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Response of direct-seeded and transplanted pearlmillet (*Pennisetum glaucum*) to nitrogen, phosphorus and biofertilizers in intercropping system

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ABSTRACT

A field experiment was conducted during the rainy (*kharif*) seasons of 1999 and 2000, at New Delhi, to study nutrient management in pearlmillet [*Pennisetum glaucum* (L.) R. Br. emend. Stuntz.]. Hybrid 'Pusa 23' in sole and intercropping system with cowpea [*Vigna unguiculata* (L.) Walp.] Variety 'Pusa Komal' under direct-seeded and transplanted conditions. The crops were grown with varying levels of N, P_2O_5 along with biofertilizers (*Azospirillum* culture + VAM). The treatments comprised 4 main plot treatments with 2 methods of planting pearlmillet with and without intercrop and 7 levels of fertilizers. The transplanting of pearlmillet was on a par with direct seeding. Although the transplanted crop had lower grain weight/ear and shorter ear length, it had more ears/m² and greater 1,000-grain weight than direct-seeded crop which led to similar yield under both the conditions. The grain yield of pearlmillet with application of 40 kg N + 30 kg P_2O_5/ha along with biofertilizers was at par with recommended dose of 60 kg N + 45 kg P_2O_5/ha indicating saving of 20 kg N and 15 kg P_2O_5/ha through biofertilizers. There was no effect of cowpea intercropped with pearlmillet in both the years.

Key words : Direct sowing, Transplanting, Biofertilizer, Rainfed, Pearlmillet, Cowpea Intercrop, Grain yield, Effective tillers

Pearlmillet is an important crop grown mostly in rainfed areas of the country. The optimum time for sowing is first fortnight of July, but sowing is invariably delayed due to erratic monsoon. The delayed sowing causes a sharp reduction in yield of pearlmillet (Meena *et al.*, 1998). Hence transplanting could be a viable option to avoid the yield losses occurring in late sown direct-seeded crop. The high-yielding hybrids of pearlmillet respond favourably to chemical fertilizers as well as biofertilizers, such as *Azospirillum* and vesicular arbuscular mycorrhizae (VAM). Besides, the cereals are also benefited from legumes grown intercropping system (Stringer *et al.*, 1996) due to nitrogen transfer from the legume to the associated cereal crop (George *et al.*, 1995). Moreover, the intercropping of a compatible legume with pearlmillet minimizes the risk under rainfed situation. Therefore, a field experiment was conducted to compare the productivity of pearlmillet grown as sole crop or intercropped with cowpea at varying levels of N, P and biofertilizers under transplanted and direct-seeded conditions.

MATERIALS AND METHODS

A field experiment was conducted at the Research Farm of Indian Agricultural Research Institute, New Delhi, during the rainy (*kharif*) seasons of 1999 and 2000. The total rainfall received during the crop season was 394.3 mm in 1999, and 571.1 mm in 2000. The soil was sandy loam in texture with pH 7.62. The experiment was laid out in split- plot design with 4 main plot treatments, viz. direct-seeded pearlmillet in pure stand, direct-seeded pearlmillet intercropped with cowpea, transplanted pearlmillet in pure stand and transplanted pearlmillet intercropped with cowpea, and 7 subplot treatments, viz. control, biofertilizers, 20 kg N+15 kg P_2O_5/ha, 20 kg N+15 kg P_2O_5/ha+biofertizers, 40 kg N + 30 kg P_2O_5, 40 kg N + 30 kg P_2O_5 + biofertilizers and 60 kg N + 45 P_2O_5/ha, with 3 replications. Pearlmillet hybrid 'Pusa 23' was sown in the second week of July using 5 kg seed/ha. At the same time, peralmillet nursery was raised separately and 20-day-old seedlings were transplanted by the end of July. Intercrop cowpea 'Pusa Komal' was sown on the same date as direct sown pearlmillet in both the years. Before sowing, pearlmillet seed was inoculated with *Azospirillum* culture by using jaggery slurry and soil was also inoculated with VAM culture in the respective treatments. The intercrop was sown in paired row pattern of 30/70 cm. Pearlmillet was given N and P fertilizers as per the treatments. Lower doses, i.e. 20 and 40 kg N/ha, were applied as basal dressing, while the higher dose of N, i.e. 60 kg N/ha, was applied in 2 splits. In all the treatments, the entire quantity of

P fertiilizer was applied at the time of sowing.

RESULTS AND DISCUSSION

Growth and yield characters

Direct-seeded pearlmillet with or without intercropped cowpea recorded a significant increase in plant height over the transplanted crop (Table 1). However, there was no effect on number of effective tillers, days to 50% flowering and dry-matter accumulation due to methods of crop establishment and intercropping with cowpea. These results confirm the findings of Patel *et al.* (1985). Biofertilizers resulted in a significant improvement in growth parameters over the control, except days to 50% flowering. The best treatment was 60 kg N+45 kg P_2O_5/ha which was at par with 40 kg N+30 kg P_2O_5/ha + biofertilizers. Thus, use of biofertilizers with low dose of N and P improved growth characters equal to higher dose of N and P.

Direct-seeded and transplanted pearlmillet with and without intercropping with cowpea did not influence significantly yield attributes of pearlmillet (Table 2). How-

Table 1. Effect of methods of establishment, intercropping and fertilizer levels on growth characters of pearlmillet at harvest

Treatment	Plant height (cm)		Effective tillers/m row length		Days to 50% flowering		Dry-matter accumulation (g/plant)	
	1999	2000	1999	2000	1999	2000	1999	2000
Methods of establishment								
Direct-seeded pearlmillet in pure stand	168.5	172.5	32.7	34.9	45.0	56.6	60.3	64.0
Direct-seeded pearlmillet with intercrop cowpea	175.6	181.4	31.9	34.9	46.7	58.4	60.9	66.8
Transplanted pearlmillet in pure stand	157.5	162.3	33.2	35.4	47.0	58.5	59.2	63.1
Transplanted pearlmillet with intercrop cowpea	160.6	166.8	33.2	35.0	47.0	58.4	61.2	64.9
CD (P=0.05)	11.6	10.6	NS	NS	NS	NS	NS	NS
Fertilizer level								
Control	135.0	141.5	22.9	26.3	43.5	55.0	42.7	47.3
Biofertilizers (VAM + *Azospirillum)*	151.0	155.4	27.2	29.1	44.2	56.0	51.7	56.7
20 kg N + 15 kg P_2O_5/ha	154.3	160.8	28.5	30.9	46.0	57.7	54.5	59.3
20 kg N + 15 kg P_2O_5/ha + biofertilizers	162.0	167.8	34.2	36.7	46.2	57.7	60.4	65.3
40 kg N + 30 kg P_2O_5/ha	166.0	170.5	35.3	38.0	47.5	58..5	64.9	69.4
40 kg N + 30 kg P_2O_5/ha + biofertilizers	189.6	193.3	39.8	41.4	49.2	60.7	72.8	77.4
60 kg N + 45 kg P_2O_5/ha	200.1	206.0	41.2	42.0	48.2	60.0	73.9	79.0
CD (P=0.05)	10.06	9.30	1.70	1.90	2.20	2.80	2.60	3.60

Table 2. Effect of method of establishment, intercropping and fertilizer levels on yield attributes and yield of pearlmillet

Treatment	Ears/ m^2		Ear length (m)		Grain weight/ ear (g)		1,000-grain weight (g)		Grain yield (q/ha)		Stover yield (q/ha)	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Methods of establishment												
Direct-seeded pearlmillet in pure stand	25.1	29.7	24.87	25.84	12.97	14.33	7.86	8.20	24.97	27.65	62.27	69.98
Direct-seeded pearlmillet with intercrop cowpea	25.9	27.8	24.73	25.89	12.50	13.95	8.01	8.45	23.42	26.41	59.95	66.50
Transplanted pearlmillet in pure stand	25.7	28.5	24.36	25.16	12.66	14.11	8.02	8.59	24.53	27.01	61.04	68.14
Transplanted pearlmillet with intercrop cowpea	24.7	28.0	23.76	24.78	12.50	13.81	8.30	8.63	23.40	26.49	60.26	66.24
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Fertilizer level												
Control	15.4	17.1	20.82	22.46	10.33	11.30	6.93	7.14	16.83	19.24	54.05	57.19
Biofertilizer (VAM + *Azospirillum*)	19.4	21.3	23.22	24.25	11.07	13.87	7.37	8.35	19.39	23.48	58.27	62.38
20 kg N + 15 kg P_2O_5/ha	21.0	23.6	24.06	24.61	11.61	13.20	7.61	8.59	21.24	24.27	60.56	64.65
20 kg N + 15 P_2O_5/ha + biofertilizers	29.5	32.0	24.81	25.41	12.83	14.56	7.90	8.47	24.59	27.82	63.25	67.05
40 kg N + 30 kg P_2O_5/ha	29.2	31.8	25.36	25.71	13.68	14.77	8.49	8.63	26.52	27.96	67.91	71.52
40 kg N + 30 kg P_2O_5/ha + biofertilizers	32.8	36.1	26.20	27.46	14.26	15.11	8.85	8.94	30.02	32.80	70.59	74.63
60 kg N + 45 kg P_2O_5/ha	33.7	35.8	26.54	28.02	14.77	15.50	9.06	9.13	29.09	33.67	70.80	75.40
CD (P=0.05)	1.3	1.5	1.20	1.49	0.64	0.90	0.40	0.46	1.44	1.71	3.02	4.02

ever, use of biofertilizer significantly improved the number of ears/m^2, length of ear, grain weight and 1,000-grain weight over the control. Maximum increase in yield attributes was recorded with 60 kg N+45 kg P_2O_5/ha, which was on a par with 40 kg N+ 30 kg P_2O_5/ha+ biofertilizers. The results are in conformity with those of Gautam and Kaushik (1985).

Yield

Due to occurrence of normal monsoon in 2000, the yield was more than that in 1999. The crop also matured about 10 days early in 1999 due to drought-escaping mechanism. The method of sowing with and without intercropping did not affect grain yield of pearlmillet. Transplanting late by the end of July provided full compensation in yield owing to more number of effective tillers than direct seeding. There was no effect of cowpea intercropped with pearlmillet in both years.

Significantly higher grain and stover yields of pearlmillet were obtained with biofertilizers over the control. In 1999, maximum increase in yield was obtained with 40 kg N+30 kg P_2O_5 + bioferilizer, which was on a par with 60 kg N+45 kg P_2O_5/ha. On the other hand, in 2000, maximum yield was recorded with 60 kg N+45 kg P_2O_5/ha, which was at par with 40 kg N + 30 P_2O_5/ha + biofertilizers. The highest stover yield was recorded with 60 kg N+45 kg P_2O_5/ha in both the years, which was at par with 40 kg N + 30 kg P_2O_5/ha + biofertilizers. These results confirm those of Gautam and Kaushik (1987).

Thus addition of biofertilizers substitute about 20 kg N/ha and 15 kg P_2O_5/ha for obtaining similar yields from pearlmillet crop. The direct seeding of pearlmillet with or without intercropping proved superior to transplanted crop.

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