E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(11): 24-28
Received: 20-08-2024
Accepted: 29-09-2024

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Influence of fertilizer application on the growth and yield of finger millet (*Eleusine coracana* L.) varieties under rainfed condition

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DOI: https://doi.org/10.33545/2618060X.2024.v7.i11Sa.1925

Abstract
An agronomic investigation was carried out at the experimental farm, Department of Agronomy, College of Agricultural biotechnology, Latur (Maharashtra), during *kharif*, 2023 to examine the impact of fertilizer levels on growth and yield of finger millet varieties. Three levels of each factor were included in the factorial randomized block design (FRBD). Nine treatment combination, each consisting of two factors with varieties and fertilizer levels were tested. First factor consists of three varieties *viz.* V_1 (Phule Nachani), V_2 (Phule Kasari) and V_3 (Dapoli-1) and second factor consists of fertilizer levels *viz.* F_1 (40:20:20 NPK kg ha^{-1}), F_2 (50:25:25 NPK kg ha^{-1}) and F_3 (60:30:30 NPK kg ha^{-1}). The results revealed that application of 60:30:30 NPK kg ha^{-1} (F_3) recorded significantly higher growth and yield attributes which was comparable with 50:25:25 NPK kg ha^{-1} (F_2) and it was significantly superior over 40:20:20 NPK kg ha^{-1} (F_1). Among the finger millet varieties Dapoli-1 (V_3) recorded significantly higher growth and yield attributes which was comparable with Phule Kasari (V_2) and significantly superior over Phule Nachani (V_1).

Keywords: Finger millet, varieties, fertilizer levels

Introduction
A group of extremely varied small-seeded grasses known as millets have been farmed in arid and semi-arid parts of the world since ancient times. Millets are crucial for climate-resilient farming and the world's food supply nutritional security in addition to food security. The most widely grown among grain millets for human consumption is ragi or finger millet particularly in Eastern and Southern Africa and Southern Asia, as food and fodder. The Poaceae family includes finger millet, also known as ragi (*Eleusine coracana* L.) The plant derives its name from its seedhead, which resembles human fingers.

The states of Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, Jharkhand, Uttaranchal, Maharashtra and Gujarat are the principal locations in India where finger millet is grown. Finger millet is grown on 12.18 lakh hectares of land in India, yielding 13.86 lakh tones of product annually or 1336 kg ha^{-1} of productivity. Finger millet grows on an area of roughly 0.70 lakh hectares in Maharashtra, producing 0.88 lakh tonnes of grain annually with a productivity of 1251 kg ha^{-1} in 2023–2024 (https://apeda.gov.in).

It is a short- to medium-day plant with an ideal photoperiod of 12 hours. It thrives in areas with moderate rainfall 500-1000 mm with an optimum of 900 mm, which is evenly distributed throughout the growing season and doesn't cause prolonged droughts. However, in areas with good distribution, it can easily tolerate rainfall as little as 130 mm. (Wamalwa *et al.*, 2017) [17].

Finger millet is a small-seeded cereal that is cultivated in regions of the semi-arid tropics with little rainfall. It is a resilient crop that can produce a respectable grain yield in conditions where most crops produce very little. In regions of the world susceptible to drought, finger millet is a staple crop that is frequently included in plans for ensuring food security. It is crucial to the nutritional requirements and financial stability of many rural households in the areas where the crop is farmed. Compared to other cereals, it has a comparatively higher concentration of dietary

fiber and calcium. (Triveni *et al*., 2017) [15]

Materials and Methods

An experiment was carried out to determine the effect of fertilizer levels on growth and yield of finger millet (*Eleusine coracana* L.) varieties during *kharif* season of 2023- 2024 at Experimental Farm, College of Agricultural Biotechnology, Latur. Geographically Latur district of Maharashtra state is located at 18º 05' to 18º 75' North latitude and 77º 25' to 77º 36' East latitude with the total geographical area is 7.37 million ha. Latur area comes under semi-arid region of Maharashtra. The average annual rainfall of the Latur district is 689.72 mm. The soil of experimental plot was clayey in texture, low in available nitrogen (228.0 kg ha^{-1}), medium in available phosphorous (15.70 kg ha^{-1}) and very high in available potassium (421 kg ha^{-1}). The soil was moderately alkaline in reaction having pH 7.08. After harvesting of crop, soil contains nitrogen (198 kg ha^{-1}), phosphorous (13.26 kg ha^{-1}) and potassium (391.22 kg $ha^{-1)}$ was available in the soil. The experiment was laid out in Factorial Randomized Block Design with nine treatments combinations, consisting of two factors, varieties and fertilizer levels which included three varieties and three levels of fertilizer. The first factor consists of varieties V_1 (Phule Nachani), V_2 (Phule Kasari) and V_3 (Dapoli-1) and second factor consists of fertilizer levels *viz*. F_1(40:20:20 NPK kg ha^{-1}), F_2 (50:25:25 NPK kg ha^{-1}) and F_3 (60:30:30 NPK kg ha^{-1}). Each treatment was replicated three times. The experimental gross plot size was 5.4 x 4.5 m^2 and net plot size was 4.8 x 3.9 m^2. Sowing was done by dibbling method on 9th July 2023. The recommended cultural practices and plant protection measures were undertaken.

Plate 1: Overall View of Experimental Field

Results and Discussion

Effect of varieties

Among the finger millet varieties, Dapoli-1 recorded higher growth attributes *viz*., number of tillers $plant^{-1}$ (2.85), number of leaves $plant^{-1}$ (34.07), mean leaf area (4.17 dm^2), leaf area index (3.06), dry matter production $plant^{-1}$ (52.56 g) than Phule Nachani and it was found comparable with Phule Kasari. Increase in the growth attributes might be due to result of their genetic make-up, soil and climatic condition as well as nutrients provided during life cycle of the crop. Similar results were reported by Nigade and More (2013) [6], Sundaresh *et al*., (2017) [14], Narayan Hebbal *et al*. (2018) [5].

Highest grain yield (2805 kg ha^{-1}), straw yield (7155 kg ha^{-1}), biological yield (9958 kg ha^{-1}) and harvest index (28) were recorded by Dapoli-1 over Phule Nachani, however it was followed by Phule Kasari. The higher grain yield of finger millet varieties was attributed due to increased total number of tillers, number of ear heads, number of fingers and length of finger Higher straw yield was attributed due to increased number of leaves, leaf area and dry matter production and effective use of fertilizers. These findings were in collaboration with the findings of Sima and Ahmad (2011) [13], Nigade and More (2013) [6] and Roy *et al*., (2001) [10].

Effect of fertilizer levels

Among the fertilizer levels, application of 60:30:30 NPK kg ha^{-1} recorded higher plant height (113 cm), number of tillers $plant^{-1}$ (2.87), number of leaves $plant^{-1}$ (34.07), mean leaf area (4.43 dm^2), leaf area index (3.16), dry matter $plant^{-1}$ (53.33 g) than 40:20:20 NPK kg ha^{-1} and it was found comparable with 50:25:25 NPK kg ha^{-1}. The increase in growth characters with application of 60:30:30 NPK kg ha^{-1} due to increased availability of nutrients leading to better nutritional environment in root zone for growth and development. The higher number of leaves $plant^{-1}$ due to favourable growth of finger millet and number increased with increase in fertilizer levels. The increase in fertilizer level significantly increased leaf area $plant^{-1}$. This is might be due to increase in leaf area expansion rate. Similar results were reported by Narayan Hebbal *et al*., (2018) [5]

Highest grain yield (2805 kg ha^{-1}), straw yield (7155 kg ha^{-1}), biological yield (9958 kg ha^{-1}) and harvest index (28) were recorded by 60:30:30 NPK kg ha^{-1} over 40:20:20 NPK kg ha^{-1}, however it was followed by 50:25:25 NPK kg ha^{-1}. The increased grain yield in Dapoli-1 with the application of 60:30:30 NPK kg ha^{-1} might be due to the fact that the crop did not experience nutrient stress at any growth stage of crop because of higher nutrition, improved vegetative growth and yield attributing characters such as number of productive tillers, number of fingers per ear head, total number of grains per finger and test weight of crop that resulted in higher grain yield. Similar results are also reported by Roy *et al*. (2001) [10]. Nigade and More (2013) [6] and Roy *et al*., (2001) [10].

Interaction effect

The effect of interaction between varieties and fertilizer levels on growth and yield attributes was found to be non-significant.

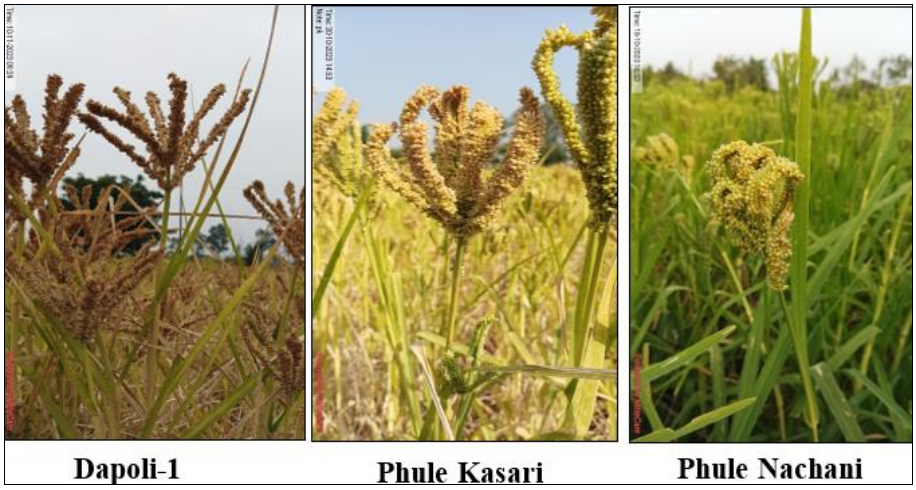

Plate.2: Difference between varieties

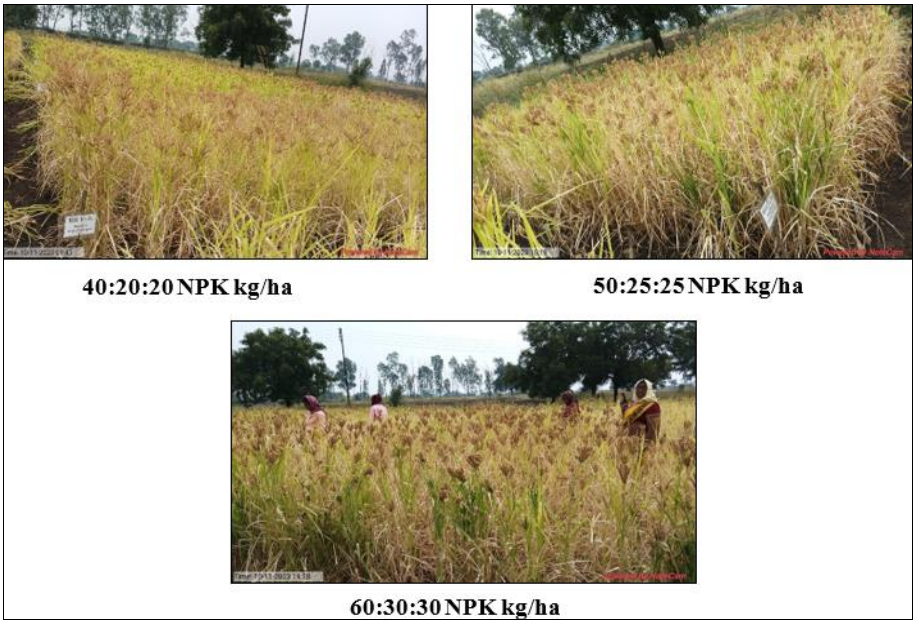

Plate 3: Difference between fertilizer levels

Table 1: Growth attributes of finger millet as influenced by varieties and fertilizer levels.

Treatments	Plant height plant^{-1} (cm)	No. of tillers plant^{-1}	No. of functional leaves plant^{-1}	Leaf area plant^{-1} (dm^2)	Dry matter plant^{-1} (g)	LAI
Varieties (V)						
V_1: Phule Nachani	108.03	2.59	31.04	3.44	45.67	2.62
V_2: Phule Kasari	115.33	2.69	33.76	3.88	49.33	3.04
V_3: Dapoli-1	98.26	2.85	34.07	4.17	52.56	3.06
S. E m ±	2.53	0.06	0.82	0.15	1.31	0.10
CD at 5%	7.60	0.20	2.46	0.45	3.94	0.30
Fertilizer levels (F)						
F_1: 40:20:20 NPK kg/ha	100.08	2.49	30.93	3.09	44.00	2.71
F_2: 50:25:25 NPK kg/ha	108.54	2.76	33.87	3.98	50.22	2.86
F_3: 60:30:30 NPK kg/ha	113.00	2.87	34.07	4.43	53.33	3.16
S.E. (m)±	2.53	0.06	0.82	0.15	1.31	0.10
C.D. at 5%	7.60	0.20	2.46	0.45	3.94	0.30
Interaction (F x S)						
S. E m ±	4.39	0.12	1.42	0.26	2.28	0.17
CD at 5%	NS	NS	NS	NS	NS	NS
General Mean	107.21	2.71	32.96	3.83	49.19	2.91

Table 2: Yield attributes of finger millet as influenced by varieties and fertilizer levels.

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (HI)
Varieties (V)				
V_1: Phule Nachani	1886	5928	7821	24
V_2: Phule Kasari	2720	6893	9625	28
V_3: Dapoli-1	2805	7155	9958	28
S.E. (m)±	91.90	161.71	239.02	-
C.D. at 5%	275.48	484.76	716.51	-
Fertilizer levels (F)				
F_1: 40:20:20 NPK kg/ha	2213	6202	8416	26
F_2: 50:25:25 NPK kg/ha	2493	6698	9202	27
F_3: 60:30:30 NPK kg/ha	2704	7076	9786	27
S.E. (m)±	91.90	161.71	239.02	-
C.D. at 5%	275.48	484.76	716.51	-
Interaction (V × F)				
S.E. (m)±	159.18	280.10	414.00	-
C.D. at 5%	NS	NS	NS	-
General Mean	2470	6658	9135	-

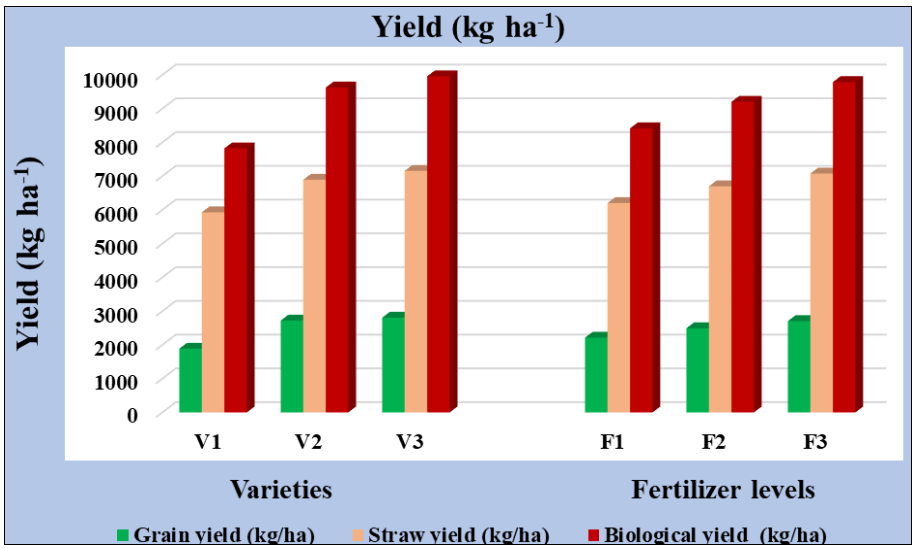

Fig 1: Grain yield, straw yield and biological yield (kg ha^{-1}) of finger millet as influenced by varieties and fertilizer levels

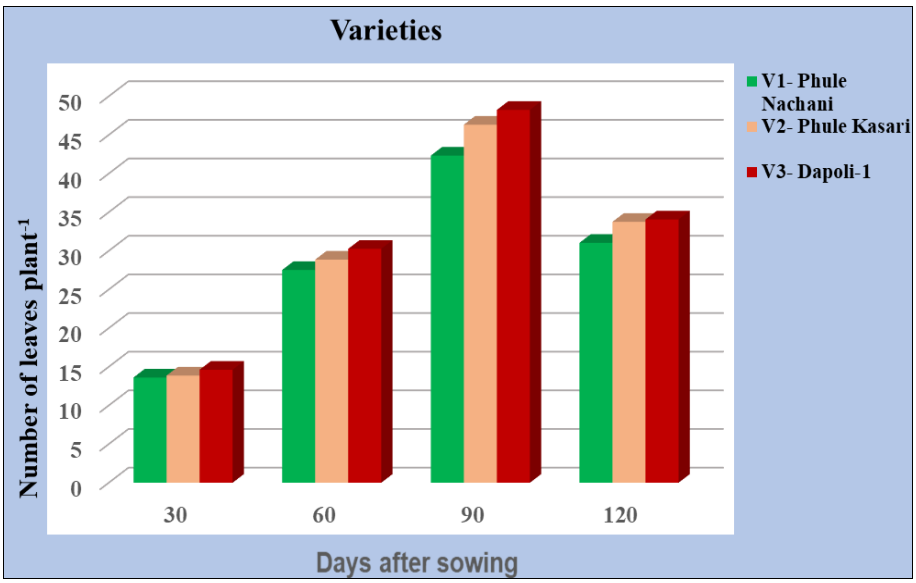

Fig 2(a): Mean number of leaves plant^{-1} of finger millet as influenced by varieties

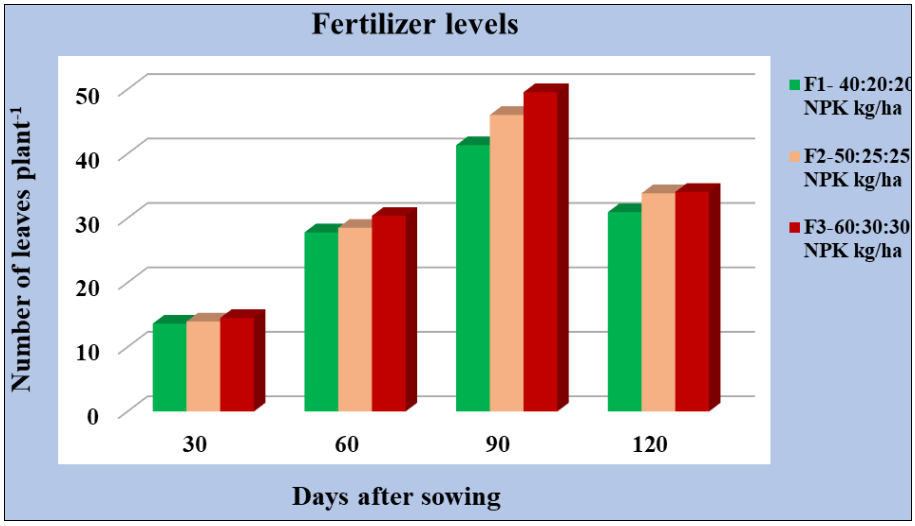

Fig 2(b): Mean number of leaves plant^{-1} of finger millet as influenced by fertilizer levels

Conclusion

Based on the result of present investigation entitled response of finger millet (*Eleusine coracana* L.) varieties to fertilizer levels under rainfed condition in *kharif* season the following inference are drawn.

- The study showed that, Dapoli-1 was found to be more remunerative for getting more growth attributes and yield attributes of finger millet.
- Whereas among the fertilizer levels, the application of 60:30:30 NPK kg ha^{-1} proved to be effective for getting higher growth attributes and yield attributes of finger millet.

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