Influence of Customized Fertilizers on Growth and Yield of Finger Millet {*Eleusine coracana (L.) Gaertn.*} in Alfisols of Southern India

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ABSTRACT: Field experiment was conducted during *kharif* 2010 and 2011 at Zonal Agricultural Research Station, UAS, GKVK, Bengaluru to study the effect of customized fertilizers on the productivity of finger millet. The experiment was laid out in Randomized Complete Block Design with different customized fertilizer treatments replicated thrice. The composition of customized fertilizer grade was 20:17:11:3:0.4% of N:P_2O_5:K_2O:S:Zn. Application of 150% customized fertilizer recorded higher plant height (102.5 cm), number of tillers/hill (7.11), total dry matter accumulation (100.41 g/hill), ears/hill (6.21) and test weight (3.65 g) compared to absolute control, 50, 75, 100 and 125% customized dose. Application of 150% customized fertilizer dose recorded significantly higher grain and straw yield (3279 and 4510 kg/ha, respectively) compared to other treatments but it was on par with application of 100 and 125% customized fertilizer application. Application of 125% customized fertilizer dose recorded higher net returns and B: C ratio.

Key words: Customized fertilizer, finger millet, growth, yield, parameters

Finger millet is an important dryland crop due to its resilience and ability to withstand aberrant weather conditions and generally grown in soils having poor water supplying capacity and nutrients. It is the staple food for millions of people in India and Africa. The grains are rich in calcium and iron besides rich in carbohydrates. It also ensures nutritional security in most parts of semi arid tropics of India. Fertilizers play a key role in improving the productivity of crops. India is the second largest user of fertilizers in the world (Tiwari, 2010). However, per hectare consumption of fertilizers is still inadequate and mining of nutrients from the soils continues to take place at an alarming rate resulting in depletion of soil fertility. The mining of nutrients from the soil on continuous basis coupled with inadequate and imbalanced use of fertilizers has resulted in increasing deficiencies of secondary and micronutrients which is limiting crop response to use of primary nutrients N, P and K. The stagnation in agricultural production and trends of decline in sustainability and profitability in crop production is mainly attributed to nutrient insufficiency and imbalance. Intensive efforts need to be made to restore soil health so that desired growth in agricultural production takes place to meet the food, fibre and fuel requirement of the population on sustained basis.

Balanced fertilization well beyond NPK is needed to break stagnation in crop yield. However, there is need to design new products to provide the customized solutions and enhance the overall use efficiency of all the plant nutrients. To get the maximum yields, crops should be provided with nutrients at optimal rate throughout the growth cycle in the most efficient manner. Customized fertilizers being crop, soil and area specific show a good promise to maintain soil health by ensuring appropriate fertilization (Tiwari, 2010). Customized fertilizers facilitate the application of the complete range of plant nutrients in the right proportion and to suit the specific requirements of a crop in different stages of growth, and are more relevant under site specific nutrient management practices. Therefore, in this context, an experiment was conducted to study the influence of customized fertilizers on growth and yield parameters of finger millet.

Materials and Methods

Field experiment was conducted during *kharif* 2010 and 2011 at Zonal Agricultural Research Station, UAS, GKVK, Bengaluru. The soil of experimental field was red sandy loam with slightly acidic soil pH (6.20) and low in organic carbon (0.49%). The initial status of available N, P_2O_5 and K_2O of the experimental site were 380.6, 27.5 and 289.2 kg/ha, respectively. The experiment was laid out in a Randomized Complete Block Design with seven treatments replicated thrice.

Treatments details are: absolute control, 50% customized fertilizer dose (187.50 kg/ha) (N 57.5 : 31.8 : 20.6 : 5.6 : 0.7 N:P_2O_5:K_2O:S:Zn kg/ha), 75% customized fertilizer dose (281.25 kg/ha) (86.2 : 47.8 : 30.9 : 8.4 : 1.1 N:P_2O_5:K_2O:S:Zn kg/ha), 100% customized fertilizer dose (375.00 kg/ha) (57.5 : 31.8 : 20.6 : 5.6 : 0.7 N:P_2O_5:K_2O:S:Zn kg/ha), 125% customized fertilizer dose (468.75 kg/ha) (143.7 : 79.7 : 51.6 : 14.0 : 1.8 N:P_2O_5:K_2O:S:Zn kg/ha), 150% customized fertilizer dose (562.50 kg/ha) (143.7 : 79.7 : 51.6 : 14.0 : 1.8 N:P_2O_5:K_2O:S:Zn kg/ha) and RDF as per package of practice (50.0 : 40.0 : 25.0 : 6.2 : 5.0 N:P_2O_5:K_2O:S:Zn kg/ha).

The composition of Customized Fertilizer Grade was 20:17:11:3:0.4% of N:P_2O_5:K_2O: S: Zn. FYM @ 7.5 t/ha was applied to all the treatments except for absolute control. Recommended dose of fertilizer (50: 40: 25 N, P_2O_5 and K2O kg/ha) was applied through urea, DAP and muriate of potash. Nitrogen was applied in two split doses viz, 50% as basal, 50% at 60 days after sowing as top dressing with full dose of P and K as basal. For the remaining treatments

different doses of customized fertilizer were applied. No fertilizer was applied in the absolute control treatment. Apart from this different levels of nitrogen was applied as top dress through urea in different customized fertilizer treatments at 60 DAS. Variety used for sowing was GPU-28. Five plants were randomly selected in each net plot area for taking observations on growth and yield attributing parameters. The crop in each net plot was harvested separately as per treatment and the values were converted in to hectare basis.

Results and Discussion

Influence of customized fertilizers on growth and yield parameters of finger millet

An increase in plant height with increase in dose of customized fertilizer application was noticed at harvest (Table 1). The plant height increased to 102.5 cm with 150% customized fertilizer dose (T_6) from 58 cm in absolute control (T_1) at harvest. There was significant increase in plant height with increase in customized fertilizer up to 100% customized fertilizer dose there after their was no significant difference in plant height. The improvement in plant height due to customized fertilizer application may be attributed to proper nourishment of crop and optimum growth. Black (1968) reported that due to enhanced nutrient uptake there will be increased cell elongation and multiplication. Also, increased activity of meristamatic cells and cell elongation with application of micronutrients (along with major nutrients) as they were known to have favourable effect on metabolic processes.

The rate of production and number of tillers in finger millet are dependent upon nutrient supply. Tillering cereals have considerable capacity to increase the number of tillers per hill under adequate manuring. Number of tillers per hill increased with increase in the fertilizer level. The mean number of tillers increased to 7.11 in 150% in customized fertilizer dose and it was 2.46 in absolute control. Lower tillers in control plot indicated deficiency of nutrients in soil. Application of 50% customized fertilizer dose (3.80) and RDF as per package of practice (4.25) recorded on par number of tillers which may be attributed to application of more or less equal quantity of nitrogen. The increased tiller production with increased fertilizer may be related to the extra nutrients provided by increased dose of customised fertilizer for the growth of tiller primordia. These results are in accordance with the findings of Maliwal *et al.* (1985).

The pre-requisite for getting higher yields in any crop is higher total dry matter production (TDM). Dry matter production increased with increase in the dose of customized fertilizer. At harvest application of 150% customized fertilizer dose (100.41 g/hill) recorded significantly higher total dry matter accumulation which was on par with 125% customized fertilizer dose (96.84 g/hill) and 100% customized fertilizer dose (92.43 g/hill), whereas, lowest was recorded in absolute control plot (32.56 g/hill). Higher total dry matter accumulation was attributed to better plant growth. Further, this was mainly due to more number of tillers and ears per hill. The results are in conformity with earlier findings of Pandusastry (1977).

Influence of customized fertilizers on yield and economics of finger millet

Significant differences in the yield of both grain and straw of finger millet were observed due to use of different doses of customized fertilizer (Table 2). Highest grain and straw yield of 3279 and 4510 kg/ha, respectively were recorded in 150% customised fertilizer dose and was on par with 125% customized fertilizer dose (3227 and 4438 kg/ha) and 100% customized fertilizer dose (3031 and 4249 kg/ha, respectively). RDF as per package of practice recorded on par grain and straw yield (2138 and 3102 kg/ha, respectively) with 50% customized fertilizer dose (2130 and 3007 kg/ha, respectively). This was due to the fact that the crop has not experienced nutrient stress at any growth stage because of balanced nutrition and improved vegetative growth and growth parameters such as total dry matter production and increased number of tillers resulted in good grain yield. Similar results have been reported by Kavalappa (1989). The lowest grain yield under absolute control was mainly due to the fact that soil was not able to meet the nutrient demand of the crop.

The variations in yield due to treatments could be attributed to the variations in the yield attributing parameters. The difference in the performance of yield attributes in various treatments could be due to variations in translocation of photosynthates from vegetative to reproductive parts.

Highest test weight was recorded in 150% customized fertilizer dose (3.65 g) which was on par with 125% customized fertilizer dose (3.61) and 100% customized fertilizer dose (3.54) (Table 3). whereas, lowest test weight was recorded in absolute control (3.00 g). The significant increase in test weight was mainly attributed to better grain filling due to improved nutrient supply. Similar finding was reported by Anil Kumar *et al.* (2003) in finger millet. With respect to economics, application of 125% customized fertilizer dose recorded higher net returns and B:C ratio compare to other treatments.

There was a significant variation or response in growth and yield parameters to customized fertilizer application upto 100% customized fertilizer dose and beyond this level, the growth and yield parameters followed the Mitcherlich's law i.e improvement in growth and yield parameters with each successive addition of fertilizer being progressively less. This was due to increased application of fertilizer than needed by the crop. Further, RDF as per package of practice and 50% customized fertilizer dose recorded on par growth and yield parameters due to application of more or less equal quantity of nutrients in both the treatments.

Table 1 : Effect of different levels of customized fertilizer on growth and yield parameters of finger millet

Treatments	Plant height (cm)			No. of tillers/hill			Total dry matter accumulation (g/hill)			No. of ears per hill at harvest			Test weight (g)		
	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean
T_1: Absolute Control	62	54	58	2.00	2.93	2.46	31.55	33.58	32.56	3.03	2.20	2.61	3.10	2.90	3.00
T_2: 50% customized fertilizer dose (187.50 kg/ha)	82	66	74	3.53	4.07	3.8	55.35	53.78	54.56	4.27	3.20	3.73	3.30	3.06	3.18
T_3: 75% customized fertilizer dose (281.25 kg/ha)	93	77	85	4.63	4.87	4.75	67.90	73.33	70.61	5.29	4.07	4.68	3.47	3.32	3.39
T_4: 100% customized fertilizer dose (375.00 kg/ha)	95	87	91	6.77	5.67	6.22	94.95	89.92	92.43	6.64	4.80	5.72	3.62	3.47	3.54
T_5: 125% customized fertilizer dose (468.75 kg/ha)	108	90	99	7.47	6.00	6.73	97.50	96.18	96.84	6.83	5.00	5.91	3.70	3.52	3.61
T_6: 150% customized fertilizer dose (562.50 kg/ha)	112	93	102.5	7.83	6.40	7.11	102.35	98.47	100.41	7.16	5.27	6.21	3.75	3.55	3.65
T_7: RDF as per package of practice	79	65	72	4.37	4.13	4.25	64.40	55.50	59.95	4.44	3.47	3.95	3.33	3.13	3.23
SEm±	3.67	2.67		0.33	0.26		2.05	3.67		0.26	0.22		0.04	0.03	
CD (P=0.05)	11.00	8.23		1.10	0.79		6.30	11.30		0.81	0.69		0.13	0.10	

Table 2 : Influence of different levels of customized fertilizer on yield and economics of finger millet

Treatment	Grain yield (kg/ha)			Straw yield (kg/ha)			Net returns (₹/ha)			B:C ratio		
	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean
T_1: Absolute Control	788	825	806.5	985	1469	1227	1794	2776	2285	1.21	1.32	1.26
T_2: 50% customized fertilizer dose (187.50 kg/ha)	2065	2195	2130	2582	3432	3007	11941	14429	13185	1.80	1.95	1.87
T_3: 75% customized fertilizer dose (281.25 kg/ha)	2595	2682	2639	3244	4196	3720	17680	19929	18804.5	2.10	2.22	2.16
T_4: 100% customized fertilizer dose (375.00 kg/ha)	3022	3040	3031	3778	4719	4249	22082	23571	22826.5	2.28	2.35	2.32
T_5: 125% customized fertilizer dose (468.75 kg/ha)	3221	3233	3227	4026	4849	4438	26520	24750	25635	2.72	2.33	2.53
T_6: 150% customized fertilizer dose (562.50 kg/ha)	3250	3307	3279	4062	4957	4510	26052	24258	25155	2.33	2.23	2.28
T_7: RDF as per package of practice	2025	2250	2138	2531	3672	3102	10692	14785	12738.5	1.68	1.93	1.81
SEm±	128	113		160	124.85							
CD (P=0.05)	384	349		480	384.72							

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