

Integrated nutrient management in pearl millet (*Pennisetum glaucum*) under rainfed conditions

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ABSTRACT

Twelve treatments, with the aim of integrating different sources of nutrient (organic, biofertilizer and chemical nitrogen) were tested at Hisar during rainy (*kharif*) season of 1993 and 1994. The results revealed that use of biofertilizer or farmyard manure (FYM) @ 2.5 tonnes/ha did not improve growth, yield and yield parameters of pearl millet significantly over the control. However, combination of these 2 sources proved significantly better over the control as well as individual application of biofertilizer or FYM @ 2.5 tonnes/ha. Combination of biofertilizer or FYM @ 2.5 tonnes/ha with 20 kg N/ha was found statistically at par with 40 kg N/ha alone, in terms of yield and yield characters. Combination of 3 sources of nutrients revealed that application of FYM @ 2.5 tonnes/ha + 20 kg N/ha + seed treatment with biofertilizer was significantly superior to 40 kg N/ha alone in terms of growth and yield attributes, grain and stover yields, net returns/ha and benefit : cost ratio.

Pearl millet [*Pennisetum glaucum* (L.) R. Br. emend. Stuntz] is a crop of arid areas where soils are mainly loamy sand (80–90% sand) with low fertility, poor microbial activity, low organic matter content (0.1–0.25), high infiltration rate (9–10 cm/ha), poor moisture-storage capacity (120–135 mm in 1.0 m soil profile) and precarious annual rainfall (150–400 mm). Under such situations, poor economic conditions of farmers and risk of crop failure do not permit the farmers to apply recommended doses of costly chemical fertilizer. Hence present study was conducted to work out efficient, economic, productive and long-lasting package of nutrients integrating various sources of nutrients.

MATERIALS AND METHODS

The field experiment was conducted at

Hisar during rainy season of 1993 and 1994. Twelve treatments consisting of 3 different sources of nutrients, i.e. organic (FYM 2.5 tonnes and 5.0 tonnes/ha), biofertilizer (*Azotobacter chroococcum* Mac 68) and chemical nitrogen (20 and 40 kg N/ha), either alone or in combination with each other, were tested in randomized block design with 3 replications. The soil was sandy loam in texture with pH 8.1, containing 0.21% organic carbon, 16 and 426 kg/ha available P and K₂O respectively. Pearl millet hybrid 'HHB 60' was sown on 9 July 1993 and 13 July 1994 and harvested on 6 and 12 October during the respective years. The FYM was applied 20 days before sowing, whereas chemical nitrogen was applied in 2 equal splits (half at sowing and remaining half at 3 weeks stage of crop) in the respective treatments. For biofertilizer treat-

ments, pearl millet seed was treated with *Azotobacter chroococcum* Mac 68 culture just few hours before sowing.

RESULTS AND DISCUSSION

Growth, yield and yield attributes

Plant height, tillers/plant, heads/plant, head length and girth increased significantly by application of either 5 tonnes FYM/ha or 20 kg N or 40 kg N/ha over the control. Application of either 2.5 tonnes FYM/ha or use of biofertilizer individually did not affect the growth and yield parameters and grain and stover yields.

Application of 2.5 FYM/ha along with seed treatment with biofertilizer *Azotobacter chroococcum* Mac-68 improved all the growth and yield attributes and grain and stover yields significantly over 2.5 tonnes FYM/ha alone.

The combination of either FYM @ 2.5 tonnes or 5 tonnes/ha or biofertilizer with 20

kg N/ha was as good as 40 kg N/ha alone, in respect of yield and yield attributes. The use of either biofertilizer or FYM @ 2.5 tonnes/ha in combination with 20 kg N/ha seems to act synergistically and there was a net saving of 20 kg N/ha. Singh *et al.* (1981) and Raghuwansi and Umat (1994) also reported increased efficiency of fertilizers in combination with FYM.

The combination of 3 various sources of nutrients (organic, biofertilizer and chemical fertilizers) was even more beneficial. Application of 2.5 tonnes FYM + 20 kg N/ha + biofertilizer was significantly better than 40 kg N/ha alone, in terms of yield and yield attributes. This kind of integrated nutrient management involving organic, biofertilizer and chemical sources of N can profitably be utilized in rainfed areas where farmers hesitate to apply costly chemical N due to risk factor involved. This may be helpful in stabilizing the pearl millet yield of

Table 1. Effect of integrated nutrient-management on growth, yield and yield attributes of pearl millet (pooled data of 2 years)

Treatment	Plant height (cm)	Tillers/plant	Heads/plant	Head length (cm)	Head girth (cm)	Grain yield (q/ha)	Stover yield (q/ha)
Control	162.11	1.05	1.02	22.04	8.23	10.24	48.26
Biofertilizer	164.00	1.18	1.15	22.07	8.27	11.37	51.30
FYM 2.5 tonnes/ha	165.15	1.24	1.20	22.12	8.28	12.15	52.70
FYM 5.0 tonnes/ha	173.45	1.54	1.52	23.40	8.37	14.60	58.67
20 kg N/ha	175.06	1.58	1.55	23.74	8.38	14.70	62.00
40 kg N/ha	183.72	2.01	1.97	26.00	8.61	20.06	74.25
FYM 2.5 tonnes/ha + biofertilizer	176.47	1.63	1.61	23.50	8.40	15.30	62.10
Biofertilizer + 20 kg N/ha	177.89	1.60	1.59	24.10	8.42	15.50	63.00
FYM 2.5 tonnes + 20 kg N/ha	182.56	1.98	1.95	25.67	8.70	19.80	72.80
FYM 5.0 tonnes + 20 kg N/ha	186.22	2.10	2.05	26.80	8.72	21.00	79.42
FYM 2.5 tonnes + 20 kg N/ha + biofertilizer	194.44	2.37	2.32	27.55	8.82	23.80	84.60
FYM 5.0 tonnes + 20 kg N/ha + biofertilizer	199.21	2.40	2.36	28.65	8.84	24.20	85.95
CD (P = 0.05)	10.21	0.32	0.32	1.29	0.12	3.12	9.21

Table 2. Effect of different treatments on net returns and benefit : cost ratio in rainfed pearl millet

Treatment	Grain yield (q/ha)	Stover yield (q/ha)	Total returns (Rs/ha)	Variable expenses (Rs/ha)	Net returns* (Rs/ha)	Benefit : cost ratio
Control	10.24	48.26	5,485.00	4,600.00	885	1.19
Biofertilizer	11.37	51.30	5,976.00	4,610.00	1,366	1.29
FYM 2.5 tonnes/ha	12.15	52.70	6,280.00	4,725.00	1,555	1.32
FYM 5.0 tonnes/ha	14.60	58.67	7,313.50	4,850.00	2,463	1.50
10 kg N/ha	14.70	62.00	7,510.00	4,744.40	2,766	1.61
40 kg N/ha	20.06	74.25	9,730.50	4,888.80	4,842	1.99
FYM 2.5 tonnes + biofertilizer	15.30	62.10	7,695.00	4,735.00	2,960	1.62
Biofertilizer + 20 kg N/ha	15.50	63.00	7,800.00	4,754.40	3,046	1.64
FYM 2.5 tonnes + 20 kg N/ha	19.80	72.80	9,580.00	4,869.40	4,711	1.96
FYM 5.0 tonnes + 20 kg N/ha	21.00	79.42	10,271.00	4,994.40	5,277	2.05
FYM 2.5 tonnes + 20 kg N/ha + biofertilizer	23.80	84.60	11,360.00	4,879.40	6,481	2.32
FYM 5.0 tonnes + 20 kg N/ha + biofertilizer	24.20	85.95	11,557.50	5,004.40	6,553	2.30

* Net returns were rounded off to the nearest rupee

rainfed areas to some extent and also improve the overall physical condition of the soils in due course of time.

Economics

Net returns (Rs 885/ha) and benefit : cost ratio (1.19) were lowest in the control treatment (Table 2). Application of 40 kg N/ha increased the net returns (Rs 485/ha) and benefit : cost ratio (1.99) considerably and were highest when compared with individual use of either biofertilizer or FYM. Combination of 2.5 tonnes FYM/ha + biofertilizer was better than 2.5 tonnes FYM/ha alone in terms of net returns and benefit : cost ratio. However, amongst combinations of 2 sources of nutrients, highest net return was recorded under 5 tonnes FYM/ha + 20 kg N/ha (Rs 5,277/ha). In combinations of 3 sources of nutrients though highest net returns were recorded

under 5 tonnes FYM/ha + 20 kg N/ha + biofertilizer (Rs 6,553/ha), the benefit : cost ratio was comparatively lower than 2.5 tonnes FYM/ha + 20 kg N/ha + biofertilizer. Sharma (1983) also reported beneficial effect of FYM in economizing the use of fertilizers in wheat-mungbean or greengram cropping sequence.

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