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

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Abstract
A field experiment was conducted during *Kharif* 2024 at the Experimental Farm of Agronomy Section, College of Agriculture, Latur to study the effect of spacings and varieties on the growth and yield of niger (*Guizotia abyssinica* L.). 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 varieties PNS-6, Phule Karala, and Phule Vaitarna as main plot and three spacings 45 × 20 cm^2, 45 × 10 cm^2, and 45 × 15 cm^2 as sub main plots. Result revealed that niger variety PNS-6 recorded significantly highest growth attributes *viz*. number of functional leaves per plant (26.45), leaf area per plant (6.36 dm^2), branches per plant (16.26) and dry matter accumulation (30.28 g) and was at par with Phule Karala and found significantly superior over Phule Vaitarana. While Phule Karala attained maximum plant height and found significantly superior over rest of the varieties. PNS-6 also recorded highest yield attributes *viz*. number of seeds per capsule (43.44), seed yield per plant (2.63 g), seed yield (566 kg ha^{-1}) and biological yield (6127 kg ha^{-1}) which was at par with Phule Karala and found significantly superior over Phule Vaitarana. Wider spacing of 45cm × 20 cm recorded significantly highest growth and yield attributes *viz*. number of functional leaves per plant (25.95), leaf area per plant (5.92 dm^2), number of branches per plant (15.91), dry matter accumulation per plant (30.51 g) and seed yield per plant (2.71 g) which was at par with 45 cm × 15 cm and found significantly superior over 45 cm × 10 cm. Whereas closer spacing 45 cm × 10 cm resulted highest plant height (174.3 cm). The highest seed yield (52 Kg ha^{-1}) and biological yield (6246 Kg ha^{-1}) with closer spacing of 45 cm × 10 cm which was at par with 45 cm × 15 cm and found significantly superior over wider spacing of 45 cm × 20 cm

Keywords: Niger, spacings, 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. It's 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 agronomic practices like appropriate plant spacing. Understanding genetic diversity and crop-environment interactions is crucial to improve its productivity under diverse agro-climatic conditions. This study explores varietal and spacing effects to maximize yield in Niger under rainfed conditions

Materials and Methods
The field investigation was conducted during *kharif* 2024 at Experimental Farm, Department of Agronomy, College of Agriculture, Latur to study the effect of spacings and varieties on growth and yield of niger (*Guizotia abyssinica* L.) during *Kharif* Season. The soil was clayey in texture, moderately alkaline (pH 7.58), low in available phosphorus (7.46 kg ha^{-1}), moderate in nitrogen

(137.98 kg ha^{-1}) and high in potassium (1045.60 kg ha^{-1}). The experiment was laid out in a Split Plot Design. The main plot consists of three varieties V_1-PNS-6, V_2- Phule Karala, and V_3-Phule Vaitarna and sub plot consist of three spacings S_1-45 cm × 20 cm, S_2-45 cm × 10 cm, and S_3-45 cm × 15 cm, were replicated thrice. Sowing of all the niger varieties was done as per treatments by dibbling. The gross plot size was 5.4 m × 4.6 m and net plot size were as per treatments. The recommended cultural practices and plant protection measures were taken. 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) [1].

Results and Discussion

Growth attributes

Effect of varieties

The mean plant height (cm), number of leaves plant^{-1}, leaf area plant^{-1} (dm^2), number of branches plant^{-1} and total dry matter accumulation plant^{-1} (g) of niger were influenced significantly due to different varieties. Phule Karala (V_2) recorded the highest plant height (171.4 cm), which was significantly superior over PNS-6 (V_1) and Phule Vaitarana (V_3). The differences were attributed to genetic variation among the varieties (Shaikh *et al*., 2019) [2].The niger variety PNS-6 (V_1) recorded highest number of leaves plant^{-1}(16.26), leaf area plant^{-1} (6.36) (dm^2), number of branches plant^{-1} (26.45) and total dry matter accumulation plant^{-1} (30.28 g) which was at pr with Phule Karala (V_2) and found significantly superior over Phule Vaitarana (V_3).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 Baswaid *et al*. (2001) [3], Hladni *et al*. (2006) [4], Kumaresan and Nadarajan (2000) [5], and Shaikh *et al*. (2019) [2].

Effect of spacings

Among the different spacings, the closer spacing of 45 cm × 10 cm (S_2) produced highest plant height (174.3 cm) which was at par with 45 cm × 15 cm (S_3) and found significantly superior over wider spacing of 45 cm × 20 cm (S_1). Taller plants with closer spacing likely due to increased competition for resources, reduced canopy spread, and higher auxin concentration promoting vertical growth. The highest number of leaves plant^{-1}(25.95), leaf area plant^{-1} (5.92 dm^2), number of branches plant^{-1} (15.91) and total dry matter accumulation plant^{-1} (30.51 g) of niger were observed with the wider spacing of 45 cm × 20 cm (S_1) which was at par with 45 cm × 15 cm (S_3) and found significantly superior over wider spacing of 45 cm × 10 cm (S_2). It might be due to wider spacing, which provided better space for lateral development. In contrast, closer spacing led to fewer leaves, branches, and lower leaf area due to resource limitations and shading. These results are in similar with earlier findings by Kivadasannavar *et al*. (2007) [6], Srivastava and Singh (2009) [7], Bindra and Kharwara(1994) [8].

Yield attributes

Effect of variety

Varietal differences significantly influenced yield components and yield in niger. The variety PNS-6 (V_1) recorded the highest number of seeds per capsule (43.44), higher seed yield per plant (2.63 g) and test weight (4.54 g), seed yield (566 kg ha^{-1}) and biological yield (6127 kg ha^{-1}) which was comparable with Phule Karala (V_2) and found significantly superior to Phule Vaitarana (V_3).The superior yield performance of PNS-6 was due to its higher number of capsules, seeds per capsule, and test weight. These results underline the superior performance of PNS-6 in terms of both seed and biomass yield and are supported by several earlier studies. Malode (2003) [9], Kadam (2007) [10], Dhange (2007) [11], Kumar *et al*. (2011) [12], Ukale (2014) [13] and Shaikh *et al*. (2019) [2].

Effect of spacings

The number of seed capsule^{-1} and test weight (g) of niger were not differed significantly due to various spacing. The wider spacing 45 cm × 20 cm (S_1) recorded higher seed yield plant^{-1}(2.71 g) of niger which was at par with 45 cm × 15 cm (S_3) and found significantly superior over 45 cm × 10 cm (S_2). The closer spacing of 45 cm × 10 cm (S_2) recorded significantly higher seed yield (520 kg/ha) and biological yield (6246 kg/ha) of niger which was at par with 45 cm × 15 cm (S_3) and found significantly superior over 45 cm × 20 cm (S_1). It might be due to increased plant density and dry matter accumulation per unit area at closer spacing. These results affirm that closer spacing enhances yield per area, while wider spacing benefits individual plant performance. Similar results were reported by Kasle *et al*. (2017) [14], Uke *et al*. (2009) [15] and Kathmale *et al*. (2008) [16], Sandeep and Kusbad (2020) [17] and Nadeem *et al*. (2015) [18].

Interaction effect: The interaction effects of variety and spacings were found to be non significant.

Table 1: Growth attributes influenced by different spacings 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}
Main: Varieties (V)					
V_1- PNS-6	162.8	26.45	6.36	16.26	30.28
V_2- Phule karala	171.4	24.37	5.11	14.62	29.72
V_3- Phule vaitran	161.7	22.74	4.51	13.77	26.47
SE ±	1.81	0.568	0.32	0.48	0.359
CD	7.13	2.22	1.28	1.88	1.412
Sub main: Spacings (S)					
S_1- 45 cm ×20 cm	159.1	25.95	5.92	15.91	30.51
S_2- 45 cm ×10 cm	174.3	22.62	4.53	13.83	27.89
S_3- 45 cm ×15 cm	162.6	25.00	5.53	14.92	28.06
SE ±	3.98	0.609	0.17	0.37	0.697
CD	12.8	1.88	0.52	1.14	2.147
Interaction (V x S)					
SE ±	6.9	1.05	0.29	0.64	1.207
CD	NS	NS	NS	NS	NS

Table 2: Yield attributes of niger influenced by various treatment

Treatment	No of seeds cpsule^{-1}	Seed yield plant^{-1} (g)	Test weight (g)	Seed yield (kg ha^{-1})	Biological yield (kg ha^{-1})
Main: Varieties (V)					
V_1- PNS-6	43.44	2.63	4.54	566	6127
V_2- Phule karala	40.33	2.59	4.36	481	5925
V_3- Phule vaitran	36.11	2.11	3.19	316	5545
SE ±	0.87	0.10	0.18	33	83
CD	3.42	0.40	0.72	128	326
Sub main: Spacings (S)					
S_1- 45 cm ×20 cm	41.33	2.71	4.03	366	5448
S_2- 45 cm ×10 cm	38.66	2.00	4.02	520	6246
S_3- 45 cm ×15 cm	38.88	2.61	4.05	477	5903
SE ±	0.96	0.07	0.108	17	148
CD	NS	0.22	NS	51	457
Interaction (V x S)					
SE ±	1.66	0.13	0.19	29	356
CD	NS	NS	NS	NS	NS

Conclusion

From above investigation, it can be concluded that niger variety PNS-6 outperformed others in most growth, yield parameters and yield and was closely followed by Phule Karala. Among the different spacings, the closer spacing of 45 cm × 10 cm was found to be more remunerative for getting higher yield of niger, which was closely followed by 45 cm × 15 cm.

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