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Effect of finger millet (*Eleusine coracana* L.) varieties to different spacings in *kharif* season

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Abstract
The field investigation entitled was conducted during *kharif* 2024 at Experimental Farm, Agronomy Section, College of Agriculture, Latur to study the response of finger millet (*Eleusine coracana* L.) varieties to spacings. The experiment was laid out in Split Plot Design with two factors and replicated thrice. Main comprises the different varieties *viz.* V_1 -Phule Nachani, V_2- Phule Kasari and V_3- Dapoli-1 and sub factor comprises the three spacings *viz.* S_1- 30 cm × 10 cm, S_2-45 cm × 15 cm and S_3 -45 cm × 20 cm. The results revealed that among the varieties Phule Nachani (V_1) recorded highest plant height (104.4 cm) which was at par with Phule Kasari (V_2) and found significantly superior over Dapoli-1 (V_3). The highest values of growth parameters *viz.* number of tillers plant^{-1} (3.12), number of leaves plant^{-1} (45.5), mean leaf area (5.14 dm^2) and dry matter production plant^{-1} (51.6 g) and highest grain yield (1763 kg ha^{-1}) and biological yield (7726 kg ha^{-1}) recorded in Dapoli-1 (V_3) which was significantly at par with Phule Kasari (V_2) and superior over Phule Nachani (V_1). Numerically highest value of harvest index (22.95%) recorded in Dapoli-1 (V_3). However, among the spacings, the wider spacing of 45 cm × 20 cm (S_3) recorded highest values of number of tillers plant^{-1} (3.24), number of functional leaves plant^{-1} (45.6), leaf area plant^{-1} (4.88 dm^2) and dry matter production plant^{-1} (51.0 g) which was at par with spacing 45 cm × 15 cm (S_2) and significantly superior over spacing 30 × 10 cm (S_1). Significantly highest values of plant height (105.4 cm), grain yield (1733 kg ha^{-1}) and biological yield (7932 kg ha^{-1}) were recorded in closer spacing 30 × 10 cm (S_1) which was found to be at par with spacing 45 cm × 15 cm (S_2) and significantly superior over 45 cm × 20 cm (S_3). Numerically highest value of harvest index (22.34%) recorded in intermediate spacing 45 cm × 15 cm (S_2).

Keywords: Finger millet, spacings, grain yield, varieties

Introduction
Finger millet (*Eleusine coracana* L. Gaertn), a nutrient-rich C4 crop, is primarily cultivated in the semi-arid regions of Asia and Africa due to its adaptability to drought, poor soils, and rainfed conditions. Originating from the highlands of Uganda and Ethiopia, it is widely grown in India, which contributes approximately 85% of the global production. Known as *ragi* in India, finger millet is valued for its high calcium, dietary fiber, and balanced amino acid content. It is consumed in traditional forms such as roti, porridge, and dumplings and plays a vital role in the diets of rural communities. Its grains can be stored for long periods, enhancing food security. Despite its benefits, finger millet remains underutilized due to limited agronomic research, labor shortages, and preference for other cereals like rice and maize. Low yields are often linked to poor seed quality and improper plant spacing. Optimizing varietal selection and spacing can significantly improve productivity. Finger millet accounts for about 9% of total millet production in India, ranking third after pearl millet (62%) and sorghum (26%). Maharashtra leads millet production among Indian states, contributing around 11% of the country's total millet output (Anonymous, 2023) [1]. In Maharashtra, the crop is mainly cultivated in hilly and sloping areas of Konkan, Nashik, Pune, and Kolhapur, which alone accounts for over 21,000 hectares under cultivation (Choudhar *et al*., 2024) [2]. The development and use of diverse crop varieties are essential for achieving sustainable, productive, and food-secure agricultural systems. Improved varieties enhance a crop's resilience by increasing resistance to diseases and enabling tolerance to environmental stresses such as drought and high temperatures.

Crop geometry is an important component to attain higher production through better utilization of moisture and nutrients from the below ground root spread and above ground plant canopy by harvesting maximum possible solar radiation and sequentially improves photosynthates formation. In the case of finger millet, low productivity is often attributed to the use of poor-quality seeds and improper spacing. Therefore, selecting suitable varieties and adopting optimal spacing practices are key strategies for improving yield. Considering above facts, the present investigation was carried out to study the Effect of finger millet (*Eleusine coracana* L.) varieties to spacings in *kharif* season.

Materials and Methods

A field experiment was conducted during the *kharif* season of 2024-25 at Agronomy farm, College of Agriculture, Latur (M.S.). The Latur district falls within the semi-arid zone of Maharashtra. The soil of the experimental site was clayey in texture, slightly alkaline, with a pH of 7.58, very low available nitrogen (137.98 kg ha^{-1}), low in available phosphorus (7.46 kg ha^{-1}) and very high in available potassium (1045.60 kg ha^{-1}). The experiment was laid out in Split Plot Design with two factors and replicated thrice. Main comprises the three different varieties *viz*. V_1 -Phule Nachani, V_2- Phule Kasari and V_3- Dapoli-1 and sub factor comprises the three spacings *viz*. S_1- 30 cm × 10 cm, S_2-45 cm × 15 cm and S_3 -45 cm × 20 cm. Each experimental unit was 5.4 m × 4.6 m in size. The net plot size varied as per the treatments. Sowing was done on 28 June, 2024 by dibbling. The recommended fertilizer dose of 60:30:30 NPK kg ha^{-1} was applied. Half the dose of nitrogen and entire dose of phosphorus and potassium in the form of urea, single super phosphate (SSP) and muriate of potash (MOP) respectively were applied as per the treatments at the time of sowing. Remaining 50% of nitrogen was applied at 30 DAS. The recommended cultural practices and plant protection measures were undertaken. The statistical technique of analysis of variance was employed to analyse the recorded data (Panse and Sukhatme, 1967) [5].

Results and Discussion

Growth attributes

Growth attributing characters of finger millet *viz*., plant height (cm), number of tillers $plant^{-1}$, and number of functional leaves $plant^{-1}$, leaf area $plant^{-1}$ (dm^2) and total dry matter production $plant^{-1}$ (g), were influenced significantly by varieties and spacings are presented in Table 1.

Effect of varieties

Among the finger millet varieties, Dapoli-1 (V_3) resulted in higher growth attributes *viz*. number of tillers $plant^{-1}$ (3.12), number of leaves $plant^{-1}$ (45.5), leaf area (5.14 dm^2) and dry matter production $plant^{-1}$ (51.6 g) which were at par with Phule Kasari (V_2) and significantly superior over Phule Nachani (V_1) However highest plant height (104.4 cm) was recorded by Phlule Nachani (V_1) which was at par with Phule Kasari (V_2) and significantly superior over Dapoli-1 (V_3). The significant differences in growth attributes of different varieties might be due to their genetic constituent. Similar results were reported by Pol *et al.,* (2024) [6].

Effect of spacings

Among the different spacings, the wider spacing of 45 cm × 20 cm (S_3) produced higher value of number of tillers $plant^{-1}$ (3.24), number of functional leaves $plant^{-1}$ (45.6), leaf area $plant^{-1}$ (4.88 dm^2) and dry matter production $plant^{-1}$ (51 g) which was at par with 45 cm × 15 cm (S_2) and found significantly superior over 30 cm × 10 cm (S_1). However, highest value of plant height (105.4 cm) was recorded with the closer spacing 30 cm × 10 cm (S_1) which was at par with 45 cm × 15 cm (S_2) and found significantly superior over 45 cm × 20 cm (S_3). It could be attributed due to higher plant population with closer spacing, resulted in taller plant height in search of adequate light. The decrease in plant height in wider spacing might be due to availability of more space and solar radiation. The numbers of tillers are highest in wider spacing because of more availability of space, nutrients, light per plant that helps to produce more number of tillers per plant resulted in more number of leaves per plant. The leaf area is highest in wider spacing because of more availability of nutrients, space and light to leaves that help to produce their maximum leaf area. Dry matter production per plant on wider spacing is maximum of ample availability of light, space and nutrients that helps to utilize them so efficiently to produce maximum dry matter per plant. Similar results were recorded by Roy *et al*. (2001) [9], Siddiqui *et al*. (2020) [10], Minz *et al*. (2021) [3] and Reddy and Singh (2021) [8].

Yield

Data in Table 2 revealed that grain and biological yield of finger millet were affected significantly due to varieties and spacings.

Effect of varieties

Among the finger millet varieties, highest grain yield (1763 kg ha^{-1}) and biological yield (7726 kg ha^{-1}) were recorded in Dapoli-1 (V_3) which was significantly at par with Phule Kasari (V_2) and found significantly superior over Phule Nachani (V_1). Numerically highest value of harvest index (22.95%) recorded in Dapoli-1(V_3). The significant differences in yield different varieties might be due to their genetic constituent. Similar results were reported by Pol *et al.,* (2024) [6].

Effect of spacings

Among the spacings, the narrow spacing 30 cm × 10 cm (S_1) recorded the highest grain yield (1733 kg ha^{-1}) and biological yield (7932 kg ha^{-1}) which was at par with the spacing of 45 cm × 15 cm (S_2) and found significantly superior over 45 cm × 20 cm (S_3). The higher value for harvest index was recorded in intermediate spacing 45 cm × 15 cm (S_2). The improved yield in closer spacing might be due to increased number of plants per unit area. The denser planting arrangement led to higher total grain yield Thus, higher plant density was the primary reason for higher yield, which was observed with narrower spacing. Similar results were recorded by Tadele *et al.,* (2016) [11], Panchal *et al* (2014) [4] and Ravindran and Ranganathan (2016) [7].

Interaction effect

The effect of interaction between varieties and spacings on growth attributes and yield were found to be non-significant.

Table 1: Growth attributing characters of finger millet as influenced by different varieties and spacings.

Treatment	Plant height (cm)	No. of tillers plant^{-1}	No. of functional leaves plant^{-1}	Leaf area plant^{-1} (dm^2)	Dry matter production plant^{-1} (g)
Varieties (V)					
V_1: Phule Nachani	104.4	2.63	37.7	3.97	43.1
V_2: Phule Kasari	100.2	2.77	42.1	4.71	49.7
V_3: Dapoli-1	94.4	3.12	45.5	5.14	51.6
S.Em±	1.8	0.09	1.2	0.14	1.7
CD at 5%	7.0	0.35	4.8	0.55	6.6
Spacings (S)					
S_1: 30 cm × 10 cm	105.4	2.18	36.9	4.27	45.0
S_2: 45 cm × 15 cm	101.4	3.09	42.8	4.66	48.3
S_3: 45 cm × 20 cm	92.2	3.24	45.6	4.88	51.0
S.Em±	3.0	0.08	1.2	0.13	1.2
CD at 5%	9.1	0.23	3.6	0.41	3.8
Interaction (V×S)					
S.Em±	5.1	0.13	2.0	0.23	2.1
CD at 5%	NS	NS	NS	NS	NS

Table 2: Grain yield (kg ha^{-1}), biological yield (kg ha^{-1}) and harvest index of finger millet as influenced by different varieties and spacings.

Treatment	Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)
Varieties (V)			
V_1: Phule Nachani	1398.85	6556.11	21.30
V_2: Phule Kasari	1567.78	7475.99	21.10
V_3: Dapoli-1	1763.10	7726.96	22.95
S.Em±	62.97	183.90	-
CD at 5%	247.24	722.08	-
Spacings (S)			
S_1: 30 cm × 10 cm	1733.80	7932.37	21.91
S_2: 45 cm × 15 cm	1579.81	7117.06	22.34
S_3: 45 cm × 20 cm	1416.11	6709.62	21.09
S.Em±	52.23	209.03	-
CD at 5%	160.94	644.09	-
Interaction (V×S)			
S.Em ±	90.46	362.05	
CD at 5%	NS	NS	

Conclusion

From above results it can be concluded that among the different varieties, Dapoli-1 was found to be more remunerative for getting higher growth and yield of finger millet followed by Phule Kasari. However, narrow spacing of 30 × 10 cm (S_1) resulted in higher growth attributing characters and yield of finger millet followed by spacing 45 × 15 cm (S_2).

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