
| **Modipuram** | | | | | | | | | |
| Basmati rice-wheat-*Sesbania* (green manure) | 95.1 | 148.3 | | 78.7 | 130.5 | | 110.6 | 170.2 | |
| Rice-barley+ mustard-mungbean | 116.2 | 100.8 (15.4) | 50.1 | 100 | 86.1 (13.0) | 40.7 | 119.4 | 108.1 (17.3) | 50.5 |
| Maize (grain)-potato-okra | 112 | 118.1 | 91.2 | 95.8 | 95.3 | 73.8 | 123.1 | 129.2 | 96.8 |
| Maize (green cobs)-mustard+ radish-*Sesbania* (green manure) | 51.2 | 30.0 (70.6) | | 44.6 | 21.9 (58.6) | | 58.6 | 34.2 (78.5) | |
| **Pantnagar** | | | | | | | | | |
| Basmati rice-wheat-sesbania (green manure) | 69.3 | 85.8 | - | 70.1 | 105.0 | - | 57.3 | 116.5 | - |
| Basmati rice-lentil-sesbania (green manure) | 81.6 | - | - | 73.1 | - | - | 66.6 | - | - |
| Basmati rice-vegetable pea-sesbania (green manure) | 68.3 | - | - | 56.6 | - | - | 57.3 | - | - |
| Basmati rice-brassica napus-sesbania (green manure) | 60.6 | 80.0 | - | 55.4 | 60.4 | - | 56.0 | 57.6 | - |
| **Raipur** | | | | | | | | | |
| Soybean-berseem | 59.3 | 100.2 | - | 63.7 | 112.9 | - | 66.4 | 144.2 | - |
| Soybean-isabgol | 58.5 | 1.5 | - | 65.4 | 5.7 | - | 67.5 | 2.8 | - |
| Soybean-onion | 55.8 | 13.8 | - | 62.3 | 14.0 | - | 65.0 | 13.2 | - |
| Soybean-safflower | 59.4 | 12.1 | - | 56.8 | 2.5 | - | 64.5 | 10.2 | - |
| **Ranchi** | | | | | | | | | |
| Rice-wheat | 77.8 | 35.7 | - | 51.7 | 43.3 | - | 68.4 | 40.0 | - |
| Rice-potato | 84.7 | 181.4 | - | 56.4 | 140.7 | - | 77.6 | 165.7 | - |
| Rice-linseed | 71.1 | 14.8 | - | 48.0 | 14.5 | - | 63.3 | 14.7 | - |
| Rice-lentil | 70.2 | 17.8 | - | 46.2 | 20.1 | - | 60.0 | 20.2 | - |

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

| Cropping systems /package | Organic | | | Inorganic | | | Integrated | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| **Bajaura** | | | | | | | | | |
| **Cu** | | | | | | | | | |
| Cauliflower-pea-tomato | 264.0 | 229.0 | 209.0 | 22.0 | 106.0 | 60.4 | 267.0 | 241.0 | 177.4 |
| French bean-cauliflower-frenchbean | 86.0 | 238.0 | 217.4 | 11.0 | 53.0 | 53.2 | 103.0 | 296.0 | 181.1 |
| Cauliflower-pea-cauliflower | 202.0 | 233.0 | | 22.0 | 64.0 | | 204.0 | 192.0 | |
| Maize+frenchbean-garlic | 200.0 | 280.0 | | 60.0 | 108.0 | | 223.0 | 367.0 | |
| **Fe** | | | | | | | | | |
| Cauliflower-pea-tomato | 3111.0 | 3386.0 | 2073.3 | 726.0 | 1746.0 | 1281.8 | 3414.0 | 3478.0 | 1831.4 |
| French bean-cauliflower-frenchbean | 1325.0 | 3424.0 | 4832.3 | 232.0 | 1444.0 | 1966.4 | 1375.0 | 45.08 | 4042.9 |
| Cauliflower-pea-cauliflower | 3050.0 | 3459.0 | | 629.0 | 2127.0 | | 3129.0 | 3200.0 | |
| Maize+frenchbean-garlic | 3018.0 | 2819.0 | | 1356.0 | 2304.0 | | 3133.0 | 4250.0 | |
| **Mn** | | | | | | | | | |
| Cauliflower-pea-tomato | 657.0 | 576.0 | 478.0 | 104.0 | 255.0 | 250.0 | 719.0 | 578.0 | 473.0 |
| French bean-cauliflower-frenchbean | 225.0 | 603.0 | 736.0 | 30.0 | 189.0 | 178.5 | 227.0 | 775.0 | 491.0 |
| Cauliflower-pea-cauliflower | 547.0 | 523.0 | | 150.0 | 299.0 | | 553.0 | 511.0 | |
| Maize+frenchbean-garlic | 324.0 | 713.0 | | 137.0 | 491.0 | | 297.0 | 996.0 | |
| **Zn** | | | | | | | | | |
| Cauliflower-pea-tomato | 283.0 | 311.0 | 279.9 | 23.0 | 124.0 | 151.7 | 217.0 | 305.0 | 272.3 |
| French bean-cauliflower-frenchbean | 172.0 | 258.0 | 526.7 | 15.0 | 52.0 | 164.4 | 149.0 | 597.0 | 373.4 |
| Cauliflower-pea-cauliflower | 277..0 | 297.0 | | 24.0 | 120.0 | | 244.0 | 271.0 | |
| Maize+frenchbean-garlic | 269.0 | 368.0 | | 49.0 | 173.0 | | 292.0 | 493.0 | |

**Table 11.1 Influence of inorganic, inorganic and integrated on Fe, Cu, Mn, Zn, Ca and Mg uptake (ppm) of crops and cropping systems at Calicut and Dharwad**

| Cropping system/ package | Fe | | | Cu | | | Mn | | | Zn | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Or-ganic | In-organic | Integ-rated | Or-ganic | In-organic | Integ-rated | Or-ganic | In-organic | Integ-rated | Or-ganic | In-organic | Integ-rated |
| **Calicut** | | | | | | | | | | | | |
| Ginger (Rhizome) | 406.0 | 528.2 | 400.7 | 26.8 | 27.9 | 24.8 | 117.2 | 223.1 | 181.1 | 37.9 | 28.1 | 33.9 |
| Turmeric (Rhizome) | 102.3 | 88.9 | 86.0 | 12.9 | 11.5 | 13.0 | 345.9 | 383.5 | 383.5 | 81.0 | 46.5 | 53.6 |
| Black pepper (Berry) | 179.3 | 151.3 | 162.5 | 78.5 | 89.3 | 75.0 | 72.3 | 64.0 | 71.8 | 33.0 | 27.5 | 26.8 |
| **Dharwad** | | | | | | | | | | | | |
| Groundnut – sorghum | 9.05 | 7.41 | 8.48 | 1.34 | 1.22 | 1.47 | 11.34 | 8.91 | 10.55 | 0.89 | 0.75 | 0.88 |
| Soybean – wheat | 8.22 | 7.36 | 7.89 | 1.57 | 1.32 | 1.43 | 11.20 | 9.65 | 10.34 | 0.89 | 0.84 | 0.83 |
| Soybean+ Pigeon pea | 8.10 | 7.74 | 7.97 | 1.61 | 1.24 | 1.64 | 11.19 | 8.93 | 10.32 | 0.90 | 0.74 | 0.78 |
| Cotton + Peas | 8.17 | 7.46 | 8.81 | 1.61 | 1.24 | 1.53 | 10.38 | 9.36 | 10.32 | 0.90 | 0.72 | 0.73 |
| Maize-chickpea | 8.48 | 7.07 | 7.97 | 1.56 | 1.33 | 1.46 | 11.29 | 8.99 | 10.39 | 0.80 | 0.65 | 0.74 |

organic package compared to inorganic for basmati rice. No difference was observed. K uptake by basmati rice was significantly higher (81.6 kg $ha^{-1}$) with organic package.

**Raipur:** Among the different crops, uptake was higher in berseem under integrated (140.1 kg $ha^{-1}$) followed by soybean (137.3 kg $ha^{-1}$). In *kharif*, soybean recorded higher K uptake (mean 65.9 kg $ha^{-1}$) while during *rabi* berseem recorded (144.2 kg $ha^{-1}$) higher K uptake under integrated package.

**Ranchi:** Rice recorded N uptake of 120.2 kg $ha^{-1}$ with organic followed by integrated (108 kg $ha^{-1}$) and inorganic (80.7 kg $ha^{-1}$). N uptake of potato was found to be higher (54.1 kg $ha^{-1}$) with organic while wheat was higher with inorganic (69.9 kg $ha^{-1}$). P uptake of rice in rice- potato system was also higher under organic package (25.4 kg $ha^{-1}$) followed by integrated (21.7 kg $ha^{-1}$). Potato recorded higher P uptake (140.7 kg $ha^{-1}$) with integrated. Like N and P, K uptake also registered similar trend in rice with organic (84.7 kg $ha^{-1}$) followed by integrated (77.6 kg $ha^{-1}$). Higher K uptake in wheat was observed with inorganic while K uptake of potato was found to be higher under organic (181.4 kg $ha^{-1}$).

## Quality of organic produces (Table 12)

**Bhopal:** Protein, oil content and methionine was estimated for soybean in *kharif*. Result revealed that protein, oil content and methionine was observed marginally higher either in organic or integrated package, but it was on par.

**Calicut:** Oil content and oleresin was estimated for ginger varieties. Variety Varda of ginger recorded higher oil content under integrated while rejetha and mahima observed better under inorganic condition. Oleresin was found to be 60.3% higher in ginger (Varda variety) with inorganic package.

**Table 12. Influence of organic, inorganic and integrated package on quality of soybean and ginger**

| Cropping system/ package | protein | | | Oil content | | | Methionine | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Or-ganic | In-organic | Integ-rated | Or-ganic | In-organic | Integ-rated | Or-ganic | In-organic | Integ-rated | Or-ganic | In-organic | Integ-rated |
| **Bhopal** | | | | | | | | | | | | |
| Soybean-duram wheat | 35.6 | 34.8 | 35.3 | 18.0 | 17.9 | 18.6 | 1.6 | 1.6 | 1.6 | | | |
| Soybean-mustard | 36.0 | 35.2 | 35.1 | 18.3 | 17.8 | 18.1 | 1.7 | 1.4 | 1.8 | | | |
| Soybean-chickpea | 35.8 | 35.2 | 35.6 | 18.4 | 18.0 | 18.3 | 1.7 | 1.8 | 1.5 | | | |
| Soybean-linseed | 35.7 | 35.8 | 35.4 | 18.2 | 17.9 | 17.9 | 1.8 | 1.6 | 1.7 | | | |
| Mean | 35.8 | 35.3 | 35.4 | 18.2 | 17.9 | 18.2 | 1.7 | 1.6 | 1.7 | | | |
| **Calicut** | | | | Oil content | | | Oleoresin | | | Acid Phosphatases (µmol PNP/g/h) | | |
| Ginger varieties Varada | | | | 0.66 | 0.99 | 1.21 | 3.35 | 5.37 | 3.06 | 10.36 | 5.43 | 10.38 |
| Rejatha | | | | 0.77 | 1.21 | 0.99 | 3.49 | 3.21 | 3.77 | 2.19 | 10.10 | 17.94 |
| Mahima | | | | 0.99 | 1.21 | 1.10 | 3.31 | 4.04 | 4.18 | 4.61 | 9.40 | 11.04 |

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

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

**Objectives:**

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

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

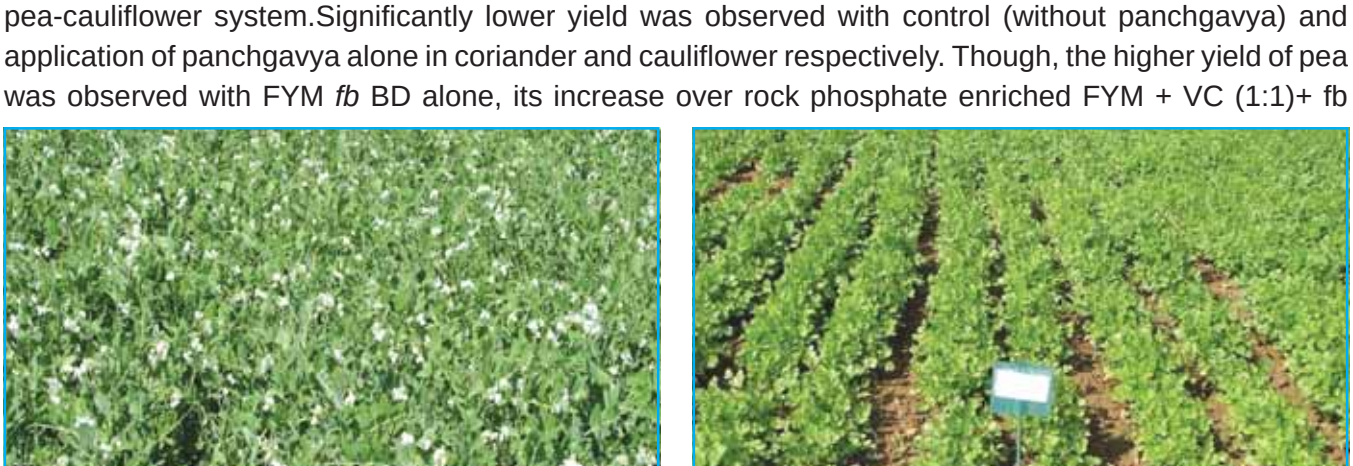
**Year of start:** 2004-05 with few centres modifying cropping system during 2007-08 and 2008-09.

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

## Results

### Grain and straw yield (Table 13)

**Bajaura:** Two systems namely coriander-pea-tomato and cauliflower-pea-cauliflower were evaluated with different organic sources. During *kharif* application of FYM *fb* biodynamic recorded significantly higher yield of coriander (11371 kg $ha^{-1}$) in coriander-pea-tomato system while yield of cauliflower (13290 kg $ha^{-1}$) was recorded with application of rock phosphate enriched FYM + VC (1:1) *fb*panchgavya in the cauliflower-pea-cauliflower system.Significantly lower yield was observed with control (without panchgavya) and application of panchgavya alone in coriander and cauliflower respectively. Though, the higher yield of pea was observed with FYM *fb* BD alone, its increase over rock phosphate enriched FYM + VC (1:1)+ fb



**Performance of pea and coriander under organic nutrient management at Bajaura**

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

| Cropping system | Source of nutrient | Grain Yield (kg/ha) | | | Straw Yield (kg/ha) | | |
|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| **Bajaura** | | | | | | | |
| Coriander-pea-tomato | Rock phosphate enriched FYM + VC (1:1) | 6937 | 6612 | 10231 | - | - | 4116 |
| | FYM *fb* BD | 11371 | 6460 | 12043 | - | - | 4355 |
| | Rock phosphate enriched FYM + VC (1:1) *fb* Panchgvya | 9878 | 5516 | 10591 | - | - | 3629 |
| | FYM *fb* BD fb Panchgvya | 7546 | 6095 | 13311 | - | - | 4822 |
| | Control | 1729 | 331 | 1494 | - | - | 647 |
| | Control with Panchgavya | 2115 | 473 | 2366 | - | - | 983 |
| | Mean | 6596 | 4248 | 8339 | - | - | 3092 |
| Cauliflower-pea-cauliflower | Rock phosphate enriched FYM + VC (1:1) | 11458 | 3188 | - | 8027 | - | - |
| | FYM *fb* BD | 11164 | 3533 | - | 7767 | - | - |
| | Rock phosphate enriched FYM + VC (1:1) *fb* Panchgvya | 13290 | 2671 | - | 9890 | - | - |
| | FYM *fb* BD fb Panchgvya | 11051 | 3032 | - | 7650 | - | - |
| | Control | 1094 | 329 | - | 693 | - | - |
| | Control with Panchgavya | 1558 | 423 | - | 1090 | - | - |
| | Mean | 8269 | 2196 | - | 5853 | | |
| | *Nutrient source | CS *NS | CS *NS | CS *NS | | | |
| | SEm± | | | | | | |
| | CD (P=0.05) | 148 443 | 131 340 | 414 195 | | | |
| **Bhopal** | | | | | | | |
| Soybean-wheat | OM | 448 | 2657 | - | 1542 | 6145 | - |
| | BD | 414 | 1425 | - | 1353 | 3501 | - |
| | OM+PG | 461 | 2728 | - | 1606 | 6242 | - |
| | OM+BD | 457 | 2459 | - | 1592 | 5803 | - |
| | OM+PG+BD | 500 | 2420 | - | 1647 | 5643 | - |
| | Control | 389 | 1592 | - | 1289 | 3970 | - |
| | Mean | 445 | 2213 | - | 1505 | 5217 | - |
| | CD (P=0.05) | 313 | 915.9 | | | | |
| Maize-chickpea | OM | 3083 | 1338 | - | - | 3669 | - |
| | BD | 2450 | 1305 | - | - | 3872 | - |
| | OM+PG | 3089 | 1365 | - | - | 3816 | - |
| | OM+BD | 2950 | 1311 | - | - | 3770 | - |
| | OM+PG+BD | 3367 | 1514 | - | - | 4021 | - |
| | Control | 2061 | 1092 | - | - | 3112 | - |
| | Mean | 2833 | 1321 | - | - | 3710 | - |
| | SEm± | | | | | | |
| | CD (P=0.05) | 318.9 | 184.9 | | 215.8 | | |

| Cropping system | Source of nutrient | Grain Yield (kg/ha) | | | Straw Yield (kg/ha) | | |
|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| **Coimbatore** | | | | | | | |
| Cotton - maize - green manure | FYM + NEOC@1/2 each | 1422 | 4111 | - | 4165 | 6616 | - |
| | Panchagavya alone | 927 | 3238 | - | 3436 | 6198 | - |
| | FYM+NEOC@1/2 each +Panchgavya | 1335 | 4159 | - | 4451 | 7135 | - |
| | Biodynamic practices | 861 | 3635 | - | 3167 | 6119 | - |
| | Biodynamic practices+ panchgavya | 1053 | 3889 | - | 3750 | 6542 | - |
| | Mean | 1119 | 3806 | - | 3794 | 6522 | - |
| Chillies - Sunflower- green manure | FYM + NEOC@1/2 each | 4735 | 1684 | - | 3005 | 3823 | - |
| | Panchgavya alone | 3784 | 1275 | - | 2497 | 3094 | - |
| | FYM+NEOC@1/2 each +Panchgavya | 4897 | 1777 | - | 3034 | 4269 | - |
| | Biodynamic practices | 3831 | 1208 | - | 2438 | 2627 | - |
| | BiodynamicPractices+ Panchgavya | 4010 | 1432 | - | 2990 | 3364 | - |
| | Mean | 4251 | 1475 | - | 2793 | 3435 | - |
| | SEm± | To be calculate | | | | | |
| | CD (P=0.05) | | | | | | |
| **Dharwad** | | | | | | | |
| Groundnut-sorghum | EC+VC+GLM @1/3 each | 2303 | 939 | | 2776 | 11843 | |
| | Panchgavya spray | 1954 | 662 | | 2161 | 10990 | |
| | EC+VC+GLM @1/3 each + Panchgavya spray | 2968 | 1023 | | 2951 | 10700 | |
| | EC+VC+GLM @1/3 each + Biodynamic spray @5g/ac | 2774 | 843 | | 2975 | 11013 | |
| | EC+VC+GLM @1/3 each+ Biodynamic spray @5g/ac+ Panchgavya spray | 2969 | 1150 | | 3149 | 10802 | |
| | FYM+VC+GLM @1/3 each | 2062 | 951 | | 2599 | 11344 | |
| | Control | 1490 | 575 | | 1887 | 9700 | |
| | Mean | 2360 | 878 | | 2643 | 10913 | |
| | SEm± | 173 | 53 | | 181 | 364 | |
| | CD (*P=0.05*) | 534 | 163 | | 559 | 1121 | |
| Maize-chickpea | EC+VC+GLM @1/3 each | 5236 | 853 | | 6218 | 1172 | |
| | Panchgavya spray | 4360 | 573 | | 4938 | 1062 | |
| | EC+VC+GLM @1/3 each + Panchgavya spray | 5781 | 916 | | 6723 | 1263 | |
| | EC+VC+GLM @1/3 each + Biodynamic spray @5g/ac | 5631 | 915 | | 6285 | 1131 | |
| | EC+VC+GLM @1/3 each+ Biodynamic spray @5g/ac+ Panchgavya spray | 6015 | 992 | | 6487 | 1144 | |
| | FYM+VC+GLM @1/3 each | 5067 | 777 | | 5544 | 1120 | |
| | Control | 3552 | 482 | | 4298 | 931 | |
| | Mean | 5092 | 787 | | 5785 | 1118 | |
| | SEm± | 338 | 32 | | 280 | 44 | |
| | CD (*P=0.05*) | 1042 | 99 | | 861 | 136 | |

| Cropping system | Source of nutrient | Grain Yield (kg/ha) | | | Straw Yield (kg/ha) | | |
|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| Chilli+onion | EC+VC+GLM @1/3 each | 835 | 2060 | | | | |
| | Panchgavya spray | 432 | 1160 | | | | |
| | EC+VC+GLM @1/3 each + Panchgavya spray | 898 | 2151 | | | | |
| | EC+VC+GLM @1/3 each + Biodynamic spray @5g/ac | 885 | 1853 | | | | |
| | EC+VC+GLM @1/3 each+ Biodynamic spray @5g/ac+ Panchgavya spray | 945 | 2181 | | | | |
| | FYM+VC+GLM @1/3 each | 652 | 1768 | | | | |
| | Control | 404 | 1198 | | | | |
| | Mean | 722 | 1767 | | | | |
| | SEm± | 52 | 144 | | | | |
| | CD (*P=0.05*) | 160 | 442 | | | | |
| **Jabalpur** | | | | | | | |
| Basmati rice – duram wheat | VC+FYM+NEOF @1/3 N each | 3249 | 3465 | | 6217 | 5246 | |
| | Panchgavya alone | 3022 | 3044 | | 5472 | 4671 | |
| | VC+FYM+NEOF@1/3N each + Panchgavya | 3409 | 3785 | | 6381 | 5793 | |
| | Biodynamic practices | 2973 | 2903 | | 5361 | 4298 | |
| | Biodynamic practices + Panchgavya | 3119 | 3260 | | 5643 | 4671 | |
| | Mean | 3154 | 3292 | | 5815 | 4936 | |
| Basmati rice - berseem | VC+FYM+NEOF @1/3 N each | 3217 | 207 | | 5746 | 61206 | |
| | Panchgavya alone | 2828 | 184 | | 5120 | 50945 | |
| | VC+FYM+NEOF @1/3N each + Panchgavya | 3455 | 214 | | 6561 | 64475 | |
| | Biodynamic practices | 2740 | 145 | | 4934 | 48828 | |
| | Biodynamic practices + Panchgavya | 3017 | 191 | | 5638 | 54195 | |
| | Mean | 3051 | 188 | | 5600 | 55930 | |
| | SEm± | | | | | | |
| | CD (P=0.05) | | | | | | |
| **Karjat** | | | | | | | |
| Rice- red pumpkin | *Kharif* FYM + rice straw + glyricidia leaves @1/3 N each *Rabi* FYM + NC +VC - @1/3 N each | 3236 | 12726 | | 3850 | | |
| | Panchgavya alone | 2701 | 6222 | | 3187 | | |
| | *Kharif* FYM + rice straw + glyricidia leaves @1/3 N each *Rabi* FYM+NC+ VC - @1/3 N each + Panchgavya | 3381 | 13356 | | 4057 | | |
| | Biodynamic practices | 2737 | 5714 | | 3256 | | |
| | Panchagavya + Biodynamic practices | 2754 | 6432 | | 3277 | | |
| | Mean | 2962 | 8890 | | 3525 | | |

| Cropping system | Source of nutrient | | Grain Yield (kg/ha) | | | Straw Yield (kg/ha) | | |
|---|---|---|---|---|---|---|---|---|
| | | | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| Rice- cucumber | *Kharif* FYM + rice straw + glyricidia leaves @1/3 N each *Rabi* FYM + NC +VC - @1/3N each | | 3414 | 12537 | | 4097 | | |
| | Panchgavya alone | | 2899 | 5282 | | 3450 | | |
| | *Kharif* FYM + rice straw + glyricidia leaves @1/3 N each *Rabi*FYM +NC + VC - @1/3 N each + Panchgavya | | 3541 | 12665 | | 4249 | | |
| | Biodynamic practices | | 2890 | 5127 | | 3439 | | |
| | Panchgavya + Biodynamic practices | | 2887 | 5634 | | 3436 | | |
| | Mean | | 3126 | 8249 | | 3734 | | |
| | | | SEm± CD | SEm± CD | | SEm± CD | | |
| | Cropping system | | 36.0 NS | 53.0 320.0 | | 43.0 NS | | |
| | Nutrient source | | 69.0 205.0 | 162.0 486.0 | | 84.0 252.0 | | |
| **Ludhiana** | *Kharif* crops | *Rabi* crops | | | | | | |
| Maize-wheat +gram-summer moong | Green manure (GM) | Farmyard manure (FYM) | 5270 | 2120(280) | | 8180 | 2790(710) | |
| | GM+Panchgavya (PG) | FYM+PG | 5420 | 2170(330) | | 7650 | 2730(730) | |
| | GM+Biodynamic (BD) | BD | 2950 | 1450(280) | | 4880 | 1820(780) | |
| | GM+ FYM+ BD | FYM+BD | 5400 | 2170(270) | | 5890 | 3000(750) | |
| | GM+PG+BD | FYM+PG+BD | 5390 | 2140(320) | | 6890 | 2710(760) | |
| | Control | Control | 1370 | 1000(190) | | 2970 | 1570(780) | |
| | Mean | | 4300 | 1842(278) | | 6077 | 2437(752) | |
| | CD (*P=0.05*) | | 1120 | 410 | | 2579 | 420 | |
| Basmati rice -wheat-green manure | GM | FYM | 3540 | 3330 | | 6670 | 4560 | |
| | GM+PG | FYM+PG | 3560 | 3240 | | 6460 | 4380 | |
| | GM+BD | BD | 3570 | 2210 | | 6640 | 3150 | |
| | GM+BD+FYM | FYM+BD | 3640 | 3320 | | 6940 | 4670 | |
| | GM+PG+BD | FYM+PG+BD | 3580 | 3470 | | 6460 | 4560 | |
| | Control | Control | 2010 | 1770 | | 3890 | 2280 | |
| | Mean | | 3317 | 2890 | | 6177 | 3933 | |
| | CD (*P=0.05*) | | 650 | 880 | | 1630 | 940 | |
| **Modipuram** | | | | | | | | |
| Basmati rice - wheat | Control | | 3270 | 2740 | | 5890 | 5270 | |
| | FYM+Vermicompost | | 4160 | 4320 | | 7060 | 6550 | |
| | Biodynamic, BD preparation | | 3880 | 3600 | | 6460 | 6360 | |
| | FYM+Vermicompost+Panchgavya | | 4380 | 4460 | | 7170 | 6930 | |
| | FYM+Vermicompost+ BD Preparation | | 4560 | 4460 | | 7320 | 6900 | |
| | FYM+Vermicompost +Panchgavya + BD Preparation | | 4620 | 4700 | | 7650 | 6930 | |
| | Mean | | 4145 | 4047 | | 6925 | 6490 | |

| Cropping system | Source of nutrient | Grain Yield (kg/ha) | | | Straw Yield (kg/ha) | | |
|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| Maize + cowpea – wheat + mustard | Control | 3770(1444) | 2540(390) | | 5970(1806) | 4680(1320) | |
| | FYM + Vermi Compost | 4880(1629) | 3830(478) | | 7020(2236) | 5570(1560) | |
| | Biodynamic, BD preparation | 4570(1595) | 3220(448) | | 6760(2212) | 4930(1480) | |
| | FYM + Vermicompost + Panchgavya | 5160(1875) | 3920(551) | | 7100(2481) | 5560(1780) | |
| | FYM + Vermicompost+ BD preparation | 5240(1881) | 4070(620) | | 7360(2560) | 6000(1810) | |
| | FYM + Vermicompost +Panchgavya + BD preparation | 5380(2083) | 4080(639) | | 7910(2668) | 6360(1870) | |
| | Mean | 4833(1751) | 3610(521) | | 7020(2327) | 5517(1637) | |
| | | SEm± CD | SEm± CD | | SEm± CD | SEm± CD | |
| | Cropping system | 115 360 (90) (283) | 52.0 320 | | 105 330 (88) (279) | 120 730 | |
| | Nutrient source | - - | 120 350 (9.8) (31.0) | | - - | 142 730 (53) (170) | |
| **Pantnagar** | | | | | | | |
| Basmati rice – chickpea | FYM+VC+NC+EC @ 1/4each | 4373 | 1871 | | 4937 | 4110 | |
| | Biodynamic (BD) | 3813 | 1071 | | 4832 | 4087 | |
| | FYM+VC+NC+EC @ 1/4each+ Panchgavya | 4451 | 2093 | | 4993 | 4855 | |
| | FYM+VC+NC+EC @ 1/4each+BD | 4440 | 1900 | | 5001 | 4128 | |
| | FYM+VC+NC+EC @1/4each+ BD+ Panchgavya | 4682 | 2440 | | 5521 | 5323 | |
| | Control (green manure/moong residues only) | 3405 | 973 | | 4767 | 3810 | |
| | Mean | 4194 | 1724 | | 5008 | 4386 | |
| | SEm± | - | 82.0 | | | 1.3 | |
| | CD (P=0.05) | - | 257.2 | | | 4.0 | |
| Basmati rice–vegetable pea –maize +moong (residues incorporation) | FYM+VC+NC+EC @ 1/4each | 3872 | 8089 | 8765(1085) | 4733 | - | |
| | Biodynamic (BD) | 2580 | 4085 | 4327(1172) | 4624 | - | |
| | FYM+VC+NC+EC @ 1/4each+ Panchgavya | 4178 | 8573 | 8744(1065) | 4862 | - | |
| | FYM+VC+NC+EC @ 1/4each+BD | 4153 | 8250 | 8629(1199) | 4815 | - | |
| | FYM+VC+NC+EC @1/4each+ BD+ Panchgavya | 4388 | 8884 | 8909(1226) | 5019 | - | |
| | Control (green manure/moong residues only) | 2696 | 4196 | 4180(997) | 4399 | - | |
| | Mean | 3645 | 7013 | 7259(1121) | 4742 | - | |
| | | SEm± CD | SEm± CD | SEm± CD | SEm± CD | | |
| | Cropping system | 94.2 557.2 | 276.4 870.9 | 500 1575 (58) (182) | 40.0 NS | | |
| | Nutrient source | 220.1 649.3 | - - | - - | 109.4 322.8 | | |

| Cropping system | Source of nutrient | Grain Yield (kg/ha) | | | Straw Yield (kg/ha) | | |
|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| **Raipur** | | | | | | | |
| Rice-chickpea | EC+CDM+NEOC @ 1/3 N each | 3917 | 1125 | | 6140 | 2604 | |
| | Bio dynamic practice | 2231 | 813 | | 3540 | 1950 | |
| | EC+CDM+NEOC@1/3Neach+ Panchagavya | 4250 | 1229 | | 6071 | 2758 | |
| | EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice | 3950 | 1250 | | 6230 | 3020 | |
| | Biodynamic practice+ EC+CDM+ NEOC@1/3 N each +Panchagavya | 4317 | 1271 | | 6830 | 2888 | |
| | Mean | 3733 | 1138 | | 5762 | 2644 | |
| Rice – mustard +lentil (alternate row) | EC+CDM+NEOC @ 1/3 N each | 3838 | 646(195) | | 6071 | 2086(258) | |
| | Bio dynamic practice | 2185 | 492(106) | | 3543 | 1636(320) | |
| | EC+CDM+NEOC@1/3Neach+ Panchagavya | 3942 | 665(206) | | 6044 | 2004(578) | |
| | EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice | 3948 | 679(211) | | 6152 | 2141(584) | |
| | Biodynamic practice+ EC+CDM+ NEOC@1/3Neach+Panchagavya | 4223 | 669(208) | | 6438 | 2043(579) | |
| | Mean | 3627 | 630(185) | | 5650 | 1982(524) | |
| | SEm± | | | | | | |
| | CD (P=0.05) | | | | | | |
| **Ranchi** | | | | | | | |
| Rice - wheat | VC+ KC (1/2 each) | 4180 | 1911 | | 6790 | 3241 | |
| | BD Preparation (CPP, BD500 & 501) | 2510 | 991 | | 4370 | 2077 | |
| | VC+K.C+Panchagavaya | 4270 | 1985 | | 6870 | 3402 | |
| | VC+K.C+BD Preparation | 4350 | 2047 | | 7000 | 3568 | |
| | VC+K.C+BD Preparation+ Panchagavya | 4530 | 2152 | | 7110 | 3687 | |
| | Mean | 3968 | 1817 | | 6428 | 3195 | |
| Rice – potato | VC+ KC (1/2 each) | 4260 | 8952 | | 7180 | 2558 | |
| | BD Preparation (CPP,BD500 & 501) | 3050 | 3683 | | 4710 | 1228 | |
| | VC+K.C+ Panchagavaya | 4350 | 9143 | | 7250 | 2612 | |
| | VC+ K.C+ BD preparation | 4660 | 9333 | | 7370 | 2667 | |
| | VC+K.C+BD preparation + Panchagavya | 4800 | 9524 | | 7510 | 2721 | |
| | Mean | 4224 | 8127 | | 6804 | 2357 | |
| | | SEm± | CD | | | | |
| | Cropping system | - | NS | | | | |
| | Nutrient Sources | - | 484 | | | | |

| Cropping system | Source of nutrient | Grain Yield (kg/ha) | | | Straw Yield (kg/ha) | | |
|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| **Umiam** | | | | | | | |
| Maize+soybean-tomato | FYM | 5670(780) | 13633 | | 8960(1200) | 1857 | |
| | VC | 5340(730) | 13633 | | 8090(1260) | 1857 | |
| | FYM+VC (1/2 each) | 5900(850) | 14537 | | 9380(1400) | 1910 | |
| | Control (no manure) | 2490(430) | 2053 | | 4470(720) | 723 | |
| | Mean | 4850(700) | 10964 | | 7720(1070) | 1587 | |
| | | SEm± CD | SEm± CD | | SEm± CD | SEm± CD | |
| | Cropping systems | - - | 490 1690 | | - - | 150 500 | |
| Maize+soybean-potato | FYM | 5750(790) | 16360 | | 9620(1270) | 2253 | |
| | VC | 5550(780) | 17323 | | 7990(1400) | 2330 | |
| | FYM+VC (1/2 each) | 5800(790) | 16797 | | 8660(1360) | 2340 | |
| | Control (no manure) | 2320(450) | 3900 | | 4540(710) | 810 | |
| | Mean | 4850(700) | 13595 | | 770091110) | 1933 | |
| | | SEm± CD | SEm± CD | | SEm± CD | SEm± CD | |
| | Cropping systems | - - | 310 1060 | | | 110 380 | |
| Maize+soybean-frenchbean | FYM | 5550(820) | 18247 | | 9570(1250) | 5363 | |
| | VC | 5350(820) | 16443 | | 8140(1410) | 4067 | |
| | FYM+VC (1/2 each) | 5770(860) | 20927 | | 8830(1520) | 4863 | |
| | Control (no manure) | 2310(460) | 5637 | | 5160(740) | 1520 | |
| | Mean | 4740(740) | 15313 | | 7930(1150) | 3953 | |
| | | SEm± CD | SEm± CD | | SEm± CD | SEm± CD | |
| | Cropping systems | 120 NS | 800 2760 | | 240 NS | 130 450 | |
| | Nutrient Sources | 120 340 | - - | | 180 530 | - - | |
| | Interaction | 200 590 | - - | | 310 930 | - - | |

panchgavya was 19 %. During *summer*, tomato recorded higher yield (13311 kg ha$^{-1}$) under FYM *fb* BD fb panchgavyaand FYM *fb* BD application and the increase over rock phosphate enriched FYM + VC (1:1) was found to be 30.1%.

**Bhopal:** The yield increase due to biodynamic and panchgavya practice over organic manure alone was found to be significant in soybean-wheat and maize-chickpea systems. However, combined application of OM+PG+BD registered higher yield in all crops except wheat and the yield increase over organic manure (OM) alone was found to be 52, 284 and 176 kg ha$^{-1}$ in soybean, maize and chickpea respectively. Wheat it recorded higher yield with the combination of organic manure and panchgavya and reduction in yield of 91.4% was observed with biodynamic alone. Application of biodynamic packages alone recorded significant increase in yield of maize and chickpea over control.

**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, maize (4159 kgha$^{-1}$), chillies (4897 kg ha$^{-1}$) and sunflower (1777 kg ha$^{-1}$) which was on par with FYM + NEOC @ ½ N each alone for all the crops. The reverse was observed with cotton which recorded higher yield (1422 kg ha$^{-1}$) with the application of FYM+NEOC @ ½ N. The yield reduction due to application of either biodynamic packages alone or panchgavya was found to be 14.4 to 65.1% in various crops compared to combined application of organic inputs (FYM+NEOC @ ½ each) with panchgavya alone. Lowest yield in all the crops were observed with application of either biodynamic packages or panchgavya alone.

**Dharwad:** Three systems namely groundnut-sorghum, maize-chickpea and chilli+onion were evaluated with six different combinations of organic packages along with control. In all the cropping systems, performance of EC+VC+GLM+biodynamic @ 12g ha$^{-1}$ with panchgavya spray was found to be better, but it is on par with EC+VC+GLM+panchgavya spray or EC+ VC+GLM+biodynamic spray @ 12g ha$^{-1}$ in most of the crops. Spray of panchgavya alone recorded significantly lower yield in all the crops compared to other sources of organic combinations. The yield increase in EC+VC+GLM+biodynamic+Panchgavya spray was found to be 99.3, 100, 69.3, 105.8, 133.9 and 82.1% in groundnut, sorghum, maize, chickpea, chilli and onion respectively over control. Straw yield of all the crops have also followed the similar trend.

**Jabalpur:** Two cropping systems namely basmati rice-wheat-green manure and basmati rice-berseem were tested with five different combinations of nutrient sources.In both the cropping systems, application of nutrients through VC+FYM+NEOF @ 1/3 N each+panchgavya recorded higher grain yield (3432, 3785 and 214 kg of basmati rice, wheat and berseem seed ha$^{-1}$) followed by VC+FYM+NEOF @ 1/3 N each. Biodynamic and panchgavya packages recorded lower yield than that of combination of organic nutrient inputs. Among the systems, grain yield of basmati rice (3325 kg ha$^{-1}$) in basmati rice-berseem was observed to be higher compared to basmati rice-wheat-green manure (3249 kg ha$^{-1}$). Though significant difference in straw yield was noticed among the different nutrient sources, VC + FYM + NEOF @ 1/3 N each recorded higher straw yield in basmati rice compared to biodynamic packages.

**Karjat:** Rice-red pumpkin and rice-cucumber systems have recorded higher yield of rice and red pumpkin and rice and cucumber with application of FYM+rice straw+*glyricidia* leaves @ 1/3$^{rd}$ each of N during *kharif* and FYM+ neemcake+vermicompost @ 1/3 each of N during *rabi* along with spray of panchgavya (3381, 13356 kg ha$^{-1}$ of rice-red pumpkin and 3541, 12665 kg ha$^{-1}$ of rice-cucumber respectively). It was at par with application of nutrients through FYM, rice straw and *glyricidia* leaves during *kharif* and FYM+neem cake and vermicompost during *rabi*. Application of either panchgavya alone or biodynamic packages or its combination registered significantly lower yield in all the crops. The reduction in yield was found to be 22.6, 107.6 and 124.8% in rice, red pumpkin and cucumber with combination of Panchgavya+biodynamic packages compared to organic sources+ panchgavya.

**Ludhiana:** Two systems namely maize-wheat+gram-summer moong and basmati rice-wheat-green manure was evaluated with different organic sources and biodynamic packages. Significantly higher grain yield of maize and wheat (5420 and 2170 kg ha$^{-1}$respectively) was recorded with green manure and panchgavyafollowed by biodynamic practice alone (2950 and 1450 kg ha$^{-1}$) and unfertilized control (1370 and 1000 kg ha$^{-1}$) but that was statistically on par with GM+FYM+BD and GM+PG+BD package. In case of basmati rice, except control, all the organic sources *viz*., green manure alone or its combination with FYM, biodynamic packages or panchgavya recorded statistically on par yield. Wheat yield was significantly lower in biodynamic packages (2210 kg ha$^{-1}$) alone and control (1770 kg ha$^{-1}$) compared to application of

FYM alone or with biodynamic and Panchgavya packages. The yield increase due to biodynamic and panchgavya packages were not significant compared to FYM alone.

**Modipuram:** Different nutrient management practices on grain and straw yield of basmati rice, maize and wheat was significantly influenced. Grain yield of basmati rice and wheat (4620 and 4700 kg $ha^{-1}$respectively) in rice-wheat system were recorded significantly higher with application of FYM+vermi compost+panchgavya+BD combination which was statistically on par to FYM+vermicompost and along with panchgavya and biodynamic preparation. Grain yield of maize (5380 kg $ha^{-1}$) was also recorded significantly higher with application of FYM+vermi compost+panchgavya+biodynamic and was found to be 26% higher than control.

**Pantnagar:** Among the nutrient management and biodynamic treatments, grain yield of basmati rice was significantly higher (4535 kg $ha^{-1}$) with FYM+VC+NC+EC @ ¼ N each+biodynamic and panchgavya preparation than biodynamic preparation alone and control with (green manuring/moog residue only). The yield reduction due to application of biodynamic packages alone was found to be 29.5% compared to combination of FYM+VC+NC+EC @ ¼ N each + biodynamic + panchgavyaapplication. Significantly higher grain yield (2440 kg $ha^{-1}$) and stover yield (5323 kg $ha^{-1}$) of chickpea were obtained with application of FYM+VC+NC+EC @ ¼ N each along with BD and PG application over other nutrient management and biodynamic treatments. Likewise, significantly higher green pod yield (8884 kg $ha^{-1}$) of vegetable pea was also recorded with combination of all organic sources. The increase in green pod yield was found to be 117.5% compared to BD alone

**Raipur:** Two systems namely rice-chickpea and rice-mustard+lentil (alternate row) were evaluated with five combinations of nutrient sources. Though application of biodynamic package + EC + CDM + NEOC @ 1/3 N each + panchgavya recorded higher yield of rice (4317 kg $ha^{-1}$) and chickpea (1271 kg $ha^{-1}$), it was on par with application of + EC + CDM + NEOC @ 1/3 N each + panchgavya 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). EC+CDM+NEOC @ 1/3 N each+biodynamic practice recorded higher yield of mustard 679 kg $ha^{-1}$. Lowest yield in all the crops was observed under biodynamic package alone. Reduction with biodynamic practice alone was found to be 48.3, 36 and 27.5% compare to application of all organic sources +panchgavya and biodynamic preparation.

**Ranchi:** Two systems namely rice-wheat and rice-potato were evaluated for its response to organic inputs in the form of vermicompost, biodynamic preparation, cow pat pit and panchgavya in various combinations. All the crops recorded higher yield with vermicompost + KC + biodynamic peparration + panchgavya (4665, 2152 and 9524 kg $ha^{-1}$ in rice, wheat and potato respectively) which was on par with, without panchgavya 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 panchgavya and biodynamic preparation over and above, the vermicompost + KC @ ½ N each was found to be very minimum in rice and wheat (8.2 and 8.4 % with panchgavya and 3.6 and 5.1% with biodynamic preparations in rice and wheat respectively). However, the contribution of panchgavya and biodynamic preparation over and above VC + KC was found to be numerically higher value in potato. The residues yield of all the crops have also recorded similar trend as that of economic yield.

**Umiam:** The experiments were conducted with different combinations of cropping systems and organic inputs. Systems namely maize + soybean (2:2)-tomato, maize + soybean (2:2) -potato and maize +

soybean (2:2) -french bean were evaluated with vermicompost, FYM and their combinations. Application of FYM + VC recorded significantly higher mean yield of maize (5840 kg $ha^{-1}$), tomato (14537 kg $ha^{-1}$)and frenchbean (green pod 20927 kg $ha^{-1}$) but the same was statistically on par with application either FYM or VC alone Combined application of FYM + VC resulted in 7.9, 6.6 and 27.3% increase in yield of maize, tomato and frenchbean respectively over vermicompost alone. The response of potato was found to be better with application of vermicompost alone which recorded yield of 17323 kg $ha^{-1}$ with vermicompost alone and the increase over FYM alone was found to be 5.9 %.

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

**Bajaura:** Soil pH did not vary among various nutrient sources. Soil organic carbon was found to be significantly higher with application of rock phosphate enriched FYM + VC (1:1) *fb*panchgavya in coriander-pea-tomato (1.39%) and cauliflower-pea-cauliflower (1.33%) system. The increase of OC in coriander-pea-tomato was found to be more than two times over control. Higher available N and K was also observed under rock phosphate enriched FYM + VC (1:1) *fb* panchgavya in the coriander-pea-tomato system while P was higher with application FYM *fbbiodynamics*. In both the systems, residual availability of Mn, Zn and Cu was found to be significantly higher with rock phosphate enriched FYM+VC @ ½ N each *fb*panchgavya compared to application of same with panchgavya or biodynamic preparation and FYM.

**Bhopal:** Soil pH, EC, available N, P and K were estimated. Results reveal that different sources of nutrients were significantly influenced by the EC, available N, P and K. However, application of bio-dynamics alone recorded significantly lower EC (0.14 ds/m). Soybean-wheat system recorded significantly higher available N in the soil (252.3 kg $ha^{-1}$) with the application of organic manure+panchgavya along with biodynamic package. Lower N, P and K was recorded with biodynamic package.

**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+panchgavya recorded higher OC (0.72%), available P (21.6 kg $ha^{-1}$), K (745 kg $ha^{-1}$) while N (259 kg $ha^{-1}$) was found to be better in FYM + NEOC @ ½ N each. In case of chillies-sunflower-green manure system, FYM + NEOC @ ½ N each+ panchgavya was found better for organic carbon and available K (0.70%, 648 kg $ha^{-1}$) however FYM + NEOC @ ½ N each recorded better available P (20.6 kg $ha^{-1}$) while N was higher with only application of panchgavya alone. Among the two systems, cotton-maize-green manure recorded slightly better residual organic carbon and available soil nutrients of P and K. Fungi, bacteria and actinomycetes count was higher in FYM + NEOC @ ½ N each + panchgavya in both the systems. Application of panchgavya or biodynamic packages alone does not increase the microbial population compared to addition of the same with FYM + NEOC.

**Dharwad:** All the physical and chemical properties of soil along with microbial count were estimated at the end of cropping cycle. Marginally higher bulk density was observed with either with EC+VC+GLM @ 1/3 N each or panchgavya spray in all the cropping systems. Soil pH and EC did not vary much due to application of different sources of nutrients. Groundnut-sorghum, maize-chickpea and chilli+onion systems recorded higher organic carbon, available N, P and K with application of EC + VC + GLM + panchgavya spray compared to other packages. Among the panchgavya and biodynamic package, combining panchgavya with organic inputs such as EC + VC + GLM was found to be more effective in terms of soil health. Among the three systems, maize-chickpea recorded better residual organic carbon and nutrients. All the micronutrients estimated were also exhibited similar trend as that of macro nutrients by recording

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

| Cropping system | Source of nutrient | BD (g/cc) | pH | EC (dS/m) | OC (%) | N (kg ha$^{-1}$) | P (kg ha$^{-1}$) | K (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| **Bajaura** | | | | | | | | |
| Coriander-pea-tomato | Rock phosphate enriched FYM + VC (1:1) | | 6.80 | | 1.50 | 281.5 | 87.2 | 289.0 |
| | FYM *fb* BD | | 7.00 | | 1.29 | 275.2 | 100.4 | 247.8 |
| | Rock phosphate enriched FYM + VC (1:1) *fb* Panchgavya | | 6.77 | | 1.39 | 456.0 | 64.6 | 323.6 |
| | FYM *fb* BD fb Panchgavya | | 6.80 | | 1.31 | 245.4 | 99.2 | 297.2 |
| | Control | | 6.53 | | 0.44 | 210.8 | 30.5 | 135.3 |
| | Control with Panchagavya | | 6.70 | | 0.57 | 213.9 | 42.3 | 140.0 |
| | Mean | | 6.77 | | 1.08 | 280.5 | 70.7 | 238.8 |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | | | |
| Cauliflower-pea-cauliflower | Rock phosphate enriched FYM + VC (1:1) | | 7.07 | | 1.09 | 245.4 | 62.8 | 204.8 |
| | FYM *fb* BD | | 7.03 | | 1.12 | 275.2 | 73.3 | 217.8 |
| | Rock phosphate enriched FYM + VC (1:1) *fb* Panchgvya | | 6.83 | | 1.32 | 251.7 | 67.7 | 211.3 |
| | FYM *fb* BD fb Panchgvya | | 7.03 | | 1.05 | 313.0 | 55.9 | 199.7 |
| | Control | | 6.87 | | 0.51 | 236.0 | 30.5 | 130.2 |
| | Control with Panchagavya | | 6.93 | | 0.56 | 242.2 | 33.6 | 137.2 |
| | Mean | | 6.96 | | 0.94 | 260.6 | 54.0 | 183.5 |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | | | |
| **Bhopal** | | | | | | | | |
| Soybean-wheat Maize-chickpea | OM | | 7.9 | 0.17 | | 244.0 | 101.5 | 558.6 |
| | BD | | 8.1 | 0.14 | | 180.3 | 24.3 | 504.0 |
| | OM+PG | | 8.0 | 0.15 | | 252.3 | 80.3 | 523.3 |
| | OM+BD | | 7.9 | 0.17 | | 249.8 | 94.0 | 546.3 |
| | OM+PG+BD | | 7.9 | 0.17 | | 239.3 | 101.9 | 537.0 |
| | Control | | 8.0 | 0.15 | | 179.8 | 24.1 | 513.8 |
| | Mean | | 8.0 | 0.16 | | 224.2 | 71.0 | 530.5 |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | | | |
| **Coimbatore** | | | | | | | | |
| Cotton - maize - green manure | FYM + NEOC@1/2 each | | | | 0.71 | 259 | 19.9 | 713 |
| | Panchgavya alone | | | | 0.65 | 211 | 19.2 | 725 |
| | FYM+NEOC@1/2 each + Panchgavya | | | | 0.72 | 249 | 21.6 | 745 |
| | Biodynamic practices | | | | 0.65 | 229 | 18.0 | 683 |
| | Biodynamic practices+ panchgavya | | | | 0.68 | 236 | 18.5 | 683 |
| | Mean | | | | 0.68 | 236.8 | 19.4 | 709.8 |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | | | |

| Cropping system | Source of nutrient | BD (g/cc) | pH | EC (dS/m) | OC (%) | N (kg ha$^{-1}$) | P (kg ha$^{-1}$) | K (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| Chillies - Sunflower - green manure | FYM + NEOC@1/2 each | | | | 0.70 | 247 | 20.6 | 631 |
| | Panchgavya alone | | | | 0.68 | 248 | 17.4 | 631 |
| | FYM+NEOC@1/2 each + Panchgavya | | | | 0.70 | 246 | 20.4 | 648 |
| | Biodynamic Practices | | | | 0.63 | 229 | 18.3 | 592 |
| | Biodynamic practices+ Panchgavya | | | | 0.64 | 221 | 17.0 | 593 |
| | Mean | | | | 0.67 | 238.2 | 18.7 | 619 |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | | | |
| **Dharwad** | | | | | | | | |
| Groundnut-sorghum | EC+VC+GLM @1/3 each | 1.21 | 7.21 | 0.21 | 0.65 | 286.4 | 32.6 | 382.1 |
| | Panchgavya spray | 1.19 | 7.27 | 0.2 | 0.64 | 272.25 | 31.1 | 367.6 |
| | EC+VC+GLM @1/3 each + Panchgavya spray | 1.17 | 7.19 | 0.21 | 0.65 | 289.39 | 32.7 | 383.9 |
| | EC+VC+GLM @1/3 each + Biodynamic spray @5g/ac | 1.21 | 7.27 | 0.22 | 0.64 | 265.27 | 31 | 365.4 |
| | EC+VC+GLM @1/3 each+ Biodynamic spray @5g/ac+ Panchagavya spray | 1.17 | 5.24 | 0.18 | 0.63 | 273.23 | 31.2 | 368.2 |
| | FYM+VC+GLM @1/3 each | 1.15 | 5.31 | 0.22 | 0.63 | 285.95 | 31.3 | 370.7 |
| | Control | 1.32 | 7.29 | 0.16 | 0.53 | 254.13 | 25 | 332.8 |
| | Mean | 1.20 | 6.68 | 0.20 | 0.62 | 275.2 | 30.7 | 367.2 |
| | SEm± | 0.02 | 0.05 | 0.02 | 0.03 | 6.25 | 0.61 | 4.69 |
| | CD (*P=0.05*) | 0.06 | NS | NS | 0.08 | 19.4 | 1.9 | 14.45 |
| Maize-chickpea | EC+VC+GLM @1/3 each | 1.24 | 7.26 | 0.22 | 0.66 | 281.53 | 33 | 380.6 |
| | Panchgavya spray | 1.25 | 7.27 | 0.2 | 0.63 | 270.23 | 31.7 | 369.7 |
| | EC+VC+GLM @1/3 each + Panchgavya spray | 1.18 | 7.21 | 0.19 | 0.69 | 286.57 | 35.1 | 384.9 |
| | EC+VC+GLM @1/3 each + Biodynamic spray @5g/ac | 1.17 | 7.24 | 0.19 | 0.63 | 263.1 | 30.6 | 364.1 |
| | EC+VC+GLM @1/3 each+ Biodynamic spray @5g/ac+ Panchgavya spray | 1.2 | 7.26 | 0.21 | 0.61 | 268.17 | 30.6 | 369.2 |
| | FYM+VC+GLM @1/3 each | 1.2 | 7.34 | 0.22 | 0.66 | 272.57 | 31.3 | 370 |
| | Control | 1.25 | 7.28 | 0.17 | 0.59 | 255.27 | 25.3 | 336.3 |
| | Mean | 1.21 | 7.27 | 0.20 | 0.64 | 271.1 | 31.1 | 367.8 |
| | SEm± | 0.02 | 0.06 | 0.02 | 0.02 | 4.34 | 0.83 | 6.38 |
| | CD (*P=0.05*) | NS | NS | NS | 0.06 | 13.37 | 2.56 | 19.66 |
| Chilli+onion | EC+VC+GLM @1/3 each | 1.23 | 7.23 | 0.19 | 0.67 | 279.73 | 33.7 | 383.2 |
| | Panchgavya spray | 1.2 | 7.25 | 0.2 | 0.63 | 267.3 | 31.4 | 367.4 |
| | EC+VC+GLM @1/3 each + Panchgavya spray | 1.23 | 7.22 | 0.23 | 0.63 | 282.33 | 33.4 | 384.3 |
| | EC+VC+GLM @1/3 each + Biodynamic spray @5g/ac | 1.22 | 7.24 | 0.2 | 0.59 | 264.57 | 30.2 | 332.6 |

| Cropping system | Source of nutrient | | BD (g/cc) | pH | EC (dS/m) | OC (%) | N (kg ha$^{-1}$) | P (kg ha$^{-1}$) | K (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| | EC+VC+GLM @1/3 each+ Biodynamic spray @5g/ac+ Panchgavya spray | | 1.23 | 7.28 | 0.2 | 0.65 | 271.53 | 30.6 | 368.9 |
| | FYM+VC+GLM @1/3 each | | 1.25 | 7.2 | 0.18 | 0.63 | 271.5 | 32.3 | 370.1 |
| | Control | | 1.29 | 7.26 | 0.18 | 0.55 | 251.93 | 25.3 | 340.5 |
| | Mean | | 1.24 | 7.24 | 0.20 | 0.62 | 269.8 | 31.0 | 363.9 |
| | SEm± | | 0.03 | 0.06 | 0.02 | 0.04 | 5.91 | 0.67 | 9.29 |
| | CD (*P=0.05*) | | NS | NS | NS | 0.12 | 18.23 | 2.07 | 28.65 |
| **Jabalpur** | | | | | | | | | |
| Basmati rice - D.wheat - GM | VC+FYM+NEOF @1/3 N each | | | 7.35 | 0.34 | 7.20 | 268.0 | 13.3 | 299.0 |
| | Panchgavya alone | | | 7.24 | 0.37 | 6.85 | 264.0 | 12.5 | 295.0 |
| | VC+FYM+NEOF@1/3N each + Panchgavya | | | 7.27 | 0.35 | 7.20 | 271.0 | 13.6 | 300.0 |
| | Biodynamic practices | | | 7.45 | 0.36 | 6.80 | 262.0 | 12.1 | 291.0 |
| | Biodynamic practices + Panchgavya | | | 7.33 | 0.39 | 7.19 | 265.0 | 12.0 | 297.0 |
| | Mean | | | 7.33 | 0.36 | 7.05 | 266.0 | 12.7 | 296.4 |
| | SEm± | | | | | | | | |
| | CD (P=0.05) | | | | | | | | |
| Basmati rice-berseem | VC+FYM+NEOF @1/3 N each | | | 7.25 | 0.36 | 7.10 | 272.0 | 13.0 | 303.0 |
| | Panchgavya alone | | | 7.15 | 0.38 | 6.88 | 265.0 | 12.4 | 300.0 |
| | VC+FYM+NEOF @1/3N each +Panchgavya | | | 7.17 | 0.36 | 7.30 | 273.0 | 13.3 | 304.0 |
| | Biodynamic practices | | | 7.18 | 0.39 | 6.85 | 263.0 | 12.5 | 295.0 |
| | Biodynamic practices + Panchgavya | | | 7.33 | 0.37 | 7.10 | 266.0 | 12.3 | 299.0 |
| | Mean | | | 7.22 | 0.37 | 7.05 | 267.8 | 12.7 | 300.2 |
| | SEm± | | | | | | | | |
| | CD (P=0.05) | | | | | | | | |
| **Karjat** | *Kharif* | *Rabi* | | | | | | | |
| Rice- red pumpkin | FYM+rice straw+ *glyricidia* leaves @1/3 each | FYM+neem cakevermin compost @1/3 each | | 6.85 | 0.46 | 1.30 | 264.7 | 21.0 | 369.8 |
| | Panchgavya alone | | | 6.80 | 0.43 | 1.24 | 239.6 | 17.8 | 344.6 |
| | FYM+rice straw+ *glyricidia* leaves @1/3 each + Panchgavya | | | 6.86 | 0.45 | 1.35 | 273.0 | 20.9 | 369.2 |
| | Biodynamic practices | | | 6.76 | 0.41 | 1.21 | 235.4 | 17.5 | 343.4 |
| | Panchgavya + Biodynamic practices | | | 6.82 | 0.45 | 1.24 | 239.6 | 18.1 | 347.8 |
| | Mean | | | 6.82 | 0.44 | 1.27 | 250.5 | 19.0 | 355.0 |

| Cropping system | Source of nutrient | | BD (g/cc) | pH | EC (dS/m) | OC (%) | N (kg ha$^{-1}$) | P (kg ha$^{-1}$) | K (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| Rice- cucumber | FYM+rice straw+ *glyricidia* leaves @1/3 each | FYM+neem cakevermin compost @1/3 each | | 6.93 | 0.47 | 1.35 | 270.0 | 21.7 | 378.7 |
| | Panchgavya alone | | | 6.84 | 0.47 | 1.25 | 240.7 | 22.5 | 357.5 |
| | FYM+rice straw+ *glyricidia* leaves @1/3 each + Panchgavya | | | 6.91 | 0.50 | 1.37 | 278.3 | 24.3 | 385.5 |
| | Biodynamic practices | | | 6.81 | 0.46 | 1.26 | 240.7 | 22.5 | 358.0 |
| | Panchgavya + Biodynamic practices | | | 6.87 | 0.45 | 1.30 | 253.2 | 23.4 | 361.7 |
| | Mean | | | 6.87 | 0.47 | 1.31 | 256.6 | 22.9 | 368.3 |
| | | | | CS Treat | CS Treat | CS Treat | CS Treat | CS Treat | CS Treat |
| | SEm± | | | 0.01 0.03 | 0.01 0.02 | 0.01 0.02 | 5.42 7.12 | 0.70 0.47 | 2.19 2.30 |
| | CD (P=0.05) | | | NS NS | NS NS | NS NS | NS NS | NS NS | NS NS |
| **Ludhiana** | *Kharif* crops | *Rabi* crops | | | | | | | |
| Maize-wheat + chickpea | Green manure (GM) | Farmyard manure (FYM) | | 7.50 | 0.284 | 0.620 | 339.8 | 69.1 | 182.4 |
| | GM+ Panchgavya (PG) | FYM+ Panchgavya (PG) | | 7.65 | 0.271 | 0.657 | 342.9 | 62.4 | 183.0 |
| | GM+ Biodynamic (BD) | Biodynamic (BD) | | 7.72 | 0.276 | 0.583 | 301.5 | 50.2 | 158.5 |
| | GM+BD+FYM | FYM+BD | | 7.67 | 0.289 | 0.617 | 334.8 | 61.6 | 181.7 |
| | GM+PG+BD | FYM+PG+BD | | 7.63 | 0.283 | 0.620 | 347.2 | 61.5 | 175.9 |
| | Control | Control | | 7.77 | 0.278 | 0.437 | 193.7 | 41.6 | 85.0 |
| | Mean | | | 7.66 | 0.280 | 0.589 | 309.98 | 57.7 | 161.1 |
| | CD (P=0.05) | | | NS | NS | 0.063 | 26.5 | 6.9 | 13.1 |
| Basmati rice - wheat-green manure | GM | FYM | | 7.52 | 0.253 | 0.617 | 350.5 | 64.1 | 189.6 |
| | GM+PG | FYM+PG | | 7.49 | 0.242 | 0.603 | 354.7 | 64.0 | 181.8 |
| | GM+BD | BD | | 7.60 | 0.243 | 0.527 | 328.3 | 54.5 | 157.8 |
| | GM+BD+FYM | FYM+BD | | 7.65 | 0.225 | 0.617 | 362.6 | 61.3 | 183.8 |
| | GM+PG+BD | FYM+PG+BD | | 7.60 | 0.249 | 0.601 | 348.9 | 65.0 | 180.9 |
| | Control | Control | | 7.58 | 0.219 | 0.367 | 252.3 | 38.1 | 99.2 |
| | Mean | | | 7.57 | 0.239 | 0.555 | 332.88 | 57.8 | 165.5 |
| | SEm± | | | | | | | | |
| | CD (P=0.05) | | | NS | NS | 0.048 | 27.1 | 7.1 | 13.3 |

| Cropping system | Source of nutrient | BD (g/cc) | pH | EC (dS/m) | OC (%) | N (kg ha$^{-1}$) | P (kg ha$^{-1}$) | K (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| **Modipuram** | | | | | | | | |
| Basmati rice - wheat | Control | | | | 0.43 | 194.1 | 16.5 | 227.1 |
| | FYM + Vermi compost | | | | 0.61 | 211.8 | 18.8 | 235.1 |
| | Biodynamic( BD) | | | | 0.49 | 207.6 | 17.8 | 231.9 |
| | FYM + Vermi compost + Panchgavya | | | | 0.58 | 207.2 | 21.0 | 235.3 |
| | FYM + Vermi compost+ BD | | | | 0.60 | 213.1 | 20.5 | 244.9 |
| | FYM + Vermi compost + Panchgavya + BD | | | | 0.55 | 219.4 | 21.4 | 249.8 |
| | Mean | | | | 0.55 | 208.9 | 19.3 | 237.4 |
| Maize + cowpea – wheat + mustard | Control | | | | 0.48 | 193.2 | 18.9 | 232.4 |
| | FYM + Vermi compost | | | | 0.56 | 225.7 | 22.6 | 250.2 |
| | Biodynamic( BD) | | | | 0.49 | 196.1 | 21.3 | 240.2 |
| | FYM + Vermi compost + Panchgavya | | | | 0.66 | 237.8 | 23.2 | 255.6 |
| | FYM + Vermi compost+ BD | | | | 0.65 | 237.4 | 25.8 | 249.9 |
| | FYM + Vermi compost + Panchgavya + BD | | | | 0.69 | 245.1 | 28.2 | 252.4 |
| | Mean | | | | 0.59 | 222.6 | 23.3 | 246.8 |
| | | | | | CS Treat | CS Treat | CS Treat | CS Treat |
| | SEm± | | | | 0.01 0.02 | 2.17 4.32 | 0.67 0.52 | 3.60 3.05 |
| | CD (P=0.05) | | | | NS 0.05 | 13.2 12.70 | NS 1.50 | NS 9.00 |
| **Pantnagar** | | | | | | | | |
| Basmati rice – chickpea – *sesbania* (green manure) | FYM+VC+NC+EC @ 1/4each | | | | 1.15 | 395.3 | 35.3 | 318.4 |
| | Biodynamic (BD) | | | | 0.84 | 368.3 | 26.1 | 235.5 |
| | FYM+VC+NC+EC @ 1/4each+ Panchgavya | | | | 1.11 | 507.0 | 30.8 | 306.1 |
| | FYM+VC+NC+EC @ 1/4each+BD | | | | 0.96 | 447.4 | 32.9 | 294.9 |
| | FYM+VC+NC+EC @1/4each+ BD+ Panchgavya | | | | 1.68 | 472.5 | 33.1 | 302.7 |
| | Control (green manure/moong residues only) | | | | 0.86 | 242.0 | 30.1 | 214.7 |
| | Mean | | | | 1.10 | 405.4 | 31.4 | 278.7 |
| Basmati rice–vegetable pea –maize+moong (moong residues incorporation) | FYM+VC+NC+EC @ 1/4each | | | | 0.77 | 454.7 | 31.9 | 284.4 |
| | Biodynamic (BD) | | | | 0.91 | 203.2 | 27.7 | 167.6 |
| | FYM+VC+NC+EC @ 1/4each+ Panchgavya | | | | 0.89 | 436.9 | 33.8 | 256.1 |
| | FYM+VC+NC+EC @ 1/4each+BD | | | | 1.01 | 379.5 | 30.7 | 280.4 |
| | FYM+VC+NC+EC @1/4each+ BD+ Panchgavya | | | | 1.15 | 356.5 | 30.7 | 277.7 |

| Cropping system | Source of nutrient | BD (g/cc) | pH | EC (dS/m) | OC (%) | N (kg ha$^{-1}$) | P (kg ha$^{-1}$) | K (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| | Control (green manure/moong residues only) | | | | 0.69 | 200.6 | 32.4 | 137.2 |
| | Mean | | | | 0.90 | 338.6 | 31.2 | 233.9 |
| | Cropping system/Nutrient source | | | | CS NS | CS NS | CS NS | CS NS |
| | SEm± | | | | 0.05 0.06 | 13.90 33.50 | 0.89 1.60 | 6.40 6.60 |
| | CD (P=0.05) | | | | NS 0.19 | NS 98.9 | NS 4.6 | 38 19.4 |
| **Raipur** | | | | | | | | |
| Rice-chickpea | EC+CDM+NEOC @ 1/3 N each | 1.22 | 7.54 | 0.25 | 0.67 | 223.0 | 14.5 | 291.0 |
| | Bio dynamic practice | 1.29 | 7.60 | 0.32 | 0.56 | 183.0 | 8.4 | 249.0 |
| | EC+CDM+NEOC@1/3Neach+ Panchagavya | 1.22 | 7.45 | 0.23 | 0.66 | 213.0 | 14.9 | 289.0 |
| | EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice | 1.20 | 7.45 | 0.26 | 0.66 | 220.0 | 13.6 | 292.0 |
| | Biodynamic practice+ EC+CDM+ NEOC@1/3Neach+Panchagavya | 1.19 | 7.42 | 0.23 | 0.68 | 228.0 | 15.5 | 317.0 |
| | Mean | 1.22 | 7.49 | 0.26 | 0.65 | 214.0 | 13.4 | 287.0 |
| Rice – mustard +lentil (alternate row) | EC+CDM+NEOC @ 1/3 N each | 1.21 | 7.52 | 0.26 | 0.62 | 215.0 | 14.1 | 277.0 |
| | Bio dynamic practice | 1.33 | 7.58 | 0.32 | 0.54 | 193.0 | 7.4 | 235.0 |
| | EC+CDM+NEOC@1/3Neach+ Panchagavya | 1.21 | 7.47 | 0.25 | 0.62 | 211.0 | 14.3 | 275.0 |
| | EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice | 1.21 | 7.42 | 0.25 | 0.65 | 211.0 | 13.6 | 275.0 |
| | Biodynamic practice+ EC+CDM+ NEOC@1/3Neach+Panchagavya | 1.21 | 7.52 | 0.27 | 0.64 | 221.0 | 14.5 | 289.0 |
| | Mean | 1.24 | 7.50 | 0.27 | 0.61 | 210.0 | 12.8 | 270.0 |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | | | |
| **Ranchi** | | | | | | | | |
| Rice - wheat | FYM+ VC @1/2 each | | | | | 263.3 | 39.9 | 151.5 |
| | BD Preparation (CPP, BD500 & 501) | | | | | 217.7 | 30.1 | 124.1 |
| | VC + K.C+Panchgavaya | | | | | 265.4 | 41.2 | 152.1 |
| | FYM+VC+ BD prepartion | | | | | 268.6 | 43.3 | 153.5 |
| | FYM+ VC+ BD + Panchagavya | | | | | 270.6 | 46.0 | 155.1 |
| | Mean | | | | | 257.1 | 40.1 | 147.3 |
| Rice – potato | FYM+ VC @1/2 each | | | | | 258.6 | 40.6 | 144.4 |
| | BD Preparation (CPP, BD500 & 501) | | | | | 213.6 | 28.8 | 122.7 |
| | VC + K.C+Panchgavaya | | | | | 260.9 | 43.6 | 147.0 |
| | FYM+VC+ BD prepartion | | | | | 263.5 | 46.2 | 149.9 |
| | FYM+VC+ BD + Panchgavya | | | | | 265.5 | 47.1 | 152.6 |
| | Mean | | | | | 252.4 | 41.2 | 143.3 |
| | *Nutrient source | | | | | CS *NS | CS *NS | CS *NS |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | NS 42.5 | NS 6.6 | NS 16.5 |

| Cropping system | Source of nutrient | BD (g/cc) | pH | EC (dS/m) | OC (%) | N (kg ha$^{-1}$) | P (kg ha$^{-1}$) | K (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| **Umiam** | | | | | | | | |
| Maize+ soybean-tomato | FYM | 1.16 | 5.13 | | 2.24 | 243.9 | 29.3 | 244.0 |
| | Vermicompost | 1.11 | 5.12 | | 2.21 | 232.6 | 28.0 | 240.1 |
| | FYM+ Vermicompost | 1.08 | 5.29 | | 2.31 | 243.2 | 29.9 | 244.6 |
| | Control | 1.14 | 4.96 | | 2.01 | 196.8 | 20.7 | 219.6 |
| Maize+ soybean-potato | FYM | 1.12 | 5.12 | | 2.25 | 241.2 | 29.0 | 245.7 |
| | Vermicompost | 1.09 | 5.10 | | 2.18 | 233.2 | 28.0 | 239.7 |
| | FYM+ Vermicompost | 1.09 | 5.04 | | 2.28 | 233.0 | 30.2 | 254.5 |
| | Control | 1.19 | 4.95 | | 1.93 | 197.8 | 20.5 | 220.8 |
| Maize+ soybean-Frenchbean | FYM | 1.15 | 5.15 | | 2.38 | 247.7 | 30.5 | 246.6 |
| | Vermicompost | 1.13 | 5.12 | | 2.28 | 237.0 | 28.8 | 241.3 |
| | FYM+ Vermicompost | 1.15 | 5.19 | | 2.38 | 245.1 | 31.7 | 253.9 |
| | Control | 1.18 | 4.77 | | 1.86 | 202.0 | 19.7 | 222.8 |
| | | SEm(±) CD | SEm(±) CD | SEm(±) CD | SEm(±) CD | SEm(±) CD | SEm(±) CD | SEm(±) CD |
| | Cropping systems | 0.01 NS | 0.04 NS | | 0.01 NS | 3.33 NS | 0.65 NS | 1.22 NS |
| | Nutrient sources | 0.012 0.036 | 0.06 0.18 | | 0.04 0.11 | 4.23 12.57 | 0.90 2.69 | 1.30 3.87 |

significantly higher residual availability with EC + VC + GLM @ 1/3 N each + panchgavya spray. However, irrespective of the cropping systems, microbial count such as fungi, bacteria and actinomycetes was higher in all the treatments which received biodynamic spray. Among the cropping systems, fungi, bacteria and actionmycetes were higher in maize-chickpea.

**Jabalpur:** At the end of cropping cycle, the soil physical and chemical properties pH, EC, OC, available N, P and K content in case of rice-wheat and rice-berseem system enhanced slightly over control under all the nutrient management package, whereas availability of N, P and K concentration in soil were higher under VC+FYM+NEOF @1/3 each+panchgavya in both the cropping system. Microbial population in soil i.e. fungi, actinomycetes and azatobactor were also enhanced with same nutrient management package.

**Karjat:** Soil pH, EC, OC, available N, P and K were estimated and results reveals that different sources of nutrients significantly influenced the soil pH, EC, organic carbon, available N, P and K. however, in both rice-red pumpkin and rice-cucumber systems, application of FYM + rice straw + glyricidia leaves @ 1/3 N each during *kharif* and FYM + NC + VC @ 1/3 N each during *rabi* with pachagavya during both the seasons recorded higher organic carbon (1.35 and 1.37% respectively), N (273 and 278.3 kg ha$^{-1}$ respectively). Among the two systems rice-cucumber performed better soil properties.

**Ludhiana:** Variation in soil pH and EC was not significant while organic carbon, soil available N, P and K was influenced due to nutrient sources. In maize-wheat + gram-moong, application of FYM+pachagavya recorded increase in organic carbon (50.3%), available N (77%), P (50 %) and K (120.5) over control. In basmati rice-wheat-green manure system, an increase of 68.1% was observed in organic carbon, 43.7%

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

| Cropping system | Source of nutrient | Mn | Zn | Cu | Fe | Fungi | Bacteria | Actino-mycetes |
|---|---|---|---|---|---|---|---|---|
| **Bajaura** | | | | | | | | |
| Coriander-pea-tomato | Rock phosphate enriched ) FYM + VC (1:1 | 9.37 | 2.77 | 1.47 | 4.67 | | | |
| | FYM *fb* BD | 11.47 | 3.33 | 1.57 | 5.47 | | | |
| | Rock phosphate enriched FYM + VC (1:1) *fb* Panchagvya | 11.27 | 2.91 | 1.25 | 5.57 | | | |
| | FYM *fb* BD fb Panchagvya | 8.87 | 2.33 | 1.43 | 5.57 | | | |
| | Control | 8.57 | 1.29 | 1.00 | 2.23 | | | |
| | Control with Panchagavya | 10.67 | 1.89 | 1.02 | 3.13 | | | |
| | Mean | 10.03 | 2.42 | 1.29 | 4.44 | | | |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | | | |
| Cauliflower-pea-cauliflower | Rock phosphate enriched FYM + VC (1:1) | 10.17 | 2.59 | 1.37 | 5.70 | | | |
| | FYM *fb* BD | 12.17 | 3.71 | 1.49 | 4.63 | | | |
| | Rock phosphate enriched FYM+ VC (1:1) *fb* Panchagvya | 10.97 | 2.51 | 1.27 | 5.43 | | | |
| | FYM *fb* BD fb Panchagvya | 8.87 | 2.27 | 1.43 | 3.77 | | | |
| | Control | 8.27 | 1.55 | 1.07 | 2.57 | | | |
| | Control with Panchagavya | 9.27 | 2.23 | 1.09 | 3.03 | | | |
| | Mean | 9.95 | 2.47 | 1.28 | 4.19 | | | |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | | | |
| **Coimbatore** | | | | | | | | |
| Cotton - maize - green manure | FYM + NEOC@1/2 each | | | | | 21.0 | 116.6 | 38.8 |
| | Panchagavya alone | | | | | 20.6 | 100.7 | 34.3 |
| | FYM+NEOC@1/2 each + Panchagavya | | | | | 22.8 | 121.6 | 41.9 |
| | Biodynamic practices | | | | | 20.2 | 103.8 | 34.7 |
| | Biodynamic practices+ panchagavya | | | | | 21.8 | 104.7 | 35.4 |
| | Mean | | | | | 21.3 | 109.5 | 37.0 |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | | | |
| Chillies-Sunflower- | FYM + NEOC@1/2 each green manure | | | | | 22.1 | 117.2 | 35.9 |
| | Panchagavya alone | | | | | 20.0 | 100.0 | 34.9 |
| | FYM+NEOC@1/2 each + Panchagavya | | | | | 22.6 | 119.2 | 41.5 |
| | Biodynamic Practices | | | | | 20.1 | 99.0 | 35.0 |
| | BiodynamicPractices+ Panchagavya | | | | | 22.4 | 101.7 | 36.6 |
| | Mean | | | | | 21.4 | 107.4 | 36.8 |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | | | |

| Cropping system | Source of nutrient | Mn | Zn | Cu | Fe | Fungi | | Bacteria | | Actino-mycetes | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dharwad** | | | | | | Ground-nut | Sor-ghum | Ground-nut | Sor-ghum | Ground-nut | Sor-ghum |
| Groundnut-sorghum | EC+VC+GLM @1/3 each | 13.8 | 1.02 | 1.27 | 10.14 | 3 | 8. 2 | 3 | 1.5 | 9 | 19 |
| | Panchagavya spray | 11.72 | 1.05 | 1.23 | 9.48 | 2 | 8.5 | 7 | 6.5 | 16 | 20 |
| | EC+VC+GLM @1/3 each + Panchagavya spray | 15.39 | 0.99 | 1.37 | 11.57 | 6 | 5 | 7 | 1.5 | 11 | 14 |
| | EC+VC+GLM @1/3 each + Biodynamic spray @5g/ac | 11.69 | 0.96 | 1.14 | 9.08 | 3 | 3 | 15 | 1.5 | 8 | 23 |
| | EC+VC+GLM @1/3 each+ Biodynamic spray @5g/ac+ Panchagavya spray | 12.55 | 0.95 | 1.25 | 9.52 | 3 | 10.5 | 7 | 17 | 8 | 30 |
| | FYM+VC+GLM @1/3 each | 12.39 | 0.9 | 1.27 | 10.16 | 2 | 6.5 | 8 | 3 | 10 | 21 |
| | Control | 10.33 | 0.83 | 0.99 | 8.05 | 2 | 6 | 2 | 16.5 | 7 | 13 |
| | Mean | 12.55 | 0.96 | 1.22 | 9.71 | | | | | | |
| | SEm± | 0.83 | 0.04 | 0.057 | 0.60 | | | | | | |
| | CD (*P=0.05*) | 2.58 | 0.14 | 0.176 | 1.85 | | | | | | |
| | | | | | | Maize | Chick-pea | Maize | Chick-pea | Maize | Chick-pea |
| Maize-chickpea | EC+VC+GLM @1/3 each | 13.66 | 1.03 | 1.44 | 10.82 | 2 | 3 | 2.5 | 14 | 48.5 | 17 |
| | Panchagavya spray | 11.49 | 1.03 | 1.31 | 9.87 | 1 | 2 | 9.5 | 7 | 21 | 5 |
| | EC+VC+GLM @1/3 each + Panchagavya spray | 15.17 | 1.01 | 1.44 | 11.15 | 1 | 2 | 1.5 | 9 | 38 | 3 |
| | EC+VC+GLM @1/3 each + Biodynamic spray @5g/ac | 11.43 | 1.01 | 1.41 | 9.06 | 1.5 | 4 | 1 | 10 | 19.5 | 11 |
| | EC+VC+GLM @1/3 each+ Biodynamic spray @5g/ac+ Panchagavya spray | 13.56 | 1.02 | 1.31 | 8.69 | 5.5 | 9 | 23.5 | 12 | 26.5 | 29 |
| | FYM+VC+GLM @1/3 each | 13.25 | 0.96 | 1.36 | 8.15 | 10.5 | 4 | 13.5 | 12 | 16 | 13 |
| | Control | 9.21 | 0.95 | 0.7 | 8.01 | 8.5 | 4 | 44 | 11 | 9.5 | 16 |
| | Mean | 12.54 | 1.00 | 1.28 | 9.39 | | | | | | |
| | SEm± | 0.98 | 0.03 | 0.14 | 0.42 | | | | | | |
| | CD (*P=0.05*) | 3.02 | 0.09 | 0.43 | 1.31 | | | | | | |
| | | | | | | Chilli | Onion | Chilli | Onion | Chilli | Onion |
| Chilli+onion | EC+VC+GLM @1/3 each | 12.92 | 0.98 | 1.44 | 9.74 | 2 | 44 | 15 | 124.5 | 6 | 49 |
| | Panchagavya spray | 10.28 | 0.98 | 1.29 | 9.54 | 2 | 15 | 2 | 35.5 | 12 | 24 |
| | EC+VC+GLM @1/3 each + Panchagavya spray | 14.47 | 1.05 | 1.57 | 10.09 | 2 | 7 | 5 | 1 | 5 | 31 |
| | EC+VC+GLM @1/3 each + Biodynamic spray @5g/ac | 11.05 | 0.98 | 1.49 | 9.03 | 2 | 25 | 5 | 1.5 | 12 | 21 |
| | EC+VC+GLM @1/3 each+ Biodynamic spray @5g/ac+ Panchagavya spray | 10.88 | 1.02 | 1.3 | 8.79 | 2 | 15 | 2 | 211.5 | 8 | 60.5 |
| | FYM+VC+GLM @1/3 each | 11.8 | 0.93 | 1.35 | 9.06 | 3 | 39 | 1 | 247 | 9 | 50 |
| | Control | 8.21 | 0.85 | 1.05 | 7.81 | 3 | 27.5 | 2 | 32.0 | 4 | 20 |
| | Mean | 11.37 | 0.97 | 1.36 | 9.15 | | | | | | |
| | SEm± | 0.8 | 0.05 | 0.07 | 0.37 | | | | | | |
| | CD (*P=0.05*) | 2.47 | 0.14 | 0.23 | 0.16 | | | | | | |

| Cropping system | Source of nutrient | Mn | Zn | Cu | Fe | Fungi | Bacteria | Actino-mycetes |
|---|---|---|---|---|---|---|---|---|
| **Jabalpur** | | | | | | | | |
| Basmati rice – duram wheat | VC+FYM+NEOF @1/3 N each | | | | | 36.1 | 47.2 | 14.3 |
| | Panchgavya alone | | | | | 36.0 | 45.0 | 19.9 |
| | VC+FYM+NEOF@1/3N each + Panchgavya | | | | | 36.6 | 47.7 | 14.5 |
| | Biodynamic practices | | | | | 36.0 | 45.0 | 13.6 |
| | Biodynamic practices + Panchgavya | | | | | 37.1 | 46.5 | 14.1 |
| | Mean | | | | | 36.4 | 46.3 | 15.3 |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | | | |
| Basmati rice - berseem | VC+FYM+NEOF @1/3 N each | | | | | 37.4 | 45.3 | 14.4 |
| | Panchgavya alone | | | | | 36.6 | 45.0 | 14.1 |
| | VC+FYM+NEOF @1/3N each + Panchgavya | | | | | 37.5 | 45.5 | 14.5 |
| | Biodynamic practices | | | | | 36.1 | 44.5 | 14.0 |
| | Biodynamic practices + Panchgavya | | | | | 37.0 | 45.0 | 14.2 |
| | Mean | | | | | 36.9 | 45.1 | 14.2 |
| | SEm± | | | | | | | |
| | CD (P=0.05) | | | | | | | |

in available N and 85.3 in K with application of GM+BD+FYM to rice and FYM + BD to other crops while, availability of P in soil was higher with GM+PG+BD in the system compared to control.

**Modipuram:** Organic carbon, available N, P, K were analysed at the end of the cropping cycle and it was observed that soil organic carbon was found to be significantly higher with application of FYM+vermicompost in basmati rice-wheat (0.61%) and maize+cowpea-wheat+mustard (0.69%) system. Reduction in organic carbon due to application of biodynamic preparation alone was found to be 24.5 and 40.8% in basmati rice-wheat and maize+cowpea-wheat+mustard system respectively. Significantly higher available N, P and K were also observed under BD preparation +FYM +vermicompost + panchgavya in both the systems. Irrespective of cropping systems maize+cowpea-wheat+mustard observed more values of OC, available N, P and K than basmati rice-wheat.

**Pantnagar:** Results revealed that soil nutritional status after completion of crop cycles were significantly influenced by different organic sources and biodynamic treatments. Among the nutrient sources and biodynamic treatments, significantly higher organic carbon (1.42 %) was found with FYM+VC+NC+EC @1/4 each +BD+panchgavyaover all other treatments. Availability of nitrogen in soil was found significantly higher (507 kg $ha^{-1}$) with treatment FYM+VC+NC+EC @1/4 each+panchgavya in rice-wheat system. However, significantly higher available P (35.3 kg $ha^{-1}$) and K (318.4 kg $ha^{-1}$) were recorded with application of FYM+VC+NC+EC @1/4 each over other biodynamic treatments. In case of basmati rice-vegetable pea-maize+moong (residues incorporation) system, FYM+VC+NC+EC @1/4 eachresulted in significantlyhigherresidual N in soil.

**Raipur:** Bulk density and EC of soil was found to be higher with biodynamic package in rice-chickpea and rice-mustard+lentil (alternate row) systems (1.29 and 1.33 g $cc^{-1}$). No significant variation among different organic sources and cropping system was observed in soil pH and EC. However, organic carbon was found to be higher under biodynamic+EC + CDM + NEOC @ 1/3 N each + panchgavya in rice-chickpea (0.68%) and EC + CDM + NEOC@ 1/3 N each + biodynamic package in rice-mustard + lentil (0.65%) system. Soil available N, P, K was not significantly influenced by different input packages in cropping systems. EC + CDM + NEOC@ 1/3 N each with use of biodynamic and panchgavya package registered higher availability of residual N, P and K in soil for both the systems.

**Ranchi:** Significantlyhigher availability of N, P and K in soil was observed with the application of VC+KC with use of biodynamic and panchgavya package in both rice-wheat and rice-potato system and lower was observed with BD Preparation (CPP, BD 500 & 501). Irrespective of cropping systems rice-wheat removes slightlymore N and K then rice-potato

**Umiam:** Bulk density, soil pH, organic carbon N, P and K were estimated with 3 different combinations of cropping systems and organic inputs. Maize + soybean (2:2)-tomato, maize + soybean (2:2) -potato and maize + soybean (2:2) -french bean were evaluated with vermicompost, FYM and their combinations. Bulk density and soil pH was significantly influenced by application of nutrient sources. Lower bulk density was recorded with application of FYM alone in the systems of maize + soybean (GM)–tomato and maize (green cob)+soybean (GM)-potato. Application of FYM+VC recorded higher organic carbon in all three systems, P and K was also found to be higher in the same treatment in the systems while availability of N in soil was found to be significantly higher by the application of farm yard manure alone.

### Nutrient uptake (Table 16-17)

**Bajaura:** Both coriander-pea-tomato and cauliflower-pea-cauliflower system recorded higher NPK concentration in plants with rock phosphate enriched FYM+VC @ ½ N each as nutrient sources. The increase of N, P and K were found to be 34, 50 and 26.2% over control with panchgavya. Application of panchgavya or biodynamic preparation also improved the concentration of NPK in all the crops compared to control. No significant improvement in panchgavya 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 to be higher with rock phosphate enriched FYM + VC @ ½ N each compared to other sources. The increase was found to be 50.8, 45.8, 10.1 and 23% in coriander, tomato, pea and cauliflower respectively.

**Dharwad:** NPK uptake was found to be significantly higher with application of EC+VC+GLM with panchgavya spray in all three systems. Uptake of all the nutrients compared to control in plants of groundnut, sorghum, maize and chickpea in the respective system have also been found higher with EC+VC+GLM with panchgavya spray. The increase in N uptake over panchgavya and biodynamic packages alone was found to be 84, 74.9, 86.7 and 31.4% groundnut, sorghum, maize and chickpea respectively. Chilli+onian system also registered higher N, P and K uptake with the same package.

**Ludhiana:** Estimation of NPK uptake in basmati rice indicates that application of panchgavya with green manuring increased N concentration slightly in basmati rice compared to other nutrient practices however P and K recorded higher concentration with application of green manuring and biodynamic practice. In case of maize, FYM+panchgavya retained higher N uptake in maize. FYM alone recorded higher P and K

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

| Cropping systems | Treatments | N | | | | P | | | | K | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean |
| **Bajaura** | | | | | | | | | | | | | |
| Coriander-pea-tomato | Rock phosphate enriched FYM + VC (1:1) | 0.80 | 1.69 | 1.37 | 1.29 | 0.40 | 0.60 | 0.44 | 0.48 | 0.57 | 0.79 | 1.24 | 0.87 |
| | FYM *fb* BD | 0.75 | 1.55 | 1.36 | 1.22 | 0.36 | 0.57 | 0.41 | 0.45 | 0.55 | 0.68 | 1.24 | 0.82 |
| | Rock phosphate enriched FYM + VC (1:1) *fb* Panchagvya | 0.73 | 1.54 | 1.34 | 1.20 | 0.34 | 0.52 | 0.45 | 0.44 | 0.56 | 0.69 | 1.27 | 0.84 |
| | FYM *fb* BD *fb* Panchagvya | 0.72 | 1.55 | 1.33 | 1.20 | 0.33 | 0.53 | 0.37 | 0.41 | 0.53 | 0.68 | 1.24 | 0.82 |
| | Control | 0.62 | 1.18 | 0.96 | 0.92 | 0.26 | 0.34 | 0.29 | 0.30 | 0.44 | 0.57 | 0.95 | 0.65 |
| | Control with Panchagavya | 0.64 | 1.24 | 1.00 | 0.96 | 0.29 | 0.35 | 0.32 | 0.32 | 0.49 | 0.59 | 0.98 | 0.69 |
| | Mean | 0.71 | 1.46 | 1.23 | | 0.33 | 0.49 | 0.38 | | 0.52 | 0.67 | 1.15 | |
| | SEm± | | | | | | | | | | | | |
| | CD (P=0.05) | | | | | | | | | | | | |
| Cauliflower-pea-cauliflower | Rock phosphate enriched FYM + VC (1:1) | 1.66 | 1.66 | | 1.66 | 0.44 | 0.62 | | 0.53 | 0.65 | 0.82 | | 0.74 |
| | FYM *fb* BD | 1.62 | 1.55 | | 1.59 | 0.41 | 0.58 | | 0.50 | 0.65 | 0.75 | | 0.70 |
| | Rock phosphate enriched FYM + VC (1:1) *fb* Panchagvya | 1.63 | 1.46 | | 1.55 | 0.41 | 0.54 | | 0.48 | 0.64 | 0.72 | | 0.68 |
| | FYM *fb* BD *fb* Panchagvya | 1.62 | 1.48 | | 1.55 | 0.41 | 0.55 | | 0.48 | 0.64 | 0.71 | | 0.68 |
| | Control | 1.47 | 1.18 | | 1.33 | 0.32 | 0.32 | | 0.32 | 0.54 | 0.55 | | 0.55 |
| | Control with Panchagavya | 1.51 | 1.16 | | 1.34 | 0.33 | 0.33 | | 0.33 | 0.55 | 0.58 | | 0.57 |
| | Mean | 1.59 | 1.41 | | | 0.39 | 0.49 | | | 0.61 | 0.69 | | |
| | SEm± | | | | | | | | | | | | |
| | CD (P=0.05) | | | | | | | | | | | | |
| **Dharwad** | | | | | | | | | | | | | |
| Groundnut-sorghum | EC+VC+GLM | 226.4 | 129.0 | | 177.7 | 48.2 | 18.0 | | 33.1 | 179.8 | 64.2 | | 122.0 |
| | Panchagavya spray | 173.5 | 116.6 | | 145.1 | 38.7 | 16.2 | | 27.5 | 141.4 | 50.4 | | 95.9 |
| | EC+VC+GLM + Panchagavya spray | 254.6 | 131.7 | | 193.2 | 56.6 | 21.2 | | 38.9 | 190.4 | 66.2 | | 128.3 |
| | EC+VC+GLM+ Biodynamic spray @5g/ac | 173.5 | 101.4 | | 137.5 | 41.6 | 16.6 | | 29.1 | 135.8 | 49.8 | | 92.8 |

| Cropping systems | Treatments | N | | | | P | | | | K | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean |
| | EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray | 198.4 | 111.7 | | 155.1 | 41.7 | 16.4 | | 29.1 | 149.2 | 52.3 | | 100.8 |
| | FYM+VC+GLM | 221.6 | 111.0 | | 166.3 | 45.2 | 15.4 | | 30.3 | 151.8 | 54.2 | | 103.0 |
| | Control | 136.6 | 75.3 | | 106.0 | 29.1 | 10.3 | | 19.7 | 115.5 | 32.8 | | 74.2 |
| | Mean | 197.8 | 111.0 | | | 43.0 | 16.3 | | | 152.0 | 52.8 | | |
| | SEm± | 16.2 | 6.6 | | | 3.7 | 2.5 | | | 12.2 | 6.0 | | |
| | CD (P=0.05) | 49.8 | 20.3 | | | 11.3 | 7.6 | | | 37.5 | 18.5 | | |
| Maize-chickpea | EC+VC+GLM | 175.5 | 131.8 | | 153.7 | 41.2 | 30.2 | | 35.7 | 141.9 | 84.9 | | 113.4 |
| | Panchagavya spray | 132.1 | 121.7 | | 126.9 | 26.9 | 21.8 | | 24.4 | 123.0 | 50.9 | | 87.0 |
| | EC+VC+GLM + Panchagavya spray | 229.6 | 136.9 | | 183.3 | 49.2 | 37.3 | | 43.3 | 198.0 | 92.0 | | 145.0 |
| | EC+VC+GLM+ Biodynamic spray @5g/ac | 155.6 | 117.9 | | 136.8 | 26.4 | 21.4 | | 23.9 | 110.7 | 44.2 | | 77.5 |
| | EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray | 169.4 | 122.4 | | 145.9 | 31.7 | 21.7 | | 26.7 | 138.2 | 49.4 | | 93.8 |
| | FYM+VC+GLM | 154.6 | 117.8 | | 136.2 | 35.0 | 26.4 | | 30.7 | 109.5 | 73.1 | | 91.3 |
| | Control | 123.0 | 104.2 | | 113.6 | 22.3 | 14.3 | | 18.3 | 77.2 | 39.7 | | 58.5 |
| | Mean | 162.8 | 121.8 | | | 33.2 | 24.7 | | | 128.4 | 62.0 | | |
| | SEm± | 14.1 | 7.5 | | | 3.4 | 3.0 | | | 7.7 | 5.3 | | |
| | CD (P=0.05) | 43.5 | 23.3 | | | 10.6 | 9.0 | | | 23.7 | 16.4 | | |
| Chilli+onion | EC+VC+GLM | 32.5 | 30.2 | | 31.4 | 8.4 | 7.6 | | 8.0 | 25.7 | 21.3 | | 23.5 |
| | Panchagavya spray | 28.1 | 26.1 | | 27.1 | 6.5 | 5.9 | | 6.2 | 22.9 | 17.0 | | 20.0 |
| | EC+VC+GLM + Panchagavya spray | 34.4 | 32.4 | | 33.4 | 9.3 | 8.4 | | 8.9 | 27.3 | 20.7 | | 24.0 |
| | EC+VC+GLM+ Biodynamic spray @5g/ac | 26.8 | 25.2 | | 26.0 | 5.7 | 5.1 | | 5.4 | 21.9 | 15.7 | | 18.8 |
| | EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchagavya spray | 28.9 | 27.3 | | 28.1 | 6.6 | 6.2 | | 6.4 | 21.2 | 14.5 | | 17.9 |
| | FYM+VC+GLM | 29.1 | 28.6 | | 28.9 | 7.0 | 6.4 | | 6.7 | 22.8 | 16.4 | | 19.6 |
| | Control | 21.4 | 20.4 | | 20.9 | 4.9 | 4.3 | | 4.6 | 16.5 | 13.2 | | 14.9 |
| | Mean | 28.7 | 27.2 | | | 6.9 | 6.3 | | | 22.6 | 17.0 | | |
| | SEm± | 2.4 | 2.5 | | | 0.7 | 0.7 | | | 2.9 | 1.7 | | |
| | CD (P=0.05) | 7.5 | 7.7 | | | 2.0 | 2.0 | | | 8.8 | 5.4 | | |

| Cropping systems | Treatments | N | | | | P | | | | K | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean |
| **Ludhiana** | | | | | | | | | | | | | |
| Maize-wheat + chickpea | Green manure (GM)+FYM | 128.4 | | | | 46.3 | | | | 92.5 | | | |
| | GM+Panchgavya(PG) | 135.3 | | | | 45.2 | | | | 79.6 | | | |
| | GM+ Biodynamic(BD) | 75.0 | | | | 28.5 | | | | 50.4 | | | |
| | GM+BD+FYM | 124.9 | | | | 37.2 | | | | 74.9 | | | |
| | GM+PG+BD | 127.0 | | | | 43.8 | | | | 77.4 | | | |
| | Control | 38.8 | | | | 17.0 | | | | 27.0 | | | |
| | Mean | 104.9 | | | | 36.3 | | | | 67.0 | | | |
| | CD (P=0.05) | 36.3 | | | | 15.3 | | | | 25.9 | | | |
| Basmati rice-wheat | Green manure (GM) | 79.3 | | | | 14.5 | | | | 111.1 | | | |
| | GM+Panchgavya(PG) | 87.2 | | | | 14.7 | | | | 110.9 | | | |
| | GM+ Biodynamic(BD) | 80.3 | | | | 13.5 | | | | 117.9 | | | |
| | GM+BD+FYM | 82.9 | | | | 16.1 | | | | 118.3 | | | |
| | GM+PG+BD | 82.7 | | | | 14.6 | | | | 115.8 | | | |
| | Control | 49.3 | | | | 8.9 | | | | 70.3 | | | |
| | Mean | 71.1 | | | | 13.9 | | | | 95.7 | | | |
| | CD (P=0.05) | 9.9 | | | | 2.4 | | | | 27.2 | | | |
| **Modipuram** | | | | | | | | | | | | | |
| Basmati rice - wheat | Control | 74.9 | 56.3 | | 65.6 | 19.5 | 13.5 | | 16.5 | 79.5 | 107.0 | | 93.3 |
| | FYM + Vermi compost | 98.3 | 90.5 | | 94.4 | 25.9 | 25.6 | | 25.8 | 104.6 | 144.1 | | 124.4 |
| | Biodynamic (BD) | 87.7 | 74.8 | | 81.3 | 22.4 | 19.3 | | 20.9 | 91.9 | 127.0 | | 109.5 |
| | FYM + Vermi compost + Panchgavya | 102.1 | 94.0 | | 98.1 | 28.0 | 27.3 | | 27.7 | 108.2 | 150.3 | | 129.3 |
| | FYM + Vermi compost+ BD | 107.6 | 98.8 | | 103.2 | 29.7 | 32.2 | | 31.0 | 113.5 | 158.7 | | 136.1 |
| | FYM + Vermi compost + Panchgavya + BD | 111.0 | 104.0 | | 107.5 | 31.0 | 35.5 | | 33.3 | 116.6 | 165.5 | | 141.1 |
| | Mean | 96.9 | 86.4 | | | 26.1 | 25.6 | | | 102.4 | 142.1 | | |
| | SEm± | 1.46 | | | | 0.64 | | | | 1.64 | | | |
| | CD (P=0.05) | 4.6 | | | | 2.0 | | | | 5.2 | | | |

| Cropping systems | Treatments | N | | | | P | | | | K | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean |
| Maize + cowpea – | Control wheat + mustard | 80.9(16.0) | 56.3 | | | 22.9(3.67) | 13.5 | | | 95.0(22.9) | 107.0 | | |
| | FYM + Vermi compost | 107.1(21.5) | 90.5 | | | 30.8(4.87) | 25.6 | | | 120.3(31.3) | 144.1 | | |
| | Biodynamic (BD) | 97.2(19.4) | 74.8 | | | 26.4(4.45) | 19.3 | | | 111.7(28.5) | 127.0 | | |
| | FYM + Vermi compost + Panchgavya | 112.7(25.3) | 94.0 | | | 34.9(5.55) | 27.3 | | | 125.4(35.6) | 150.3 | | |
| | FYM + Vermi compost+ BD | 116.3(26.7) | 98.8 | | | 37.4(5.82) | 32.2 | | | 134.9(36.7) | 158.7 | | |
| | FYM + Vermi compost + Panchgavya + BD | 123.1(29.7) | 104.0 | | | 41.6(6.18) | 35.5 | | | 144.5(38.5) | 165.5 | | |
| | Mean | 106.2 | 86.4 | | | 32.3 | 25.6 | | | 122.0 | 142.1 | | |
| | | | CS | treat | | | CS | treat | | | CS | treat | |
| | SEm± | 1.80 (0.39) | 1.4 | 2.14 | | 0.55 (0.15) | 0.71 | 0.57 | | 1.74 (1.31) | 2.17 | 3.17 | |
| | CD (P=0.05) | 5.7(1.2) | 8.5 | 6.3 | | 1.7(0.48) | NS | 1.7 | | 5.5(4.1) | 13.2 | 9.4 | |
| **Pantnagar** | | | | | | | | | | | | | |
| Basmati rice–chickpea | FYM+VC+NC+EC @ 1/4each | 136.3 | 121.6 | | 129.0 | 18.4 | 13.6 | | 16.0 | 126.9 | | 71.5 | 136.3 |
| | Biodynamic (BD) | 102.1 | 34.9 | | 68.5 | 18.1 | 6.1 | | 12.1 | 127.9 | | 70.0 | 102.1 |
| | FYM+VC+NC+EC @ 1/4each+ Panchgavya | 120.8 | 82.6 | | 101.7 | 20.3 | 13.2 | | 16.8 | 108.7 | | 62.7 | 120.8 |
| | FYM+VC+NC+EC @ 1/4each+BD | 143.9 | 72.3 | | 113.6 | 16.3 | 11.7 | | 14.0 | 110.2 | | 62.1 | 154.8 |
| | FYM+VC+NC+EC @1/4each+ BD+ Panchgavya | 154.8 | 135.4 | | 139.7 | 20.9 | 13.0 | | 17.0 | 137.0 | | 77.0 | 143.9 |
| | Control (green manure/moong residues only) | 124.7 | 41.0 | | 82.9 | 14.4 | 6.7 | | 10.6 | 104.8 | | 57.7 | 124.7 |
| | Mean | 130.5 | 81.3 | | | 18.1 | 10.7 | | | 119.3 | 18.8 | | |
| | SEm± | | 12.8 | | | | 1.3 | | | | 2.3 | | |
| | CD (P=0.05) | | 40.2 | | | | 4.0 | | | | 7.3 | | |
| Basmati rice – vegetable pea –maize+ moong (moong residues incorporation) | FYM+VC+NC+EC @ 1/4each | 125.0 | | | | 14.4 | | | | 100.2 | | | |
| | Biodynamic (BD) | 84.6 | | | | 12.4 | | | | 103.5 | | | |
| | FYM+VC+NC+EC @ 1/4each+ Panchgavya | 118.5 | | | | 17.6 | | | | 112.5 | | | |
| | FYM+VC+NC+EC @ 1/4each+BD | 136.3 | | | | 16.5 | | | | 118.0 | | | |

| Cropping systems | Treatments | N | | | | P | | | | K | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean |
| | FYM+VC+NC+EC @1/4each+ BD+ Panchgavya | 144.4 | | | | 19.2 | | | | 118.5 | | | |
| | Control (green manure/moong residues only) | 101.0 | | | | 11.6 | | | | 101.6 | | | |
| | Mean | 118.3 | | | | 15.3 | | | | 109.0 | | | |
| | Cropping system/ Nutrient sourece | CS | NS | | | CS | NS | | | CS | NS | | |
| | SEm± | 2.5 | 4.3 | | | 0.0 | 0.8 | | | 3.7 | 6.2 | | |
| | CD (P=0.05) | 11.8 | 12.5 | | | 0.2 | 2.4 | | | 9.9 | 18.3 | | |
| **Raipur** | | | | | | | | | | | | | |
| Rice-chickpea | EC+CDM+NEOC @ 1/3 N each | 65.5 | 51.4 | | 58.5 | 14.2 | 13.7 | | | 114.9 | 24.1 | | 69.5 |
| | Bio dynamic practice | 35.4 | 36.6 | | 36.0 | 7.8 | 9.5 | | | 62.8 | 16.8 | | 39.8 |
| | EC+CDM+NEOC@1/3Neach+ Panchagavya | 71.6 | 55.3 | | 63.5 | 17.2 | 15.4 | | | 116.2 | 25.7 | | 71.0 |
| | EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice | 65.7 | 57.0 | | 61.4 | 15.3 | 17.0 | | | 118.2 | 27.8 | | 73.0 |
| | Biodynamicpractice+ EC+CDM+ NEOC@1/3Neach+Panchagavya | 75.5 | 58.8 | | 67.2 | 16.7 | 16.2 | | | 126.0 | 26.6 | | 76.3 |
| | Mean | 62.4 | 51.8 | | | 14.1 | 14.4 | | | 107.2 | 24.2 | | |
| Rice- mustard+lentil (alternate row) | EC+CDM+NEOC @ 1/3 N each | 62.6 | 25.1 | | 43.9 | 15.0 | 4.5 | | | 112.3 | 29.6 | | 71.0 |
| | Bio dynamic practice | 32.8 | 17.5 | | 25.2 | 8.0 | 3.0 | | | 61.3 | 22.3 | | 41.8 |
| | EC+CDM+NEOC@1/3Neach+ Panchagavya | 64.7 | 25.2 | | 45.0 | 14.6 | 4.4 | | | 113.9 | 29.3 | | 71.6 |
| | EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice | 64.6 | 28.5 | | 46.6 | 16.3 | 4.7 | | | 115.7 | 32.7 | | 74.2 |
| | Biodynamicpractice+EC+CDM+ NEOC@1/3Neach+Panchagavya | 69.3 | 27.4 | | 48.4 | 16.1 | 4.4 | | | 122.5 | 31.9 | | 77.2 |
| | Mean | 58.4 | 24.7 | | | 13.9 | 4.2 | | | 104.5 | 29.2 | | |
| | SEm± | | | | | | | | | | | | |
| | CD (P=0.05) | | | | | | | | | | | | |
| | Source X Cropping | | | | | | | | | | | | |
| **Ranchi** | | | | | | | | | | | | | |
| Rice - wheat | FYM+ VC @1/2 each | 106.1 | 52.1 | | 79.1 | 18.5 | 9.2 | | 13.9 | 78.5 | 40.3 | | 59.4 |
| | BD Preparation (CPP, BD500 & 501) | 62.2 | 26.3 | | 44.3 | 9.1 | 4.5 | | 6.8 | 47.4 | 25.5 | | 36.5 |
| | VC + K.C+Panchgavaya | 109.3 | 54.2 | | 81.8 | 18.6 | 9.3 | | 14.0 | 78.4 | 41.6 | | 60.0 |

| Cropping systems | Treatments | N | | | | P | | | | K | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean |
| | FYM+VC+ BD Prepartion | 111.7 | 55.7 | | 83.7 | 20.1 | 9.5 | | 14.8 | 79.9 | 42.6 | | 61.3 |
| | FYM+ VC+ BD + Panchgavya | 116.2 | 58.3 | | 87.3 | 20.8 | 10.2 | | 15.5 | 82.8 | 45.0 | | 63.9 |
| | Mean | 101.1 | 49.3 | | | 17.4 | 8.5 | | | 73.4 | 39.0 | | |
| Rice – potato | FYM+ VC @1/2 each | 111.7 | 96.1 | | 103.9 | 18.2 | 22.5 | | 20.4 | 82.0 | 113.3 | | 97.7 |
| | BD Preparation (CPP, BD500 & 501) | 74.7 | 42.5 | | 58.6 | 11.8 | 9.0 | | 10.4 | 51.9 | 49.3 | | 50.6 |
| | VC + K.C+Panchgavaya | 113.9 | 97.8 | | 105.9 | 19.5 | 23.7 | | 21.6 | 83.2 | 116.0 | | 99.6 |
| | FYM+VC+ BD Prepartion | 120.6 | 99.1 | | 109.9 | 20.8 | 24.1 | | 22.5 | 86.0 | 116.7 | | 101.4 |
| | FYM+VC+ BD + Panchgavya | 124.4 | 98.7 | | 111.6 | 20.1 | 24.5 | | 22.3 | 87.5 | 117.1 | | 102.3 |
| | Mean | 109.1 | 86.8 | | | 18.1 | 20.7 | | | 78.1 | 102.5 | | |
| | CD (P=0.05) CS | NS | 2.89 | | | NS | 1.68 | | | NS | 6.73 | | |
| | Nutrient source NS | 9.34 | 5.58 | | | 11.18 | 7.03 | | | 8.08 | 6.71 | | |
| **Umiam** | | | | | | | | | | | | | |
| Maize + soybean-tomato | FYM | 157.2 | 230.6 | | 193.9 | 31.5 | 41.6 | | 36.6 | 141.5 | 198.3 | | 169.9 |
| | Vermicompost | 139.1 | 184.9 | | 162.0 | 28.9 | 47.9 | | 38.4 | 132.2 | 154.0 | | 143.1 |
| | Integrated (½ FYM+ ½ vermicompost) | 154.1 | 228.5 | | 191.3 | 32.2 | 45.4 | | 38.8 | 140.2 | 175.4 | | 157.8 |
| | Control (no manure) | 41.0 | 40.5 | | 40.8 | 7.8 | 9.2 | | 8.5 | 38.9 | 44.3 | | 41.6 |
| | Mean | 122.8 | 171.1 | | | 25.1 | 36.0 | | | 113.2 | 143.0 | | |
| Maize + soybean - potato | FYM | 164.7 | 241.0 | | 202.9 | 33.5 | 43.9 | | 38.7 | 148.2 | 208.6 | | 178.4 |
| | Vermicompost | 146.7 | 201.6 | | 174.2 | 28.8 | 38.0 | | 33.4 | 139.3 | 188.7 | | 164.0 |
| | Integrated (½ FYM+ ½ vermicompost) | 161.4 | 283.7 | | 222.6 | 34.1 | 48.8 | | 41.5 | 146.8 | 219.9 | | 183.4 |
| | Control (no manure) | 43.1 | 29.0 | | 36.1 | 7.7 | 12.5 | | 10.1 | 40.9 | 33.3 | | 37.1 |
| | Mean | 128.9 | 188.8 | | | 26.0 | 35.8 | | | 118.8 | 162.6 | | |
| Maize + soybean - french bean | FYM | 181.4 | 278.3 | | 229.9 | 35.5 | 39.5 | | 37.5 | 163.2 | 295.0 | | 229.1 |
| | Vermicompost | 159.5 | 218.3 | | 188.9 | 31.7 | 31.6 | | 31.7 | 151.5 | 183.6 | | 167.6 |
| | Integrated (½ FYM+ ½ vermicompost) | 177.7 | 311.4 | | 244.6 | 36.2 | 43.9 | | 40.1 | 161.7 | 308.0 | | 234.9 |
| | Control (no manure) | 47.3 | 56.9 | | 52.1 | 9.5 | 10.1 | | 9.8 | 44.9 | 58.7 | | 51.8 |
| | Mean | 141.5 | 216.2 | | | 28.2 | 31.3 | | | 130.4 | 211.3 | | |

## Table 17. Influence of source of nutrients on Fe, Mn, Zn and Cu uptake of different crops at Bajaura

| Cropping systems | Source of nutrients | Fe (ppm) | | | | Mn (ppm) | | | | Zn (ppm) | | | | Cu (ppm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean | *Kharif* | *Rabi* | *Summer* | Mean |
| Coriander-pea-tomato | Rock phosphate enriched FYM + VC (1:1) | 545.0 | 275.7 | 397.0 | 405.9 | 82.9 | 79.0 | 136.3 | 99.4 | 34.0 | 36.3 | 73.7 | 48.0 | 30.4 | 25.3 | 46.3 | 34.0 |
| | FYM fb BD | 538.7 | 273.3 | 388.3 | 400.1 | 83.3 | 75.3 | 138.7 | 99.1 | 33.5 | 33.4 | 73.3 | 46.7 | 25.8 | 24.1 | 39.7 | 29.9 |
| | Rock phosphate enriched FYM + VC (1:1) fb Panchgvya | 542.0 | 273.7 | 382.0 | 399.2 | 82.3 | 74.0 | 139.3 | 98.5 | 34.4 | 34.3 | 68.3 | 45.7 | 25.5 | 23.5 | 43.7 | 30.9 |
| | FYM fb BD fb Panchgvya | 535.7 | 272.0 | 382.0 | 396.6 | 84.6 | 74.7 | 138.7 | 99.3 | 33.0 | 34.1 | 69.3 | 45.5 | 23.9 | 24.5 | 39.7 | 29.4 |
| | Control | 357.7 | 250.0 | 264.0 | 290.6 | 53.7 | 61.0 | 87.3 | 67.3 | 15.3 | 21.3 | 42.3 | 26.3 | 15.0 | 13.9 | 29.0 | 19.3 |
| | Control with Panchgavya | 361.3 | 251.7 | 267.3 | 293.4 | 55.0 | 62.7 | 92.0 | 69.9 | 16.2 | 23.0 | 45.3 | 28.2 | 14.4 | 13.9 | 31.0 | 19.8 |
| | Mean | 480.1 | 266.1 | 346.8 | 364.3 | 73.6 | 71.1 | 122.1 | 88.9 | 27.7 | 30.4 | 62.1 | | 22.5 | 20.9 | 38.2 | |
| Cauliflower-pea-cauliflower | Rock phosphate enriched FYM + VC (1:1) | 433.7 | 275.0 | | 354.4 | 77.4 | 80.3 | | 78.9 | 35.5 | 37.4 | | 36.5 | 32.5 | 29.5 | | 31.0 |
| | FYM fb BD | 435.7 | 273.7 | | 354.7 | 74.9 | 76.7 | | 75.8 | 31.8 | 36.6 | | 34.2 | 27.1 | 25.3 | | 26.2 |
| | Rock phosphate enriched FYM + VC (1:1) fb Panchgvya | 432.3 | 274.0 | | 353.2 | 74.7 | 73.3 | | 74.0 | 34.3 | 37.5 | | 35.9 | 26.8 | 22.9 | | 24.9 |
| | FYM fb BD fb Panchgvya | 430.7 | 274.7 | | 352.7 | 74.2 | 73.3 | | 73.8 | 30.1 | 34.6 | | 32.4 | 23.9 | 24.4 | | 24.2 |
| | Control | 350.3 | 242.7 | | 296.5 | 45.7 | 59.7 | | 52.7 | 15.1 | 21.0 | | 18.1 | 13.7 | 17.3 | | 15.5 |
| | Control with Panchgavya | 352.7 | 248.7 | | 300.7 | 47.7 | 62.0 | | 54.9 | 16.0 | 22.6 | | 19.3 | 14.2 | 18.1 | | 16.2 |
| | Mean | 405.9 | 264.8 | | 335.4 | 65.8 | 70.9 | | 68.4 | 27.1 | 31.6 | | | 23.0 | 22.9 | | |
| | SEm± | | | | | | | | | | | | | | | | |
| | CD (P=0.05) | | | | | | | | | | | | | | | | |

uptake and it was found increase to the tune of 62.4 and 83.5% over biodynamic practice alone. N, P and K uptake by maize under all the nutrient sources was significantly higher than the BD application alone and unfertilized control.

**Modipuram:** Nutrient uptake by basmati rice, maize and wheat in the systems under different nutrient management practices was significantly affected and observed that N, P and K uptake was higher with application of FYM +vermicompost+panchgavya+ BD preparation in both the systems which being statistically on par to FYM + vermi compost+BD compared to other nutrient sources. Biodynamic preparation alone could not enhance the N concentration in the plants and reduction is found to be 26.6, 26.6 and 23.1% in basmati rice, maize and wheat respectively. P and K followed the similar trend for all the crops during *kharif* and *rabi*.

**Pantnagar:** In both the systems, N, P and K uptake of basmati rice was found to be significantly higher with FYM+VC+NC+EC @ ¼ N each+biodynamic preparation+panchgavya application (149.6, 20 and 127.7 kg $ha^{-1}$ of N, P and K respectively) which was on par with FYM+VC+NC+EC+BD compared to biodynamic practices (93.4, 15.3 and 115.7 kg $ha^{-1}$ of NPK respectively). In chick pea, application of FYM, VC, NC and EC as nutrient sources along with biodynamic and panchgavya recorded higher N (135.6 kg $ha^{-1}$) while P and K uptake (13.6 and 29.2 kg $ha^{-1}$) was found to be higher under organic sources FYM+VC+NC+EC @ ¼ N each compared to combining the same with either panchgavya or biodynamic preparation. Among the cropping systems, significantly higher N, P and K uptake was recorded with rice-chickpea-*sesbania* over to rice-vegetable pea-maize+moong.

**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+panchgavya registered significantly higher N and K in all the crops in both the systems (72.4 and 124.3 kg $ha^{-1}$ in rice, 58.8 and 126 kg $ha^{-1}$ in chickpea) while P was observed with EC+CDM+NEOC @ 1/3 N each+biodynamic. Application of biodynamic and panchgavya packages contributed significantly in nutrient uptake compared to application of nutrient sources *viz.*EC+ CDM + NEOC. Rice-chick pea system remove more N, P and K from the soil than rice-mustard+lentil.

**Ranchi:** N, P and K uptake were estimated and results reveals that in both the systems uptake of NPK was found to be significantly higher by nutrient sources of VC + KC + biodynamic preparation + panchgavya 120.3, 20.4 and 85.2 kg $ha^{-1}$ in rice, 58.3, 10.2 and 45 kg $ha^{-1}$ in wheat and 99.1, 24.1 and 117.1 kg $ha^{-1}$ in potato. Rice-potato system removed numerically more N (109.1 and 86.8 kg $ha^{-1}$), P (18.1 and 20.7 kg $ha^{-1}$) and K (78.1 and 102.5 kg $ha^{-1}$) compared to rice-wheat system (101.1 and 49.3 N, 17.4 and 8.5 P and 73.4 and K 39 kg $ha^{-1}$).

**Umiam:** Application of FYM or combined with vermicompost resulted in higher uptake of N, P and K in maize, tomato and potato in all three systems namely, maize + soybean (2:2)-tomato, maize + soybean (2:2) -potato and maize + soybean (2:2)-frenchbean.

### Quality parameters (Table 18)

Protein content of soybean and maize was estimated for crops grown in *kharif* at Bhopal. Significant variation among different organic input packages was observed. Protein content was found to be higher with incorporation of organic manure along with biodynamic and panchgavya application. Other

combinations of organic nutrient sources and PG and OM alone recorded on par protein content in soybean and maize in the systems.

### Economics of nutrient sources and cropping systems (Table 19)

**Bajaura:** Application of FYM *fb*BD to coriander-tomato-pea system recorded higher gross returns of Rs. 5,29,456 $ha^{-1}$ which is more than 5 times higher than control with panchgavya of Rs. 82633 $ha^{-1}$. Net returns (Rs. 4,58,035 $ha^{-1}$) and B: C ratio (6.41) was also higher in the same treatment.Application of rock phosphate enriched FYM+VC followed by biodynamic spray in cauliflower-pea-cauliflower system recorded higher net returns (Rs. 97,488 $ha^{-1}$) and B: C ratio (1.81). Among the cropping system, coriander-pea-tomato gave maximum net return of Rs. 2,82,805 $ha^{-1}$ with 3.92 of benefit: cost ratio.

**Coimbatore:** Application of FYM+NEOC @ ½ N each to cotton-maize-green manure recorded higher net returns Rs. 88,198 $ha^{-1}$ whereas application of FYM+NEOC @ ½ N each with panchgavyato chilli-sunflower-green manure recorded higher net returns (Rs. 94,977 $ha^{-1}$). Among the two systems, chilli-sunflower-green manure recorded 8.7% higher net returns than cotton-maize system. Application of either panchgavya or biodynamic package alone recorded lower net returns among all the treatments.

**Dharwad:** Application of EC + VC+ GLM + biodynamic spray @ 12 g $ha^{-1}$+ panchgavya spray resulted in higher gross and net returns with B:C ratio due to lower cost of cultivation in groundnut-sorghum, maize-chickpea and chilli+onion system. The increase in net returns over control was found to be 153, 125 and 175% in groundnut-sorghum, maize-chickpea and chilli+onion systems respectively due to combined application of panchgavya and biodynamic spray along with other organic inputs such as EC, VC and GLM. Among the three cropping systems, chilli+onion registered 25.7 and 114.7% higher net returns over groundnut-sorghum and maize-chickpea systemsrespectively.

**Jabalpur:** Among the various sources of nutrients, application of VC+ FYM+ NEOF @ 1/3 N each+panchgavya was found to give higher net returns (Rs. 1,05,560 and 1,45,408/ $ha^{-1}$) and B: C ratio (2.91 and 3.47) in basmati rice-wheat-green manure and basmati rice-berseem systems. Though, marginal increase in cost of cultivation due to panchgavya was observed in this treatment, due to increase in yield, net returns and B: C ratio was better.Among the two systems, basmati rice-berseem recorded higher net returns (Rs. 1,21,084 $ha^{-1}$). The net returns and B: C ratio was lower in application of panchgavya or biodynamic packages alone to both the 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 net returns and B: C ratio compared to application of panchgavya and biodynamic packages along with green manure and FYM which recorded on par for net return and B:C ratio. Although gross returns of basmati rice-wheat-green manure system was higher in GM +PG +BD for basmati rice and FYM +PG +BD for other crops, it was closely followed by GM+ FYM +biodynamic combination. Among the systems, maize-wheat+gram-summer moong recorded 37.3 and 14.1% higher net returns and B: C ratio than basmati rice-wheat-green manure.

**Modipuram:** Among the various sources of nutrients, application of FYM+vermicompost+panchgavya+BD preparation resulted in higher gross and net returns of Rs. 2,09,090 and 1,35,211 $ha^{-1}$ in maize+cowpea-wheat+mustard system and it was statistically on par to FYM+vermicompost with combination of either

**Table 18. Influence of source of nutrients on quality parameters of different crops at Bhopal**

| Cropping systems | Source of nutrients | Protein |
|---|---|---|
| Soybean-wheat | OM (Organic Manure) | 35.5 |
| | BD (Biodynamics) | 35.5 |
| | OM + PG | 35.6 |
| | OM + BD | 35.6 |
| | OM+PG+BD | 35.7 |
| | Control | 35.5 |
| | Mean | 35.6 |
| Maize-chickpea | OM | 9.52 |
| | BD | 9.45 |
| | OM + PG | 9.68 |
| | OM + BD | 9.62 |
| | OM+PG+BD | 9.73 |
| | Control | 9.42 |
| | Mean | 9.6 |
| | SEm± | |
| | CD (*P=0.05*) | |

**Table 19. Influence of source of nutrients on economics of different cropping systems**

| Cropping system | Source of nutrient | Gross returns (Rs ha$^{-1}$) | Cost of cultivation (Rs ha$^{-1}$) | Net returns (Rs ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|---|
| **Bajaura** | | | | | |
| Coriander-pea-tomato | Rock phosphate enriched FYM + VC (1:1) | 443846 | 74069 | 369777 | 4.99 |
| | FYM *fb* BD | 529456 | 71421 | 458035 | 6.41 |
| | Rock phosphate enriched FYM + VC (1:1) *fb* Panchgavya | 459963 | 80772 | 379190 | 4.69 |
| | FYM *fb* BD *fb* Panchgavya | 496277 | 78124 | 418153 | 5.35 |
| | Control | 57896 | 31075 | 26821 | 0.86 |
| | Control with Panchgavya | 82633 | 37778 | 44855 | 1.19 |
| | Mean | 345012 | 62207 | 282805 | 3.92 |
| Cauliflower-pea-cauliflower | Rock phosphate enriched FYM + VC (1:1) | 151306 | 53859 | 97448 | 1.81 |
| | FYM *fb* BD | 158094 | 71946 | 86148 | 1.20 |
| | Rock phosphate enriched FYM + VC (1:1) *fb* Panchgavya | 149838 | 83402 | 66436 | 0.80 |
| | FYM *fb* BD *fb* Panchgavya | 144867 | 78649 | 66218 | 0.84 |
| | Control | 15063 | 27825 | -12763 | -0.46 |
| | Control with Panchgavya | 20319 | 34528 | -14209 | -0.41 |
| | Mean | 106581 | 58368 | 48213 | 0.63 |

| Cropping system | Source of nutrient | Gross returns (Rs ha$^{-1}$) | Cost of cultivation (Rs ha$^{-1}$) | Net returns (Rs ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|---|
| **Coimbatore** | | | | | |
| Cotton - maize - green manure | FYM + NEOC (1/2+1/2) | 140509 | 52311 | 88198 | 1.69 |
| | Panchgavya alone | 100247 | 36877 | 63370 | 1.72 |
| | FYM+NEOC*(1/2+1/2)+Panchgavya | 136555 | 55878 | 80677 | 1.44 |
| | Biodynamic Practices | 102837 | 40104 | 62733 | 1.56 |
| | Biodynamic practices+ Panchgavya | 117142 | 42198 | 74944 | 1.78 |
| | Mean | 119458 | 45474 | 73984 | 1.64 |
| Chillies-sunflower-green manure | FYM + NEOC (1/2+1/2) | 145854 | 54175 | 91679 | 1.69 |
| | Panchgavya alone | 114012 | 43073 | 70939 | 1.65 |
| | FYM+NEOC*(1/2+1/2)+Panchgavya | 152118 | 57141 | 94977 | 1.66 |
| | Biodynamic Practices | 112446 | 43316 | 69130 | 1.60 |
| | Biodynamic practices+ Panchgavya | 123732 | 48343 | 75389 | 1.56 |
| | Mean | 129632 | 49210 | 80423 | 1.63 |
| **Dharwad** | | | | | |
| Groundnut-sorghum | EC+VC+GLM | 113466 | 29777 | 83689 | 3.36 |
| | Panchgavya spray | 90925 | 28706 | 62219 | 2.78 |
| | EC+VC+GLM + Panchgavya spray | 145480 | 31315 | 114165 | 4.36 |
| | EC+VC+GLM+ Biodynamic spray @5g/ac | 129688 | 27620 | 102068 | 4.08 |
| | EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchgavya spray | 148002 | 28606 | 119396 | 4.68 |
| | FYM+VC+GLM | 105187 | 30088 | 75099 | 3.16 |
| | Control | 72022 | 24818 | 47204 | 2.63 |
| | Mean | 114967 | 28704 | 86263 | 3.58 |
| Maize-chickpea | EC+VC+GLM | 84490 | 31625 | 52865 | 4.06 |
| | Panchgavya spray | 65185 | 28375 | 36810 | 3.06 |
| | EC+VC+GLM + Panchgavya spray | 92200 | 33430 | 58770 | 4.27 |
| | EC+VC+GLM+ Biodynamic spray @5g/ac | 88197 | 28498 | 59699 | 4.8 |
| | EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchgavya spray | 95724 | 29400 | 66324 | 5.54 |
| | FYM+VC+GLM | 81673 | 32028 | 49645 | 3.93 |
| | Control | 55707 | 26244 | 29463 | 2.9 |
| | Mean | 80454 | 29943 | 50511 | 4.08 |
| Chilli+onion | EC+VC+GLM | 151458 | 20838 | 130620 | 4.64 |
| | Panchgavya spray | 72990 | 20724 | 52266 | 2.46 |
| | EC+VC+GLM + Panchgavya spray | 162707 | 20848 | 141859 | 4.96 |
| | EC+VC+GLM+ Biodynamic spray @5g/ac | 154778 | 20116 | 134662 | 4.83 |

| Cropping system | Source of nutrient | | Gross returns (Rs ha$^{-1}$) | Cost of cultivation (Rs ha$^{-1}$) | Net returns (Rs ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|---|---|
| | EC+VC+GLM+ Biodynamic spray @5g/ac+ Panchgavya spray | | 170334 | 20836 | 149498 | 5.17 |
| | FYM+VC+GLM | | 118080 | 22237 | 95843 | 3.57 |
| | Control | | 69573 | 15286 | 54287 | 2.79 |
| | Mean | | 128560 | 20126 | 108434 | 4.06 |
| **Jabalpur** | | | | | | |
| Basmati rice – durum wheat | VC+FYM+NEOF @1/3 N each | | 150500 | 53750 | 96750 | 2.80 |
| | Panchgavya alone | | 136405 | 53000 | 83405 | 2.57 |
| | VC+FYM+NEOF@1/3N each +Panchgavya | | 160900 | 55340 | 105560 | 2.91 |
| | Biodynamic practices | | 132385 | 53160 | 79225 | 2.49 |
| | Biodynamic practices + Panchgavya | | 143175 | 53500 | 89675 | 2.68 |
| | Mean | | 144673 | 53750 | 90923 | 2.69 |
| Basmati rice – berseem | VC+FYM+NEOF @1/3 N each | | 192909 | 58500 | 134409 | 3.30 |
| (Fodder + Seed) | Panchgavya alone | | 165493 | 57000 | 108493 | 2.90 |
| | VC+FYM+NEOF @1/3 N each +Panchgavya | | 204388 | 58980 | 145408 | 3.47 |
| | Biodynamic practices | | 156117 | 56900 | 99217 | 2.74 |
| | Biodynamic practices + Panchgavya | | 175893 | 57998 | 117895 | 3.03 |
| | Mean | | 178960 | 57876 | 121084 | 3.09 |
| **Ludhiana** | | | | | | |
| | *Basmati rice* | *Other crops* | | | | |
| Maize-wheat+gram-summer | Green manure (GM) | Farmyard manure (FYM) | 149068 | 54463 | 94605 | 2.70 |
| moong | GM+ Panchgavya(PG) | FYM+ Panchgavya(PG) | 147410 | 58963 | 88447 | 2.50 |
| | GM+ Biodynamic(BD) | Biodynamic(BD) | 127275 | 57963 | 69312 | 2.20 |
| | GM+BD+FYM | FYM+BD | 151524 | 58363 | 93161 | 2.60 |
| | GM+PG+BD | FYM+PG+BD | 152180 | 61163 | 91017 | 2.50 |
| | Control | Control | 81890 | 41863 | 40027 | 2.00 |
| | Mean | | 134891 | 55463 | 79428 | 2.42 |
| Basmati rice- wheat-green manure | Green manure (GM) | Farmyard manure (FYM) | 126501 | 49025 | 77476 | 2.60 |
| | GM+ Panchgavya(PG) | FYM+ Panchgavya(PG) | 130092 | 53525 | 76567 | 2.40 |
| | GM+ Biodynamic(BD) | Biodynamic(BD) | 80814 | 42525 | 38289 | 1.90 |
| | GM+BD+FYM | FYM+BD | 127276 | 52525 | 74551 | 2.40 |
| | GM+PG+BD | FYM+PG+BD | 128019 | 57025 | 70994 | 2.20 |
| | Control | Control | 48312 | 39025 | 9287 | 1.20 |
| | Mean | | 106836 | 48942 | 57861 | 2.12 |

| Cropping system | Source of nutrient | Gross returns (Rs ha$^{-1}$) | Cost of cultivation (Rs ha$^{-1}$) | Net returns (Rs ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|---|
| **Modipuram** | | | | | |
| Basmati rice - wheat | Control | 124998 | 27478 | 97521 | 3.55 |
| | FYM + Vermi compost | 167971 | 64433 | 103537 | 1.61 |
| | Biodynamic( BD) | 150316 | 46078 | 104237 | 2.26 |
| | FYM + Vermi compost + Panchgavya | 174015 | 69170 | 104845 | 1.52 |
| | FYM + Vermi compost+ BD | 179221 | 67033 | 112187 | 1.67 |
| | FYM + Vermi compost + Panchgavya + BD | 183674 | 71683 | 111990 | 1.56 |
| | Mean | 163366 | 57646 | 105720 | 2.00 |
| Maize +cowpea - wheat + mustard | Control | 140025 | 27755 | 112270 | 4.05 |
| | FYM + Vermi compost | 185944 | 66628 | 119316 | 1.79 |
| | Biodynamic( BD) | 168432 | 47586 | 120846 | 2.54 |
| | FYM + Vermi compost + Panchgavya | 196486 | 71278 | 125208 | 1.76 |
| | FYM + Vermi compost+ BD | 201718 | 69228 | 132489 | 1.91 |
| | FYM + Vermi compost + Panchgavya + BD | 209090 | 73878 | 135211 | 1.83 |
| | Mean | 183616 | 59392 | 124223 | 2.30 |
| **Pantnagar** | | | | | |
| Basmati rice – chickpea | FYM+VC+NC+EC @1/4 each | 253741 | 55262 | 198479 | 4.59 |
| | Biodynamic (BD) | 192087 | 55017 | 137070 | 3.49 |
| | FYM+VC+NC+EC @1/4 each +Panchgavya | 268128 | 55766 | 212362 | 4.81 |
| | FYM+VC+NC+EC @1/4 each +BD | 257653 | 55766 | 201887 | 4.62 |
| | FYM+VC+NC+EC @1/4 each +BD+Panchgavya | 294731 | 55766 | 238965 | 5.29 |
| | Control | 172615 | 49606 | 123009 | 3.48 |
| | Mean | 239826 | 54531 | 185295 | 4.38 |
| Basmati rice – | FYM+VC+NC+EC (1/4+1/4+1/4+1/4) | 351585 | 85133 | 266452 | 4.13 |
| vegetable pea–maize+ | Biodynamic (BD) | 235143 | 83328 | 151815 | 2.82 |
| moong (moong | FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+Panchgavya | 369083 | 84344 | 284739 | 4.38 |
| residuesincorporation) | FYM+VC+NC+EC 1/4+1/4+1/4+1/4)+BD | 372268 | 85068 | 287200 | 4.38 |
| | FYM+VC+NC+EC (1/4+1/4+1/4+1/4)+BD+ Panchgavya | 388759 | 86240 | 302519 | 4.51 |
| | T6=Control | 228863 | 73446 | 155417 | 3.12 |
| | Mean | 324284 | 82927 | 241357 | 3.89 |
| **Raipur** | | | | | |
| Rice-chickpea | EC+CDM+NEOC @ 1/3 N each | 104412 | 55790 | 48622 | 1.15 |
| | Biodynamic practice | 65353 | 25398 | 39955 | 0.64 |
| | EC+CDM+NEOC@1/3Neach+Panchagavya | 113194 | 60572 | 52622 | 1.15 |
| | EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice | 109221 | 59699 | 49522 | 1.21 |
| | Biodynamic+ EC+CDM+NEOC @1/3N each +Panchgavya | 115929 | 62407 | 53522 | 1.17 |
| | Mean | 101622 | 52773 | 48849 | 1.06 |

| Cropping system | Source of nutrient | Gross returns (Rs ha$^{-1}$) | Cost of cultivation (Rs ha$^{-1}$) | Net returns (Rs ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|---|
| Rice- mustard+lentil | EC+CDM+NEOC @ 1/3 N each | 95638 | 41228 | 54410 | 0.76 |
| | Bio dynamic practice | 58760 | 18090 | 40670 | 0.44 |
| | EC+CDM+NEOC@1/3Neach+Panchgavya | 98405 | 39995 | 58410 | 0.68 |
| | EC+CDM+NEOC @ 1/3 N each + Bio dynamic practice | 99453 | 44143 | 55310 | 0.80 |
| | Biodynamic+EC+CDM+NEOC@1/3Neach+ Panchgavya | 103609 | 44299 | 59310 | 0.75 |
| | Mean | 91173 | 37551 | 53622 | 0.69 |
| **Ranchi** | | | | | |
| Rice - wheat | FYM+ VC @1/2 each | 122952 | 58736 | 64217 | 2.09 |
| | BD Preparation (CPP, BD500 & 501) | 72448 | 30369 | 42079 | 2.39 |
| | VC + K.C+Panchgavya | 126166 | 61046 | 65121 | 2.07 |
| | FYM+VC+ BD prepartion | 129316 | 61466 | 67850 | 2.10 |
| | FYM+ VC+ BD + Panchgavya | 134454 | 65666 | 68788 | 2.05 |
| | Mean | 117067 | 55456 | 61611 | 2.14 |
| Rice – potato | FYM+ VC @1/2 each | 160117 | 88448 | 71669 | 1.81 |
| | BD Preparation (CPP, BD500 & 501) | 89708 | 56614 | 33094 | 1.58 |
| | VC + K.C+Panchgavya | 163313 | 92648 | 70664 | 1.76 |
| | FYM+VC+ BD Prepartion | 169983 | 91178 | 78805 | 1.86 |
| | FYM+VC+ BD + Panchgavya | 174149 | 95378 | 78771 | 1.83 |
| | Mean | 151454 | 84853 | 66601 | 1.77 |
| **Umiam** | | | | | |
| Maize+ soybean-tomato | FYM | 234623 | 74094 | 160529 | 3.17 |
| | Vermicompost | 215635 | 95708 | 119927 | 2.25 |
| | FYM+ Vermicompost | 232098 | 86365 | 145733 | 2.69 |
| | Control | 53934 | 49753 | 4181 | 1.08 |
| | Mean | 184073 | 76480 | 107593 | 2.30 |
| Maize+soybean-potato | FYM | 242501 | 93233 | 149268 | 2.60 |
| | Vermicompost | 244824 | 105808 | 139016 | 2.31 |
| | FYM+ Vermicompost | 246440 | 103232 | 143208 | 2.39 |
| | Control | 75447 | 67933 | 7514 | 1.11 |
| | Mean | 202303 | 92552 | 109752 | 2.10 |
| Maize+ soybean-frenchbean | FYM | 334664 | 76013 | 258651 | 4.40 |
| | Vermicompost | 318655 | 88638 | 230017 | 3.60 |
| | FYM+ Vermicompost | 350571 | 87416 | 263156 | 4.01 |
| | Control | 114736 | 50763 | 63973 | 2.26 |
| | Mean | 279657 | 75708 | 203949 | 3.57 |

BD or PG as nutrient sources. Among the two systems, basmati rice-berseem recorded higher net returns (Rs. 1,21,084 $ha^{-1}$). The net returns and B: C ratio was lower with application of panchgavya or biodynamic packages alone to both the systems.

**Pantnagar:** Application of biodynamic package and panchgavya along with FYM +VC +NC +EC @ ¼ N each registered higher gross and net returns (16.1 and 20.4%) in basmati rice-chickpea-*sesbania* (green manure) and (10.6 and 13.5%) in basmati rice-vegetable pea-maize+moong (residues incorporation ) systems respectively compared to FYM +VC +NC +EC alone. In the first system, B:C ratio was higher (5.29) in FYM +VC +NC +EC @ ¼ N each+biodynamic package and panchgavya spray owing to higher gross return (Rs. 2,94,731 $ha^{-1}$), but lower cost of cultivation (Rs. 55,766 $ha^{-1}$) which was closely followed in biodynamic spray alone with FYM+VC+NC+EC@1/4 N each (Rs. 2,57,653 $ha^{-1}$ 55,766 $ha^{-1}$ and 4.62 of gross return, cost of cultivation and B:C ratio respectively). However, in the second system, FYM +VC +NC +EC either with panchgavya alone or panchgavya + biodynamic package recorded the higher B: C ratio (4.51 and 4.38) compared to control and biodynamic package alone. Basmati rice-vegetable pea-maize+moong (residues incorporation) was found to be better by 35.2 and 30.2 % in terms of gross and net returns respectively compared to basmati rice-chickpea-*sesbania* (green manure).

**Ranchi:** The gross and net returns (Rs. 1,34,454 and 64,429 $ha^{-1}$ respectively) were higher with VC+ KC+BD+panchgavya in rice-wheat system. However, higher B: C ratio of 2.39 was recorded with BD preparation (CPP, BD 500 &501) alone owing to its lower cost of cultivation (Rs. 30,369 $ha^{-1}$). In rice-potato system, though FYM+VC+BD preparation+ panchgavya also recorded higher gross returnsand net returns (Rs. 1,74,149 and 78,771 $ha^{-1}$ respectively) even though cost of cultivation was lower in application of BD preparation alone. Among the systems, rice-potato recorded 29.4 and 8.1% higher gross and net returns, though cost of cultivation was 53% more compared to rice-wheat system.

**Umiam:** Maximum gross return, net return and B:C ratio (Rs. 2,34,623, 1,60,529/ha and 3.17 respectively) was recorded with application of FYM inmaize+soybean (GM)–tomato system. In other two systems application of FYM+VC resulted in higher gross return of Rs. 2,46,440 and 3,50,571 $ha^{-1}$ in maize (green cob)+soybean (GM)-potato and soybean-frenchbean system. Application of FYM alone in themaize-potato system resulted in higher net return of Rs. 1, 49,268, though cost of cultivation was lower. Among the cropping systems maize-frenchbean gave 80% more return as compared to other systems.

# 7.3 Evaluation of Pest and disease management package for organic farming

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

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

**Year of start:** 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. During the year, Bajaura, Calicut and Modipuram centres have conducted the experiment.

**Treatments:** There are no common treatments for all the centres, but they varied from location to location. The number of cropping system tested varied from 1 to 2 along with experimental results. Treatments and centre wise data on yield, pest and disease infestation, soil properties and economics are presented in table 20-22.

## Results

### Bajaura (Table 20)

Tomato crop in cauliflower-pea-tomato system was tested under different pest and disease management packages involving leaf extracts, natural products and bio control agents like *Bacillus thuringiensis* under different combinations. Infestation of pest and diseases like fruit borer, fruit rot and other factors were assessed in tomato apart from recording yield loss due to these factors in different treatments. Yield of all the crops in the system have also been recorded. Infestation of fruit borer (2.0%) and other factors other pests and diseases) (7.08%) in tomato was significantly lower with application of Lipel (*Bacillus thuringiensis*sub sp. kurstaki) @ 1 litre/ha and it was followed by the Dipel 8L @ 0.5 litre/ha and neembaan (Azedarachtin 0.15%) @ 2.5 ml/l . Among different bio-pesticidal treatments, mixture of Dipel 8L @ 0.5 litre/ha and neembaan (*Azedarachtin* 0.15%) @ 2.5 ml/l was found to be significantly effective in reducing yield loss (1.78%) due to fruit borer in comparison to control (15.05%). Yield loss due to fruit rot diseases and other factors varied from 7.0 to 10.89 and 6.56 to 10.24% in other factors and no significant variation was observed among the different treatments. Lower yield loss of 6.56% was observed with other pest and diseases factors under spray of Dipel (*Bacillus thuringiensis* sub sp. kurstaki) @ 1 litre/ha alone. Fruit rot of tomato was lower with Nomurea rileyi (Nolep) @ 2 gm/litre of water + tween -80 (0.05%) as emulsifier. Significant difference in yield of tomato was observed among the different treatments as the yield difference between best performing treatment *Bacillus thuringiensis var. kurstaki* (Dipel 8L) @ 0.5L/ha + neembaan (0.15%)@2.5ml/L 8215 kg $ha^{-1}$) and least performing treatment of neembaan (*Azedarachtin* 0.15% EC) @ 1ml/L (7196 kg $ha^{-1}$) over control that was only 5528 kg $ha^{-1}$.Compared to control, higher tomato yield was realized with application of *Bacillus thuringiensis var. kurstaki* (Dipel 8L) @ 0.5L/ha + neembaan (0.15%)@2.5ml/L as this particular treatment recorded lower incidence of fruit borer and yield loss due to fruit borer and other factors.

**Table 20. Efficacy of various bio-insecticidal treatments for the management of fruit borer on tomato (summer) at Bajaura.**

| Treatments | Fruit infestation (%) (Based on No. of fruits per plot during the entire crop season) due to | | | Total yield (q/ha) | Market-able yield (q/ha) | Yield loss (%) due to | | |
|---|---|---|---|---|---|---|---|---|
| | Fruit Borer | Fruit Rot | Other Factors | | | Fruit Borer | Fruit Rot | Other Factors |
| *Bacillus thuringiensis var. kurstaki* (Dipel 8L) @ 0.5L/ha + Neembaan (0.15%)@2.5ml/L | 2.38 (1.83) | | | 10026 | 8215 | 1.78 (1.66) | 8.44 (3.06) | 7.70 (2.91) |
| Bhang (*Cannabis sativa*)10% ALE + Cow Urine (3%)+ Tween -80 (0.05%) as emulsifier | 3.37 (2.08) | 9.19 (3.16) | 9.01 (3.12) | 9490 | 7466 | 3.40 (2.08) | 8.34 (3.02) | 9.52 (3.19) |
| Karvi (*Roylea cinerea*) @ 10% ALE + Cow Urine (3%)+ Tween -80 (0.05%) as emulsifier | 4.65 (2.36) | 7.82 (2.92) | 9.69 (3.26) | 9110 | 7531 | 3.86 (2.19) | 7.06 (2.82) | 7.74 (2.95) |
| *Metarhizium anisopliae* @ 2g per litre of water + Tween -80 (0.05%) as emulsifier | 6.38 (2.71) | 9.45 (3.22) | 9.58 (3.22) | 9827 | 7574 | 4.96 (2.44) | 8.55 (3.09) | 9.56 (3.23) |
| *Nomurea rileyi* (Nolep) @ 2 gm per litre of water + Tween -80 (0.05%) as emulsifier | 7.06 (2.83) | 7.53 (2.88) | 8.69 (3.10) | 10110 | 7919 | 6.02 (2.64) | 7.10 (2.80) | 8.35 (3.05) |
| Neembaan (azedarachtin 0.15% EC) @ 1ml/L | 6.19 ( 2.67) | 8.43 (3.07) | 8.30 (3.03) | 8934 | 7196 | 5.34 (2.51) | 7.00 (2.83) | 7.22 (2.84) |
| Dipel (*Bacillus thuringiensis sub sp. kurstaki*) @ 1.0 L/ha | 2.00 (1.72) | 8.08 (3.00) | 7.08 (2.83) | 9270 | 7797 | 1.88 (1.68) | 7.48 (2.91) | 6.56 (2.74) |
| Control (untreated check) | 13.90 (3.86) | 10.19 (3.34) | 8.87 (3.14) | 8746 | 5528 | 15.05 (4.01) | 10.89(3.45) | 10.24 (3.35) |
| CD (P =0.05) | (0.37) | NS | NS | NS | 1284 | (0.37) | NS | NS |

Figures with in parentheses are * Square root transformed values

## Calicut (Table 21)

Rhizome rot infestation in ginger and yield of ginger and turmeric were recorded with six treatments comprising of IISR 6, 8, 13, 51, 151, P1AR6, PB21C cultures, ginger endophytic bacteria (GEB 17 and 18) and rhizobacteria combinations (GRB 57 and 58) were tested along with absolute control. Rhizome rot infestation in ginger was lower with IISR 6, 8, 13, 51, 151, P1AR6, PB21C cultures and ginger rhizobacteria (GRB 57) compared to absolute control. The reduction in infestation was observed to be 90.9 and 50% respectively. Significantly higher rhizome yield of ginger and turmeric was observed with ginger endophytic bacteria GEB 18 (14210 and 10900 kg $ha^{-1}$ respectively) which was on par with IISR 6, 8, 13, 51, 151, P1AR6, PB21C cultures. Owing to higher infestation of rhizome rot in ginger with GRB 58 application, lower yield of 3755 kg $ha^{-1}$ was recorded which 147% is lower than absolute control. However, in turmeric, ginger rhizobacteria 35 recorded the lower yield (4500 kg $ha^{-1}$).

**Table 21. Rhizome rots disease incidence (%) and yield of ginger and turmeric under different PGPR treatments in ginger at Calicut**

| Treatments | Rhizome rot disease incidence (%) in ginger | Yield (kg $ha^{-1}$) | |
|---|---|---|---|
| | | Ginger | Turmeric |
| IISR 6, 8, 13, 51, 151;P1AR6, PB21C | 0.50 | 12460 | 8850 |
| GEB 17 (Ginger endophytic bacteria) | 1.50 | 10290 | 5450 |
| GEB18 (Ginger endophytic bacteria) | 1.50 | 14210 | 10900 |
| GRB 57 (Ginger rhizobacteria) | 1.00 | 5885 | 9050 |
| GRB 58 (Ginger rhizobacteria) | 8.50 | 3755 | 7900 |
| CAPSULE (Ginger rhizobacteria 35) | 0.00 | 10880 | 4500 |
| Control | 5.50 | 9275 | 10450 |

## Modipuram (Table 22)

Four management packages *viz.*, summer ploughing treated and untreated, green manure treated and untreated were evaluated in basmati rice-chickpea and basmati rice-mustard systems. The results reveal that green manure treated and untreated plots recorded higher grain yield of basmati rice (4070 and 3835 kg $ha^{-1}$ respectively) and mustard (1320 and 1130 kg $ha^{-1}$) while chick pea recorded 1020 and 810 kg $ha^{-1}$ withgreen manure treated and untreated respectivelycompared to untreated plots of summers ploughing and green manure. Basmati rice-chickpea cropping system recorded higher net returns (Rs.70940/ha) which is to the tune of 32% higher than basmati rice-mustard system (Rs.53718/ha). Irrespective of cropping systems, green manuring indicated better net returns and B:C ratio as compared to summer ploughing. Treating the crops with bio pesticides has indicated much higher net returns than untreated plots.

**Table 22. Influence of pest and disease management practices under organic farming on yield, straw yield and economics of cropping systems at Modipuram**

| Cropping system | Pest and disease management practice | Yield (kg ha$^{-1}$) | | | Straw yield (kg ha$^{-1}$) | | |
|---|---|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Summer* | *Kharif* | *Rabi* | *Summer* |
| Basmati rice -mustard | Green manure-untreated | 3750 | 810 | | 5880 | 3110 | |
| | Green manure-treated | 3870 | 1020 | | 6040 | 3520 | |
| | Summer ploughing-untreated | 3450 | 720 | | 5460 | 2440 | |
| | Summer ploughing-treated | 3730 | 850 | | 5340 | 3400 | |
| | | | SEm± CD | | | SEm± CD | |
| | Soil management | | 18 111 | | | 50 310 | |
| | Pest management | | 34 132 | | | 110 440 | |
| Basmati rice- chick pea | Green manure-untreated | 3920 | 1130 | | 6030 | 3810 | |
| | Green manure-treated | 4270 | 1320 | | 5820 | 4150 | |
| | Summer ploughing-untreated | 3530 | 890 | | 5480 | 3280 | |
| | Summer ploughing-treated | 3610 | 1100 | | 5580 | 4010 | |
| | | SEm± CD | SEm± CD | | SEm± CD | SEm± CD | |
| | Cropping system | 360 NS | | | 147 NS | | |
| | Soil management | 48.0 190 | 33 200 | | 114 450 | 43 260 | |
| | Pest management | 68 NS | 39 150 | | 65 NS | 112 440 | |

| Economics of cropping systems | | Gross returns (Rs ha$^{-1}$) | Cost of cultivation (Rs ha$^{-1}$) | Net returns (Rs ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|---|
| Basmati rice -mustard | Green manure | 107858 | 49222 | 58636 | 1.19 |
| | Summer ploughing | 96248 | 45592 | 50656 | 1.11 |
| | Untreated | 97303 | 46307 | 50996 | 1.10 |
| | Treated | 102734 | 48150 | 54584 | 1.13 |
| | Mean | 101036 | 47318 | 53718 | 1.13 |
| Basmati rice- chick pea | Green manure | 121799 | 44118 | 77681 | 1.76 |
| | Summer ploughing | 106542 | 40488 | 66054 | 1.63 |
| | Untreated | 108796 | 41203 | 67593 | 1.64 |
| | Treated | 115477 | 43046 | 72431 | 1.68 |
| | Mean | 113154 | 42214 | 70940 | 1.68 |

# 7.4 Weed management under organic farming

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

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

**Year of start:** 2004-05, treatments were modified in 2009-08.

**Treatments:** There are no common treatments for all the centres, but they varied from location to location. The number of cropping systems tested at each location ranges from 1 to 3. The details of treatments are given in Table 23-28 along with experimental results.

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

## Results

### Coimbatore (Table 23, 24, 25, 27 and 28)

Five treatments comprising of un-weeded check, two hand weeding, spray of aqueous leaf extract at 3-4 leaf stage of weeds, hand weeding + aqueous leaf extract spray and weed free check was evaluated in rice-greengram-green manure system and observations on weed count (no's/$m^{-2}$,dry), weight of weeds (g $m^{-2}$),yield, soil properties, microbial count and economics were taken. Treatment weed free recorded maximum reduction of weed population (7.2 and 9.2 $m^{-2}$) and total dry weight (0.3 and 3.9 g $m^{-2}$) of weeds at 25 and 45 DAT followed by combination of two hand weeding+spray of aqueous leaf extract at 3-4 leaf stage of weeds in rice. In both rice and green gram, weed free condition recorded higher yield (3829 and 584 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 81.6 and 194% increase yield of rice and green gram over un-weeded 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 35 and 58.2% in rice and green gram compared to weed free. 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 (0.71% in each). Residual availability of soil N, P and K also followed the similar trend. Compared to un-weeded check, hand weeding, hand weeding+leaf extract spray, leaf extract spray alone and weed free check recorded 10.5, 12.3, 19.8 and 22.2% higher fungal population. Though bacteria and actinomycetes population was not significantly influenced by weed management packages, numerically higher bacteria was observed under aqueous leaf extract spray while actinomycetes was higher under weed free check. Higher gross and net returns of Rs. 89,006 and 53,326 $ha^{-1}$ were observed under weed free check in rice-green gram-green manure system. The next best treatment for weed management in terms of economics was found to be two hand weeding+spray of aqueous leaf extract at 3-4 leaf stage of weeds to both the crops in the system which recorded gross and net returns of Rs. 84,186 and 51,146 $ha^{-1}$ respectively. A reduction of 49% in net returns was observed under spray of aqueous leaf extract alone compared to two hand weeding package whereas un-weeded check recorded 64.3% reduction in net returns over weed free condition.

**Table 23. Influence of weed management practices under organic farming on weed count and dry weight**

| Cropping system/ weed management practices | No. of weeds $m^{-2}$ | | weed dry weight ($g/m^2$) | |
|---|---|---|---|---|
| **Coimbatore** (Rice-green gram-green manure) *Kharif* | 25 DAT | 45 DAT | 25 DAT | 45 DAT |
| Un-weeded control | 80.1 | 158.5 | 31.3 | 87.2 |
| Two hand weeding | 40.3 | 55.7 | 12.2 | 35.4 |
| Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed /herb / tree | 63.1 | 89.0 | 20.8 | 59.8 |
| Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree | 31.8 | 21.1 | 10.7 | 21.5 |
| Weed free | 7.2 | 9.2 | 0.3 | 3.9 |
| SEm± | | | | |
| CD (P=0.05) | | | | |
| **Dharwad** (Crop-Groundnut) | 20 DAS | 60 DAS | 20 DAS | 60 DAS |
| Aqueous spray of cassia at 25% as pre-emergent application. | 186.3 | 182.7 | 199 | 192 |
| Aqueous spray of cassia at 25% as post-emergent application. | 162.6 | 213.7 | 210 | 202 |
| Aqueous spray of parthenium at 25% as pre-emergent application. | 179.5 | 217.3 | 246 | 230 |
| Aqueous spray of parthenium at 25% as post-emergent application | 182.8 | 218.0 | 237 | 214 |
| Aqueous spray of *Prosopis juliflora* at 25% as pre-emergent application. | 184.8 | 245.7 | 230 | 212 |
| Aqueous spray of *Prosopis juliflora* at 25% as post-emergent application. | 184.4 | 216.7 | 240 | 225 |
| One hand weeding at 20 DAS + Two hand hoeing at 20 and 40 DAS. | 198.8 | 148.0 | 131 | 122 |
| One hand weeding at 20 DAS + Two hand hoeing at 20 and 40 DAS+Aqueous spray of cassia at 25% as pre-emergent application | 196.7 | 99.7 | 149 | 122 |
| One hand weeding at 20 DAS + Two hand hoeing at 20 and 40 DAS +Aqueous spray of parthenium at 25% as pre-emergent application | 149.5 | 151.3 | 149 | 121 |
| One hand weeding at 20 DAS + Two hand hoeing at 20 and 40 DAS +Aqueous spray of at 25% as pre-emergent *Prosopis juliflora* | 118.2 | 105.3 | 131 | 117 |
| Sorghum stubble mulch. | 171.2 | 157.3 | 129 | 123 |
| Wheat straw mulch. | 183.3 | 99.3 | 107 | 98 |
| Weed free | 4.5 | 54.7 | 96 | 86 |
| Weedy check. | 209.2 | 309.7 | 324 | 315 |
| SEm± | 21.1 | 12.0 | 21 | 19 |
| CD (P=0.05) | 60.6 | 34.5 | 61 | 56 |
| **Jabalpur** (Basmati rice-wheat) | | | | |
| Un weeded control | 17.65 | 9.32 | | |
| Two hand weeding /mechanical weeding | 9.53 | 5.57 | | |
| Spray of 3-4 leaf stage of weeds | 10.31 | 8.21 | | |

| Cropping system/ weed management practices | | No. of weeds $m^{-2}$ | | weed dry weight ($g/m^2$) | |
|---|---|---|---|---|---|
| Two hand weeding /mechanical weeding + spray of 3-4 leaf stage of weeds | | 8.09 | 4.6 | | |
| Weed free | | 1.91 | 1.43 | | |
| SEm± | | | | | |
| CD (P=0.05) | | | | | |
| **Pantnagar** | | | | | |
| **Basmati rice-wheat** | | | | | |
| ***Kharif*** | ***Rabi*** | ***Kharif*** | ***Rabi*** | ***Kharif*** | ***Rabi*** |
| Weedy check | Weedy check | 53.7 | 246.3 | | 263.0 |
| Use of conoweeder | One HW at 25-30 DAS | 25.3 | 126.0 | | 97.7 |
| One hand weeding at 25-30 DAT | Two HW at 25-30& 45-50 DAS | 22.3 | 78.0 | | 23.7 |
| Two hand weeding at 25 & 45-50 DAT | Stale seed bed + 1HW at 30-35 DAS | 19.7 | 101.0 | | 70.0 |
| | SEm± | | | | 38.2 |
| | CD (P=0.05) | | | | 89.6 |
| **Basmati rice-lentil** | | | | | |
| Weedy check | Weedy check | 58.7 | - | | 519.3 |
| Use of conoweeder | One HW at 25-30 DAS | 31.3 | - | | 84.7 |
| One hand weeding at 25-30 DAT | Two HW at 25-30& 45-50 DAS | 28.0 | - | | 32.0 |
| Two hand weeding at 25 & 45-50 DAT | Stale seed bed + 1HW at 30-35 DAS | 19.0 | - | | 93.0 |
| | SEm± | | | | |
| | CD (P=0.05) | | | | |
| **Basmati rice-*Brassica napus*** | | | | | |
| Weedy check | Weedy check | 48.7 | 268.0 | | 531.6 |
| Use of conoweeder | One HW at 25-30 DAS | 32.7 | 146.0 | | 127.3 |
| One hand weeding at 25-30 DAT | Two HW at 25-30& 45-50 DAS | 30.3 | 73.2 | | 58.7 |
| Two hand weeding at 25 & 45-50 DAT | Stale seed bed + 1HW at 30-35 DAS | 12.0 | 111.6 | | 117.2 |
| | SEm± | 1.6 | | | 84.9 |
| | CD (P=0.05) | 4.7 | | | 260.8 |
| **Raipur (Rice-mustard)** | | | | | |
| *Kharif* | *Rabi* | *Kharif* | *Rabi* | *Kharif* | *Rabi* |
| Weedy check | Weedy check | 29.2 | 522 | 26.8 | 706.0 |

| Cropping system/ weed management practices | | No. of weeds $m^{-2}$ | | weed dry weight ($g/m^2$) | |
|---|---|---|---|---|---|
| Use of cono weeder with square planting of 20 X 20 cm | Stale seed bed | 10.9 | 261 | 13.7 | 234.2 |
| 1 HW at 25-30 DAT | 1 HW at 25-30 DAS | 17.5 | 205 | 27.6 | 404.8 |
| 2 HW at 25-30 and 45-50 DAT | 2 HW at 25-30 and 45-50 DAS | 7.7 | 65 | 6.6 | 94.5 |
| Aqueous spray of neem oil at 15-20 DAT + 1 HW at 40-50 DAT | Aqueous spray of neem oil at 15-20 DAT + 1 HW at 40-50 DAT | 23.2 | 354 | 21.4 | 437.9 |
| **Ranchi** | | **Rice – wheat** | | **Rice – linseed** | |
| | | ***Kharif*** | ***Rabi*** | ***Kharif*** | ***Rabi*** |
| Un-weeded Control | | 56.63 | 45.4 | 56.18 | 45.0 |
| Two hand hoeing 25 & 40 DAT/DAS | | 9.17 | 13.1 | 8.03 | 12.9 |
| Aqueous leaf extract at 3-4 leaf stage of weeds | | 52.22 | 42.4 | 52.17 | 41.0 |
| Two hand hoeing 25 & 40 DAT/DAS+ Aqueous leaf extract at 3-4 leaf stage of weeds | | 9.60 | 11.9 | 8.67 | 9.6 |
| Weed free (manual) | | 1.67 | 8.9 | 0.29 | 8.0 |
| One hand weeding/ hoeing (25 DAT/ DAS )+ W3 | | 28.64 | 31.7 | 29.06 | 29.2 |
| CD (P=0.05) | | | | | |
| Cropping system | | NS | NS | NS | NS |
| Weed management | | 2.58 | 3.61 | 2.58 | 3.61 |
| **Umiam** (Maize-mustard) | | | | | |
| | | 30 DAS | 60 DAS | 30 DAS | 60 DAS |
| Mechanical weeding (20 DAS) + HW once (after earthing up) | | 769.0 | 187.9 | 74.2 | 30.6 |
| Mulching with fresh *Eupatorium/Ambrossia* @ 10t/ha (after earthing up) | | 629.2 | 312.0 | 56.8 | 25.7 |
| HW twice (20 & 40 DAS) | | 270.4 | 242.3 | 24.2 | 12.7 |
| Soybean green manure incorporation in situ (1:1) + HW once | | 515.3 | 279.8 | 33.8 | 22.0 |
| Weed free check | | - | - | - | - |
| Weedy check | | 933.0 | 432.1 | 147.3 | 38.9 |

## Dharwad (Table 23, 24 and 28)

Weed management packages under organic farming in groundnut was evaluated with 14 treatments comprising of aqueous leaf spray of cassia, parthenium, *Prosopis juliflora* in each condition of pre and post emergence of weeds along with hand weeding, hand hoeing, sorghum stubble mulch, wheat straw mulch, weed free and weedy check. A reduction of 43.5 and 28.5% in weed population and 66 and 51.1% in dry weight was observed at 20 and 60 days after sowing with weed management packages of one hand weeding at 20 DAS+two hand hoeing at 20 and 40 DAS+aqueous spray of cassia at 25% as pre-emergent application compared weedy check. The result indicates, weed free check recorded higher pod yield of groundnut (3041 kg $ha^{-1}$). The next best treatment was one hand weeding at 20 DAS+two hand

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

| Cropping system/ weed management practices | Grain yield | | Straw yield | |
|---|---|---|---|---|
| | *Kharif* | *Rabi* | *Kharif* | *Rabi* |
| **Coimbatore** (Rice-green gram-green manure) | | | | |
| Un-weeded control | 2048 | 179 | 3233 | |
| Two hand weeding | 3514 | 454 | 4725 | |
| Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed /herb / tree | 2488 | 244 | 4558 | |
| Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree | 3716 | 526 | 5056 | |
| Weed free | 3839 | 584 | 5308 | |
| SEm± | | | | |
| CD (P=0.05) | | | | |
| **Dharwad** (Groundnut) | | | | |
| Aqueous spray of cassia at 25%as pre-emergent application | 2230 | | | |
| Aqueous spray of cassia at 25%as post-emergent application | 2403 | | | |
| Aqueous spray of parthenium at 25%as pre-emergent application | 2259 | | | |
| Aqueous spray of parthenium at 25%as post-emergent application | 2325 | | | |
| Aqueous spray of Prosopis juliflora at 25%as pre-emergent application | 2320 | | | |
| Aqueous spray of Prosopis juliflora at 25%as post-emergent application | 2340 | | | |
| One hand weeding at 20DAS+two hand hoeing at 20 and 40 DAS | 2701 | | | |
| One hand weeding at 20DAS+two hand hoeing at 20 and 40 DAS+ Aqueous spray of cassia at 25%as pre-emergent application | 2822 | | | |
| One hand weeding at 20DAS+two hand hoeing at 20 and 40 DAS+ Aqueous spray of parthenium at 25% as pre-emergent application | 2811 | | | |
| One hand weeding at 20DAS+two hand hoeing at 20 and 40 DAS+ Aqueous spray of Prosopis juliflora at 25%as pre-emergent application | 2650 | | | |
| Sorghum stubble mulch | 2669 | | | |
| Wheat straw mulch | 2779 | | | |
| Weed free | 3041 | | | |
| Weedy check | 1993 | | | |
| SEm± | 136 | | | |
| CD (P=0.05) | 392 | | | |
| **Jabalpur** (Basmati rice-Wheat) | | | | |
| Un weeded control | 1793 | 1536 | 3110 | 2428 |
| Two hand weeding /mechanical weeding | 3755 | 3707 | 7023 | 6172 |
| Spray of 3-4 leaf stage of weeds | 2109 | 2325 | 4031 | 3858 |

| Cropping system/ weed management practices | | Grain yield | | Straw yield | |
|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Kharif* | *Rabi* |
| Two hand weeding /mechanical weeding + Spray of 3-4 leaf stage of weeds | | 4109 | 4320 | 7981 | 7062 |
| Weed free | | 4724 | 4887 | 9339 | 7998 |
| SEm± | | | | | |
| CD (P=0.05) | | | | | |
| **Karjat** (Rice-greengram) | | | | | |
| Unweeded control | | 3014 | 1074 | 4238 | 3125 |
| 2 Hand Hoeings at 20 and 40/30 DAT / DAS | | 3703 | 1364 | 4673 | 3969 |
| Spraying aqueous leaf extract of *Ipomea carnea @ 10 per cent* at 10 DAT / DAS | | 3287 | 1157 | 4458 | 3367 |
| 2 HHs ($T_2$) + Spr. *Ipomea carnea* ($T_3$) | | 3722 | 1410 | 4711 | 4103 |
| Mulching with *Ipomea carnea* @ 5 t $ha^{-1}$ at 10 DAT / DAS | | 3335 | 1158 | 4481 | 3370 |
| Incorporation of *Ipomea carnea* @ 10 t $ha^{-1}$ | | 3736 | 1463 | 4730 | 4257 |
| Spraying aqueous leaf extract of *Chromolaena odorata @10 per cent* at 10 DAT / DAS | | 3316 | 1314 | 4657 | 3824 |
| 2 HHs ($T_2$) + Spr. *Chromolaena odorata* ($T_7$) | | 3688 | 1340 | 4623 | 3899 |
| Mulching with *Chromolaena odorata* @ 5 t $ha^{-1}$ at 10 DAT / DAS | | 3438 | 1256 | 4576 | 3655 |
| Incorporation of *Chromolaena odorata* @ 10 t $ha^{-1}$ | | 3707 | 1375 | 4685 | 4001 |
| 2 Hand weedings at 20 and 40 DAT / DAS | | 3993 | 1542 | 4998 | 4487 |
| SEm± | | 0.96 | 0.87 | 0.81 | 1.95 |
| CD (P=0.05) | | 2.94 | 2.16 | 2.49 | 6.00 |
| **Ludhiana** (Basmati rice-Wheat) | | | | | |
| *Kharif* | *Rabi* | | | | |
| Hand pulling (HP) @ 25-30 DAT | Hand weeding (HW) @ 30- 35 DAS | 2870 | 5250 | 4410 | 6850 |
| Hand Pulling @ 25-30 & 40-45 DAT | HW @ 30-35 & 45-50 DAS] | 2820 | 5320 | 4450 | 6650 |
| ES* @ 15-20 DAT + HP @ 40-45 DAT | T3 [ES @ 20-25 DAS + 1 HW @ 45-50 DAS | 2810 | 4930 | 4590 | 6540 |
| Square planting + cono weeder | Bed sowing + 2 HW @ 30-35 & 45-50 DAS | 2930 | 5100 | 4910 | 5850 |
| High density + HP @ 25-30 DAT | Higher seed rate (25%) @ 15 cm row spacing | 3150 | 4540 | 4990 | 5730 |
| Control | 2810 | 4530 | 4850 | 5650 | |
| CD (P=0.05) | NS | 360 | NS | NS | |

| Cropping system/ weed management practices | | Grain yield | | Straw yield | |
|---|---|---|---|---|---|
| | | *Kharif* | *Rabi* | *Kharif* | *Rabi* |
| **Pantnagar** | | | | | |
| *Kharif* | *Rabi* | | | | |
| Basmati rice-wheat | | | | | |
| Weedy check | Weedy check | 2943 | 3020 | 4786 | 3986 |
| Use of conoweeder | One HW at 25-30 DAS | 3999 | 4039 | 5667 | 4554 |
| One hand weeding at 25-30 DAT | Two HW at 25-30& 45-50 DAS | 3627 | 4946 | 5055 | 4970 |
| Two hand weeding at 25 & 45-50 DAT | Stale seed bed + 1HW at 30-35 DAS | 3785 | 4449 | 5196 | 4938 |
| | SEm± | | 134.7 | | 71.0 |
| | CD (P=0.05) | | 465.8 | | 245.5 |
| Basmati rice-lentil | | | | | |
| Weedy check | Weedy check | 3183 | | 4245 | |
| Use of conoweeder | One HW at 25-30 DAS | 4300 | | 5755 | |
| One hand weeding at 25-30 DAT | Two HW at 25-30& 45-50 DAS | 3843 | | 5023 | |
| Two hand weeding at 25 & 45-50 DAT | Stale seed bed + 1HW at 30-35 DAS | 4170 | | 5260 | |
| | SEm± | | | | |
| | CD (P=0.05) | | | | |
| **Basmati rice-*Brassica napus*** | | | | | |
| Weedy check | Weedy check | 3120 | 663 | 4942 | 1486 |
| Use of conoweeder | One HW at 25-30 DAS | 4132 | 781 | 4596 | 1885 |
| One hand weeding at 25-30 DAT | Two HW at 25-30& 45-50 DAS | 3707 | 1350 | 4512 | 2514 |
| Two hand weeding at 25 & 45-50 DAT | Stale seed bed + 1HW at 30-35 DAS | 3821 | 1276 | 4548 | 2328 |
| | | Cropping system / Weed Manag-ement | Cropping system / Weed Manag-ement | Cropping system / Weed Manag-ement | Cropping system / Weed Manag-ement |
| | SEm± | 46.0 / 80.4 | - / 37.2 | 90.3 / 149.9 | - / 39.7 |
| | CD (P=0.05) | 179.8 / 238.9 | - / 128.7 | 353.0 / 445.4 | - / 137.0 |
| **Raipur** | | | | | |
| Weedy check | Weedy check | 2101 | 257 | 4974 | 917 |
| Use of cono weeder with square planting of 20 X 20 cm | Stale seed bed | 3466 | 547 | 7160 | 1804 |
| 1 HW at 25-30 DAT | 1 HW at 25-30 DAS | 3235 | 598 | 6619 | 2008 |
| 2 HW at 25-30 and 45-50 DAT | 2 HW at 25-30 and 45-50 DAS | 3553 | 662 | 7445 | 2259 |
| Aqueous spray of neem oil at | Aquious spray of neem oil at | 3138 | 550 | 6799 | 1954 |
| 15-20 DAT + 1 HW at 40-50 DAT | 15-20 DAT + 1 HW at 40-50 DAS | | | | |
| SEm± | | | | | |
| CD (*P=0.05*) | | | | | |

| Cropping system/ weed management practices | Grain yield | | Straw yield | |
|---|---|---|---|---|
| | *Kharif* | *Rabi* | *Kharif* | *Rabi* |
| **Ranchi** | | | | |
| Rice–wheat | | | | |
| Un weeded Control | 1758 | 1058 | 3521 | 1962 |
| Two hand hoeing 25 & 40 DAT/ DAS | 3472 | 1746 | 5020 | 2657 |
| Spray of aqueous leaf extract at 3-4 leaf stage of weeds | 2171 | 1111 | 4184 | 2006 |
| Two hand hoeing 25 & 40 DAT/ DAS+ Aqueous leaf extract at 3-4 leaf stage of weeds | 3579 | 2011 | 5194 | 2800 |
| Weed free (manual). | 3898 | 2143 | 5497 | 2855 |
| One hand weeding / hoeing (25 DAT/DAS) + Aqueous leaf extract at 3-4 leaf stage of weeds | 3258 | 1534 | 5004 | 2491 |
| **Rice–linseed** | | | | |
| Un weeded Control | 1652 | 437 | 3183 | 886 |
| Two hand hoeing 25 & 40 DAT/ DAS | 3318 | 794 | 4917 | 1376 |
| Aqueous leaf extract at 3-4 leaf stage of weeds | 2079 | 489 | 3811 | 966 |
| Two hand hoeing 25 & 40 DAT/ DAS+ Aqueous leaf extract at 3-4 leaf stage of weeds | 3453 | 820 | 4966 | 1429 |
| Weed free (manual). | 3777 | 873 | 5024 | 1508 |
| One hand weeding / hoeing (25 DAT/DAS) + Aqueous leaf extract at 3-4 leaf stage of weeds | 3108 | 661 | 4539 | 1243 |
| | Cropping system / Weed Manag-ement | Cropping system / Weed Manag-ement | Cropping system / Weed Manag-ement | Cropping system / Weed Manag-ement |
| CD (P=0.05) | NS / 4.58 | NS / 9.46 | NS / 4.58 | NS / 9.46 |
| **Umiam** (Maize–totia) | | | | |
| Mechanical weeding (20 DAS) + HW once (after earthing up) | 3060 | 490 | 6660 | 920 |
| Mulching with fresh *Eupatorium/Ambrossia* @ 10t/ha (after earthing up) | 4010 | 620 | 9050 | 1130 |
| HW twice (20 & 40 DAS) | 2850 | 460 | 6260 | 840 |
| Soybean green manure incorporation in situ (1:1) + HW once | 3580 | 430 | 7730 | 780 |
| Weed free check | 3000 | 440 | 6150 | 850 |
| Weedy check | 2760 | 370 | 5300 | 730 |
| SEm± | 510 | 60 | 390 | 120 |
| CD (P=0.05) | NS | NS | 1230 | NS |

hoeing at 20 and 40 DAS+aqueous spray of cassia at 25% as pre-emergent application which was at par with one hand weeding at 20DAS+two hand hoeing at 20 and 40 DAS+Aqueous spray of parthenium at 25% as pre-emergent application. Among the aqueous sprays, spray of cassia and *prosopis juliflora* as post emergent was found to be more effective than pre or post emergence application of parthenium.

Post emergence spray of aqueous leaf extract was found to be better than pre emergence application. The next better treatment in term of economics was one hand weeding at 20 DAS+two hand hoeing at 20 and 40 DAS+aqueous spray of cassia at 25% as pre-emergent application which was at par with one hand weeding at 20DAS+two hand hoeing at 20 and 40 DAS+Aqueous spray of parthenium at 25% as pre-emergent application.

### Jabalpur (Table 23, 24, 25, 27 and 28)

Weed management packages viz., two hand/mechanical weeding, spray at 3-4 leaf stage of weeds and its combination along with weed free and un-weeded control were evaluated in basmati rice-wheat system. Result reveals that significantly lower numbers of weeds in kharif and rabi was recorded under weed free condition followed by combination of two hand/mechanical weeding and spray at 3-4 leaf stage of weeds in basmati rice and wheat crop as compared to unweeded control. Weed free recorded higher grain yield of rice (4724 kg $ha^{-1}$) and wheat (4887 kg $ha^{-1}$) followed by combination of two hand weeding + spray at 3-4 leaf stage of weeds which recorded 129 and 181% higher grain yield of rice and wheat respectively compared to unwedded check. Straw yield of both the crops also exhibited the similar trend. Residual availability of organic carbon, N, P and K were found to be higher under weed free condition than the other treatments. Though bacteria and actinomycetes population was not significantly influenced by weed management packages, numerically higher bacteria and actinomycetes was observed under weed free or spray of 3-4 leaf stage of weeds. Higher gross (Rs 2,15.840 $ha^{-1}$), netreturn (Rs. 1,60,690 $ha^{-1}$) and B: C ratio (3.91) was recorded with weed free condition in rice-wheat system even though high cost of cultivation (Rs. 55,150 $ha^{-1}$) was noticed in weed free condition. The next best treatment in terms of gross, net returns and B: C ratio was combination of two hand/mechanical weeding+spray at 3-4 leaf stage of weeds (Rs. 1,89,125, 1,38,525 $ha^{-1}$ and 3.74 respectively).

### Karjat (Table 24)

Weed management packages under organic farming in rice-green gram system was evaluated with 11 treatments comprising of unweeded control, 2 hand hoeings at 20 and 40/30 DAT/DAS, spraying aqueous leaf extract of *Ipomea carnea* @ 10%at 10 DAT/DAS, combination of 2 hand hoeing andSpr. *Ipomea carnea* , mulching with *Ipomea carnea* @ 5 t $ha^{-1}$ at 10 DAT/DAS, incorporation of *Ipomea carnea* @ 10 t $ha^{-1}$, spraying aqueous leaf extract of *Chromolaena odorata @10 per cent* at 10 DAT/DAS, combination of 2 HHs andSpr. *Chromolaena odorata* , mulching with *Chromolaena odorata* @ 5 t $ha^{-1}$ at 10 DAT/DAS, incorporation of *Chromolaena odorata* @ 10 t $ha^{-1}$ and 2 hand weedings at 20 and 40 DAT/DAS. All the weed management treatments significantly increased rice and green gram yield as compared to unweeded control except spraying of aqueous leaf extract of *Ipomea carnea* @ 10% per cent at 10 DAT. Significantly higher yield of rice and green gram recorded with two hand weeding at 20 and 40 DAT/DAS (3993 and 1542 kg $ha^{-1}$) followed by incorporation of *Ipomea carnea* @ 10 t $ha^{-1}$ (3736 and 1463 kg $ha^{-1}$) which recorded 24 and 36.2% higher grain yield of rice and green gram respectively compared to unweeded check. Straw yield of both the crops also exhibited the similar trend. The next best treatment was incorporation of *Chromolaena odorata* @ 10 t $ha^{-1}$which was at par with 2 hand hoeings at 20 and 40/30 DAT/DAS application.

### Ludhiana (Table 24)

Five management packages along with unweeded control was evaluated in basmati rice-wheat system. Observations on grain and straw yield were recorded. High density planting + hand weeding at 25-30 DAT

## Table 25. Influence of weed management practices under organic farming on soil physical and chemical properties at the end of cropping cycle

| Cropping system/ weed management practices | *BD | pH | EC dSm$^{-1}$ | OC | Available N (kg ha$^{-1}$) | Available P (kg ha$^{-1}$) | Available K(kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| **Coimbatore** (Rice-green gram-GM) | | | | | | | |
| Un weeded control | | | | 0.64 | 195 | 22.8 | 541 |
| Two hand weeding | | | | 0.69 | 253 | 26.7 | 637 |
| Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree | | | | 0.67 | 201 | 23.3 | 555 |
| Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree | | | | 0.71 | 259 | 28.1 | 647 |
| Weed free | | | | 0.71 | 265 | 29.8 | 695 |
| SEm± | | | | SEm± CD | SEm± CD | SEm± CD | SEm± CD |
| CD (P=0.05) | | | | | | | |
| **Jabalpur** (Basmati rice-wheat) | | | | g kg$^{-1}$ | | | |
| Un weeded control | | 7.32 | 0.45 | 6.62 | 235 | 11.6 | 230 |
| Two hand weeding /mechanical weeding | | 7.32 | 0.40 | 6.40 | 244 | 12.6 | 238 |
| Spray of 3-4 leaf stage of weeds | | 7.33 | 0.39 | 6.51 | 240 | 12.4 | 237 |
| Two hand weeding /mechanical weeding + spray of 3-4 leaf stage of weeds | | 7.35 | 0.41 | 6.42 | 247 | 13.0 | 255 |
| Weed free | | 7.30 | 0.39 | 6.55 | 251 | 13.5 | 250 |
| SEm± | | | | | | | |
| CD (P=0.05) | | | | | | | |
| **Pantnagar** (Basmati rice – wheat) | | | | | | | |
| *Kharif:* Weedy check<br>*Rabi:* Weedy check | | | | 0.95 | 371.6 | 35.6 | 203.8 |
| *Kharif:* Use of cono weeder<br>*Rabi:* One HW at 25-30 DAS | | | | 1.06 | 370.1 | 32.7 | 198.6 |
| *Kharif:* One hand weeding at 25-30 DAT<br>*Rabi:* two HW at 25-30& 45-50 DAS | | | | 1.06 | 365.3 | 28.0 | 240.7 |
| *Kharif:* Two hand weeding at 25 & 45-50 DAT<br>*Rabi:* Stale seed bed + 1HW at 30-35 DAS | | | | 0.96 | 330.9 | 38.7 | 194.4 |
| **Basmati rice-lentil** | | | | | | | |
| *Kharif:* Weedy check<br>*Rabi:* Weedy check | | | | 1.10 | 363.8 | 32.0 | 197.6 |
| *Kharif:* Use of cono weeder<br>*Rabi:* One HW at 25-30 DAS | | | | 1.07 | 384.2 | 31.1 | 224.4 |
| *Kharif:* One hand weeding at 25-30 DAT<br>*Rabi:* two HW at 25-30& 45-50 DAS | | | | 1.01 | 374.8 | 31.2 | 220.2 |
| *Kharif:* Two hand weeding at 25 & 45-50 DAT<br>*Rabi:* Stale seed bed + 1HW at 30-35 DAS | | | | 0.98 | 382.6 | 33.4 | 223.5 |
| **Basmati rice-*Brassica napus*** | | | | | | | |
| *Kharif:* Weedy check<br>*Rabi:* Weedy check | | | | 0.98 | 384.2 | 27.2 | 225.5 |
| *Kharif:* Use of cono weeder<br>*Rabi:* One HW at 25-30 DAS | | | | 0.93 | 349.7 | 36.1 | 219.1 |
| *Kharif:* One hand weeding at 25-30 DAT<br>*Rabi:* two HW at 25-30& 45-50 DAS | | | | 1.08 | 390.6 | 38.1 | 208.2 |

| Cropping system/ weed management practices | *BD | pH | EC dSm$^{-1}$ | OC | Available N (kg ha$^{-1}$) | Available P (kg ha$^{-1}$) | Available K(kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| *Kharif:* Two hand weeding at 25 & 45-50 DAT *Rabi:* Stale seed bed + 1HW at 30-35 DAS | | | | 1.04 | 359.1 | 27.5 | 231.0 |
| CD (P=0.05) | | | | SEm± CD | SEm± CD | SEm± CD | SEm± CD |
| Cropping system | | | | 0.02 NS | 4.0 15.6 | 0.8 NS | 3.0 11.8 |
| Weed management | | | | 0.03 NS | 7.7 NS | 0.9 NS | 4.1 12.2 |
| **Raipur** (Rice-mustard) | | | | | | | |
| Weedy check | 1.44 | 7.54 | 0.21 | 0.45 | 204 | 10.07 | 276 |
| *Kharif:* Use of cono weeder with square planting *Rabi:*.Stale seed bed | 1.42 | 7.52 | 0.20 | 0.44 | 227 | 10.80 | 287 |
| 1 HW at 25-30 DAT | 1.37 | 7.56 | 0.21 | 0.46 | 229 | 12.20 | 298 |
| 2 HW at 25-30 and 45-50 DAT | 1.36 | 7.52 | 0.19 | 0.46 | 236 | 13.87 | 306 |
| Aqueous spray neem oil at 15-20 DAT + 1 HW at 40-50 DAT | 1.41 | 7.53 | 0.22 | 0.46 | 221 | 11.27 | 287 |
| SEm± | | | | | | | |
| CD (P=0.05) | | | | | | | |
| **Ranchi** | | | | | | | |
| Rice-wheat | | | | | | | |
| Un weeded Control | | | | | 236.2 | 33.5 | 194.0 |
| Two hand hoeing 25 & 40 DAT/ DAS | | | | | 245.2 | 40.3 | 207.3 |
| Aqueous leaf extract at 3-4 leaf stage of weeds. | | | | | 241.1 | 34.7 | 196.2 |
| Two hand hoeing 25 & 40 DAT/ DAS + Aqueous leaf extract at 3-4 leaf stage of weeds | | | | | 247.2 | 41.2 | 210.0 |
| Weed free (manual) | | | | | 259.2 | 42.4 | 218.3 |
| One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds | | | | | 237.6 | 37.6 | 202.8 |
| **Rice-linseed** | | | | | | | |
| Un weeded Control | | | | | 231.1 | 33.2 | 195.5 |
| Two hand hoeing 25 & 40 DAT/ DAS | | | | | 244.9 | 38.9 | 204.6 |
| Aqueous leaf extract at 3-4 leaf stage of weeds. | | | | | 236.8 | 34.4 | 197.4 |
| Two hand hoeing 25 & 40 DAT/ DAS + Aqueous leaf extract at 3-4 leaf stage of weeds | | | | | 247.8 | 38.9 | 207.7 |
| Weed free (manual) | | | | | 251.9 | 40.2 | 210.3 |
| One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weeds | | | | | 235.7 | 35.7 | 201.7 |
| Umiam (Maize– mustard) | | | | | | | |
| Mechanical weeding (20 DAS) + HW once (after earthing up) | | 5.54 | | 2.43 | 276.2 | 18.2 | 278.7 |
| Mulching with fresh *Eupatorium/Ambrossia* @ 10t/ha (after earthing up) | | 5.62 | | 3.18 | 270.0 | 24.6 | 281.7 |
| HW twice (20 & 40 DAS) | | 5.33 | | 2.39 | 251.1 | 20.5 | 263.0 |
| Soybean green manure incorporation in situ (1:1) + HW once | | 5.47 | | 2.63 | 257.4 | 19.4 | 279.1 |
| Weed free check | | 5.58 | | 2.21 | 276.2 | 19.4 | 271.3 |
| Weedy check | | 5.12 | | 2.19 | 234.8 | 23.5 | 243.9 |
| SEm± | | 0.15 | | 0.09 | 6.65 | 2.46 | 3.91 |
| CD (*P=0.05*) | | NS | | 0.29 | 20.94 | NS | 12.33 |

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

### Pantnagar (Table 23, 24, 25, 26 and 28)

Three weed management packages namely use of conoweeder, one hand weeding at 25-30 DAT, two hand weeding at 25 & 45-50 DAT during *kharif* and one hand weeding at 25-30 DAS, two hand weeding at 25-30& 45-50 DAS and stale seed bed+1 hand weeding at 30-35 DAS in *rabi*, along with weedy check were evaluated in three cropping systems namely basmati rice-wheat-*sesbania* (green manuring), basmati rice-lentil-*sesbania* (green manuring) and basmati rice-*brassica napus*-sesbania (green manuring). Observations on weed count, total dry weight, grain, straw yield, soil properties, NPK uptake by crops along with economics were taken. Total weeds count during *kharif* and broad leaved weeds count during *rabi* was found to be significantly lower in all the three systems with 2 hand weeding at 25-30 and 45-50 DAS during *kharif* and one hand weeding at 25-30 DAT during *rabi*. Among the three cropping systems, basmati rice-wheat-s*esbania* recorded lower weeds number compared to other systems. The reduction in total dry weight of weeds during *rabi* was significantly higher in two hand weeding at 25-30 and 45-50 DAS. The reduction over weedy check was found to be more than 10 times in basmati rice-wheat-*sesbania*, more than 16 times in basmati rice-lentil-*sesbania* and nine times more in 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 34.4% increase in yield over weedy check. This was closely followed by two hand weeding at 25-30 & 45-50 DAT in *kharif* and stale seed bed+one hand weeding at 30-35 DAS during *rabi*. The yield of wheat and *brassica napus* 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 63.8 and 103.6% respectively for wheat and *brassica napus*. Weedy check registered significantly lower yield in all the three systems. Straw yield of all the crops in the three systems resulted in similar trend as that of grain yield. No significant variation in available soil organic carbon, N, P and K was observed in all the three systems with various weed management packages. Among the three systems residual organic carbon and N was found to be higher with basmati rice-lentil-*sesbania* (green manuring) system.Nutrient uptake were significantly influenced by different weed management practices, however, no variation in


**Weed management practice in rice under organic condition at Pantnagar**

**Table 26. Influence of weed management practices under organic farming on N, P and K uptake (kg ha$^{-1}$) by crops**

| | | *Kharif* | | | *Rabi* | | |
|---|---|---|---|---|---|---|---|
| | | N | P | K | N | P | K |
| **Pantnagar** | | | | | | | |
| **Basmati rice–wheat** | | | | | | | |
| ***Kharif*** | ***Rabi*** | | | | | | |
| Weedy check | Weedy check | 49.0 | 11.4 | 97.8 | 63.0 | 15.4 | 70.0 |
| Use of conoweeder | One HW at 25-30 DAS | 55.3 | 13.2 | 119.2 | 76.0 | 18.8 | 86.0 |
| One hand weeding at 25-30 DAT | Two HW at 25-30& 45-50 DAS | 47.9 | 13.1 | 102.7 | 103.0 | 20.7 | 101.0 |
| Two hand weeding at 25 & 45-50 DAT | Stale seed bed + 1HW at 30-35 DAS | 50.5 | 14.4 | 105.0 | 80.0 | 23.9 | 108.0 |
| Mean | | 50.7 | 13.0 | 106.2 | 80.5 | 19.7 | 91.3 |
| **Basmati rice-lentil** | | | | | | | |
| Weedy check | Weedy check | 48.5 | 10.9 | 91.1 | | | |
| Use of conoweeder | One HW at 25-30 DAS | 71.8 | 14.8 | 124.9 | | | |
| One hand weeding at 25-30 DAT | Two HW at 25-30& 45-50 DAS | 74.4 | 15.8 | 110.2 | | | |
| Two hand weeding at 25 & 45-50 DAT | Stale seed bed + 1HW at 30-35 DAS | 70.2 | 15.4 | 116.7 | | | |
| Mean | | 66.2 | 14.2 | 110.7 | | | |
| **Basmati rice-*brassica napus*** | | | | | | | |
| Weedy check | Weedy check | 55.2 | 13.0 | 110.1 | 18.0 | 4.6 | 28.0 |
| Use of conoweeder | One HW at 25-30 DAS | 60.2 | 14.5 | 99.5 | 21.0 | 5.6 | 31.0 |
| One hand weeding at 25-30 DAT | Two HW at 25-30& 45-50 DAS | 49.9 | 14.3 | 110.9 | 31.0 | 8.4 | 51.0 |
| Two hand weeding at 25 & 45-50 DAT | Stale seed bed + 1HW at 30-35 DAS | 61.4 | 15.1 | 103.2 | 25.0 | 8.8 | 48.0 |
| Mean | | 56.7 | 14.2 | 105.9 | 23.8 | 6.9 | 39.5 |
| | | SEm± CD (P=0.05) | SEm± CD (P=0.05) | SEm± CD (P=0.05) | SEm± CD (P=0.05) | SEm± CD (P=0.05) | SEm± CD (P=0.05) |

| | *Kharif* | | | *Rabi* | | |
|---|---|---|---|---|---|---|
| | **N** | **P** | **K** | **N** | **P** | **K** |
| **Cropping system** | 1.72 | 6.74 | 0.74 | NS | 2.71 | NS |
| Weed management | 2.99 | 8.89 | 0.79 | 2.36 | 4.33 | 12.87 |
| wheat | 2.7 | 9.4 | 0.8 | 2.9 | 6.4 | 22.3 |
| Brassica | 2.1 | 7.3 | 0.5 | 1.8 | 2.1 | 7.2 |
| **Ranchi** | | | | | | |
| **Rice-wheat** | | | | | | |
| Un weeded Control | 46.0 | 8.8 | 39.5 | 23.0 | 5.5 | 25.7 |
| Two hand hoeing 25 & 40 DAT/ DAS | 83.5 | 12.7 | 58.2 | 38.8 | 9.0 | 35.3 |
| Aqueous leaf extract at 3-4 leaf stage of weeds. | 57.3 | 9.7 | 44.6 | 24.8 | 5.9 | 25.9 |
| Two hand hoeing 25 & 40 DAT/ DAS +Aqueous leaf extract at 3-4 leaf stage of weed | 91.0 | 16.7 | 61.0 | 43.5 | 10.3 | 36.7 |
| Weed free (manual) | 99.5 | 18.0 | 65.1 | 45.7 | 10.5 | 37.0 |
| One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weed | 76.1 | 12.9 | 55.3 | 34.9 | 8.0 | 32.2 |
| Mean | 75.6 | 13.1 | 54.0 | 35.1 | 8.2 | 32.1 |
| **Rice-linseed** | | | | | | |
| Un weeded Control | 43.8 | 7.9 | 34.7 | 11.4 | 5.5 | 28.0 |
| Two hand hoeing 25 & 40 DAT/ DAS | 82.2 | 13.4 | 58.6 | 21.5 | 9.4 | 43.3 |
| Aqueous leaf extract at 3-4 leaf stage of weed | 50.1 | 10.2 | 42.3 | 13.1 | 5.9 | 28.0 |
| Two hand hoeing 25 & 40 DAT/ DAS +Aqueous leaf extract at 3-4 leaf stage of weed | 87.2 | 15.7 | 59.5 | 22.0 | 9.2 | 43.1 |
| Weed free (manual) | 95.2 | 15.6 | 57.4 | 23.5 | 9.8 | 42.0 |
| One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weed | 75.0 | 12.4 | 51.1 | 18.5 | 7.8 | 35.1 |
| Mean | 72.3 | 12.5 | 50.6 | 18.3 | 7.9 | 36.6 |

**Table 27. Influence of weed management practices under organic farming on microbial population in the end of cropping cycle at Coimbatore**

| Cropping system/ weed management practices | Fungi | Bacteria | Actinomycetes ($x10^3$ CFU/g of dry soil) | Azotobacter | Phosphate solubilizing bacteria (PSB) |
|---|---|---|---|---|---|
| **Coimbatore** (Rice-green gram-green manure) | | | | | |
| Un weeded control | 16.2 | 96.0 | 28.7 | | |
| Two hand weeding | 17.9 | 98.9 | 27.1 | | |
| Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree | 18.2 | 107 | 32.0 | | |
| Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree | 19.4 | 102 | 30.5 | | |
| Weed free | 19.8 | 105 | 32.6 | | |
| **Jabalpur** (Basmati rice-wheat) | ($10^4$/g) | ($10^6$/g) | ($10^6$/g) | ($10^6$/g) | ($10^6$/g) |
| Un weeded control | 45.8 | 56.4 | 13.2 | 29.6 | 18.0 |
| Two hand weeding /mechanical weeding | 45.0 | 55.5 | 13.0 | 30.0 | 13.2 |
| Spray of 3-4 leaf stage of weeds | 47.8 | 56.0 | 12.8 | 31.1 | 16.0 |
| Two hand weeding /mechanical weeding + spray of 3-4 leaf stage of weeds | 47.0 | 56.1 | 12.5 | 30.2 | 17.4 |
| Weed free | 40.9 | 56.5 | 13.4 | 30.5 | 18.5 |

uptakes was observed under different cropping systems except N. Uptake of nitrogen (66.2 kg $ha^{-1}$), phosphorus (14.2 kg $ha^{-1}$) and potassium (110.7 kg $ha^{-1}$) was significantly higher in rice crop with rice-lentil-*sesbania* cropping system. Among the weed management practices, significantly higher N and P was recorded with one hand weeding (74.4 and 15.8 kg $ha^{-1}$ respectively) while potassium (124.9 kg $ha^{-1}$) was recorded higher in during *kharif* with use of conoweeder. Economic analysis indicates, in all the systems, use of conoweeder during *kharif* and one hand weeding at 25-30 DAS during *rabi* recorded higher net returns and B: C ratio in all the three systems. This was closely followed by one hand weeding during *kharif* and stale seed bed+one hand weeding during *rabi*. Among the three systems, basmati rice-wheat-*sesbania* (green manuring) recorded higher net return of Rs 1,37,975 $ha^{-1}$ however B: C ratio was observed with basmati rice-lentil-*sesbania* (4.5) system. In general use of conoweeder, stale seed bed and hand weeding are found to be suitable weed management technique under organic farming conditions.

### Raipur (Table 23, 24, 25 and 28)

Weed management packages 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, dry weight of weeds, grain and straw yield along with soil fertility status were recorded. Maximum reduction in total weed count was observed with use of 2 hand weeding at 25-30 and 45-50 days after transplanting/sowing in rice and mustard. Reduction was found to be 73.6% in rice and 87.5% in mustard compared to weedy check. Use of conoweeder with square planting in rice contributed for 62.7% reduction while stale seed bed to mustard resulted in 50% reduction in total weed count. Aqueous spray at 15-20 DAT+1HW at 40-50 DAT recorded 20.5 and 32.2% reduction in rice and mustard respectively. Dry weight of weed also exhibited similar trend as that of weed count. Weed management package, 2 hand weeding at 25-30 and 45-50 DAT/DAS recorded significantly higher yield of rice (3553 kg $ha^{-1}$) and mustard (622 kg $ha^{-1}$) and it was 69.1 and 157% higher over weedy check. Aqueous spray and one hand weeding recorded 13.2 and 20.4% reduction in yield compared to best performing treatment of 2 hand weeding at 25-30 and 45-50 DAS and 2 hand weeding to rice and mustard respectively. Use of conoweeder with square planting was the next best weed management package and it was found to be increase 65% in rice. Straw yield also exhibited similar trend as that of grain yield. Post-harvest analysis of soil indicates no significant variation in bulk density, pH, EC and available N, P and K. Use of conoweeder with square planting recorded lower organic carbon of 0.44% while 2 hand wedding and aqueous spray+1 hand weeding package recorded higher organic carbon content (0.46% in both the treatments). Residual N, P and K was recorded under management package of 2 hand weeding at 25-30 and 45-50 DAS. Higher gross and net return of rice-mustard system was recorded with 2 hand weeding at 25-30 and 45-50 DAS of Rs. 89,431 $ha^{-1}$ and Rs. 35,716 $ha^{-1}$ respectively while befit cost ratio (1.72) was recorded use of cono weeder with square planting in rice and stale seed bed in mustard.

### Ranchi (Table 23, 25, 26 and 28)

Four weed management packages 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 weed dry weight, grain, straw yield, NPK uptake and economics were taken.Weed free (manual) registered significantly lower weed dry weight in both the system. Two hand hoeing at 25 and 40 DAS/DAT with use of aqueous leaf extract at 3-4 leaf stage registered significantly lower weed dry weight during *kharif* and *rabi* in both the systems. On an average reduction of more than 5 times in rice, more than 3 times in wheat and linseed was recorded over to unweeded (control). It was at par with two hand hoeing 25 and 40 DAS/DAT. In all the crops in the systems, weed free recorded higher grain yield followed by two hand hoeing at 25 and 40 DAT/DAS with aqueous leaf extract spray at 3-4 leaf stage. Spray of aqueous leaf extract alone recorded reduction in yield to the tune of 44.6% in rice, 48.2% in wheat and 44% in linseed. Keeping the field free from weeds gave yield advantage of 125% in rice, 102.5% in wheat and 99.8% in linseed over unweeded control. Similar trend was observed for straw yield of all the crops. Keeping the field free from weeds through hand weeding recorded higher availability of nitrogen, phosphorus and potash in the soil and uptake of NPK in all the crops, this was closely followed by two hand hoeing + aqueous leaf extract spray at 3-4 leaf stage of weeds. In both rice-wheat and rice-linseed system, weed free recorded higher net return of Rs 57,549 and 37,121 $ha^{-1}$ and B: C ratio of 2.07 and 1.40 respectively followed by two hand weeding and aqueous leaf extract spray at 3-4 leaf stage of net return of Rs 49,315 and 31,386 $ha^{-1}$ respectively in rice-wheat and rice-linseed system. Unweeded control and spray of aqueous leaf extract resulted in lower net returns and B:C ratio indicating loss, over investment.

**Table 28. Influence of weed management practices under organic farming on economics (Rs ha$^{-1}$) of cropping systems**

| Cropping system/weed management practices | Gross returns | Cost of cultivation | Net returns | B:C ratio |
|---|---|---|---|---|
| **Coimbatore** (Rice-green gram-GM) | | | | |
| Un weeded control | 41521 | 22510 | 19011 | 1.18 |
| Two hand weeding | 77470 | 33060 | 44410 | 0.74 |
| Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree | 52346 | 26260 | 26086 | 1.01 |
| Two hand weeding + Spray of 3-4 leaf stage of weeds, aqueous leaf extract of some local weed/herb/tree | 84186 | 33040 | 51146 | 0.65 |
| Weed free | 89006 | 35680 | 53326 | 0.67 |
| **Dharwad** (Groundnut) | | | | |
| Aqueous spray of cassia at 25%as pre-emergent application | 66894 | 13933 | 47094 | 3.38 |
| Aqueous spray of cassia at 25%as post-emergent application | 72077 | 14101 | 52877 | 3.75 |
| Aqueous spray of parthenium at 25%as pre-emergent application | 67758 | 14264 | 47358 | 3.32 |
| Aqueous spray of parthenium at 25%as post-emergent application | 69739 | 14526 | 49099 | 3.38 |
| Aqueous spray of Prosopis juliflora at 25%as pre-emergent application | 69614 | 14532 | 48974 | 3.37 |
| Aqueous spray of Prosopis juliflora at 25%as post-emergent application | 70188 | 14727 | 49188 | 3.34 |
| One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS | 81019 | 16115 | 58819 | 3.65 |
| One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS+Aqueous spray of cassia at 25%as pre-emergent application | 84647 | 16187 | 62807 | 3.88 |
| One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS+Aqueous spray of parthenium at 25%as pre-emergent application | 84338 | 16407 | 62018 | 3.78 |
| One hand weeding at 20DAS+Two hand hoeing at 20 and 40 DAS+ Aqueous spray of Prosopis juliflora at 25%as pre-emergent application | 79372 | 15970 | 57172 | 3.58 |
| Sorghum stubble mulch | 83063 | 16274 | 60863 | 3.74 |
| Wheat straw mulch | 83357 | 16309 | 61157 | 3.75 |
| Weed free | 91237 | 17109 | 68437 | 4.00 |
| Weedy check | 59797 | 13613 | 38797 | 2.85 |
| SEm± | 4090 | | 4090 | 0.19 |
| CD (P=0.05) | 11756 | | 11756 | 0.56 |

| Cropping system/weed management practices | Gross returns | Cost of cultivation | Net returns | B:C ratio |
|---|---|---|---|---|
| **Raipur** (Rice-mustard) | | | | |
| Weedy check | 48338 | 44715 | 3623 | 1.08 |
| *Kharif:* Use of cono weeder with square planting *Rabi:* Stale seed bed | 83400 | 48615 | 34785 | 1.72 |
| 1 HW at 25-30 DAT | 81116 | 50715 | 30401 | 1.60 |
| 2 HW at 25-30 and 45-50 DAT | 89431 | 53715 | 35716 | 1.66 |
| Aqueous spray neem oil at 15-20 DAT + 1 HW at 40-50 DAT | 77912 | 51915 | 25997 | 1.50 |
| **Ranchi** | | | | |
| **Rice - wheat** | | | | |
| Un weeded Control | 59720 | 55693 | 3680 | 0.25 |
| Two hand hoeing 25 & 40 DAT/ DAS | 102959 | 59845 | 43074 | 1.63 |
| Aqueous leaf extract at 3-4 leaf stage of weed | 68608 | 56113 | 12289 | 0.59 |
| Two hand hoeing 25 & 40 DAT/ DAS +Aqueous leaf extract at 3-4 leaf stage of weed | 109845 | 60265 | 49315 | 1.82 |
| Weed free (manual). | 117745 | 60676 | 57549 | 2.07 |
| One hand weeding / hoeing (25 DAT/DAS)+aqueous leaf extract at 3-4 leaf stage of weed | 95653 | 58881 | 37591 | 1.44 |
| **Rice - linseed** | | | | |
| Un weeded Control | 42337 | 46458 | -4105 | -0.20 |
| Two hand hoeing 25 & 40 DAT/ DAS | 79276 | 50195 | 29074 | 1.11 |
| Aqueous leaf extract at 3-4 leaf stage of weed | 51353 | 46878 | 4474 | 0.16 |
| Two hand hoeing 25 & 40 DAT/ DAS +Aqueous leaf extract at 3-4 leaf stage of weed | 82001 | 50615 | 31386 | 1.18 |
| Weed free (manual). | 88147 | 51026 | 37121 | 1.40 |
| One hand weeding / hoeing (25 DAT/DAS)+ Aqueous leaf extract at 3-4 leaf stage of weed | 72327 | 49370 | 22957 | 0.88 |

### Umiam (Table 23, 24 and 25)

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), hand weeding twice at 20 and 40 DAS, soybean green manure incorporation insitu (1:1)+one hand weeding was evaluated along with weed free and weedy checks in maize-mustard system. Observations on weed count at 30 and 60 DAS (*kharif*), grain, straw yield and post-harvest soil parameters were taken. Hand weeding twice resulted in significantreductionin weed population and dry weight $m^{-2}$ compared to other treatments.Use of mulching with fresh *Eupatorium/Ambrosia* alone was not effective in controlling of weeds as it recorded the reduction in weed population and dry weight to the tune of 27.8 and 34.1% respectively compared to weedy check. In both maize and mustard, mulching with fresh *Eupatorium/ Ambrosia* @ 10 t $ha^{-1}$ (after earthing up) recorded higher yield followed by oybean green manure incorporation insitu (1:1)+one hand weeding. The increase in yield under mulching with fresh *Eupatorium/Ambrosia* was found to be 33.7 and 45.3% in maize and 40.9 and 67.6% in mustard over weed free and weedy checks respectively. In situ incorporation of soybean green manure and hand weeding to both the crops was more effective than two hand weeding (20 and 40 DAS) alone. Two hand weeding (20 and 40 DAS)recorded lower yield compared to mechanical weeding (20 DAS) + hand weeding once (60 DAS) or weed free check. Straw yield also exhibited the similar trend. Post-harvest analysis of soil sample indicates that soil was in acidic condition and no significant variation in pH was observed. Organic carbon content of soil ranged from 2.19 to 3.18% in various treatments and mulching with fresh *Eupatorium/Ambrosia* @ 10 t $ha^{-1}$ recorded the higher organic carbon followed by *in-situ* incorporation of soybean as green manure+one hand weeding (2.63%). Residual available N (276.2 kg $ha^{-1}$) was significantly higher with mechanical weeding (20DAS)+hand weeding once (60 DAS) and weed free check which was closely followed by mulching with fresh *Eupatorium/ Ambrosia* @ 10 t $ha^{-1}$ (270 kg $ha^{-1}$). Available P and K in soil were also higher with mulching with fresh *Eupatorium/Ambrosia* @ 10 t $ha^{-1}$+one hand weeding.

# 8. PUBLICATIONS AND HUMAN RESOURCE DEVELOPMENT

## 8.1 Publications

### Research Papers

R.S. Singh, Janardan Prasad, R.P. Manjhi and C.S. Singh (2012). Efficient Alternative Cropping Systems. Published by PDFSR (ICAR), Modipuram, Meerut (UP) in pp. 124-130

Devkant Prasad, M.S. Yadava and C.S. Singh (2013) Diversification of rice (*Oryza sativa*)- based cropping systems for higher productivity, profitability and resource use effciciency under irrigated ecosystem of Jharkhand. Indian Journal of Agronomy 58(3): 264-270

Niru Kumari, C.S. Singh, J. Prasad, M.K. Singh and Rajesh Kumar (2013) Influence of organic nutrient sources on productivity of rice (Oryza sativa)-based cropping systems in Jharkhand. Indian Journal of Agronomy 58(3): 277-281.

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

### Book Chapters

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

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

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

Singh A B, Sammi Reddy K, Manna MC and Subba Rao A (2011). Efficient Utilization of farm wastes for sustainable agriculture Published by Agro-techPublishingAcademyUdaipur, pp 1-328.

Singh A B, Sammi Reddy K, Manna MC and Subba Rao A (2011). Recycling Organic wastes Soil Health and Productivity. Published by Agro-techPublishingAcademyUdaipur, pp 1-344.

### Presentation in Symposium/Seminar/Conference

K.K. Agrawal, Megha Dubey and Suchi Gangwar (2012). Effect of organic, inorganic and integrated nutrient management on grain yield of basmati rice in rice based cropping system. Paper presented in “Third International Agronomy Congress on Agriculture Diversification, Climate Change Management and Livelihoods” organized by Indian Society of Agronomy, ICAR, New Delhi held at New Delhi on 26-30 Nov. 2012.

Dr. V. K. Shukla attended the workshop cum group meeting of "Network Project on Organic Farming" Organized by Project Directorate of Farming System Research held at ICAR Research Complex, Sikkim Centre, Tadong, Gangtok on 26-27 April 2013.

C.S. Singh, Niru Kumari and Rajesh Kumar (2012). Effect of different nutrient input system on productivity and soil health of rice (Oryza sativa) based cropping system. In 3rd National Symposium on Agriculture production and protection in context of climate change at Birsa Agricultural University, Ranchi, Jharkhand. 03-05 November, 2012, pp 87.

C.S. Singh, Niru Kumari and Rajesh Kumar (2012). Effect of different combination of organic sources on productivity, profitability and nutrient status of soil in rice (Oryza sativa) based cropping sequence. In 3rd National Symposium on Agriculture production and protection in context of climate change at Birsa Agricultural University, Ranchi, Jharkhand. 03-05 November, 2012, pp 142.

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

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

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

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

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

Attended National Symposium on "Resource Utilization Through Integrated Farming System and Biodiversity Conservation in Dry lands" held during December 20-22, 2011 at Bhuj, organized by CAZARI, Jhodpur.

Attended International Conference on "Organic Bihar and Launching of Bihar Jai B" held during June, 22-24, 2011 at Patna.

## Bulletin

Chandra Shekhar Singh, Arvind Kumar Singh, Malay Kumar Singh and Bal Krishna Jha (2013). Jhaivik Krishi ki Unnat Taknik. Published by Department of Agronomy, Birsa Agricultural University, Ranchi.

## Popular Article

C.S. Singh, Arvind Kumar Singh and Ashok Kumar Singh (2012). Samakit Krishi Pranali. Souvenir published by Indian Agricultural Research Institute, March 2012, pp 1-4.

## Pamphlets

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

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

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

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

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

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

# 9. APPENDIX

## Details of crops and varieties used in experiment at various locations

| Crop | Variety | Duration (days) |
|---|---|---|
| **Bajaura** | | |
| Tomato (Summer) | *RK123* | Medium |
| French bean (Summer) | *Deepshikha* | Medium |
| Cauliflower (Summer) | *Megha* | Medium |
| French bean (*Kharif*) | *Falguni* | Medium |
| Cauliflower (*Kharif*) | *Swati* | Medium |
| French bean (*Kharif*) | *Long Yard (TN-18)* | Medium |
| Maize (*Kharif*) | *Girja* | Medium |
| Pea (*Rabi*) | *Azad P-1* | Medium |
| Cauliflower (*Rabi*) | *71 No* | Medium |
| Garlic(*Rabi*) | *GHC-1* | Long |
| Cauliflower (*Kharif*) | *Swati* | Medium |
| Pea (*Rabi*) | *Azad P-1* | Medium |
| **Bhopal** | | |
| Soybean | JS-335 | |
| D.Wheat | HI-8498 | |
| Mustard | Pusa Bold | |
| Chickpea | JG-130 | |
| Linseed | JL-9 | |
| **Calicut** | | |
| Ginger | Varada, Rejatha and Mahima | Short |
| Turmeric | Alleppey Supreme,Prathibha | Short |
| Black Pepper | Sreekara, Panniyur -1 | Long |
| **Coimbatore** | | |
| GM (Sunnhemp) | CO 1 | 45,46 |
| Cotton | MCU 12 | 148 |
| Maize | NK6240 | 105 |
| Chillies | PKM 1 | 172 |
| Sunflower | TNAU SFHCO2 | 101 |
| Brinjal | CO 2 | 172 |
| Daincha (Green manure) | Local | 57 |
| Rice | White Ponni | 154 |
| Greengram | CO 6 | 82 |
| G M (Sunnhemp) | CO 1 | 45 |
| Cotton | MCU 12/Suraj | 167/170 |
| Maize | CO1 | 93 |
| Chillies | K1 | 170 |

| Crop | Variety | Duration (days) |
|---|---|---|
| Sunflower | CO 4 | 92 |
| Brinjal | CO 2 | 170 |
| Sunflower | CO 4 | 92 |
| Daincha (GM) | Local | 63 |
| Rice | White Ponni | 141 |
| Greengram | CO 6 | 64 |
| **Dharwad** | | |
| Groundnut | GPBD-4 | 105-110 days |
| Rabi sorghum | DSV-4 | Medium |
| Soybean | JS-9305 | 85-90 days |
| Durum wheat | DWR 2006 | 85-90 days |
| Soybean | JS-9305 | 85-90 days |
| Pigeonpea | TS-3R | 180 days |
| Chickpea | JG-11 | 85-90 days |
| Cotton | DHB-915 | 175-180 days |
| Peas | Arka komal | 60 days |
| Maize | Arjun | 110-115 days |
| Chickpea | JG-11<br>JS-335 | Medium<br>85-90 days |
| G.Nut | Dh 4-3<br>Dh 86<br>Dh 2000-1<br>Dh 101<br>Mutant III<br>JL 24<br>TMV 2<br>TGLPS 3<br>GPBD 4<br>GPBD 5 | <br><br><br><br><br><br><br><br><br>105-110 days |
| Chickpea | JJ-11<br>BGD-103<br>A-1<br>BG-1105<br>BG-256<br>ICCV-10<br>KAK-2<br>ICCV-2 | Long<br><br>-<br>-<br>-<br>-<br>-<br>- |
| French bean | Arka Komal | |
| **Modipuram** | | |
| Basmati Rice | Basmati 370 / PB-2 | /120 |
| Rice | Saket-4 | |
| Maize cob | Star-56 | |
| Maize grain | Star-56 | |
| Wheat | PBW-343 | |
| Barley | Ajad | |
| Mustard | Pusa Bold | 115 |
| Radish | Ivory White | |
| Potato | Chipsona-3 | |
| Okra | Arka Anamika | |
| Green gram | SML-668 | |

| Crop | Variety | Duration (days) |
|---|---|---|
| Chickpea | Awarodhi | 160 |
| Cowpea | Pusa barsati | |
| Mungbean | Pusa Vishal | |
| **Jabalpur** | | |
| Basmati rice | Pusa Basmati -1 | 127 |
| Durum wheat | MPO – 1106 | 140 |
| Chickpea | JG-322 | 128 |
| Berseem | JB-1 | 174/160 |
| Veg.Pea | Arkel | 98 |
| Sesame | TKG-55 | 123 |
| Sorghum | MP Chari | 51 |
| Green manuring | sunhemp | 47 |
| **Karjat** | | |
| Rice | *Karjat - 4* | Early |
| Groundnut | *SB-XI* | Early |
| Maize (Sweet corn) | *Sugar-75* | Early |
| Mustard | *Varuna* | Early |
| *Dolichos* bean(Green pod vegetable) | *Konkan Bhushan* | Early |
| Red pumpkin | *MPH 1* | Medium |
| Cucumber | *Himangi* | Medium |
| Green gram | *Vaishali* | |
| Mango | *Alphonso* | 15 years old mango trees |
| **Ludhiana** | | |
| Cotton | F-1861 | |
| Chickpea | GPP-2/BG-1053 | |
| Maize | Peral Popcorn/PMH-1/J-1006 | |
| B.Rice | PB-2 | |
| Wheat | PBW-621 | |
| S.Moong | SML-668 | |
| Turmeric | Local | |
| Onion | Pb.Naroya | |
| Potato | Kufri Jyoti | |
| Bajra | PCB-164 | Short |
| Cowpea | CL-367 | Short |
| Sorghum | SL-44 | Short |
| Guara | Guara-80 | Short |
| Berseem | BL-10 | Short |
| Oats | OL-9 | Short |
| **Raipur** | | |
| Soybean | JS – 335 | Medium |
| Berseem | JB-2 | Medium |
| Isabgol | GI-2 | Medium |
| Onion | Nasik red | Medium |
| Safflower | NARI-NH 1 | Medium |
| Rice | Sugandhmati/ Kasturi | Medium |
| GM seeding | - | - |

| Crop | Variety | Duration (days) |
|---|---|---|
| GM Incorporation | - | - |
| 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 |
| **Pantnagar** | | |
| *Sesbania* | Ses pant - 1 | |
| Rice | Pusa Basmati -1 / Pusa basmati - 1121 | Medium |
| Wheat | PBW-343/ PBW-502 | Medium |
| Lentil | Pant Lentil - 8 | Medium |
| Vegetable Pea | Arkel | Early |
| *B. napus* | PRB 2004-3-04 | Medium |
| Chick pea | Pant Kabuli Chana-1 | |
| Maize | Kanchan | |
| Moong | Pant Moong-5 | |
| **Umiam** | | |
| Maize (green cob/seed) | DA 61-A | 80/110 days |
| Soybean | JS-80-21 | 40 days/142days |
| Frenchbean | Naga local | 100 days/120days |
| Toria | M-27 | 127 days |
| Tomato | Avinash-2 | 140 days/105days |
| Potato | Kufri jyoti | 105/110 days |
| Rice (sunken bed) *kharif* | IR-64/Lumpnah/Vivek dham/Sahsarang-1 | 142days/142days/ 132days/151days |
| Rice (raised bed) | Bhalum-1 | 125days |
| Carrot | New curoda | 98days |

# 10. ANNEXURE

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# ACRONYMS

ALE : Aquous leaf extract

ASE : Aquous seed extract

B:C : Benefit:Cost

BD : Biodynamic

CC : Cost of cultivation

CDM : Cowdung manure

Cu : Copper

EC : Enriched compost

ECe : Electrical conductivity

fb : followed by

Fe : Iron

FYM : Farm yard manure

GLM : Green leaf manure

GM : Green manure

GR : Gross returns

IM : Integrated management

K : Potassium

KC : Karanj cake

Mn : Manganese

MOP : Muriate of potash

N : Nitrogen

NC : Neem coated

NEOC : Non edible oil cakes

NPV : Nuclear Polyhedrosis virus

NR : Net returns

OC : Organic carbon

P : Phosphorus

PG : Panchagavya

pH : Negative logarithum of hydrogen ion concentration

PPM : Parts per million

RP : Rock phosphate

SSP : Single super phosphate

VC : Vermicompost

Zn : Zinc

# NOTES

# NOTES

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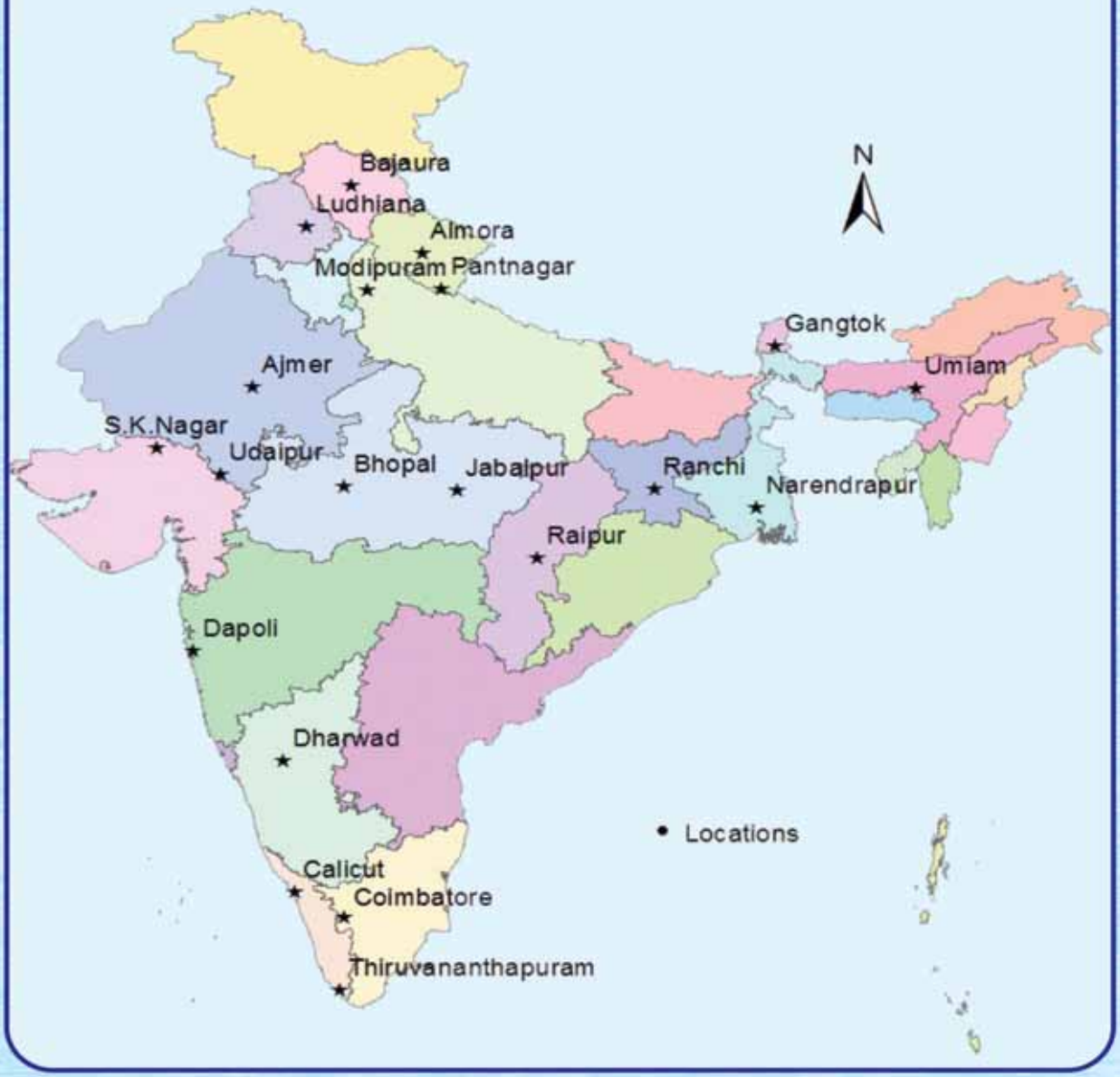
## Location of Network Project on Organic Farming (NePOF)

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