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Research Paper

Effect of integrated plant nutrient management on pearlmillet (*Pennisetum glaucum*) productivity in rainfed subtropic Shiwalik foothills of Jammu and Kashmir

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ABSTRACT

A field experiment was conducted during the rainy (*kharif*) seasons of 2013, 2014 and 2015 at Advanced Centre for Rainfed Agriculture, Rakh-Dhiansar, Jammu to study the effect of integrated nutrient management on productivity of pearlmillet [*Pennisetum glaucum* (L.) R. Br.]. The experiment was laid out in randomized block design with 8 treatments, replicated thrice. Application of 100% recommended dose of NPK significantly improved the growth parameters, yield attributes, yield and nutrient uptake of pearlmillet which was statistically at par with other nutrient resource combinations like 75% N inorganic + 25% N through vermicompost, 75% N inorganic + 25% N through FYM and 50% N inorganic + 50% N through vermicompost. Application of 100% NPK (RDF) also resulted in higher net returns (₹34.9 × 10^3/ha) and benefit: cost ratio (3.0) followed by 75% inorganic + 25% N through FYM (net returns, ₹27.4 × 10^3/ha; B:C ratio, 2.4) with respect to pearlmillet productivity.

Key words : Economics, Nutrient uptake, Pearlmillet, Yield

Pearlmillet is one of the major coarse grain crops which is predominantly grown in rainfed low soil-moisture conditions. In Asia, it is an important cereal crop of India, Pakistan, China and other parts of South-eastern Asia. In India, pearlmillet is the fifth most important cereal grain crop grown next to rice, wheat, maize and sorghum and is largely grown in Rajasthan, Gujarat, Maharastra, Tamil Nadu, Uttar Pradesh, Haryana and Karnataka in the rainy season during June to September. Of late, its cultivation has gained more importance owing to increasing evidences of lower seasonal rainfall, terminal heat and frequent occurrence of extreme weather events coupled with scanty water resources (Singh *et al.,* 2010). Farmers generally apply imbalanced chemical fertilizers leading to nutrient deficiency of other than applied nutrients that leads to declined organic carbon level in soil. Therefore, application of chemical fertilizers alone may not keep pace with time in maintenance of soil fertility for sustaining higher productivity and hence, adequate and balanced use of manures and fertilizers is essential for better soil health (Gupta, 2001).

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The gap between nutrient removal and supply under rainfed situations calls for integrated nutrient management strategy involving use of inorganic fertilizers and organic manures (Prasad, 2011). Hence present investigation was initiated to find out the effect of integrated nutrient management on growth, productivity and relative economics of pearlmillet under rainfed situations.

MATERIALS AND METHODS

A field experiment was conducted during the rainy seasons (*kharif*) of 2013, 2014 and 2015 in randomized block design with 3 replications at the Research farm of Advanced Centre for Rainfed Agriculture, Rakh-Dhiansar, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu. The soil of experimental site was sandy loam in texture, with a *p*H of 6.58, low in organic carbon (0.28%), available nitrogen (172 kg/ha), medium available phosphorus (15.1 kg/ha) and potassium (108 kg/ha). The experiment consisted of 8 treatments of inorganic and organic combinations of nutrient sources, viz. control, 100% NPK inorganic (RDF), 75% N inorganic + 25% N through FYM, 50% N inorganic + 50% N through FYM, 100% N through FYM, 75% N inorganic + 25% N through vermicompost (VC), 50% N inorganic + 50% N through vermicompost and 100% N through

vermicompost. Pearlmillet hybrid 'Nandi 65' was sown at 45 cm × 10 cm spacing. The recommended dose of NPK, i.e 50 : 30 : 15 kg/ha was applied. Half dose of nitrogen and full dose of phosphorus and potassium to the tune of 30 and 15 kg, respectively, was applied basal and the remaining nitrogen (25 kg) was applied 35 days after sowing of crop. The total mean monthly rainfall received during the crop season was about 870, 659.2 and 584.7 mm during the respective *kharif* seasons of 2013, 2014 and 2015.

RESULTS AND DISCUSSION

Growth parameters

Different integrated nutrient-management treatments had a significant influence on plant height, tillers/m row length, and dry-matter accumulation of pearlmillet. Application of 100% recommended dose of fertilizers significantly improved the plant height, tillers/m row length and dry-matter accumulation as compared to the rest of the treatments; however, it was statistically at par with 75% N inorganic + 25% N through vermicompost. Treatments comprising 75% N inorganic + 25% N through FYM and 50% N + 50% N through vermicompost were also statistically at par with each other for plant height, tillers/m row length and dry-matter, whereas significantly lowest values were recorded in the control treatments (Table 1). Improvement in growth parameters owing to integrated use of inorganic fertilizers and organic manures could be attributed to better availability of major and minor nutrients that are essentially required in various metabolic processes which ultimately resulted in better mobilization of synthesized carbohydrates into amino acids and proteins that in turn stimulated rapid cell-division and cell elongation and facilitated the faster vegetative growth. Similar results were also reported by Singh and Chauhan (2016). Among the organics, application of vermicompost resulted in the maximum plant height, number of tillers/m row length and dry-matter accumulation. Superiority of organics in combination with inorganic is contributed by vermicompost and FYM application, enriching the supply of all the essential macro and micronutrients higher than other organic sources. The vermicompost and FYM enhanced soil physical, chemical and biological properties and thus overall vegetative growth of the crop (Bana *et al*., 2012).

Yield attributes and yield

The yield-attributing characters such as ear length, ear girth, grain weight/ear, 1000 grain weight, along with grain and stover yields were significantly influenced due to different treatments (Table 2). Application of 100% recommended dose of fertilizer recorded superior yield attributes as compared with the control, 100% N through FYM and 100% N through vermicompost. However, these were statistically at par with 75% N inorganic + 25% N through vermicompost, 75% N inorganic + 25% N through FYM and 50% N inorganic + 50% N through vermicompost and also remained superior to the rest of the treatments which may be ascribed to increased availability of nutrients in soil owing to the fact that the combined application of inorganic and organic sources might have enhanced the organic carbon content in soil and improved water-holding capacity of soil which resulted in better uptake and response of applied nutrients. The application of 100% NPK (RDF) recorded significantly higher grain and stover yields of pearlmillet. However, among the integrated nutrient-management treatments, significantly higher grain and stover yields were recorded in the treatment where 75% N inorganic + 25% N through vermicompost followed by treatments, i.e. 75% N inorganic +25% N through FYM and 50% N inorganic + 50% with the corresponding yield value of 2.6, 2.5 and 2.4 t/ha respectively. The improved vegetative growth under these

Table 1. Effect of integrated nutrient management on growth and development of pearlmillet (pooled data of 3 years)

Treatment	Plant height (cm)	Tillers/m row length	Dry-matter accumulation (g/plant)
Control	203.3	20.9	53.0
100% NPK	229.1	35.8	80.9
75% N inorganic + 25% N through FYM	219.9	30.8	77.8
50% N inorganic + 50% N through FYM	211.8	28.6	74.3
100% N through FYM	208.3	25.0	67.7
75% N inorganic + 25% N through VC	225.3	34.1	80.3
50% N inorganic + 50% N through VC	219.6	30.7	79.3
100% N through VC	213.6	27.1	69.8
SEm±	2.0	0.6	0.4
CD (P=0.05)	6.3	1.9	1.2

VC, Vermicompost

Table 2. Effect of integrated nutrient management on yield attributes, grain yield and relative economics of pearlmillet (pooled data of 3 years)

Treatment	Ear length (cm)	Ear girth (cm)	Grain weight/ear (g)	1,000-grain weight (g)	Grain yield (t/ha)	Stover yield (t/ha)	Net returns (× 10^3₹/ha)	Benefit: cost ratio
Control	20.7	9.6	18.2	10.0	1.6	4.3	15.0	1.8
100% NPK	24.4	11.2	29.6	12.6	2.9	6.1	34.9	3.0
75% N inorganic + 25% N through FYM	23.7	10.4	26.8	11.8	2.5	5.8	27.4	2.4
50% N inorganic + 50% N through FYM	22.2	10.1	25.3	11.0	2.2	5.6	22.8	2.0
100% N through FYM	22.1	10.0	23.7	10.7	2.2	5.6	21.6	1.9
75% N inorganic + 25% N through VC	23.9	10.7	29.1	12.3	2.6	6.0	28.8	2.3
50% N inorganic + 50% N through VC	23.1	10.4	28.3	12.1	2.4	5.8	23.0	1.8
100% N through VC	22.5	10.2	24.8	11.5	2.3	5.7	18.9	1.5
SEm±	0.58	0.12	0.31	0.25	0.1	0.1	–	–
CD (P=0.05)	1.79	0.36	0.95	0.76	0.16	0.15	–	–

VC, Vermicompost

treatments might have enhanced the synthesis of carbohydrates, leading to better yield attributes which ultimately enhanced the grain yield. Our results confirm the findings of Parihar *et al*. (2010). Also integration of organics might have helped in increased photosynthetic activity thereby resulted in accumulation of photosynthates which might have translocated to sink due to better source-sink relationship. Similar results were reported by Bana *et al.* (2012).

Economics

Net returns (34.9 × 10^3 ₹/ha) and benefit: cost ratio (3.0) of pearlmillet production were higher with application of recommended dose of fertilizer followed by 75% N inorganic + 25% N through FYM (Table 2).

Nutrient uptake

Integrated nutrient management treatments increased the total uptake of N, P and K in comparison to control (Fig.1). Significantly higher NPK uptake was recorded with application of 100% NPK (RDF) followed by integrated use of 75% N inorganic + 25% N through vermicompost and 50% N Inorganic + 50% N through vermicompost. This might have happened owing to improved nutritional environment in the rhizosphere as well as its utilization by the plant. These results are in conformity with the findings of Meena and Gautam (2005). Application of organic sources resulted in balanced supply of macro and micronutrients improving the bio-chemical properties of the soil (Bana *et al.* 2016).

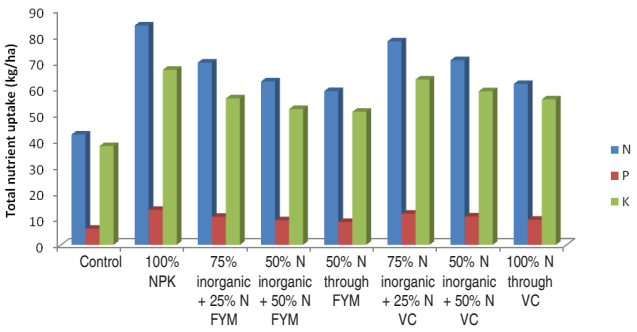

Fig. 1. Total uptake of nutrients by different treatments

It may be concluded that the application of 100% NPK (RDF) recorded significantly higher grain and stover yield of pearlmillet. However, among the integrated nutrient management, application of 75% N through chemical fertilizer and 25% N through vermicompost with recommended doses of phosphorus and potassium produced significantly higher grain and stover yields, which could be viable option for sustaining productivity in rainfed region of subtropic foothills.

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