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Research Article

EFFECT OF PLANT GEOMETRY AND GRADED NPK LEVELS ON GROWTH AND YIELD OF TRANSPLANTED FINGER MILLET (*Eleusine coracana* L.)

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Abstract: A field experiment was conducted at Agricultural College and Research Institute, Killikulam (TNAU) during *rabi* season (2018-2019) to study the effect of different plant geometry and graded NPK levels on growth and yield of transplanted finger millet (*Eleusine coracana* L.). The experiment was laid out in randomized block design and replicated thrice with eight treatments. Treatments comprised of three plant geometry (30 × 10 cm, 25 × 25 cm and 30 × 30 cm) in combination with three graded levels of NPK (100%, 125% and 150% RDF, respectively). All the treatments are significantly influenced the growth, yield characters and yield of transplanted finger millet over the absolute control. Adaption of wider spacing with increased level of NPK (25 × 25 cm + 150% RDF) showed significantly higher growth characters, yield attributes and yield followed by treatment 25 × 25 cm + 125% RDF. The lowest growth characters, grain and straw yield was recorded in absolute control.

Keywords: *Finger millet, Plant geometry, Fertilizer level, Growth, Yield attributes, Yield*

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Introduction

Finger millet (*Eleusine coracana* L.) is most important millet crop extensively grown in various regions of India and Africa, constitutes as a stable food for a low income group of the population in these countries [4]. In India it is extensively grown in Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, Bihar, Gujarat, Maharashtra and in the hilly regions of UP and HP. It is considered as poor man's food and has capable to produce consistent yield even under marginal lands [11] and provide valuable resource at times of famine. It is produced using extensive production system where limited capital input is utilized [9]. It ranks sixth in production after wheat, rice, maize, sorghum and bajra in India [11]. Finger millet is grown globally on more than 4 m ha with a total production of 5 m t of grains, of which India alone produces about 2.2 m t [13]. In India, it is grown in an area of 1.01 m ha with the production of 1.38 m t and productivity is 1363 kg ha^{-1}. In Tamil Nadu, it has been growing in an area of 0.61 lakh ha with 1.14 lakh t production and 1865 kg ha^{-1} productivity [5]. Nutritionally, finger millet is a wonder grain due to it has the highest calcium content among all cereals (344 mg/ 100g). It also contain about 5-8% protein, 1-2% ether extractives, 65-75% carbohydrates, 15-20% dietary fibre and 2.5-3.5% mineral [1]. The main reason of low productivity and profitability are mainly *viz*., lower fertilizer dose, poor crop management, less fertilizer use efficiency and adherence of farmers to traditional crop management practices. Plant geometry plays a vital role in determining crop yield. If plant to plant and row to row spacing is too low plants competes with each other and often lodge. If the plant spacing is too high, growing space is under utilized it leads lowering the yield. Due to mining of nutrients from the soil on continue basis there is need to increase the application of fertilizer at sufficient quantity to meet out the required yield to the crop. In an effort to improve field performance of finger millet, there is need to improve the management of the crop, mainly plant spacing and nutrient requirement. Therefore, in this context, an experiment was conducted to study the influence of plant geometry and graded NPK levels on growth and yield of transplanted finger millet.

Materials and Methods

The field experiment was conducted during *rabi* season of 2018-2019 in the Garden Land Farm of AC & RI, Killikulam to study effect of plant geometry and graded NPK levels on growth and yield of transplanted finger millet (*Eleusine coracana* L.). The experiment was laid out in Randomized Block Design with three replication. The study consists of eight treatments *viz*., T_1 – Absolute control (Random planting without fertilizer application), T_2 - 30 × 10 cm + 100% RDF, T_3 - 25 × 25 cm + 100% RDF, T_4 - 25 × 25 cm + 125% RDF, T_5 - 25 × 25 cm + 150% RDF, T_6 - 30 × 30 cm + 100% RDF, T_7 - 30 × 30 cm + 125% RDF, T_8 - 30 × 30 cm + 150% RDF. The finger millet variety Co (Ra) 15 was used as test variety. The nursery was prepared with raised beds of 1.5 m width and of convenient length by broadcasting recommended seed rate of 5 kg ha^{-1}. Transplanting of 20 days old seedlings in main field was done as per the treatment spacing. The fertilizer was applied at appropriate quantity as stated in the treatment schedule. The recommended nutrient dose of N, P_2O_5 and K_2O (60-30-30 kg ha^{-1}) was applied. Entire dose of phosphorus, potassium and half dose of nitrogen were applied as basal. The remaining half dose of the nitrogen was equally top dressed at 30 and 45 DAT. Observation on plant height, LAI, number of tillers hill^{-1}, dry matter production, number of productive tillers hill^{-1}, fingers earhead^{-1}, grains earhead^{-1}, finger length, grain and straw yield of finger millet were recorded.

Results and Discussion

Growth characters

Plant geometry and graded NPK levels were significantly influenced the growth characters *viz*., plant height, number of tillers hill^{-1}, leaf area index and dry matter production [Table-1]. The plant height (108.40cm) was found superior in treatment 25 × 25 cm + 150% RDF, which was comparable treatment 25 × 25 cm + 125% RDF (107.60 cm), which was significantly differ from other treatments. Next to these treatments, 30 × 30 cm + 150% RDF recorded higher plant height (105.30 cm) which was on par with treatment 30 × 30 cm + 125% RDF (105.00 cm).

Table-1 *Effect of plant geometry and graded NPK levels on growth characters of transplanted finger millet*

Treatments		Plant height (cm)	LAI	Number of tillers hill^{-1}	DMP (kg ha^{-1})
T1	Absolute control	93.1	2.64	3.1	5816
T2	30 × 10 cm + 100 % RDF	95.6	3.25	4.6	6349
T3	25 × 25 cm + 100 % RDF	99.1	3.63	6.0	6760
T4	25 × 25 cm + 125 % RDF	107.6	4.71	9.8	7522
T5	25 × 25 cm + 150 % RDF	108.4	4.90	10.2	7634
T6	30 × 30 cm + 100 % RDF	101.2	3.69	6.4	6841
T7	30 × 30 cm + 125 % RDF	105.0	4.17	8.0	7102
T8	30 × 30 cm + 150 % RDF	105.3	4.28	8.4	7258
	SEd±	0.72	0.15	1.0	121
	CD (P=0.05)	1.5	0.32	1.2	246

Table-2 *Effect of plant geometry and graded NPK levels on yield attributes of transplanted finger millet*

Treatments		Number of productive tillers hill^{-1}	Number of fingers earhead^{-1}	Number of grains earhead^{-1}	Finger length (cm)
T1	Absolute control	1.4	4.5	897	6.5
T2	30 × 10 cm + 100 % RDF	3.0	5.1	1045	7.4
T3	25 × 25 cm + 100 % RDF	4.9	5.8	1204	7.9
T4	25 × 25 cm + 125 % RDF	7.1	7.2	1797	9.6
T5	25 × 25 cm + 150 % RDF	7.3	7.5	1908	9.8
T6	30 × 30 cm + 100 % RDF	5.1	6.0	1316	8.2
T7	30 × 30 cm + 125 % RDF	6.3	6.5	1605	8.8
T8	30 × 30 cm + 150 % RDF	6.4	6.6	1656	9.1
	SEd±	0.12	0.17	65	0.15
	CD (P=0.05)	0.25	0.36	131	0.32

Table-3 *Effect of plant geometry and graded NPK levels on grain and straw yield of transplanted finger millet*

Treatments		Test weight (g)*	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	HI*
T1	Absolute control	2.55	1659	3077	0.35
T2	30 × 10 cm + 100 % RDF	2.65	1898	3328	0.36
T3	25 × 25 cm + 100 % RDF	2.71	2294	3726	0.38
T4	25 × 25 cm + 125 % RDF	2.80	2646	4081	0.39
T5	25 × 25 cm + 150 % RDF	2.81	2692	4129	0.39
T6	30 × 30 cm + 100 % RDF	2.69	2358	3789	0.38
T7	30 × 30 cm + 125 % RDF	2.75	2478	3913	0.39
T8	30 × 30 cm + 150 % RDF	2.77	2514	3950	0.39
	SEd±	-	54	59	-
	CD (P=0.05)	NS	112	121	NS
*Data not statistically analysed					

This may be due wider spacing with increasing fertilizer levels resulted in reduce the competition between plants, increase the interception of solar radiation, photosynthesis, and nutrient supply helps in vigorous growth of transplanted finger millet. This was evidenced by Prakasha *et al.* (2018) and Chittapur *et al.* (1994). Whereas, absolute control recorded lowest plant height of 93.10 cm. This may be due to higher plant population leads to competition among plants for the growth factors. The similar trends was also noticed in leaf area index and treatment 25 × 25 cm + 150% RDF recorded significantly higher LAI (4.90), which was significantly on par with 25 × 25 cm + 125% RDF (4.71). Next to these treatments, 30 × 30 cm + 150% RDF recorded significantly higher LAI (4.28), which was at par with 30 × 30 cm + 125% RDF (4.17). This may be due to large leaf length, breadth and more number of leaves produced with wider spacing and increased fertilizer level leads increased the nutrient availability and it helped to get more LAI. These results are in accordance with findings of Krishnamurthy (1988). However, lowest LAI was recorded in absolute control (2.64).Initially tiller production starts slowly, increase steadily and attains its peak at 60 DAT and then decline. Maximum number of tillers hill^{-1} was observed in 25 × 25 cm + 150% RDF (10.2), which was significantly at par with 25 × 25 cm + 125% RDF (9.8) compared to other treatments. It was followed by 30 × 30 cm + 150% RDF produced significantly more number of tillers hill^{-1} (8.4) which was on par with 30 × 30 cm + 125% RDF (8.0). The reason behind this may be higher availability of nutrients to the plant at higher NPK levels and wider spacing resulted in good growth and development of auxiliary buds leading to higher number of tillers. Similar results were reported by Prakasha *et al.* (2018), Narasimhamurthy and Hedge (1981), Sampath *et al.* (2017). The less number of tillers hill^{-1} was recorded in absolute control (3.1).Significantly higher dry matter production was produced with 25 × 25 cm + 150% RDF (7634 kg ha^{-1}), which was on par with 25 × 25 cm + 125% RDF (7522 kg ha^{-1}). It was followed by treatment 30 × 30 cm + 150% RDF (7258 kg ha^{-1}) recorded dry matter accumulation, which was significantly on par with 30 × 30 cm + 125% RDF (7102 kg ha^{-1}). The lowest dry matter accumulation was recorded in absolute control (5816 kg ha^{-1}). This higher dry matter production might be better growth of crop which resulted in higher dry matter accumulation in leaves and stem. Similar results were also observed by Shivprasad and Singh (2017) in fodder sorghum, Prakasha *et al.*, (2018) in finger millet.

Yield characters and yield

Significantly, the number of productive tillers hill^{-1} was maximum in 25 × 25 cm + 150% RDF (7.3), which was comparable with 25 × 25 cm + 125% RDF (7.1). It was followed by 30 × 30 cm + 150% RDF (6.4), which was significantly on par with 30 × 30 cm + 125% RDF (6.3). This may be due to with higher root volume encourage the nutrient supply to plants which leads to higher productive tiller production. The less number of productive tillers hill^{-1} was obtained with absolute control (1.4). Among the treatments, 25 × 25 cm + 150% RDF recorded higher number of finger earhead^{-1} and grains earhead-1 (7.5 and 1908, respectively) but it was comparable with 25 × 25 cm + 125% RDF (7.2 and 1799, respectively). It was followed by treatment 30 × 30 cm + 150% RDF recorded the number of finger earhead-1 and grains earhead^{-1} (6.6 and 1656, respectively) which was significantly on par with 30 × 30 cm + 125% RDF (6.5 and 1605, respectively). However, the less number of finger earhead^{-1} and grains earhead^{-1} was registered in absolute control (4.5 and 897, respectively). Lower availability of plant nutrients and closer spacing which led the plant to uptake less amount of nutrient and increased competition between plants resulted in reduced growth and development of plants compared to increased levels of NPK. This result was similar in line with Benson and Matinde, (2019).The maximum finger length was observed in 25 × 25 cm + 150% RDF (9.8 cm), which was significantly on par with 25 × 25 cm + 125% RDF (9.6 cm).

It was followed by treatment 30 × 30 cm + 150% RDF recorded higher finger length (9.1 cm) which was significantly on par with 30 × 30 cm + 125% RDF (8.8 cm). This may be due to increase in plant spacing and level of fertilizer increases the length of finger millet. Similar result was observed by Kipgen *et al*. (2018). the lowest finger length was obtained with absolute control (6.5 cm). Significantly highest grain and straw yield was recorded in 25 × 25 cm + 150% RDF (2692 and 4129 kg ha^{-1}, respectively), which was on par with 25 × 25 cm + 125% RDF (2646 and 4081 kg ha^{-1}, respectively). It was followed by 30 × 30 cm + 150% RDF (2514 and 3950 kg ha^{-1}, respectively), which was on par with 30 × 30 cm + 125% RDF (2478 and 3913 kg ha^{-1}, respectively). The increased grain yield obtained in 25 × 25 cm + 125% RDF over farmers practice of 30 × 10 cm + 100% RDF and absolute control were 28 and 37% respectively. This might be due to the optimum plant population with higher levels of NPK which was reflected in crop growth and yield attributing characters resulting in more grain and straw yield. This result was supported by the findings of Prakasha *et al*. (2018) and Rani *et al*. (2017). The lowest grain and straw yield were obtained with absolute control (1659 and 3077 kg ha^{-1}, respectively). These results are in consonance with the finding of Dasbak *et al*., (2014) in finger millet.

Conclusion

The result of present investigation clearly indicated that, finger millet transplanted at a spacing of 25 × 25 cm + 150% RDF gave significantly maximum growth and yield characters. However, for economic purpose the planting of 25 × 25 cm + 125% RDF can be recommended for obtaining better growth and maximum yield in finger millet.

Application of research: In general, most of the millets growing farmers in India raising their crop only by broadcasting with inadequate nutrient supply in marginal land. When the farmers are transplanting finger millet at wider spacing (as like SRI in rice) and also that crop is supplied with increased fertilizer will reflected on the increased yield. In such situation this research might help the farmers.

Research Category: Plant geometry, Fertilizer level

Abbreviations: RDF: Recommended dose of fertilizer, LAI: leaf area index, DAT: Days after transplanting, m: meter, ha: hectare, cm: centimetre, %: percent, kg: kilogram, SRI: System of Rice Intensification

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Study area / Sample Collection: Garden Land Farm, AC & RI, Killikulam

Cultivar / Variety name: Finger millet (*Eleusine coracana* L.) - Co (Ra) 15

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