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

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; 8(8): 1037-1041
Received: 23-05-2025
Accepted: 27-06-2025

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Growth and yield of niger (*Guizotia abyssinica* L.f. Cass) as influenced by different land configuration and varieties

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DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i8o.3690

Abstract
A field experiment was conducted during *Kharif* 2024 at the Experimental Farm of Agronomy Section, College of Agricultural Biotechnology, Latur, to study the Effect of land configuration on growth and yield of niger (*Guizotia abyssinica* L.) variety in kharif season. The soil was clayey in texture, moderately alkaline, low in available phosphorus, moderate in nitrogen and high in potassium. The experiment was laid out in a Split Plot Design with three land configuration Flat bed, Ridges and Furrow and Broad Bed Furrow three varieties PNS-6, Phule Karala, and Phule Vaitarna. Result revealed that BBF land configuration recorded significantly highest growth attributes plant height (161.72 cm), number of functional leaves per plant (36.36), number of branches per plant (9.16), leaf area per plant (17.14) and dry matter accumulation (13.29) This is might be due to favourable seed bed, aeration, more conservation of water in broad bed furrow and was at par with Ridges and Furrow where as least in flat bed. BBF also recorded highest yield attributes *viz*. number of seeds per capsule (26.58) seed yield (539 kg ha^{-1}), stalk yield (3785 kg ha^{-1}), biological yield (4324kg ha^{-1}) and harvest index (12.46%) and was at par with Ridges and Furrow where as least in flat bed.
Phule Vaitarna recorded significantly highest growth attributes *viz*. plant height (159.46 cm), number of functional leaves per plant (35.69), number of branches per plant (9.07), leaf area per plant (17.11^{dm-2}) and dry matter accumulation (12.80) and was at par with Phule karala and least at PNS-6. Phule Vaitarna also recorded highest yield attributes *viz*. highest yield attributes *viz*. seed yield, number of seed per capsule, stalk yield, biological yield and harvest index.

Keywords: Land configuration, BBF**,** Niger, varieties, growth, yield

Introduction
Niger (*Guizotia abyssinica* L.), a member of the Compositae family, is an important oilseed crop grown primarily in India, Ethiopia, East Africa, the West Indies, and Zimbabwe. Among these, India and Ethiopia are the leading producers globally. Key niger-producing states include Madhya Pradesh, Bihar, Maharashtra, Odisha, Karnataka, and Tamil Nadu. Despite being considered a minor oilseed globally, it holds significant value in rainfed and tribal farming systems, particularly on marginal lands and hill slopes. The crop is highly adaptable, resistant to pests and diseases, and contributes to soil conservation and land restoration.

Its seeds contain 40% oil, rich in linoleic and oleic acids, and the oil is valued for its edible and medicinal uses. Niger thrives under low-input conditions but suffers from low productivity due to traditional farming practices and poor soil fertility.

Enhancing yield, it requires the development of high-yielding varieties and optimized land configuration like Broad Bed Furrow. Understanding genetic diversity and crop-environment interactions is crucial to improve its productivity under diverse agro-climatic conditions. This study explores land configuration and varietal effects to maximize yield in Niger under rainfed conditions

Materials and Methods
The field investigation entitled “Effect of land configurations on growth and yield of Niger (*Guizotia abyssinica* L.) varieties during *kharif* season.” Was conducted during *kharif* 2024 at

research farm of agronomy section, college of agricultural biotechnology, Latur, VNMKV, Parbhani. The soil was clayey in texture, moderately alkaline (pH 7.08), low in available phosphorus (15.70 kg ha^{-1}), moderate in nitrogen (228.0 kg ha^{-1}) and high in potassium (421kg ha^{-1}). The experiment was laid out in a Split Plot Design with three land configuration Flat bed, Ridges and Furrow and Broad Bed Furrow and three varieties PNS-6, Phule Karala, and Phule Vaitarna Were replicated thrice. Sowing of all the niger varieties was done as per treatments by dibbling the seed 8-10 kg. The recommended cultural practices and plant protection measures were taken. Fertilizer *viz.*, Nitrogen and Phosphorus were applied to respective plots by using Urea and SSP uniformly in the lines opened for sowing as per treatments.

Five plants were randomly selected and tagged from each net plot to record biometric observations at various growth stages. These same plants were later harvested individually for post-harvest analysis. After harvesting, the plants from each net plot were threshed, and the seeds Were collected.

The harvested seeds from each net plot were cleaned and weighed in kilograms. After separating the seeds from the total biological yield, the remaining plant material (including stems and husk) was treated as straw yield. The final weight of this straw was recorded in kilograms per net plot, which were then converted into straw yield (kg ha^{-1}) by multiplying hectare factor.

$$\text{Harvest index \%} = \frac{\text{Seed yield (Kg ha}^{-1})}{\text{Biological yield (Kg ha}^{-1})} \times 100$$

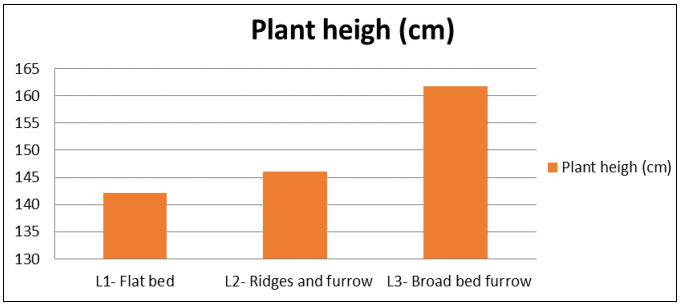
Where, straw yield = Stalks + leaves

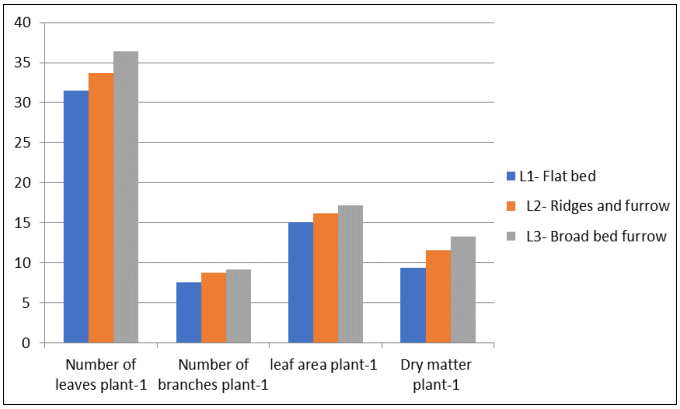
The data collected from various observations were organized into tables and analyzed using analysis of variance (ANOVA). The significance of treatment was tested by F test (Panse & Sukhatme, 1967) [7].

Results and Discussion

Effect of land configuration on growth attributes

The mean plant heigh (cm), number of leaves plant^{-1}, number of branches plant^{-1}, Leaf area plant^{-1} (dm^{-2}) were increased upto harvest. land configuration significantly influenced the growth parameters of niger. Broad Bed Furrow (L_3) produced taller plants. This is might be due to favourable seed bed, aeration, more conservation of water in broad bed furrow. The maximum number of functional leaves plant^{-1} was recorded with the sowing of niger on broad bed furrow (L3), which was at par with the ridges and furrow (L2) and found significantly superior over flat bed (L1). This is might be due to the height and further vigorous growth and accordingly more photosynthesis in broad bed furrow. The maximum mean leaf area plant^{-1} was recorded with the sowing of niger on broad bed furrow (L3), This might be due to overall favourable growth and more functional leaves produced in treatment. The maximum number of branches plant^{-1} was recorded with the sowing of niger on broad bed furrow (L3) This is might be due to the more plant height and vegetative growth of the plants grown on broad bed furrow (L3). Moreover, the space available for side rows. The maximum total dry matter plant^{-1} was recorded with the sowing of niger on broad bed furrow This might be due to luxurious growth and higher growth attributes recorded in broad bed furrow than rest of land configurations and thus overall growth reflected in higher dry matter Lakhera Vishnuprakash (2008), Dhale S. Y. (2017), Shaikh (2018), and Bhadre C.K. (2020) [3, 4, 6, 9].



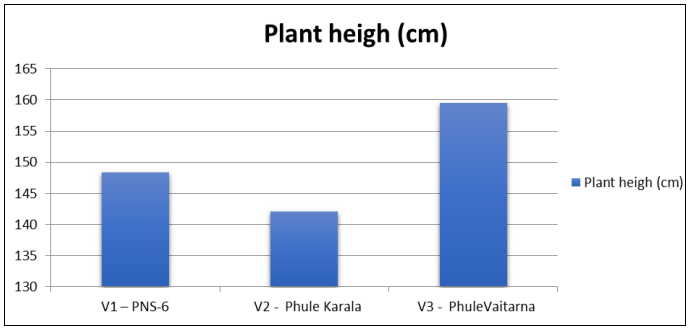


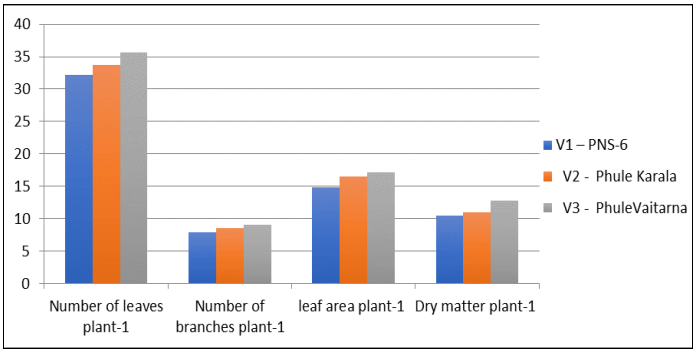
Effect of varieties on growth attributes

The mean plant height (cm), number of leaves plant^{-1}, number of branches plant^{-1}, Leaf area plant^{-1} (dm^{-2}), Total dry matter (gm) was increased upto harvest. Varietal differences significantly influenced plant height, number of functional leaves, leaf area, and number of branches of niger. Phule Vaitarana (V_3) recorded the highest plant height, followed closely by Phule Karala (V_2), both significantly taller than PNS-6 (V_1), which consistently showed the least height. This might be due to superior vegetative growth, capped photosynthetic capacity and initial vigorous growth resulted in more height of the crop Banne A.A. (2014) and Bhavsar V.V. (2017) [10].

The number of functional leaves per plant was significantly higher in Phule Vaitarana across all stages, and was statistically at par with Phule Karala, while PNS-6 recorded the fewest leaves. Similar varietal effects were observed for leaf area, with Phule Vaitarana producing significantly higher leaf area per plant and was at par with Phule karala, while PNS -6 recorded the least leaf area, attributed to its stronger genetic potential for leaf development.

In terms of branching, Phule Vaitarana again outperformed other varieties, recording significantly more branches per plant throughout all growth stages and was at par with Phule karala. This can be linked to enhanced cell division and elongation supported by both favorable environmental conditions and inherent varietal traits. These findings are consistent with earlier studies by Bhavsar V.V. (2017) [10].



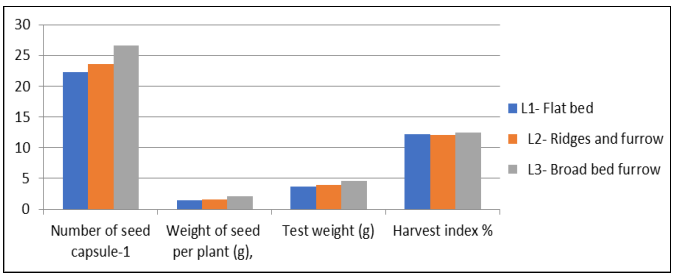


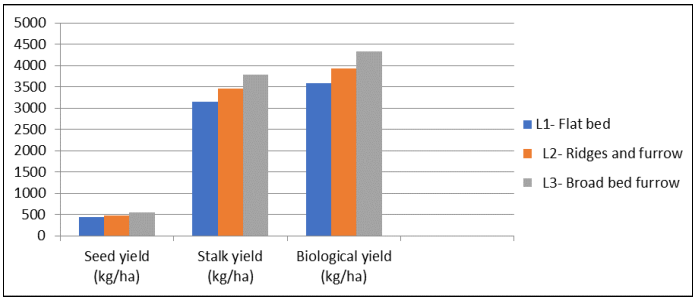
Effect of land configuration on yield attributes

Number of seed capsule^{-1}, Weight of seed per plant (g), Test weight (g), Seed yield (kg/ha), Stalk yield, biological yield, Harvest index. were increased upto harvest. land configuration significantly influenced the growth parameters of niger. Broad Bed Furrow (L_3) produced higher Number of seed capsule^{-1}. This is might be due to better soil conditions, moisture regulation, nutrient uptake, and overall plant health. The maximum Weight of seed per plant (g) was recorded with the sowing of niger on broad bed furrow (L3), which was at par with the ridges and furrow (L2) and found significantly superior over flat bed (L1). This is might be due to the overall better growth, development with the support of conserved soil moisture, reflected in higher seed weight per plant. The maximum Test weight (g) was recorded with the sowing of niger on broad bed furrow. The maximum number of Seed yield (kg/ha) was recorded with the sowing of niger on broad bed furrow This is may be observed due to favourable seed bed, better aeration, scope for more space, light interception benefit of more conserved moisture in furrows and its support at critical stages of crop like flowering, flower head and development.

The maximum Stalk yield (kg/ha) was recorded with the sowing of niger on broad bed furrow This might be due This is may be observed due to the more favourable conditions in overall growth and yield attributing characters.

The maximum biological yield (kg/ha) was recorded with the sowing of niger on broad bed furrow This might be due This is may be observed due to the more favourable conditions in overall growth and yield attributing characters. The maximum Harvest index (%) was recorded with the sowing of niger on broad bed furrow Harvest index is considered as utility of yield contributing parameter to assess the translocation efficiency of crop plant. It may be due to higher seed yield in proportionate to biological yield. Barfa Vinod (2016), Dhale S. Y. (2017), Shaikh (2018), and Bhadre C.K. (2020) [1, 3, 4, 9].

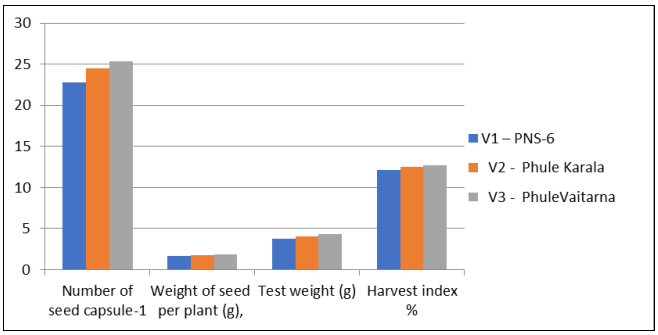




Effect of variety on yield attributes

Varietal differences significantly influenced yield and yield components in niger. The variety Phule Vaitarana (V_3) recorded the highest number of seeds per capsule (25.33), which was at par with Phule Karala (V_2) both varities found to be superior over PNS-6 (V_1). Phule Vaitarana also showed significantly higher Weight of seed per plant (g) (1.84 g) and test weight (4.30g), attributed to its stronger genetic potential and superior sink capacity. These traits contributed to its highest seed yield (504 kg ha^{-1}), followed by Phule Karala (486 kg ha^{-1}) and PNS-6 (459 kg ha^{-1}). The superior yield performance of Phule Vaitarana was due to its higher number of capsules, seeds per capsule, and test weight. A positive correlation was also observed between grain yield and traits such as total dry matter, number of grains and capsules per plant, and harvest index.

Phule Vaitarana also recorded the highest stalk yield (3460 kg ha^{-1}), biological yield (3964 kg ha^{-1}), and harvest index (12.71%), due to enhanced vegetative growth, photosynthetic efficiency, and biomass production. These results underline the superior performance of Phule Vaitarana in terms of both seed and biomass yield and are supported by several earlier studies. Bhavsar V.V. (2017), Beldar Shilpa (2023) [2, 11]



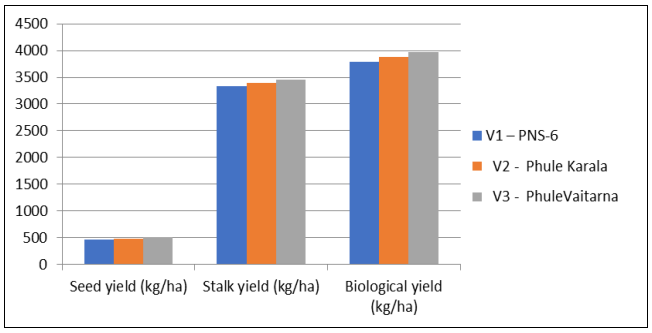


Table 1: Growth attributes influenced by different land configurations and varieties at harvest

Treatment	Mean plant height (cm)	Mean number of functional leaves plant^{-1}	Mean leaf area (dm^2) plant^{-1}	Mean number of branches plant^{-1}	Mean dry matter accumulation plant^{-1}
Land Configuration (L)					
L1- Flat bed	142.11	31.47	15.07	7.60	9.35
L2-Ridges and furrow	146.01	33.70	16.18	8.73	11.58
L3- Broad bed furrow	161.72	36.36	17.14	9.16	13.29
SE ±	1.56	0.54	0.19	0.24	0.16
CD	6.13	2.15	0.77	0.94	0.63
Varieties (V)					
V1- PNS-6	148.33	32.13	14.82	7.95	10.45
V2- Phule karala	142.05	33.72	16.47	8.47	10.97
V3-Phule vaitarana	159.46	35.69	17.11	9.07	12.80
SE ±	3.75	0.88	0.40	0.23	0.29
CD	11.57	2.73	1.25	0.72	0.92
Interaction					
SE ±	6.50	1.53	0.70	0.40	0.51
CD	NS	NS	NS	NS	NS
General Mean	149.95	33.84	16.13	8.50	11.41

Table 2: Yield attributes of niger influenced by various treatment

Treatment	No of seeds cpsule^{-1}	Weight of seed per plant (g)	Test weight (g)
Land Configuration (L)			
L1- Flat bed	22.30	1.50	3.65
L2-Ridges and furrow	23.63	1.60	3.88
L3- Broad bed furrow	26.58	2.11	4.65
SE ±	0.77	0.06	0.17
CD	3.05	0.24	0.67
Varieties (V)			
V1- PNS-6	22.74	1.63	3.80
V2- Phule karala	24.45	1.74	4.07
V3-Phule vaitarana	25.33	1.84	4.30
SE ±	0.60	0.05	0.12
CD	1.87	0.15	0.38
Interaction			
SE ±	1.05	0.087	0.21
CD	NS	NS	NS
General Mean	24.17	1.74	4.06

Table 3: Seed yield, stalk yield, biological yield (kg/ha) and harvest index as influenced by different treatments

Treatment	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest Index (%)
	Land Configuration (L)			
L1- Flat bed	435	3146	3581	12.14
L2-Ridges and furrow	475	3454	3929	12.08
L3- Broad bed furrow	539	3785	4324	12.46
SE ±	16.78	112.77	98.22	-
CD	65.89	442.79	385.67	-
	Variety (V)			
V1- PNS-6	459	3329	3788	12.11
V2- Phule karala	486	3397	3883	12.51
V3-Phule vaitarana	504	3460	3964	12.71
SE ±	11.32	88.89	90.39	-
CD	34.89	273.9	278.53	-
	Interaction			
SE ±	19.61	153.9	156.56	-
CD	NS	NS	NS	-
General Mean	483	3428	3911	12.34

Conclusion

The study revealed that both Land configuration and varietal differences significantly influenced the growth and yield of niger. Broad Bed Furrow enhanced highest yield per hectare This is may be observed due to favourable seed bed, better aeration, scope for more space, light interception benefit of more conserved moisture, which was at par with ridges and furrow. Among varieties Phule vaitarana outperformed others in most growth and yield parameters, and was at par with Phule karala, while PNS-6 recorded the least growth and yield parameters, highlighting its superior genetic potential and adaptability, making it the most suitable for maximizing productivity under given agro-climatic conditions.

Acknowledgement

We are grateful to College of Agriculture, Latur, and VDCOAB

Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani for the financial assistance and infrastructure facilities provided for the conduct of this work.

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