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YIELD AND ECONOMICS OF FINGER MILLET (*ELEUSINE CORACANA* L.) AS INFLUENCED BY VARIETIES AND DIFFERENT SPACINGS IN *KHARIF* SEASON

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ABSTRACT

The field investigation entitled "Effect of finger millet (*Eleusine coracana* L.) varieties to spacings in *kharif*" was conducted during *kharif* 2024 at Experimental Farm, Agronomy Section, College of Agriculture, Latur. The experiment was laid out in Split Plot Design with two factors and replicated thrice. Whereas, first factor comprises the different varieties *viz.* V_1 (Phule Nachani), V_2 (Phule Kasari) and V_3 (Dapoli-1), second 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 experimental results revealed that significantly highest values of yield parameters *viz.*, number of ear head plant^{-1} (2.99), weight of ear head (14.43g), number of fingers ear head^{-1} (8.48), ear head length (8.74 cm) and weight of grains plant^{-1} (17.99g) were recorded by variety Dapoli-1 (V_3) which was at par with Phule Kasari (V_2) and found significantly superior over Phule Nachani (V_1). Highest value for grain yield (1763 kg ha^{-1}) and biological yield (7726 kg ha^{-1}), gross monetary returns (86392 ha^{-1}) and net monetary returns (42423 ha^{-1}) were recorded by variety Dapoli^{-1} (V_3) which was at par with Phule Kasari (V_2) and found significantly superior over Phule Nachani (V_1). Among the spacing highest values of yield parameters *viz.*, number of ear head plant^{-1} (2.72), weight of ear head (15.41 g), number of fingers ear head^{-1} (8.11), ear head length (8.76 cm) and weight of grains plant^{-1} (17.11 g). However, among spacings, grain yield (1733.80 kg ha^{-1}) and biological yield (7932.4 kg ha^{-1}), gross monetary returns (84956 ha^{-1}) and net monetary returns (40827 ha^{-1} under closer row spacing of 30 × 10 cm, which was at par with 45 × 15 cm row spacing and found significantly superior over 45 × 20 cm.

***Key words*:** Finger millet, Vaieties, Spacings

Introduction

Finger millet (*Eleusine coracana* L. Gaertn), a nutrient-rich C,, 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 (Sakamma *et al*., 2018).

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 row 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 (APEDA, 2023-2024). 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).

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*"

Material and Method

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. Whereas, first factor comprises the different varieties *viz*. V_1 (Phule Nachani), V_2 (Phule Kasari) and V_3 (Dapoli^{-1}), second factor comprises the three row 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. Seed rate used for sowing was depended upon different row spacing. 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.

Methodology

1. **Number of ear heads plant^{-1}:** The number of ear heads in the five composite plants were individually counted and averaged.
2. **Weight of ear heads plant^{-1} (g):** The weight of harvested ear heads from five composite plants was weighed individually and averaged and expressed in g.
3. **Number of fingers ear head^{-1}:** Number of fingers counted from each finger in the five composite plants were individually counted and averaged.
4. **Finger length (cm):** Ear head length was measured from base to the tip of ear head and it was expressed in cm.
5. **Ear head weight (g):** The ear head weight was worked out by taking the oven dry weight of ear head.
6. **Test weight (g):** Grain sample were drawn from the net plot yield of each treatment and from these, 1000 grains were counted and weighed in g.
7. **Grain yield (kg ha^{-1}):** The grain yield per net plot was recorded and computed on hectare basis after multiplied with the hector factor, which is expressed in kg ha^{-1}.
8. **Biological yield (kg ha^{-1}):** The biological yield refers to the total biomass produced by a crop, which includes both the grain and straw yield and expressed in kg ha^{-1}.
9. **Gross monetary returns (ha^{-1}):** The gross monetary returns obtained under different treatments in the present study, were calculated based on the prevailing market prices of produce of kodo millet during the experimental year and expressed as ha^{-1}.
10. **Net monetary returns (ha^{-1}):** The net monetary returns of each treatment were calculated by deducting the cost of cultivation of respective treatments from gross monetary returns for the corresponding treatments and expressed as ha^{-1}.
11. **Benefit Cost Ratio:** Benefit cost ratio was worked out for each treatment by using the following formula.

$$\text{B:C ratio} = \frac{\text{Gross returns (Rs. Ha}^{-1})}{\text{Cost of cultivation (Rs. ha}^{-1})}$$

Table 1: Finger length plant^{-1} (cm), Grain yield plant^{-1} (g) and Test weight (g) of finger millet as influenced by varieties and different spacings at harvest.

Treatment	No. of ear heads plant $^{-1}$	Weight of ear head (g)	No. of fingers ear head $^{-1}$	Finger length (cm)	Weight of grains plant $^{-1}$ (g)	Test weight (1000 grains) (g)
Varieties (V)						
V_1: Phule Nachani	2.17	12.47	7.39	6.79	14.31	2.20
V_2: Phule Kasari	2.57	13.56	7.77	8.56	16.41	2.71
V_3: Dapoli-1	2.99	14.43	8.48	8.74	17.99	2.73
S.E.m±	0.12	0.32	0.20	0.25	0.63	0.05
CD at 5%	0.45	1.25	0.78	0.98	2.47	0.21
Spacings (S)						
S_1: 30 cm × 10 cm	2.38	9.96	7.53	7.01	15.34	2.48
S_2: 45 cm × 15 cm	2.62	15.09	7.99	8.32	16.28	2.63
S_3: 45 cm × 20 cm	2.72	15.41	8.11	8.76	17.11	2.53
S.E.m±	0.08	0.36	0.20	0.25	0.41	0.10
CD at 5%	0.24	1.10	NS	0.76	1.25	NS
Interaction (V × S)						
S.E.m ±	0.14	0.62	0.35	0.43	0.70	0.17
CD at 5%	NS	NS	NS	NS	NS	NS

Result and Discussion

Yield attributes

Yield attributing characters of finger millet *viz*., number of ear heads plant ^{1} weight of ear head plant^{-1}(g), number of fingers ear head^{-1}, finger length (cm), grain weight plant^{-1} (g) and test weight (g) were influenced by varieties and spacing, are presented in Table 1.

Effect of varieties

Yield attributing characters of finger millet *viz*., number of ear heads plant^{-1} (2.99), weight of ear head plant^{-1} (14.43g), number of fingers ear head^{-1} (8.48), finger length (8.74 cm), grain weight plant^{-1} (17.99 g) and test weight (2.73 g) were recorded highest in Dapoli^{-1}(V_3) which was at par with Phule Kasari (V_2) and found significantly superior over Phule Nachani (V_1). This might be due to genetic constituents of varieties. Similar results were found by Pol *et al*., (2024).

Effect of row spacing

Yield attributing characters of finger millet *viz*., number of ear heads plant^{-1} (2.72), weight of ear head plant^{-1} (15.41 g), finger length (cm), grain weight plant^{-1} (g) and test weight (g) were influenced by varieties and spacing, are presented in Table 2. Among all above attributes recorded highest in wider spacing 45 cm × 20 cm (S_3) which was at par with 45 cm × 15 cm (S_2) and found superior over 30 cm × 10 cm (S_1) which were recorded at harvest. Number of fingers ear head^{-1} (8.11) recorded highest in wider spacing 45 cm × 20 cm (S_3) followed by 45 cm × 15 cm (S_2) and 30 cm × 10 cm (S_1). These highest values of yield attributes in wider spacing is because of ample availability of resources like light, nutrients and space that helps for production of more efficiently them in assimilates which are made during photosynthesis and transfer from source to sink during maturing phase. Similar results were recorded by Aghara *et al*., (2023), Patel *et al*., (2018), Amulya *et al*., (2022) and Ncediso *et al*., (2017).

Yield

Data in Table 2 revealed that grain and biological yield of finger millet was affected significantly due to varieties and difference 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*., (2016).

Effect of row spacing

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 45cm × 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.

Table 2: Grain yield (kg ha^{-1}), Biological yield (kg ha^{-1}), harvest index, gross monetary returns (ha^{-1}), net monetary returns (ha^{-1}) and B:C ratio of finger millet as influenced by different treatments.

Treatment	Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest Index	Gross monetary returns (ha^{-1})	Net monetary returns (ha^{-1})	B:C ratio
Varieties (V)						
V_1: Phule Nachani	1398.85	6556.11	21.30	68544	24734	1.56
V_2: Phule Kasari	1567.78	7475.99	21.10	76821	33012	1.75
V_3: Dapoli-1	1763.10	7726.96	22.95	86392	42423	1.96
S.E.m±	183.90	-	3085	3085	-	
CD at 5%	247.24	722.08	-	12115	12115	-
Spacings (S)						
S_1: 30 cm × 10 cm	1733.80	7932.37	21.91	84956	40827	1.92
S_2: 45 cm × 15 cm	1579.81	7117.06	22.34	77411	33682	1.77
S_3: 45 cm × 20 cm	1416.11	6709.62	21.09	69389	25660	1.59
S.E.m±	52.23	209.03	-	2559	2559	-
CD at 5%	160.94	644.09	-	7886	7886	-
Interaction (V × S)						
S.E.m ±	90.46	362.05	-	4433	4433	-
CD at 5%	NS	NS	-	NS	NS	-

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), Panchal *et al* (2014) and Ravindran and Ranganathan (2016).

Economics

The gross monetary returns (ha^{-1}), net monetary returns (ha^{-1}) and B:C ratio of finger millet were affected significantly due to varieties and spacings, are presented in Table 2.

Effect of varieties

Among the finger millet varieties, the highest gross monetary returns (86392 ha^{-1}), and net monetary returns (51,590 ha^{-1}) of finger millet 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 benefit cost ratio (1.96) recorded in Dapoli-1(V_3). The observed disparities in economic parameters such as gross and net returns are primarily a consequence of the yield variability among varieties, which in turn is influenced by their inherent genetic constitution. Similar results were reported by Pol *et al.*, (2016).

Effect of row spacing

Among the spacings, the narrow spacing 30 cm × 10 cm (S_1) recorded the highest gross monetary returns (84956 ha^{-1}), net monetary returns (40827 ha^{-1}) and benefit cost ratio (1.92) which was at par with the spacing of 45 cm × 15 cm (S_2) and found significantly superior over 45cm × 20 cm (S_3). Numerically highest value benefit cost ratio (1.92) recorded in spacing 30 cm × 10 cm (S_1). The increased net returns with this narrower row spacing were primarily due to the higher grain yield. The higher plant population in the closer row spacing 30 cm × 10 cm resulted in a greater grain yield compared to the wider 45 × 20 cm row spacing. The results were found to correlate with the findings of Roy *et al*. (2001), Hebbal *et al*. (2018), Mane (2019) and Govinakoppa (2021).

Interaction Effect

The interaction effect of varieties and spacings on the yield and yield attributes, economics were found to be statistically non-significant.

Conclusion

From above results it can be concluded that among the different varieties, Dapoli-1 recorded the highest yield attributes, grain yield, biological yield, gross and net monetary returns, as well as benefit–cost of finger millet followed by Phule Kasari. However, among the spacings, yield-attributing characters of finger millet were superior under the wider spacing of 45 × 20 cm. In contrast, the narrower spacing of 30 × 10 cm produced significantly higher grain and biological yields, which was at par with 45 × 15 cm spacing. Economic analysis revealed that the closer spacing of 30 × 10 cm resulted in significantly higher gross returns, net returns, which was at par with 45 × 15 cm spacing. Highest value of benefit–cost ratio recorded in 30 × 10 cm spacing.

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