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Effect of Spacing and age of Seedling on Growth and Yield of finger Millet (*Eleusine coracana* L.)

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ABSTRACT: A field experiment was carried out during *kharif* season of 2020 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P.). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.28%), available N (225kg/ha), available P (19.50kg/ha) and available K (213.7kg/ha). The treatments consisted of three different row spacing *viz.* 20 cm × 10 cm, 25 cm × 10 cm and 30 cm × 10 cm and three different age of seedling *viz.* 15 day old seedling, 20 day old seedling, and 25 day old seedling, whose effect was observed on Finger millet (GPU - 28). The experiment was laid out in Randomized Block Design with 9 treatments and replicated thrice. The results revealed that treatment with 20 cm × 10 cm + 20 days old seedling recorded maximum plant height (77.74 cm), more number of tillers per plant (7.39), plant dry weight (13.64 g/plant), number of grains per ear head (2013.67), number of effective tillers/m^2 (149.17/m^2), grain yield (2680.00 kg/ha), and stover yield (5651.00kg/ha). However, maximum gross return (INR 1,12,851.30/ha), net return (INR 78,896.33/ha) and B: C ratio (2.32) were also recorded with treatment combination of 20 cm × 10 cm + 20days old seedling. It reveals from the study that the treatment 9 (20cm × 10cm + 20 days old seedling) Contribute to enhance the rate of development and crop yield by increasing grain yield.

Keywords: Finger miller, Row spacing, Age of seedling, Growth, Yield.

INTRODUCTION

Finger millet (*Eleusine coracana* L.) ranks first in terms of area covered (50%) and contributes 2/3 of total output (2.8 m). *Eleusine coracana* L., also known as ragi, marua, mandua, nagli, kapi, and nachni in various Indian languages, is a member of the Poaceae family. The crop is well suited to very low and marginal uplands where other crops are unable to thrive (AICSMIP, 2014). Finger millet is thought to have originated about 3,000 years BC in Africa's Uganada and Ethiopia (Seetharam, 2007 and Brahmachari *et al.*, (2019) and spread to India about the same time. It is the most important small millet in the tropics, accounting for 12% of the global millet region (ICRISAT, 2011) and cultivated in more than 25 countries in Africa and Asia.

The appropriate spacing and age of seedlings are most important management factor affecting the agronomic characteristics of wheat suitable combination of seedling day and spacing could increase grain yield of Finger millet. Wider spacing was superior to narrow spacing in terms of enhanced grain and straw yield. Moreover, the ideal crop geometry can reduce the seed rate, healthy stand in the main field and ensure higher productivity. The average yield of finger millet is more under square planting of young seedlings with single seedling $hill^{-1}$(Kalaraju *et al*., 2011). The age of seedlings is another important factor as it has a tremendous influence on the tiller dynamics, tiller production, grain formation and other yield contributing characteristics (Pasuquin *et al*., 2008). Young seedlings are transplanted to preserve the potential for high tillering and extensive rooting ability than the aged seedlings. In view of the above observations a field experiment was conducted to find out the effect of crop geometry and age of seedlings on yield attributing traits, yield of finger millet.

MATERIALS AND METHODS

A field experiment was carried out during *kharif* season of 2020 at the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P.). This area is situated on the right side of the Yamuna river by the side of Prayagraj-Rewa road about 12 km from the city. Prayagraj has a subtropical and semi-arid climatic condition, south-eastern position of Uttar Pradesh prevails with both extremes of temperature, *i.e.* winter (4°C) and summer (48°C). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1) analyzed by using glass electrode pH meter, electrical conductivity 0.26 ds/m analyzed using conductivity meter (Jackson, 1973), organic carbon (0.38%) by Walkley and Black method (Nelson and Sommer, 1982), available nitrogen (225 kg/ha) estimated by alkaline permanganate method by Subbiah

and Asija (1956), available phosphorous (19.50 kg/ha) by Olsen's method (Nelson and Sommer, 1982), and available K (213.7kg/ha) analyzed by Flamephotometry (Jackson, 1973). The present experiment was laid out in randomized block design (RBD) consisted of 9treatments and each replicated thrice *viz.*, T_1 - 20cm × 10cm + 15 days old seedling, T_2 - 20cm × 10cm + 20 days old seedling, T_3 - 20cm × 10cm + 25 days old seedling, T_4 - 25cm × 10cm + 15 days old seedling, T_5 - 25 cm × 10cm + 20 days old seedling, T_6 - 25 cm × 10cm + 25 days old seedling, T_7 - 30 cm × 10cm + 15 days old seedling, T_8 - 20cm × 10cm + 20 days old seedling and T_9 - 20cm × 10cm + 25 days old seedling. The nutrient sources were Urea, SSP, MOP to fulfill the requirement of Nitrogen, Phosphorus and Potassium.The recommended dose of Nitrogen was 60 kg/ha, Phosphorous 30 kg/ha and Potassium 30 kg/ha applied as basal at the time of sowing according to treatment combination. The data recorded for different characteristics were subjected to statistical analysis by adopting the method of analysis of variance (ANOVA) as described by Gomez and Gomez (1984). The significance of comparison was tested. The significant difference values were computed for 5 percent probability of error. Wherever the variance ratio (F value) was found significant, critical difference (CD) values were computed for the comparison among the treatment mean.

RESULTS AND DISCUSSION

A. Plant height (cm)

The Plant height of finger millet recorded at harvest differed significantly as influenced by Spacing and Age of seedling (Table 1). At harvest, highest plant height (77.74cm) was recorded with treatment combination of 20cm × 10cm + 20 days old seedling which was significantly superior overall the treatments except with treatment combination of 20cm × 10cm + 15 days old seedling (76.09cm), 25cm × 10cm + 20 days old seedling (77.37 cm) and 30cm × 10cm + 20 days old seedling (75.67 cm) which were statistically at par with 20cm × 10cm + 20 days old seedling. At all the stages of plant growth, plant height was found to be increased with increase in plant density. It could be attributed to the fact that higher plant density would certainly reduce the amount of light availability to the individual plant, especially to lower leaves due to greater shading. As the mutual shading increases at higher plant densities, the plant tends to grow taller. Due to the elongation of nodes of over aged seedlings in the nursery leads to increase in plant height. Similar findings were reported by Rajesh *et al.,* (2011).

B. Plant dry weight (g/plant)

The Plant dry weight of finger millet recorded at harvest differed significantly as influenced by Spacing and Age of seedling. At harvest, maximum plant dry weight (13.64 g/plant) was recorded with treatment combination of 20cm × 10cm + 20days old seedling which was significantly superior over all the treatments except with treatment combination of 30 cm × 10cm + 20 days old seedling (13.39 g/plant) and 25 cm × 10cm + 20 days old seedling (13.34 g/plant). Increased plant population due to closer spacing and double seedlings/hill increased the number of tillers and eventually increased the plant dry matter production. Improvement of leaves might have increased the photosynthetic efficiency of finger millet and have induced to produce more plant dry matter production. This was in accordance with the earlier findings of Borale *et al.,* (2002), Kalaraju *et al.,* (2011) and Rajesh (2011).

C. Number of tillers per plant

The analyzed data presented in Table 1 showed at harvest significantly maximum number of tillers per plant (7.39) was recorded with treatment combination of 20cm × 10cm + 20days old seedling which was significantly superior over all the treatments except with treatment combination of 30cm × 10cm + 20 days old seedling (6.79) and 25 cm × 10cm + 20 days old seedling (7.01). The increase in tiller number was due to closer spacing and 20 days age seedlings which resulted in more population and number of tillers per unit area.

Table 1: Effect of spacing and age of seedlings on Growth attributes of finger millet.

Treatments	Plant height(cm) at harvest	Dry weight (g/plant) at harvest	Number of tillers/plant at harvest
20cm × 10cm + 15 days old seedling	76.09	13.09	6.14
20cm × 10cm + 20days old seedling	77.74	13.64	7.39
20cm ×10cm + 25days old seedling	72.27	12.94	6.67
25cm × 10cm + 15days old seedling	74.78	12.79	6.05
25cm × 10cm + 20days old seedling	77.37	13.34	7.01
25cm × 10cm + 25days old seedling	74.44	13.12	5.98
30cm × 10cm + 15days old seedling	74.85	12.88	6.34
30cm × 10cm + 20days old seedling	75.67	13.39	6.79
30cm × 10cm + 25days old seedling	73.52	12.97	6.44
SEm(±)	0.802	0.132	0.205
CD (p=0.05)	2.38	0.39	0.61

In comparison to others, wider crop geometry resulted in a higher number of tillers/plant at all growth stages. Individual plants could have made better use of available resources such as space, foraging area for root systems, light utilisation, and so on, resulting in increased tiller output in treatments with a wider spacing. Similarly increased number of tillers/hill under wider spacing was very well documented by Awan *et al*., (2007), Kalaraju *et al*., (2011), Dahal and Khadka (2012).

C. Yield Attributes

Number of effective tillers/m^2. Treatment with spacing 20 cm × 10 cm + 20 days old seedling was recorded maximum Number of effective tillers/m^2 (149.17) which was significantly superior over all the treatments. However, treatment with spacing 25 × 10 cm + 20 days old seedling (146.10) and 30 × 10 cm + 20 days old seedling (144.53) were statistically at par with treatment combination of spacing 20 cm × 10 cm + 20 days old seedlings. Age of seedlings, various crop geometry practices and number of seedlings/hill statistically influenced the number of productive tillers in finger millet. The number of tillers per unit area was higher, whereas productive tillers were lower due to poor conversion of tillers to productive tillers. Under 20 cm × 10 cm spacing with young seedlings leads to better conversion of total number of tillers to productive tillers eventually produced more productive tillers. By transplanting of younger seedlings along with soil, keeping the roots intact, that resulted in early adaptation of the young seedlings to soil and climatic condition there by recording better growth and yield attributes. The finding of Uphoff (2002) confirmed these results.

Number of grains/ear head. Treatment with spacing 20 cm × 10 cm + 20 days old seedling was recorded maximum number of grains per ear head (2013.67) which was significantly superior over all the treatments. However, treatment with spacing 25 × 10 cm + 20 days old seedling (1891.00) and 30 × 10 cm + 20 days old seedling (1877.33) were statistically at par with treatment combination of spacing 20cm × 10cm + 20 days old seedlings. Plant spacing of 20 cm × 10 cm with young seedlings provides favourable microclimate to crop for effective utilization of available moisture, nutrient and its early adoption leads to better partitioning of photosynthates to reproductive parts there by recording better growth and yield attributes. Ram *et al*., (2014) also reported similar findings.

D. Yield

Grain yield (kg/ha). Treatment with spacing 20 cm × 10 cm + 20 days old seedling was recorded maximum Grain yield (2680 kg/ha) which was significantly superior over all the treatments. However, treatment with spacing 25 × 10 cm + 20 days old seedling (2409 kg/ha) and 30 × 10 cm + 20 days old seedling (2452 kg/ha) were statistically at par with treatment with spacing 20cm × 10cm + 20 days old seedlings. Lower grain yield was recorded under wider spacing because total number of plants per unit area was far lesser than with closer planting. Optimum planting pattern is the pre-requisite for proper utilization of growth resources and ultimately to exploit the potential productivity of any crop. This is in agreement with the findings of Suresh (2013) and Gurjar *et al.,* (2018).

Straw yield (kg/ha). Treatment with spacing 20 cm × 10 cm + 20 days old seedling was recorded maximum straw yield of (5651 kg/ha) which was significantly superior over all the treatments. However, treatment with spacing 25 × 10 cm + 20 days old seedling (5489 kg/ha) and 30 × 10 cm + 20 days old seedling (5221 kg/ha) were statistically at par with treatment combination of spacing 20 cm × 10cm + 20 days old seedlings. More plant population mowing to closer spacing at 20 cm × 10 cm and 20 days age seedlings might have contributed to maximum plant dry matter production and number of leaves which ultimately enhanced the straw yield. Similar findings were reported by (Rajesh, 2011) and Kalaraju *et al.,* (2011).

Table 2: Effect of spacing and age of seedlings on Yield attributes and yield of finger millet.

Treatments	Number of effective tillers/m^2	Number of grains/ear head	Grain yield (kg/ha)	Straw yield (kg/ha)
20cm × 10cm + 15 days old seedling	132.97	1681.00	1982.00	4317.00
20cm × 10cm + 20days old seedling	149.17	2013.67	2680.00	5651.00
20cm × 10cm + 25days old seedling	140.67	1672.67	2166.00	4423.00
25cm × 10cm + 15days old seedling	140.03	1572.67	2296.00	4632.00
25cm × 10cm + 20days old seedling	146.10	1891.00	2409.00	5489.00
25cm × 10cm + 25days old seedling	135.60	1717.00	2245.00	4691.00
30cm × 10cm + 15days old seedling	141.93	1692.33	2236.00	4663.00
30cm × 10cm + 20days old seedling	144.53	1877.33	2452.00	5221.00
30cm × 10cm + 25days old seedling	139.80	1737.67	2155.00	4434.00
SEm(±)	2.33	60.55	92.87	230.81
CD(P=0.05)	6.91	179.91	275.92	685.77

Effect of spacing and age of seedling on economics of Finger millet. Experimental results revealed that different spacing and age of seedling significantly increased the economics of Finger millet. Higher gross return (INR 1,12,851.30/ha), Net return (INR78,896.33/ha) and benefit cost ratio (2.32) were recorded with the treatment combination of 20 cm × 10cm + 20 days old seedling and minimum gross return (INR 83,583.33/ha), net return (INR49,628.33/ha) and benefit cost ratio (1.46) were recorded with the treatment combination of 20cm × 10cm + 15 days old seedling.

Table 3: Effect of spacing and age of seedlings on Economics of finger millet.

Treatments	Total cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B : C ratio
20cm × 10cm + 15 days old seedling	33955.00	83583.33	49628.33	1.46
20cm × 10cm + 20days old seedling	33955.00	112851.30	78896.33	2.32
20cm × 10cm + 25days old seedling	33955.00	91049.67	57094.67	1.68
25cm × 10cm + 15days old seedling	33655.00	96471.67	62816.67	1.87
25cm × 10cm + 20days old seedling	33655.00	101862.70	68207.67	2.03
25cm × 10cm + 25days old seedling	33655.00	94491.00	60836.00	1.81
30cm × 10cm + 15days old seedling	33355.00	94090.00	60735.00	1.82
30cm × 10cm + 20days old seedling	33355.00	103301.30	69946.33	2.10
30cm × 10cm + 25days old seedling	33355.00	90620.67	57265.67	1.72

Plate 1. Tagging, weeding, dry weight, overview and matured stage of Finger millet crop at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, during kharif, 2020.

CONCLUSION

The findings based on above research trial indicated that spacing and age of seedling gave positive effect on growth and yield of Finger millet. The treatment combination 20cm × 10cm + 20 days old seedling was found more productive (2680.00kg/ha) as well as economically viable (INR78,896.33/ha). Concluded that treatments of 20cm × 10cm + 20 days old seedling is beneficial for farmers practice.

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