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Effect of spacing and phosphorous levels on yield and economics of finger millet (*Eleusine coracana* L.)

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Abstract
A field experiment was carried out at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P) in *Zaid* 2021 to determine the effect of spacing and phosphorus levels on growth and yield of finger millet. The treatments comprise of three spacing's *viz.*, (30 x 10 cm, 45 x 10 cm, 60 x 10 cm) and three phosphorus levels (20 kg/ha P, 30 kg/ha S and 40 kg/ha S) The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice. The results showed that application of Phosphorus on various Spacing's showed significant variation for growth and yield parameters. Among all the treatments, application of 40 kg P with 60 cm row spacing recorded maximum Plant height (86.41 cm), No. of tillers/plant (12.54), Plant dry weight (14.68 g), No. of fingers/plant (6.71), Test weight (3.09 g/1000 seeds) whereas application of 40 kg P with 30 cm row spacing recorded grain yield (2.94 t/ha) and straw yield (6.22 t/ha) and Harvest Index (32.11 %). However, the Maximum Gross returns (102900.00 INR/ha), Net returns (70048.00 INR/ha) and B: C ratio (2.13) was recorded with spacing of 30x40 cm+ Phosphorus at 40 kg/ha as compared to other treatments.

Keywords: Finger Millet, Phosphorus, Spacing, Tillers, Fingers, growth and yield

Introduction
Finger millet (*Eleusine coracana* L.) Gaertn is cereal grass grown mostly for its grain. Finger millet is a robust, tufted, tillering annual grass, up to 170 cm high. The inflorescence is a panicle with 4-19 fingers like spikes that resembles a first when mature, hence the name of finger millet. The spikes bear up to 70 alternate spikelet's carrying 4 to 7 small seeds (Aparna *et al.,* 2019) [2]. The seed pericarp is independent from the kernel and can be easily removed from the seed coat. Finger millet is a staple food in many African and South Asian countries. It is also considered a helpful famine crop as it is easily stored for lean years.

Finger millet is a primary crop in Karnataka, Tamil Nadu and Gujarat, while the same is a minor crop in Telangana. Hence, the spatial distribution of millets either as a primary crop or as allied crops largely depends on the growing habitat and the amount of rainfall the region receives. (Sundaresh and Basavarajaa 2017) [21] While sorghum predominates in areas receiving annual rainfall beyond 400mm, pearl millet rivals it in areas with annual rainfall of 350 mm. Further, the small millets like finger millet, foxtail millet, barnyard millet, little millet and proso milletare found in most of the southern and central states in India especially whenever annual rainfall is below 350 mm, perhaps where no other cereal crop can grow under such moisture stress (Shinggu and Gani 2012) [19].

The productivity of finger millet in the country and as well as state is very low as compared to potential yield of improved genotypes. The main for low productivity is due to an imbalance in nutrients coupled with adverse climatic conditions, late transplanting, faulty methods of cultivation and little or no use of fertilizers. The secret of boosting its yields mainly lies in suitable planting method and properly fertilizing the crop. Proper sowing method is one of the important nonmonetary inputs in crop production, which affects the crop growth, yield and quality to greater extent. Method of establishment play an important role to exploit all available resources for growth as it provides optimum growing condition. Transplanting is an economically ideal alternative to seeding (Kalaraju *et al.,* 2009) [10].

The development of cropping systems such as appropriate inter-row spacing will help crop themselves to compete with weed. Several reports indicated that crops planted in narrow row spacing suppress weed growth more than when planted in wider row spacing. In spite of the crop importance, information on weed management practices in finger millet is limited. Hence,

this study aimed at determining the separate and interactions on yield and weed destiny of finger millet (Roy *et al*., 2002) [16].

Materials and methods

The experiment was carried out during Zaid season of 2021 at the CRF (Crop Research Farm) SHUATS, Department of Agronomy, Naini Agricultural institute, Sam Higginbottom University of Agricultural, Technology and Sciences, Prayagraj, Uttar Pradesh. The crop Research Farm is situated at 25.750 N latitude, 87.190 E longitude and at an altitude of 98m above mean sea level. This area is situated on the right side of the river Yamuna and by opposite side of Prayagraj city. All the facilities required for crop cultivation were available. Treatment comprised T_1 30 cm + 20 kg/ha Phosphorous, T_2 30 cm + 30 kg/ha phosphorous, T_3 30cm + 40 kg/ha Phosphorus, T_4 45 cm + 20 kg/ha Phosphorous, T_5 45 cm + 30 kg/ha Phosphorous, T_6 45cm + 40 kg/ha phosphorous, T_7 60 cm + 20 kg/ha Phosphorous, T_8 60cm + 30kg/ha Phosphorous, T_9 60 cm +40 kg/ha Phosphorous of These were replicated thrice on Randomized Block Design recommended dose of fertilizers was applied at the sowing time in Urea, SSP, MOP form.

Statistical analysis

Experiment data collected was subjected to statically analysis by adopting fishers method of analysis of variance (ANOVA). Critical Difference (CD) values were calculated the 'F' test was found significant at 5% level.

Result and discussion

Effect of Spacing and Phosphorus levels on yield attributes of Finger millet

From the observations seed yield or grain t/ha (2.94) was more and significant in treatment with treatment 3 with spacing of 30x40 cm + Sulphur at 40 kg/ha which was more significantly higher over rest of the treatments expect treatment 2 with spacing of 30x30 cm
+ Phosphorous at 30 kg/ha and treatment 6 with spacing 40x40 cm + Phosphorous at 40 kg/ha which were statistically at par with spacing of 30x10 cm (s2) + Sulphur at 30 kg/ha. 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) [22].

From the observations straw yield t/ha (6.22) was more and significant in treatment with treatment 3 with spacing of 30x40 cm + Sulphur at 40 kg/ha which was significantly higher over rest of the treatment expect treatment 2 with spacing of 30x30 cm + Phosphorous at 40 kg/ha which were statistically at par with spacing of 30x10 cm (S2) + Sulphur at 30 kg/ha. It might be more plant population owing to closer spacing at 20 x 10 cm might have contributed to maximum dry matter accumulation and number of leaves which ultimately enhanced the straw yield. Similar findings were reported earlier by (Kalaraju *et al*., 2011) phosphorus plays a crucial role in millet production. The significant increase in grain and stover yield of pearl millet was largely a function of improved growth and the consequent increase in different yield attributes as mentioned above. This favorable effect might be owing to the fact that P is well known for its role as 'Energy currency' and plays a key role in development and energy transformation in various vitally important metabolic processes in the plant (Singh *et al*., 2017) [20].

Effect of Spacing and Phosphorus levels on Economics of Finger millet

Cost of cultivation increased with increasing levels of phosphorus. Maximum gross returns (102900.00 INR/ha), net returns (70048.00 INR/ha) and B:C ratio (2.13) of finger millet were recorded with the application of 30x40 cm+ Phosphorus at 40 kg/ha.

Table 1: Effect of Spacing and Phosphorous levels on yield attributes and economics of Finger millet

Treatments	Grain yield (t/ha)	Stover yield (t/ha)	Cost cultivation (INR/ha)	Net return (INR/ha)	Gross return (INR/ha)	B:C ratio
1. 30 cm + 20+kg/ha Phosphorous	2.62	5.74	32490.00	91700.00	58972.00	1.80
2. 30 cm + 30+kg/ha Phosphorous	2.86	6.10	32728.00	100100.00	67610.00	2.08
3. 30 cm + 40+kg/ha Phosphorous	2.94	6.22	32852.00	102900.00	70048.00	2.13
4. 45 cm + 20+kg/ha Phosphorous	2.58	5.58	32490.00	90300.00	57572.00	1.75
5. 45 cm + 30+kg/ha Phosphorous	2.68	5.85	32728.00	93800.00	61310.00	1.88
6. 45 cm + 40+kg/ha Phosphorous	2.78	5.98	32852.00	97300.00	64448.00	1.96
7. 60 cm + 20+kg/ha Phosphorous	2.43	5.32	32490.00	85050.00	52322.00	1.59
8. 60 cm + 30+kg/ha Phosphorous	2.48	5.41	32728.00	86800.00	54310.00	1.67
9. 60 cm + 40+kg/ha Phosphorous	2.54	5.63	32852.00	88900.00	56048.00	1.70
F-Test	S	S	-	-	-	-
SEm (±)	0.08	0.11	-	-	-	-
CD (P=0.05)	0.23	0.32	-	-	-	-

Conclusion

Based on the findings it may be concluded that for optimum Seed yield and economics, the performance of Finger millet is best with spacing of 30x40 cm+ Phosphorus at 40 kg/ha The conclusion drawn based on one season data only which require for further conformation for recommendation.

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