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RESEARCH ARTICLE

Finger millet performance affected by different nutrient management options under foothill condition of Nagaland

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Abstract

The proposed experiment was performed in the *kharif* season of 2024 in the Agronomy farm of Nagaland University, SAS Medziphema Campus, entitled 'Performance of finger millet [*Eleusine coracana* (L.) Gaertn. under different nutrient management practices in foothill conditions. The design used for the experiment was RBD (Randomised block design) with 8 treatments and 3 replications, which resulted in a total of 24 plots. Plant height increased with the advancement of crop age, with dwarf plants in the control treatment and treatments where only organic sources were used and all other treatments were statistically at par with each other. Leaf area index increased in all treatments up to 50 DAS and then decreased due to senescence of leaves. During 50 to 75 DAS, T_8 treatment showed maximum CGR (1.79), which may be due to better availability of nutrients from FYM decomposition and improvement in soil aeration and temperature and the lowest CGR (0.98) in T_1 treatment. At 50 DAS, maximum tillers (2.98) were found in the T_2 treatment and minimum in the T_1 (1.48) treatment. Maximum number of finger head^{-1} were found in T_5 treatment (7.99), which was statistically at par with all treatments except T_1. T_3 treatment achieved maximum seed yield (2459.3 kg/ha), which was statistically at par with T_2 and T_4 treatment because of good photosynthesis area, which was indicated by leaf area index, good number of tillers.

Keywords: Finger millet, poultry manure, FYM, Chemical fertilizer, yield

Introduction

Finger millet is one of the millet crops grown in various parts of India and also in Nagaland for a long time. In the current climatic situation where average temperature is increasing, and the shortage of water is on the rise in surface water bodies as well as groundwater reservoirs, this crop is one of the best options for ensuring climate health and nutritional wellbeing of the population. Coming to the nutritional status of finger millet, it contains a high amount of crude fibre (gm) 3.6 and a good amount of calcium (mg) 344, whereas in wheat and rice, 1.2, 0.2, and 41, 10, respectively. Being a low-input-requiring crop, finger millet has been reported to respond well to nutrient application and organic nutrition (Ullasa *et al*., 2017), and it can also be raised purely as organic (Gull *et al*., 2014). Among primary nutrients, nitrogen (N) plays a vital role in plant growth and development (Panda *et al*. 2022; Sairam *et al*. 2020; 2023). N promotes vegetative growth, improves the leaf area index, increases chlorophyll synthesis, and so on (Di Mola *et al*. 2019). So, in order to see the possibility of replacing some amount of chemical fertilizer used in finger millet production with organic sources of nutrients like FYM and Poultry manure, this experiment was designed. In hilly regions, most farmers use an integrated farming system on their farms to fulfil all demands. So, the easy will be the availability of FYM and Poultry manure, which will finally help in reducing the cost of cultivation.

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Material and Methods

The proposed experiment was performed in the *kharif* season of 2024 in the Agronomy farm of Nagaland University,

SAS Medziphema Campus, entitled 'Performance of finger millet [*Eleusine coracana* (L.) Gaertn. under different nutrient management practices in foothill conditions. Variety 'Simhadri' was used. The design of the experiment was RBD (Randomised block design) with 8 treatments and 3 replications, which resulted in a total of 24 plots. The initial pH of the soil was 4.7, which is acidic in nature. Treatment details: $T_{1=}$Control (No chemical fertilizer and organic source), $T_{2=}$100% RDF (Recommended dose of fertilizer), T_3 =50% N from Poultry manure + 50% N and balance P, K from chemical fertilizer, T_4 =50% N from FYM + 50% N and balance P, K from chemical fertilizer, T_5 =100% N from Poultry manure + balance P, K from chemical fertilizer, T_6 = 100% N from FYM + balance P, K from chemical fertilizer, $T_{7=}$100% N, P and K by Poultry manure, T_8 =100% N, P and K by FYM. Average annual rainfall in this region varies from 2000 to 2500 mm. During summertime, the mean temperature is found in the range of 21 to 32°C. In treatment having application of chemical fertiliser, an initial basal dose was applied before sowing, and split application of nitrogen was done, while poultry manure and FYM were applied 40 days before sowing of the crop. The data generated were statistically analyzed using the analysis of variance technique (ANOVA) as applied to a randomized block design (Panse and Sukhatme, 1985).

Results and Discussion

At the initial stage of observation (25 DAS), plant height was observed to be minimum in T_7 treatment, which was statistically at par with all the treatments except T_2, T_3, and $T_{4,}$ where N was applied fully or in part by using chemical fertilizer, which helped in the initial growth of the plant (Table 1). Similarly, Rurinda *et al* suggested that NPK fertilizer as a starter dose helps in getting good results due to good initial growth as compared to the sole application of manure. At 50 DAS and 75 DAS, the shortest plants of finger millet were found in treatment $T_{8,}$ where 100% NPK was applied by FYM (47.08 and 55.7%, respectively), followed by the control treatment, as nutrients are released slowly from organic sources and no nutrient applied in the control treatment. At 50 DAS, the tallest plants were observed in T_5 treatment (78.09), which was statistically at par with other treatments except T_1, T_6 and T_8. At 75 DAS, T_4 treatment recorded the tallest plants of finger millet (81.67 cm), which was statistically at par with all treatments except T_1, T_7 and T_8 where no nutrients were applied in T_1 treatment and in T_4 and T_8 only organic source of nutrients were used which resulted in slow availability of nutrients within short time and resulted in short plants. In T_4 treatment, 50% N was applied by FYM, which helped in better aeration and soil temperature and resulted in better plant growth along with the use of chemical fertilizers, which gave fast results in making nutrient availability (Agarwal *et al*., 1995).

Leaf area index increased from 25 to 50 DAS among different treatments in finger millet and then decreased from 50 to 75 DAS due to drying and shrinking of leaves (Table 1). The highest leaf area index at 25 DAS (2.07) was found in the T_2 treatment, having the application of chemical fertilizers, which helped in initial better growth of leaves, which was statistically at par with T_3 and $T_{4,}$ where 50% N was applied by chemical fertilizers (1.97, 1.93, respectively). Leaf area index was found to be minimum in T_1 (1.00) as there was no application of nutrients either by organic or inorganic source. At 50 and 75 DAS, leaf area index was observed to be highest in the T_2 treatment (5.24 and 4.50, respectively) and lowest in the control treatment.

In the present experiment, crop growth rate was maximum from 25-50 DAS and then it decreased from 50 to 75 DAS due to a decrease in accumulation of dry matter with time (Table 1). During 25 to 50 DAS, maximum CGR (3.42) was found in T_4 treatment, which was statistically at par with T_3 and T_5 and minimum was observed in T_8 (1.85), followed by T_1 (1.90). During 50 to 75 DAS, T_8 treatment showed maximum CGR (1.79), which may be due to better availability of nutrients from FYM decomposition and improvement in soil aeration and temperature and the lowest CGR (0.98) in T_1 treatment because of lack of availability of nutrients and poor soil condition. Maximum RGR in all treatments was found during 25 to 50 DAS due to good photosynthetic activity at this stage of the crop, as it was an active crop growth period and then during 50 to 75 DAS, RGR decreased in all treatments. T_5 treatment recorded maximum RGR (0.106) during 25-50 DAS and it was maximum (0.025) in T_8 treatment during 50 to 75 DAS.

At 50 DAS, maximum tillers (2.98) were found in T_4 treatment and minimum in T_8 (1.48) treatment (Table 2). Maximum number of finger head^{-1} were found in T_5 treatment (7.99), which was statistically at par with all treatments except T_1 (6.99), where lack of nutrients resulted in fewer finger heads due to no external application of organic or inorganic source of nutrients. T_2 treatment recorded the maximum length of fingers (8.19 cm), which was statistically at par with all treatments except T_1 (6.21 cm) due to good availability of nutrients, which resulted in better plant growth, and finally length of fingers also improved. In the control treatment (T_1), the crop took a minimum of days to mature (95.3 days; Table 2). This was the result of forced maturity due to a lack of nutrients, which resulted in early completion of the life cycle of plants. In all other treatments, nutrients were applied either by chemical fertilizer, organic sources, or their combination, so days to maturity varied from 107 to 110 but were statistically at par with each other. As test weight is a genetic character of a particular variety, all treatments were statistically at par with each other.

As seed yield is result of different yield contributing characters like healthy plant growth, good photosynthesis and translocation of photosynthesis to ear/head, so T_3 treatment achieved maximum seed yield (2459.3 kg/ha)

Table 1: Effect of different nutrient management practices on plant height (cm), leaf area index, CGR (g $m^{-2}day^{-1}$) and RGR (g $g^{-1}day^{-1}$) of finger millet [*Eleusine coracana* (L.) Gaertn.] under the foothill condition of the Eastern Himalaya

Treatments	*Plant height*			*Leaf area index*			*CGR*		*RGR*	
	25 DAS	*50 DAS*	*75 DAS*	*25 DAS*	*50 DAS*	*75 DAS*	*25–50 DAS*	*50–75 DAS*	*25–50 DAS*	*50–75 DAS*
T_1	14.84	47.18	56.00	1.00	2.07	1.97	1.90	0.98	0.083	0.015
T_2	22.11	69.62	81.33	2.07	5.24	4.50	2.93	1.61	0.089	0.016
T_3	21.49	75.08	80.67	1.97	4.93	3.74	3.29	1.06	0.094	0.010
T_4	20.95	77.68	81.67	1.93	4.90	3.67	3.42	0.70	0.096	0.006
T_5	14.02	78.09	79.13	1.72	3.67	3.50	3.18	1.45	0.106	0.014
T_6	13.47	58.17	79.83	1.70	3.64	3.43	2.42	1.70	0.099	0.019
T_7	13.40	68.03	72.55	1.30	2.96	2.80	2.53	1.25	0.101	0.015
T_8	13.49	47.08	55.71	1.32	3.00	2.90	1.85	1.79	0.089	0.025
SEm±	0.64	3.38	2.57	0.07	0.18	0.13	0.08	0.12	0.001	0.001
CD ($p = 0.05$)	1.97	10.26	7.82	0.21	0.54	0.39	0.24	0.39	0.003	0.004

Table 2: Effect of different nutrient management practices on tillers per plant, number of finger heads, days to maturity, and test weight of finger millet [*Eleusine coracana* (L.) Gaertn. under the foothill condition of the Eastern Himalaya

Treatments	*Tillers per plant*	*Numbers of finger head*	*Days to maturity*	*Test weight (g)*
T_1	1.91	6.99	95.33	2.90
T_2	1.94	7.66	107.04	2.93
T_3	2.91	7.33	109.50	2.98
T_4	2.98	7.66	109.26	2.97
T_5	1.84	7.99	110.47	2.93
T_6	1.81	7.66	109.91	2.93
T_7	1.49	7.33	106.14	2.93
T_8	1.48	7.33	108.01	2.90
SEm±	0.09	0.29	2.82	0.09
CD (P =0.05)	0.28	0.90	8.57	0.29

because chemical fertilizers provide the initial kick (shown in CGR at 25 DAS) while poultry manure provides sustained release of nutrients and improved soil physical properties during the grain filling stage which was statistically at par with T_2 and T_4 treatment because of good photosynthesis area which was indicated by leaf area index, good number of tillers, number of finger per head and length of fingers (Table 3). Good plant growth was observed in treatments where only organic manures (poultry manure and FYM) were used, but due to the slow release of nutrients resulted in less seed yield as these require long term experiments to get more good results and minimum seed yield (602 kg/ha) was observed in control treatment because of poor crop growth and yield contributing characters like tillers, length of fingers. Application of nutrients by a combination of chemical and organic sources helps in increasing yield, as reported by Pallavi *et al.* Use of organic manures helped in buffering the acidity of soil because the organic matter present in them helps in increasing soil cation exchange capacity and better absorption of nutrients from soil, which finally resulted in maximum seed yield inT_3 treatment. Application of 100% recommended dose of fertilizer through chemical fertilizers resulted in the production of maximum straw yield (4568 kg/ha), which was a result of good plant height, good crop growth rate, and good number of tillers, which was statistically at par with T_3 and T_5. In treatments with only the application of nutrients through poultry manure and FYM, straw yield was comparatively lower. Rurinda *et al* also reported that sole application of manure may not result in good results in finger millet because of slow release of nutrients, so a starter dose of NPK fertilizer may help in achieving good yield. Minimum straw yield was found in the control treatment (1089 kg/ha) due to poor vegetative growth as well as less photosynthesis. Minimum harvest index (32.09) was found in T_8 treatment, while harvest index was statistically at par for other treatments.

Table 3: Effect of different nutrient management practices on seed yield, straw yield and harvest index of finger millet [*Eleusine coracana* (L.) Gaertn.] under the foothill condition of the Eastern Himalaya

Treatments	*Seed yield (kg/ha)*	*Straw yield (kg/ha)*	*Biological yield (kg/ha)*	*Harvest index%*
T_1	602.24	1089.96	1692.21	35.59
T_2	2381.87	4568.50	6950.37	34.29
T_3	2459.31	4459.53	6918.85	35.53
T_4	2247.16	4198.19	6445.35	34.89
T_5	2040.91	4264.83	6305.74	32.38
T_6	2190.43	3945.13	6135.56	35.67
T_7	1777.66	3411.71	5189.37	34.26
T_8	1599.69	3384.75	4984.45	32.09
SEm±	76.10	111.83	112.63	1.13
CD (p = 0.05)	230.84	339.20	341.64	3.43

Conclusion

Based on the results of this study, it is concluded that the application of nutrients through chemical fertilizer and manure helped in better growth and yield of finger millet as compared to the control. Treatments where only manure was applied showed initial poor growth and yield due to slow release of nutrients, but a starter dose of chemical fertilizer along with manure resulted in better plant growth and yield. This was because of initial good growth due to chemical fertilizer and good moisture absorption by manures, which was comparable with 100% application of chemical fertilizers only. However, such trials over the long term will help in providing more precise results.

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