academicJournals

Vol. 10(49), pp. 4505-4514, 3 December, 2015
DOI: 10.5897/AJAR2013.8312
Article Number: 0C94FCC56254
ISSN 1991-637X

http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Participatory seed production of small millets among tribal farmers of Bastar region, Chhattisgarh, India

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Received 30 November, 2013; Accepted 21 August, 2015

Small millets could be better option under vagaries of rainfall and dry situation of the region when rice and other crops get failed regularly because it tolerates water stress, drought and erosion. Plenty of lands were available as upland in this region which might be converted in small millets production by participation of farmer in seed production programme for uplifting economic of farmers. Ten clusters were formed involving villages with initial technological supports to enhance productivity. The productivity of small millets from 4.00 to 20 q/ha on average with introduction of improved varieties, line sowing, weed management, nutrient management as rain fed system.

Key words: Front line demonstration, small millets, seed production, participatory mode.

INTRODUCTION

Bastar District is a southern part of the Chhattisgarh having an area of 8755.79 km² and Jagdalpur is the district headquarters. According to the 2011 census the district has a population of 1,411,644, roughly equal to the nation of Swaziland or the US state of Hawaii, in which more than 65% population belong to tribes like *Maria, Muriya, Bhatra, Halba, Gond, Parja, Dhurva* etc.. The district has a population density of 140 inhabitants per square kilometre. Rice is grown predominantly during *kharif* season as rain fed crop having 2.39 lakh hectare area but the productivity of this crop is very low 8.53 q/ha in Bastar region of Chhattisgarh. The irrigated area is 1.67% and irrigation coverage is only 1.2% whereas fertilizer use (4.6 kg/ha) are very less, which is insufficient to supply adequate nutrient to the high demand crops. The pattern of livelihood in Bastar continues to be dictated by agricultural practices are traditional. Use of wooden ploughs is overwhelming while the number of iron ploughs is negligible. The same is true of bullock carts *viz.*, the number of tractors is negligible while the bullock carts are all pervasive. The usage of traditional agricultural implements has lowered the production of agriculture. The *kharif* crops grown here are paddy, small millets, horse gram, urd, arhar, jowar and maize. Under such situation, only small millets can be grown because it is in their food habit and cultivation practices where rice cannot perform well in uncertain rainfall and sometimes rice completely fails to due this factor, but small millets could be a good answer for the situation because it requires less rain than rice and other; tolerant drought, erosion control. Plenty of land available as upland in this region which might be converted in seed production of small millets on upland during *kharif*. This concept was kept in mind in inception of seed production programme

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Figure 1. Weed management by intercultural operation in kodo millet.

Figure 2. Contingency crop planning by gap filling.

so that farmers can get handsome returns.

METHODOLOGY

The targeted villages were grouped in clusters of 3 to 10 villages as per the farmers who were grew small millets, ten clusters viz., cluster 1: Bastanar cluster 2: Turenar, Cluster 3: Tokapal, cluster 4: Kumali, cluster 5: Chitrakote, Cluster 6: Dharmaur, cluster 7: Narayanpur, Cluster 8: Bakawand, Cluster 9: Dantewada and cluster 10: Mendri. The technologies given to every clusters were varieties (improved vs. local land races), crop establishment methods (line sowing vs. broadcasting), weed management (mechanical and herbicidal vs. control) nutrition (nitrogen, phosphorus and potash); two groups were formed after selection of site and farmer as seed production included foundation and certified seed production whereas grain production included truth label seed or below grade on farmers' fields for on consumption and selling in markets (Samui et al., 2000). On the basis of farmers' investment analyzed the cost of cultivation, gross income, net income and benefit-cost ratio along with areas coverage on upland on clusters previous and present situation. The following steps were taken in formulation of research and extension works:

Step I: Replacement of existing local landraces by giving them improved cultivars and kept other agronomical approaches similar as they adopted earlier *viz.*, broadcasting of seeds, no weeding and no nutrient management. This replacement made the farmers to adopt the new intervention because farmers apparently found yield enhancement and opened the opportunity to involve new agro-techniques for motivation and adoption.

Step II: Another important innovation was intervened through demonstration of line sowing by seed drill. The problems consorted in line sowing due to lack of suitable implement for small millets; mostly traditional implements were used in farming. This was solved initially by bamboo based *Nari* plough fitted in country plough along with plastic funnel where only seeds were poured. Shorter window of sowing, the rainfed upland rice is commonly sown than small millets in broadcasting method and millets are next crops. Now-a-day rainfall uncertainty made them compulsion to change the upland crops under such adverse situation. This made farmers to mold very easy for adopting line sowing technologies in small millets over rice and triggered in coming years with introduction of seed-cum-fertilizer drill (bullock drawn) and demonstrated on farmer's field in presence of 50 farmers. This time seed sowing and fertilizer application was done in lines. But large areas were not covered until the tractor drawn drill was introduced in next years (Figure 8).

Step III: The uplands were almost followed aerobic cultivation provided wide range of growing environment to the weeds. The weeds were competed with crops initial 15 to 30 days; hence it would be managed properly by manual and mechanical methods but manual weeding is costlier due to labour engaged. The weeds were suppressed by summer ploughing which reduced up to 60% and remaining were managed by application of isoproturon and oxyflourfen at 0.5 kg/ha as pre-emergence. Lines were maintained 30 cm apart, this space was used for weed management by running *desi* plough (Beushening plough), the plough are smaller in size to run in between rows, simultaneously suppressed the weeds, aerated root zones and loosened the soil profile. These practices adopted for suppressing the weeds up to 70% with higher yield was demonstrated after adoption of line sowing practices, which was effective in controlling weeds (Figure 4).

Step IV: Small millets are livelihood crop of tribal communities but due to introduction of commercial crops on uplands slashed the area coverage in this region; and it was still under the great pressure of crops dwindling but this has been taken as a challenge in 2003 onward under AICSMIP to enhance the coverage over uplands. Initially it was provided inputs in form of seeds, fertilizer and techniques to farmers and gradually became adoptive and started using their own inputs; the upland rice is not productive so much on same piece of land shifted toward small millets cultivation now.

Step V: Under motivation and adoption of technologies boosted the famers for producing the quality seed on their own lands. The foundation and certified seed of ragi (finger millet), kodo millet and little millet are being adopted by the farmers and earned higher income than truth label (T/L) seed production. After registration they are assured for seed lifting made famers to cultivate the small millets. The quality seed production also contributed to Seed Certification Corporation because it is a pocket specific crops and it could not be produced somewhere else in country except some particular region.

RESULTS AND DISCUSSION

Entry of new cultivars

New varieties (Table 1) have their own dimension but

Table 1. Varieties performed under farmers' field with improved technologies in last ten years.

S/N	Crop	Varieties	Liking feature	Area coverage (acre)	Yield potential (q/ha)	Increased % over local
1	Finger millet	GPU 28	High yielding, rain fed cultivar, long open finger	600	20-30	200
		VR 708,	High yielding, suited for stress condition	300	20-25	175
		Rantagiri	High yielding, Short stature, medium finger	200	18-20	150
		VL 149	High yielding, Pigmented finger	120	15-20	140
		PR 202	High yielding, tolerant to blast	100	15-18	135
2	Kodo millet	RBK 155	Regular raceme, compact grains, more productive	400	18-25	150
		JK 48	More tillers, lodging tolerant, high yielding	250	15-20	140
3	Little millet	JK 8	High yielding, lax panicle	200	5-8	200
		BG 1	Medium height, synchronized maturity	120	4-6	180

with the time and requirement changed the potentiality. Fine tuning with agronomical demand of cultivars could be resulted in higher production by introducing new cultivars over existing locals. The change was seen with 200% yield enhancement in last 10 years on demonstration fields. Quality seed (foundation and certified) production on farmers' fields can be a way of revenue generation in near future under demand of 100 to 500 quintal seed yearly.

Refined technologies

Traditional technologies need refinement with present demand because earlier practices were not synchronized to pace of production (Mokidue et al., 2011). In remote areas, the traditional plough are still under use requires new bullock drawn implements and optimum mechanization. So, it is compulsion to refine the existing techniques crop establishment, broadcasting of seeds created the problem for weeding which might be answer is line sowing provided good mechanical weed management practices in between rows needed weed management (mechanical, herbicidal and IWM) (Figure 4 and 9).

Nutrient management

At the time of programme planning less number of farmers were applied fertilizer on upland that causes the drastic reduction in yield potential due to depletion of available nutrients of the soil without proper nutrient management (not only major nutrients but secondary nutrient also) for improving yield. Time of sowing (shifting of monsoon from mid June to Mid July) is also managed as per the monsoon early or late onset which increases the success over failures in traditional system and broadcasting can be replaced with line sowing (Hiremath and Nagaraju, 2010). Line sowing opened the way of nutrient management by placing fertilizers in rows which enhanced the yield in critical period of demand detailed in Tables 2 to 4, Figures 5 and 6.

Mechanization

The expansion of land coverage on cultivation of small millets was required which was done through mechanization. In similar concept, adoption of improved practices and drudgery reduced in sowing by seed cum fertilizers drill improved yield potential and same time labour engagement was cut down under shortage of laboring. Introduction of the bullock drawn and tractor drawn implements were introduced as per need of farmer (Figure 10). Definitely they became habitual to use this system in all clusters at least 50% of adopted farmers in 10 years, which are now sharing the implements during cropping season in same cluster. Jeengar et al. (2006) found that use of machineries in reducing drudgery was remunerative and time manager (Figures 1, 2, and 3).

Seed bank

Continuous replacing of local land races with improved varieties supported the higher production of small millets created the demand among the farmers through barter system (exchange method) or giving to relatives when they come as guest in home of the farmers. Ultimately this could run the channel of popularized in untouched areas and quite often spread in weekly or daily local market (*Hadri* or *Pasra*) of nearby villages. The village seed bank itself generated due to introduction of technologies and motivation the farmers; now they started keeping the seed in traditional or improved structure as available with them like paddy storages. It was easily maintained since they had their own established system in villages. In case of crop failure, this

Table 2. Impact of improved agro-techniques on yield potential of small finger millets (mean of ten years)

Target	Village	Farmer	Crop establishment			Nutrition			Varieties			Weed management		
			LS	BC	Increase %	Bal fert(NPK)	No Fert	Increase %	Imp	Local	Increase %	Herb	Local	Increase %
Cluster 1	7	15	20.23	5.23	386.81	17.78	6.05	294.12	22.58	7.13	316.69	20.44	7.18	284.68
Cluster 2	6	13	21.35	6.35	336.22	18.90	5.34	353.93	23.70	8.25	287.27	21.56	8.30	259.76
Cluster 3	8	21	18.25	3.25	561.54	15.80	4.56	346.49	20.60	5.15	400.00	18.46	5.20	355.00
Cluster 4	5	15	24.35	9.35	260.43	21.90	8.76	250.00	26.70	11.25	237.33	24.56	11.30	217.35
Cluster 5	6	14	26.67	9.67	275.80	24.22	9.80	247.14	29.02	13.57	213.85	26.88	13.62	197.36
Cluster 6	4	12	24.37	9.37	260.09	21.92	7.86	278.88	26.72	11.27	237.09	24.58	11.32	217.14
Cluster 7	3	17	17.89	2.89	619.03	15.44	6.09	253.53	20.24	4.79	422.55	18.10	4.84	373.97
Cluster 8	5	18	23.45	8.45	277.51	21.00	9.48	221.52	25.80	10.35	249.28	23.66	10.40	227.50
Cluster 9	5	15	23.34	8.34	279.86	20.89	10.35	201.84	25.69	10.24	250.88	23.55	10.29	228.86
Cluster 10	5	16	16.75	1.75	957.14	14.30	4.78	299.16	19.10	3.65	523.29	16.96	3.70	458.38
Mean	5.40	15.60	21.67	6.47	421.44	19.22	7.31	274.66	24.02	8.57	313.82	21.88	8.62	282.00

*LS, line sowing; BC, benefit:cost ratio; Bal Fer, balance fertilizers; NPK, nitrogen, phosphorus and potash and herb- herbicides.

Table 3. Impact of improved agro-techniques on yield potential of small kodo millets (mean of ten years).

Target	Village	Farmer	Crop establishment			Nutrition			Varieties			Weed management		
			LS	BC	Increase %	Bal fert (NPK)	No Fert	Increase %	Imp	Local	Increase %	Herb	Local	Increase %
Cluster 1	9.00	16.00	15.48	6.94	223.05	15.02	5.03	298.61	16.91	5.86	288.57	15.87	5.09	311.79
Cluster 2	8.00	13.00	16.60	8.06	205.96	16.14	4.32	373.61	18.03	6.98	258.31	16.99	6.21	273.59
Cluster 3	10.00	22.00	13.50	4.96	272.18	13.04	3.54	368.36	14.93	3.88	384.79	13.89	3.11	446.62
Cluster 4	7.00	15.00	19.60	11.06	177.22	19.14	7.74	247.29	21.03	9.98	210.72	19.99	9.21	217.05
Cluster 5	8.00	17.00	21.92	13.38	163.83	21.46	8.78	244.42	23.35	12.30	189.84	22.31	11.53	193.50
Cluster 6	6.00	13.00	19.62	11.08	177.08	19.16	6.84	280.12	21.05	10.00	210.50	20.01	9.23	216.79
Cluster 7	5.00	17.00	13.14	4.60	285.65	12.68	5.07	250.10	14.57	3.52	413.92	13.53	2.75	492.00
Cluster 8	6.00	19.00	18.70	10.16	184.06	18.24	8.46	215.60	20.13	9.08	221.70	19.09	8.31	229.72
Cluster 9	7.00	21.00	18.59	10.05	184.98	18.13	9.33	194.32	20.02	8.97	223.19	18.98	8.20	231.46
Cluster 10	8.00	17.00	12.00	3.46	346.82	11.54	3.76	306.91	13.43	2.38	564.29	12.39	1.61	769.57
Mean	**7.40**	**17.00**	**16.92**	**8.38**	**222.08**	**16.46**	**6.29**	**277.93**	**18.35**	**7.30**	**296.58**	**17.31**	**6.53**	**338.21**

*LS, line sowing; BC, benefit:cost ratio; Bal Fer, balance fertilizers; NPK, nitrogen, phosphorus and potash and herb- herbicides.

system would help to revive this in coming year as managed in this way. Areas expansion became easier when it was linked with seed production programme on farmers' field under rain fed condition for sustainability of small millets; whereas almost other cereals failed quite often

Table 4. Impact of improved agro-techniques on yield potential of small little millets (mean of ten years).

Target	Village	Farmer	Crop establishment			Nutrition			Varieties			Weed management		
			LS	BC	Increase %	Bal fert (NPK)	No Fert	Increase %	Imp	Local	Increase %	Herb	Local	Increase %
Cluster 1	6	13	12.48	3.94	316.75	12.02	3.25	369.85	13.91	1.29	1078.29	12.87	2.09	615.79
Cluster 2	5	10	13.60	5.06	268.77	13.14	2.54	517.32	15.03	2.41	623.65	13.99	3.21	435.83
Cluster 3	7	19	10.50	1.96	535.71	10.04	1.76	570.45	11.93	2.18	547.25	10.89	1.89	576.19
Cluster 4	4	12	16.60	8.06	205.96	16.14	3.96	407.58	18.03	5.41	333.27	16.99	3.29	516.41
Cluster 5	5	14	18.92	10.38	182.27	18.46	4.09	451.34	20.35	7.73	263.26	19.31	2.90	665.86
Cluster 6	3	10	16.62	8.08	205.69	16.16	3.06	528.10	18.05	5.43	332.41	17.01	1.97	863.45
Cluster 7	2	14	10.14	1.60	633.75	9.68	1.29	750.39	11.57	2.09	553.59	10.53	1.78	591.57
Cluster 8	3	16	15.70	7.16	219.27	15.24	4.68	325.64	17.13	4.51	379.82	16.09	3.20	502.81
Cluster 9	4	18	15.59	7.05	221.13	15.13	3.67	412.26	17.02	4.40	386.82	15.98	3.87	412.92
Cluster 10	5	14	9.00	0.46	1956.52	8.54	3.45	247.54	10.43	2.08	501.44	9.39	2.16	434.72
Mean	**4.40**	**14.00**	**13.92**	**5.38**	**474.58**	**13.46**	**3.18**	**458.05**	**15.35**	**3.75**	**499.98**	**14.31**	**2.64**	**561.56**

*LS, line sowing; BC, benefit:cost ratio; Bal Fer, balance fertilizers; NPK, nitrogen, phosphorus and potash and herb- herbicides.

due to vagaries of monsoon during crop period. It was well established phenomenon that producers and consumers were same in earlier turned them to cultivate in limited areas or in backyard for own consumption but it became a commercial cultivation in presence of assurance of seeds lifting. Seed bank establishment in village is an important issue for gearing up the production chain as reported by Yadav et al. (2007) in pulse demonstration.

Productivity enhancement

The technologies adopted enhanced yield level over local practices which were undertaken in nearby field for comparison. The outstanding performance of the best management techniques resulted into enhanced productivity. The best management techniques were accounted as line sowing, quality seed production, balance fertilizer found effective in achieving higher productivity (20-25 q/ha for ragi, 15-20 q/ha for kodo millet and 5-7 q/ha for little millet). On other hand, local agronomical practices could produce up to 2 to 5 q/ha which was lower than grain production. Conversion of maximum lands into productive lands through growing millets made profitable in achieving eco-friendly management under degrading environment of agriculture (Figure 7). Similar result was seen in pulse demonstration by Singh et al. (2005a).

Income enhancement

Certainly income enhanced when production of small millets was more triggered the market demands are in peak, whereas quality seeds like foundation, certified seed on farmers field were sold at Rs 30 to 40 per kg of produce by buy back system under registration by seed corporation led the farmers for higher income, earlier it was no value of lands due to barren lands now converted in productive lands through quality seed production as shown in Tables 5 to 7. Mukherjee (2003) and Reddy (2010) also reported the similar findings in case of income enhancement through demonstrations on farmers' field with technologies back up initially.

Value addition

Value addition in small millets was good interaction with farm and off-farm people for popularization of small millets instantly. After production of grain, processing is must to convert it into convenient forms like ready to eat and primary cooking. It includes the products which could be prepared at home level like finger millet multi grain flour and ragi malt for tribal ladies whereas other forms which requires slight primary

Figure 3. Side drain line under water logging condition.

Figure 4. Beushening for weed suppression in finger millet.

Figure 5. Pouring of seed and fertilizer in seed drill.

Figure 6. Bullock drawn seed cum fertilizer sown little millet

Figure 7. Root growth under good tilth.

processing like frying roasting etc was kept away in value addition of small millets, for which trainings and machinery support had been given them by linking other projects had the provision. Singh et al. (2005b) has suggested that involvement of secondary agriculture boosted the adoption of demonstration. The ultimately opened the channel for selling it in outlets of self help groups and tied up with Sanjeevani, Department of Forest, Chhattisgarh. The processing centre of the selected villages was equipped with grinding machine,

Table 5. Impact of technologies in income generation through seed and grain production of finger small millets in clusters.

Target	Seed production				Grain production				Areas coverage (%)			
	Cost of cultivation	Gross income	Net income	B:C ratio	Cost of cultivation	Gross income	Net income	B:C ratio	Income over grain production	Available upland	Previous	at present
Cluster 1	21336	57372.28	36036.28	1.69	12071	30345	18274	1.51	111.57	53	12	44.0
Cluster 2	22680	60548.60	37868.60	1.67	13415	32025	18610	1.39	120.36	45	13	45.0
Cluster 3	18960	51757.00	32797.00	1.73	9795	27375	17580	1.79	96.38	32	15	47.0
Cluster 4	26280	69056.60	42776.60	1.63	16915	36525	19610	1.16	140.40	54	16	48.0
Cluster 5	29064	75636.12	46572.12	1.60	20799	48006	27207	1.31	122.50	43	23	55.0
Cluster 6	26304	69113.32	42809.32	1.63	16939	36555	19616	1.16	140.54	37	18	50.0
Cluster 7	18528	50736.04	32208.04	1.74	10263	26835	16572	1.61	107.66	65	21	53.0
Cluster 8	25200	66504.20	41304.20	1.64	17935	42210	24275	1.35	121.10	54	19	51.0
Cluster 9	25068	66192.24	41124.24	1.64	18803	39678	20875	1.11	147.77	36	16	48.0
Cluster 10	17160	47503.00	30343.00	1.77	8095	25125	17030	2.10	84.05	45	20	52.0
Mean	23058.00	61441.94	38383.94	1.67	14503.00	34467.90	19964.90	1.45	119.23	46.40	17.30	49.30

*LS, line sowing; BC, benefit:cost ratio; Bal Fer, balance fertilizers; NPK, nitrogen, phosphorus and potash and herb- herbicides.

Table 6. Impact of technologies in income generation through seed and grain production of kodo small millets in clusters.

Target	Seed production				Grain production				Areas coverage (%)			
	Cost of cultivation	Gross income	Net income	B:C ratio	Cost of cultivation	Gross income	Net income	B:C ratio	income over grain production	Available upland	Previous	at present
Cluster 1	14246	46868	32622.08	2.29	8679	26670.0	17991.0	2.07	181.32	61	10	42
Cluster 2	20590	49820	29230.40	1.42	13023	28350.0	15327.0	1.18	190.71	53	11	43
Cluster 3	16870	41649	24778.80	1.47	11303	23700.0	12397.0	1.10	199.88	40	13	45
Cluster 4	24190	57728	33538.40	1.39	15623	32850.0	17227.0	1.10	194.69	62	14	46
Cluster 5	26974	63844	36869.92	1.37	17407	36330.0	18923.0	1.09	194.84	51	21	53
Cluster 6	24214	57781	33567.12	1.39	18647	32880.0	14233.0	0.76	235.84	45	16	48
Cluster 7	16438	40700	24261.84	1.48	10871	23160.0	12289.0	1.13	197.43	73	19	51
Cluster 8	23110	55356	32246.00	1.40	17543	31500.0	13957.0	0.80	231.04	62	17	49
Cluster 9	22978	55066	32088.04	1.40	17411	31335.0	13924.0	0.80	230.45	44	14	46
Cluster 10	15070	37695	22624.80	1.50	9503	21450.0	11947.0	1.26	189.38	53	18	50
Mean	20468	50650.74	30182.74	1.51	14001.00	28822.50	14821.50	1.13	204.56	54.18	15.72	47.16

*LS, line sowing; BC, benefit: cost ratio; Bal Fer, balance fertilizers; NPK, nitrogen, phosphorus and potash and herb- herbicides.

Table 7. Impact of technologies in income generation through seed and grain production of little small millets in clusters.

Target	Seed production				Grain production				Areas coverage (%)			
	Cost of cultivation	Gross income	Net income	B:C ratio	Cost of cultivation	Gross income	Net income	B:C ratio	income over grain production	Available upland	Previous	At present
Cluster 1	7423.00	23652.24	16229.24	2.19	6278.00	16369.56	10091.56	1.61	136.01	46	8	29
Cluster 2	9786.00	22120.80	12334.80	1.26	7641.00	14946.12	7305.12	0.96	131.84	38	9	30
Cluster 3	7047.00	23964.20	16917.20	2.40	4902.00	16659.52	11757.52	2.40	100.09	25	11	32
Cluster 4	11230.00	26176.28	14946.28	1.33	9085.00	18715.60	9630.60	1.06	125.55	47	12	33
Cluster 5	10223.00	29267.52	19044.52	1.86	8078.00	21588.84	13510.84	1.67	111.38	36	19	40
Cluster 6	9354.00	26488.24	17134.24	1.83	7209.00	19005.56	11796.56	1.64	111.94	30	14	35
Cluster 7	10234.00	21468.52	11234.52	1.10	8089.00	14339.84	6250.84	0.77	142.06	58	17	38
Cluster 8	9876.00	24531.40	14655.40	1.48	7731.00	17186.72	9455.72	1.22	121.33	47	15	36
Cluster 9	9805.00	23680.60	13875.60	1.42	7660.00	16395.92	8735.92	1.14	124.09	29	12	33
Cluster 10	8247.00	22064.08	13817.08	1.68	6102.00	14893.40	8791.40	1.44	116.29	38	16	37
Mean	9322.50	24341.39	15018.89	1.65	7277.50	17010.11	9732.61	1.39	122.06	39.18	13.72	34.16

packing machine and stencils used in processing of small millets. At present, three processing unit are working at Narayanpur, Turenar and Bastanar.

Tribal farmers are off stream people and reside away from cities due to dependency on agriculture activities with existing system of farming. It had to improve the existing system with positive outputs through farming in sustaining form that is why this farming community had been targeted for agricultural improvement and extension in last 10 years undergone demonstrations, trainings, field visits etc.

Research output enhanced yield

1. Intercropping in ragi and kodo millets are important agronomical manipulation in focus of enhancing soil health as well as sustainability of productivity. 4:1 and 4:2 (Ragi:pigeon pea) gave good response in generation of income and fortifying the pulse demand along with remunerative. Horse gram is existing crop of the region chose in intercropping (Poonia and Pithia, 2011).
2. Sequential cropping of little millet with niger made the system profitable because little millet is harvested in mid *kharif* (near 20 August) and soil moisture still remains can provide sufficient moisture to niger plant under rain fed situation. The niger crop sowed in between harvested rows in zero-tillage system. The rate of niger is 25 to 30 rupees per kg would enhance the profitability.
3. Small millets belong to Poaceae family and this family is well known for soil conservation. Upland condition facilitates the erosion and run-off of top soil because of less hindrance in the way of flow during rainy period. Farmers became aware about cultivation of small millets which are always grown on sloppy upland and well drain soil. The need of hours is to sow crops in lines across the slope to solve the problem.
4. Scooping is a practice involves small spade out ditches in between rows of crops at 1 feet interval along the line. The ditch helped the water infiltration and prolongs the moisture availability period the crops up to 10 days to avoid short time stress.
4. Running of country plough between rows will work as soil loosening and weed suppression simultaneously and it gave strength to plant and yield attributing characters.
5. Initial application of phosphorus and potash as basal enhanced the use efficiency and nitrogen applied as top dress at 20 and 40 days after sowing helped in enhancing yield.
6. Hill placement of FYM and one top dressing of nitrogen at 40 days provided sufficient growth and yield of small millets under rain fed condition over blanket application of FYM.

Conflict of Interests

The authors have not declared any conflict of interests.

Figure 8. Bullock drawn seed cum fertilizer drill.

Figure 9. Transplanting of finger millet behind desi plough.

Figure 10. Harvesting of finger millet by reaper at farmer' field.

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