Annual Progress Report: 2016-17

2. Agronomy

Intercropping with Field bean and Finger millet

Harvester and modified seed cum fertilizer drill

Annual Progress Report: 2016-17

2. Agronomy

Contents

2. Agronomy

Executive summary

Field experiments were conducted during *Kharif* – Rabi 2016-17 at different AICRP Small millets centers to evaluate pre- released small millet genotypes for fertility response and to develop technologies for increasing productivity and profitability.

Evaluation of pre- released genotypes to fertility levels

- 100 per cent recommended dose of fertilizer was optimum to get higher yields in Finger millet, Foxtail millet and Proso millet, whereas 125 per cent RDF for Little millet.
- Test varieties of VL 379 (Finger millet), BL 150 (little millet), SiA 3163 (Foxtail millet) and TNPM 228 (Proso millet) were superior to local or national checks which gave 24.16 %, 49.49 %, 15.23 % and 28.13 % increase in grain yield respectively.

Nutrient management in small millets.

- Seed treatment with biofertilizers and micro nutrients along with RDF application was superior to raise the Finger millet production both under rainfed and irrigated condition.
- Inclusion of sunhemp as green manure in rice fallows and 75% RDF enhanced the productivity and profitability of succeeding finger millet in irrigated condition.

Assessing the performance of small millets to different sowing windows.

- Need based agronomic management practices are necessary to tackle mid and late season drought to increase yield level and for moisture conservation.

Weed management for small millets.

- Cultural practices like two inter cultivation along with one hand weeding improve the yield level in finger millet, kodo millet and little millet crops.

Conservation agriculture in small millets.

- Summer ploughing was a best practice for moisture conservation under rainfed conditions for cultivation of minor millets

Millet based cropping systems for sustainable productivity.

- Production of millets through inter/sequence cropping with legumes improve the soil health and productivity

Detailed report

2.1. Evaluation of pre- released genotypes to fertility levels

Field experiments were conducted at Almora, Athiyandal, Bengaluru, Jagdalpur, Kolhapur, Nandyal, Peddapuram, Ranichauri and Vizianagaram to evaluate the response of pre-released small millet genotypes to fertility levels. Results revealed that the grain yield and economics varied with locations and fertility levels (Table 2.1.1 to 2.1.6).

2.1.1. Finger millet

Fertility levels: Application of 100 per cent recommended dose of fertilizer (RDF) gave higher grain yield (3186 kg/ha) and B: C ratio (3.64). Increasing fertility levels increased the grain yield by 48.21 and 47.75% at Vizianagaram, Ranichauri respectively and decreased yield levels at Peddapuram (-72.72 %) and Almora (-80.38 %)

Performance of varieties: Test variety VL 379 was superior to local check with 24.11 % increase in grain yield followed by VL 352 (12.38 %). Test variety VL 379 was significantly superior to local check (34.44% increases) at Vizianagaram but no significant yield levels at Peddapuram and Almora. Test variety VL 352 gave 42.37% increase in yield at Ranichauri. Interaction between pre-released varieties and fertility levels were not significant. Test varieties were more remunerative than the respective check (Table 2.1.1).

2.1.2. Foxtail millet

Fertility levels: Significantly higher grain yield (21.20 % increases) was obtained in 100 per cent RDF application with B: C ratio of 3.07 at Nandyal

Performance of varieties: Test variety SiA 3163 recorded significantly higher grain yield of 15.24 % and B: C ratio of 3.16 followed by SiA 3159 (8.06 % increase). Interaction between pre-released varieties and fertility levels were not significant l. Test varieties were more remunerative than the local checks (Table 2.1.2).

2.1.4. Little millet

Fertility levels: Higher grain yield (1048 kg/ha) and B: C ratio 2.00 was recorded in 125 per cent RDF. Significantly increased the grain yield (71.53 % increase) at Jagdalpur and Athiyandal (28.87% increase) by Increasing fertility levels but Varied yield levels in Kolhapur

Performance of varieties: Test variety BL 150 was significantly superior to national check JK-8 and OLM 203 with 55.49 % and 49.45 % respectively followed by TNPSU 174 (19.61 and 14.96 % respectively). Test variety BL 150 was significantly superior to national check JK 8 (227.63% increase) and OLM 203 (168.63 %) at Jagdalpur. Test variety TNPSU 174 gave 24.77 and 51.15 % significantly higher yield over national checks at Athiyandal. Interaction between pre-released varieties and fertility levels were significant at Jagdalur but not significant at Kolhapur and Athiyandal. Test varieties were more remunerative than the national checks (Table 2.1.4).

2.1.6. Proso millet

Fertility levels: Higher grain yield (1370 kg/ha) and B: C ratio (1.52) was observed in 100 per cent RDF. Grain yield varied with different fertility levels. However higher grain yield of 86.22 % was noticed in 125 % RDF at Athiyandal and -9.89 % yield at Bengaluru.

Performance of varieties: Test variety TNPM 228 was significantly superior to local check GPUP 21 with 28 % increase in yield followed by TNPM 234 (19.32 % increase). Test variety DHPRMV 2721 was significantly superior to local check GPUP21 (20% increase) at Bengaluru, whereas TNPM 228 gave 47.32 % significantly higher yield at Athiyandal. Interaction between pre-released varieties and fertility levels were not significant. Test varieties were more remunerative than the local and national check (Table 2.1.6)

2.2 Nutrient management in small millets

2.2.1 Studies on seed palleting with biofertilizer and micro nutrients on growth and yield of finger millet

To develop package for low input management and to bring about ease in cultivation, an experiment was conducted for third successive season at Bengaluru and Kanke to study the effect of seed coating of biofertilizer *viz., Azospirillium brasilence*, *Bacillus megathelium* and *psuedomonos fluroscence* along with micro nutrients zinc sulhaphate and boron @ 3 grams / kg seed were evaluated at different fertility levels 50, 75 and 100 per cent RDF. The data on growth, yield and economics were presented in Table 2.2.1

Mean over location data indicated that seed treatment with biofertilizers and micro nutrients with 100 per cent RDF application gave higher grain yield (72.27 %) and B: C ratio (1.65) compared to absolute control but it was on a par with other treatments. Significantly higher grain yield (34.49 % increase) and B:C ratio (1.49) was obtained in Bengaluru by application of Farm yard manure (FYM) with micro nutrients and biofertilizer seed treatment, whereas grain yield of 100..92 % and B:C ratio of 2.01 was recorded in seed treatment with biofertilizers and micro nutrients with 100 per cent RDF application.

2.2.2. Studies on efficient fertilizer management in finger millet under irrigated condition (Mandya)

Efficacy of different doses of fertilizer application through briquettes *viz.,* 100 per cent, 75 per cent and 50 per cent RDF in comparison with SAU's recommendation and farmers practice trial was laid out to study the judicious use of fertilizers and economic benefit of system was conducted fourth successive seasons at Mandya under irrigated conditions (Table 2.2.2).

Higher grain yield (90.64 % increase), straw yield (117.68 % increase), higher net returns (Rs.92557) was recorded in application of RDF with 7.50 t/ha FYM compared to absolute control, which was on a par with 75 per cent RDF through briquettes gave 4637 kg/ha grain yield, straw yield (7465 kg/ha), seed weight (3.4 g) and highest B: C ratio (3.55).

2.2.3 Production package for organic finger millet under irrigated condition (Mandya)

To develop production package for organic finger millet, an experiment was conducted for the seventh successive seasons at ZARS Mandya to study the efficacy of different sources of organic manures on N equivalent basis (FYM, Poultry manure, press mud and composted green biomass) in enhancing productivity of finger millet. Growth, yield and economics recorded during *kharif* 2016 were presented in Table 2.2.3

Significantly higher grain yield (4616 kg/ha) and straw yield (7432 kg/ha) and B: C ratio (2.81) was obtained in SAU's recommended package compared to other treatments. However, it was on a par with that of application of 150 kg N through Pressmud (4616 kg/ha and 7307 kg /ha grain and straw yield respectively).

2.2.4 Production package for organic finger millet under rainfed condition

To know the efficacy of different organic manures *viz*., FYM, vermicompost, poultry manure and their combinations on yield and economics of finger millet experiment was conducted for fourth successive seasons at Kolhapur under rain fed condition (Table 2.2.4)

Application of recommended dose of fertilizer gave significantly higher grain yield (2094 kg/ha), straw yield (2774 kg/ha) and B:C ratio (1.37) compared to absolute control. Nutrient uptake and availability was also higher in RDF.

2.2.5 Fertilizer management for rice –ragi cropping sequence under irrigated condition at Mandya.

An experiment was conducted to know the effect of different levels of fertilizer application on rice- ragi and rice-*Sunnehemp*-ragi cropping system was initiated during 2014 at ZARS Mandya. The results of cropping season 2016 are presented in Table 2.2.5

Rice- S*unhemp* - Ragi crop sequence with 75% RDF recorded significantly higher grain yield (4168 kg/ha), straw yield (6975 kg/ha), gross return (Rs. 1,14,659/-), net return (Rs.68,826/-) and higher B: C Ratio (2.50) compared to Rice-Ragi sequence with 75 % RDF.

2.2.6 Effect of *Sesbania* mulching on productivity of finger millet

Study was conducted for the seven consecutive seasons at Almora to known the effect of with and without sesbania mulching along with different fertility levels on growth and yield of finger millet. The data on grain and straw yields are presented in Table 2.2.6

Significantly higher grain yield (10.37 %) and straw yield (13.32 %) was obtained in *Sesbania* mulching. Whereas 100 per cent RDF gave significantly higher grain yield (265.34 %) compared to absolute control.
Interaction between mulching and fertilizer levels was significant on grain yield. Mulching sesbania with 50 % RDF and 50 % FYM gave higher yield (2469 kg/ha)

2.2.7 Effect of plant growth promoting *rhizo* bacteria on growth, nutrient uptake and yield of Finger millet

An experiment was initiated at Almora to study the effect of different strains of Pseudomonas on grain yield of finger millet are presented in Table 2.2.7. Significantly increased grain yield of 15.67 per cent and straw yield (10.48 %) was obtained by application of Pseudomonas strain PGERs 17 compared to absolute control

2.2.8 Studies on zinc fortification in foxtail millet

To study the efficacy of zinc application through soil or foliar spray and their combinations on growth and yield of foxtail millet were undertaken in medium black soils of Nandyal under rainfed condition. The data on grain yield, economics and nutrient content were presented in Table 2.2.8.

There was no significant difference was observed in grain and straw yield by different methods of Zinc application. However, higher B:C ratio of 2.02 was noticed in soil application of $ZnSo_4$ at 25 kg/ha. Whereas significantly higher Zinc content in plant (76 ppm) and grain (85 ppm) as influenced by soil application of zinc sulphate at 12.50 kg/ha with foliar spray of 0.25 per cent.

2.2.9 Organic farming research in small millets – A comparative study

Field experiment was initiated on all millet centres during 2016 cropping season to study and evaluate the appropriate nutrient management practices in small millets and assess the grain quality (Table.2.2.9). All centre results revealed that integrated nutrient management practices gave superior yield level.

2.3 Assessing the performance of small millets to different sowing windows

2.3.1 Performance evaluation of different methods of crop establishment on growth and yield of finger millet under rainfed / irrigated condition.

Different methods of crop establishment were studied and evaluated under rainfed (Jagdalpur and Kanke) and irrigated condition (Mandya). The results are presented in Table 2.3.1.

Mean over location data indicated that SRI method of transplanting/sowing (transplanting 15 days old one seedling per hill (rainfed)/sowing 1-2 seeds per hill (irrigated)) gave 25.21 per cent higher yield, 12.71 per cent straw yield and B: C ratio of 2.52 compared to transplanting 2-3 seedlings per hill in flat bed but it was on a par with other treatments. Significantly higher grain yield (5248 kg/ha), straw yield (9503 kg/ha) and B: C (3.14) was recorded in SRI method of transplanting (transplanting 15 DOS one seedling per hill) at Kanke is a better practice of crop establishment for enhancing productivity. Whereas in Jagdalpur planting in ridges/ furrows was a better practice which gave significantly higher grain yield (6.60 %), straw yield (3.53 %) and B: C ratio (2.16) compared other methods of crop

establishment but it was on a par with other treatments. Increased grain yield (11.16 %), straw yield (13.38 %) and higher B: C ratio (2.68) was recorded in SRI method of sowing (sowing of 1to 2 seeds per hill) at Mandya under irrigated condition

2.3.2 Need based crop management practices to mitigate drought under rainfed condition (response farming): Addressing the problem of climate change

An experiment was initiated during 2012 to evaluate different need based agronomic management practices/ drought mitigation practices for tackling aberrations (early season, mid season and late season droughts) that may occur during the crop calendar at Bengaluru and Athiyandal. The data of *Kharif* 2016 on yield and economics were presented in Table 2.3.2

Mean over location data indicated that mid season drought influencing more on yield and economics. Higher yield (984 kg/ha) and straw yield (1650 kg/ha) was obtained in mid season drought. Among need based agronomic practices, dry sowing recorded higher yield (980 kg/ha) and it is best adopted to mitigate drought. During the cropping season 2016 Bengaluru experienced early, mid and late season drought. Results showed that late season drought gave higher yield (1028 kg/ha) and B: C ratio (1.28) which influence on yield levels. Among management practices application of 150% RDF N immediately after alleviation of stress influenced yield levels about 1008 kg/ha. Mid season drought was experienced at Athiyandal which gave 995 kg/ha grain yield with B: C ratio of 1.1. Among management practices sowing of seeds under dry season gave (1025 kg/ha) yield level.

2.3.3 Effect of sowing dates and finger millet varieties for delayed sowing condition at Kolhapur

To find out right time of sowing and suitable varieties of finger millet to fit into contingency planning, an experiment was initiated at Kolhapur during 2013. The data on growth and yield of the experiment 2016 are presented in Table 2.3.3. Finger millet sown during 4th week of June recorded significantly higher grain and straw yield (1891 and 2458 kg/ha. respectively) however; it was on a par with finger millet sown during 2nd week of July. Significantly higher grain yield and straw yield (1771 and 2266 kg/ha respectively) was recorded with the variety Phule Nachani which was on a par with the variety GPU 28. The interaction effects between sowing dates and varieties were found to be non significant.

2.3.4 Screening of small millets for problematic soils

An experiment was conducted during 2012 cropping season at Athiyandal for screening and selection of suitable crop and varieties under alkaline soils. The data on grain yield for the cropping season 2016 are presented in Table 2.3.4.

Crops: Finger millet recorded significantly higher grain (2029 kg/ha) and straw yield (3122 kg/ha) followed by Kodo millet recorded grain yield of 1823 kg/ha and straw yield of 2845 kg/ha.

Varieties: Performance of small millet varieties revealed that Co 15 of Finger millet (27.30 %), TNAU 86 of Kodo millet (56.91%), CO 2 of Barnyard millet (37.29%), CO 7 of Foxtail millet (35.95 %), CO 4 of Little millet (32.25 %) and TNPM 228 of Proso millet (47.21%) gave higher grain yield. The interaction effects found to be significant between the crops and varieties.

2.3.5 Evaluation of different dry land crops under late sown conditions.

Evaluation of suitable dry land crops for vagaries of monsoon and fit into contingency planning was studied at Nandyal during 2016. The data on grain yield and economics were presented in Table 2.3.5.

Among different crops sown sunflower gave higher yield (2133 kg/ha) and B: C ratio (4.65) followed by jowar (1444 kg/ha) red gram was a better choice which gave significantly higher foxtail millet grain equivalent yield (7090 kg/ha)

which was followed by cluster been cotton and castor (4496, 4063 and 3478 kg/ha. FTMGEY respectively). Soybean, foxtail millet and sun flower (1444, 1713 and 1980 kg/ ha, respectively) gave lowest yield.

2.4 Weed management for small millets

2.4.1 Chemical weed control studies in finger millet under rainfed / irrigated conditions

To find out the efficacy of pre-emergent herbicides either alone or combined with one Intercultivation were compared with standard cultural practice of two Intercultivation and one hand weeding experiment was initiated during 2015 cropping season at Bengaluru, Athiyandal, Kanke, Kolhapur, Jagdalpur, Mandya and Vizianagaram. The data on yield and B: C ratio of *Kharif* season 2016 was presented in Table.2.4.1

The results revealed that on location mean basis, two inter cultivation along with one hand weeding significantly increased grain yield (80.75 %), straw yield (80.44 %) and B: C ratio (1.97) was noticed both in rainfed and irrigated condition. Next best was Pre emergence application of Isoproturon @ 0.5 kg a.i. / ha along with one intercultivation (68.50 %, 71.76 % and 2.08 of grain yield, straw yield and B: C ratio respectively). Two intercultivation with one hand weeding gave significantly higher grain yield (1567, 2245, 4289, 2514, 1838, 4697 and 2385 kg/ha at Bengaluru, Athiyandal, , Kanke, Kolhapur, Jagdalpur , Mandya (irrigated) and vizianagaram (irrigated),respectively) compared to absolute control.

2.4.2 Weed management studies in finger millet under irrigated condition

Field experiment was laid out at Mandya during 2016 to know the efficacy of pre-emergent and post emergent herbicides with one Intercultivation on growth and yield of finger millet. The data on yield and B:C ratio are presented in Table 2.4.2.

Among the different weed management practices, significantly higher grain yield (4569) and straw yield (6899 kg/ha) was recorded with Pre-emergent application of butachlor 750 g a.i./ha with one hand weeding which was on a par with that of two intercultivation and one hand weeding (4466 kg/ha) and post emergement application of ethoxysulfuron 10SC 15 g a.i./ha (4300 kg/ha).

2.4.3 Evaluation of pre and post emergence herbicides in foxtail millet during summer under irrigated condition

Study the effect of pre emergence application of butachlor at 0.5 kg and 1.0 kg a. l/ha and post emergence application of 2, 4-D Na salt @ 0.5 kg/ha either single or combination to reduce weeds and enhancing productivity of foxtail millet experiment was initiated at RRS Nandyal during 2014 *kharif* under irrigated conditions. The data on grain and straw yield of 2016 cropping season are presented in Table 2.4.3.

Pre-emergence application of oxadiargyl @ 70 gm/ha gave significantly higher yield of 2443 kg/ha followed by pre-emergence application of pretilachlor @0.75 kg/ha (2435 kg/ha) and straw yield of 4956 kg/ha. Weed control efficiency (78.60 %) was higher in hand weeded. Unweeded check gave lower grain yield (1711 kg/ha).

2.4.4 Chemical weed control studies in Kodo millet under rainfed condition

An experiment was conducted to known the efficacy of different pre-emergent herbicides either alone or combination with Intercultivation practices were studied at Athiyandal, Dindori, Jagdalpur and Rewa centres during *kharif* 2016 (Table 2.4.4).

Mean over locations data indicated that two inter cultivation along with one hand weeding significantly increased grain yield (1691 kg/ha), straw yield (2635 kg/ha and plant height (76.97 cm). Results of Athiyandal and Dindori indicated that two intercultivation with one hand weeding gave significantly higher grain yield (1155 and 1930 kg/ha,

respectively). Whereas in Jagadalpur pre emergence application of Isoproturon @0.5 kg a. I /ha along with one inter cultivation gave significantly higher grain yield (1752 kg/ha), straw yield (6381 kg/ha) and (B: C ratio 2.09).

2.4.5 Chemical weed control studies in little millet

Field trials were conducted at Athiyandal and Jagdalpur to find out the efficacy of different herbicide for controlling weeds and increase the profitability of little millet crop during *kharif* 2016.The data on yield and economics are presented in Table 2.4.5. Results revealed that yield levels varied with locations. Standard cultural practice of two inter cultivation and one hand weeding gave significantly higher grain yield (1079 kg/ha) at Athiyandal but it was on a par with pre emergence application of isoproturon @ 0.5 kg a.i/ ha along with one inter cultivation at 40-45 DAS (985 kg/ha), whereas at Jagdalpur pre-emergence application of isoproturon @ 0.5 kg a.i/ha along with one Intercultivation at 40-45 DAS gave significantly higher grain yield (1551 kg/ha).

Mean over location data also indicated that, two inter cultivation and one hand weeding gave significantly higher grain yield (1079 kg/ha) followed by pre-emergence application of isoproturon @ 0.5 kg a.i / ha along with one Intercultivation at 40-45 DAS was a better weed management practice for getting higher productivity of little millet (985 kg/ha).

2.4.6 Effect of different methods of crop and weed management practices on growth and yield of barnyard millet

To improve the productivity and profitability of barnyard millet by adopting different crop and weed management practices were studied at Ranichauri (Table 2.4.6). The results indicated that, among different crop establishment methods, using high seed rate 15-18 kg/ha gave higher grain yield (2382 kg/ha), straw yield (6117 kg/ha) and B:C ratio (3.36). Whereas in weed management practices, one intercultivation with one hand weeding gave significantly higher grain yield (2321 kg/ha), straw yield (5754 ka/ha) and B: C ratio (2.88).

2.5 Conservation agriculture in small millets

2.5.1 Conservation farming and its effects on yield of finger millet

Field experiment was initiated on Finger millet during 2013 cropping season at Berhampur, Jagdalpur and Kanke to find out the effect of moisture conservation practices to bring stability and sustainability in production. The data on yield and economics of Kharif season 2016 are presented in Table. 2.5.1.

Results revealed that summer ploughing gave comparable grain yield (2740 kg/ha), straw yield (6192 kg/ha), HI and B: C ratio (1.43). whereas in cultural practices, combination of opening of a conservation furrows after every 6-8 rows, mulching with crop residues, weed control through herbicide and rotation with legumes are necessary to get higher yield levels (3393 kg/ha), straw yield (7271 kg/ha) and B:C ratio (1.68). Similar trend was observed in Kanke and Jagdalpur with respect to tillage practices. Whereas in Berhampur conservation/minimum tillage gave higher grain yield (2122 kg/ha).

2.5.2 Effect of moisture stress at different growth stages of foxtail millet

Field experiment was initiated during summer 2013-14 at Nandyal to know the effect of moisture stress at different growth stages of foxtail millet. The data on grain yield, straw yield and available soil moisture for the year 2015-16 were presented in Table.2.5.2. Results revealed that pre- sowing irrigation and irrigation at 20-25 and 40-45 days after sowing of foxtail millet was found to significant and gave higher grain yield (2262 kg/ha) and straw yield (5448 kg/ha) which was on a par with pre sowing irrigation and providing irrigation at 40-45 and 60-65 days after sowing (2042 kg/ha). Available moisture decreased with increasing crop duration.

2.5.3 Studies on conservation farming and its effects on growth and yield of Kodo millet

To study the effect of moisture conservation practices followed during *kharif* season on the productivity of kodo millet, an experiment was conducted at, Dindori and Rewa for the 4th successive season. The data on yield and economics for the cropping season 2016 are presented in Table 2.5.3.

Conservation or minimum tillage gave higher yields (2856 kg/ha) with B:C ratio of 1.98 and combination of cultural practices like opening of conservation furrow after every 6-8 rows, mulching with crop residues, hebicide application and rotation with legumes every alternate year gave significantly higher grain yield (2985 kg/ha) and B:C ratio 2.01. Similar trend was also observed in Dindori.

2.5.4 Studies on conservation farming and its effects on growth and yield of little millet

To study the effect of moisture conservation practices followed during *kharif* season on the productivity of little millet, an experiment was conducted at Berhampur, Kanke, Dindori and Rewa for the 4th successive season. The data on yield and economics for the cropping season 2016 are presented in Table 2.5.4.

Mean over location data revealed that summer ploughing was a good conservation practices to get higher yields in little millet which gave higher grain yield (1462 kg/ha) and combination of cultural practices like opening of conservation furrow after every 6-8 rows, mulching with crop residues, hebicide application and rotation with legumes every alternate year gave significantly higher grain yield (2094 kg/ha). Similar trend was also observed in Berhamur, Kanke, Dindori and in Rewa Conservation or minimum tillage gave higher yields (876 kg/ha)

2.6 Millet based cropping systems for sustainable productivity

2.6.1 Inter cropping studies in finger millet

To improve the productivity and profitability of finger millet to introduce inter cropping system which enhance the yield and soil health. An experiment was initiated at Berhampur, Jagdalpur and Vizianagaram during 2014 cropping season. The data on grain yield, inter crop yield, finger millet grain equivalent yield for *Kharif* 2016 season are presented in Table.2.6.1.

Results indicated that sole crop of finger millet gave significantly higher grain and straw yield (1902, 2996 and 5219, 7880 kg/ha at Berhampur and Vizianagaram respectively), whereas in Jagdalpur inter cropping of finger millet + cow pea (8:2) gave significantly higher yield (1883 kg/ha). On mean basis, Maximum grain yield (1992 kg/ha) was recorded by sowing of sole finger millet followed by finger millet + Bhendi (8:2) inter crop gave 1986 kg/ha yield and B: C ratio (2.7).

2.6.2 Inter cropping studies in Finger millet + Amaranthus

Field experiment was conducted at Ranichauri to find out feasibility inter cropping of finger millet and amaranthus and optimum spatial ratio and initiated during 2015 cropping season under rainfed condition. The data on finger millet equivalent yield and economics of the cropping season 2016 are presented in Table 2.6.2.

Higher finger millet grain and straw equivalent yield (1712 and 4775 kg/ha, respectively), Net return (Rs.30144), B: C ratio (2.21) was recorded in Mixed cropping of finger millet and Amaranthus (90:10 by weight) compared to farmers practice.

2.6.3 Inter cropping studies in Foxtail millet

An experiment was initiated at Nandyal during 2016 to find out feasible inter cropping system in foxtail millet to enhance yield and soil fertility. The data on foxtail millet equivalent yield and inter crop yield are presented in Table 2.6.3.

Results revealed that intercropping of green gram with foxtail millet at 3:3 ratio gave higher foxtail millet grain equivalent yield (729 kg/ha) and inter crop yield (157 kg/ha). However higher grain yield (370 kg/ha) of foxtail millet was observed in inter cropping of foxtail millet with black gram (3:3 ratio).

2.6.4 Intercropping studies in Kodo millet

To select a suitable inter crops in Kodo millet an experiment was conducted at Jagdalpur and Rewa centres during *kharif* 2015 cropping season (Table 2.6.4).

Different crops were tried as inter crop in Kodo millet, significantly higher grain yield (2346 and 2021 kg/ha), Net returns (Rs.34591 and Rs.33068) and higher B: C (4.53 and 2.05) was obtained in sole crop of Kodo millet at Jagdalpur and Rewa respectively followed. Next best was Kodo millet + maize (8:2) inter cropping at Jagdalpur (1675 kg/ha) and Kodo millet + pigeon pea (8:2) inter cropping at Rewa centre (1723 kg/ha). Mean over locations data indicated that, sole crop of Kodo millet was a better cropping system for getting higher kodo millet grain equivalent yield (2183 kg/ha).

2.6.5 Inter cropping studies in little millet

Different dryland crops were tested as intercrops in little millet to select a suitable and remunerative inter crop in little millet a study was conducted at Athiyandal, Dindori and Rewa centres. The data on yield and economics are presented in Table.2.6.5.

Results revealed that at Athiyandal: Intercropping of Little millet + urd gave significantly higher little millet grain equivalent yield (3312 kg/ha), whereas higher B: C ratio was noticed in little millet plus pigeon pea inter cropping (2.40) followed by little millet + bhendi (8:2) (2.31). Mean over years data also showed similar trend. Intercropping of little millet and pigeonpea (8:2) gave higher little millet grain equivalent yield (1880 and 3492 kg/ha, respectively at Dindori and Rewa) compared to other intercropping systems tried.

Mean over locations data showed that, intercropping of little millet and pigeonpea (8:2) gave higher little millet grain equivalent yield and B:C ratio (2813 kg/ha and 2.02).

2.6.6 Sustainable intercrop association of Niger in little millet

Sole crop of little millet recorded highest grain (1080 kg/ha) and straw yield (14.04 kg/ha), LMGEY (2230 kg/ha) and Higher B: C ratio (1.34) which was significantly superior over all other treatments. Among inter crops little + Niger (4:1) gave higher yield (Table.2.6.6)

2.6.7 Sequence cropping studies in little millet

Field experiment was conducted at Berhampur, Dindori, Kanke, Jagdalpur and Rewa centres to identify a suitable sequence crops after little millet.(Table 2.6.7).

Mean over locations data revealed that higher grain yield (1174 kg/ha) was obtained by introducing safflower or cowpea as sequence crop after little millet. Whereas higher B:C ratio (2.22) was recorded in little millet followed by lentil. Among locations sequence cropping of little millet and niger or lentil or gaur gave higher grain yield (1777 kg/ha at Jagdalpur, 722 kg/ha at Kanke and sole crop of little millet at Rewa (1243 kg/ha) compared to other crop combinations.

2.6.8 Inter copping studies in barnyard millet

Field experiment was conducted at Ranichauri to find out feasibility inter cropping of barnyard millet and amaranthus and optimum spatial ratio and initiated during 2015 cropping season under rainfed condition. The data on barnyard millet equivalent yield and economics of the cropping season 2016 are presented in Table.2.6.8. Higher barnyard millet grain and straw equivalent yield (2012 and 5358 kg/ha, respectively), Net return (Rs.37310), B: C ratio (2.73) was recorded in Mixed cropping of barnyard millet and Amaranthus (90:10 by weight) compared to farmers practice.

2.6.9 Identification of profitable barnyard millet based cropping sequence in organic mode under rainfed conditions

An experiment was initiated during *kharif* 2010 at Ranichauri for Identification of profitable barnyard millet based cropping sequence in organic condition was evaluated to select suitable and profitable cropping systems (Table. 2.6.9). Results revealed that application of 7.5 t FYM /ha gave significantly higher grain yield (2445 kg/ha) compared to without FYM (1982 kg/ha). Among different crop sequences studied barnyard millet grain equivalent yield was not significant.

2.7 Mechanization in small millets

2.7.1 Mechanization in foxtail millet

Field experiment was conducted to evaluate different mechanical sowing methods of foxtail millet at Nandyal. Among different sowing methods, using tractor drawn seed drill for sowing gave higher grain yield (55 %) compared to Farmers Practice and it is economically feasible (Table 2.7.1).