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Effect of integrated nutrient management on growth and yield of niger (*Guizotia abyssinica* L.)

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Abstract
Agronomical an investigation was carried out held during the kharif season of 2021-22, at the Agronomy Experimental Farm Department, Agriculture college, Latur. To investigate the impact of integrated nutrient management on niger development and yield. The experiment was designed using Randomized Block Design (RBD). The nine therapies were tested three times. The treatments were T_1: Control, T_2: 50% RDF + Azotobacter + PSB, T_3: 75% RDF + Azotobacter + PSB, T_4: 50% RDF + Vermicompost + PSB, T_5: 75% RDF + Vermicompost + PSB, T_6: 50% RDF + Vermicompost + Azotobacter + PSB, T_7: 75% RDF + Vermicompost + Azotobacter + PSB, T_8: 50% RDF + Neem seed cake + Azotobacter + PSB, T_9: 75% RDF + Neem seed cake + Azotobacter + PSB. Each experimental unit's gross (total) and net plot sizes were 5.4 meter × 4.5 meter and 4.5 meter x 3.9 meter, respectively. On July 17, 2021, sowing was carried out using the dibbling method and a seed rate of 5 kg/ha. For the niger crop, the recommended fertilizer dose (RDF) was 40: 20: 00: kg NPK ha^{-1}. The result of the experiment revealed that 75% RDF + Vermicompost + Azotobacter + PSB recorded significantly highest seed yield.

Keywords: Integrated nutrient management, growth, yield, niger, *Guizotia abyssinica* L.

Introduction
Nine oilseed crops can be grown in India under a variety of agro-ecological circumstances, including two non-edible oilseeds (castor and linseed) and seven edible oilseeds (groundnut, rapeseed, mustard, soybean, sunflower, sesame, and safflower). Niger, a member of the asteraceae/compositae family and a significant oilseed crop in India, is called *Guizotia abyssinica* L. Even though it is regarded as a small oilseed crop on a worldwide and national scale, it is crucial in rainfed environments, on hill slopes, and in soils with a coarse texture, particularly on steep slopes and in shallow soils of marginal lands.

In Ethiopia, Nigerian seed is a significant oilseed crop, making up roughly 50% of the nation's oilseed output. It is also grown in India, albeit to a considerably lesser extent India produces only around 3% of the world's oilseeds. Whereas the majority of other crops and oilseeds struggle to grow, Niger seed does well on wet soils. This makes it a crucial crop for Ethiopia, where waterlogged soils are a significant issue, to save soil and restore damaged land.

Niger is a two-cotyledon annual herb. The cotyledons arise above the soil surface during the epigeal germination process. The cotyledons are long-lasting and range in color from pale green to brownish. The successive leaves get bigger after the first pair of small, paired leaves. On the stem, the leaves are arranged in opposition to one another, but at the stem's apex, they are arranged alternately. The hue of the leaf can range from light green to dark green, and the leaf border can be smooth or pointed. The plant is often moderately to heavily branched, and the niger stem is typically smooth to slightly rough. Niger stems are hollow and easily breakable.

Light, sandy soils with low fertility are often used to cultivate crops in Niger. It can be farmed either as a monoculture or as an intercrop. When intercropped, the principal crop in Niger receives the land preparation and culture. Niger seed has a total ash content of 4.58%, which is made up of phosphoric acid (1.35%), lime (0.12%), acid soluble chloride (0.02%), and acid insoluble chloride (1.01%).

Niger oil is a bluish-white, sweet-tasting edible oil with a mild odor. Utilizing any kind of oil expeller, it is removed. Other important characteristics of the oil include:

- Specific gravity: 0.9157
- Refractive index: 1.446 at 40 °C
- Melting point: 73 to 85 °C

- Acetyl value: 24.1
- Saponification value: 194.6
- Reichert-Meissl number: 0.85
- Iodine value: 126.4
- Bromine absorption: 79.8%
- Insoluble fatty acid: 94.3%

The oil contains 85.4% unsaturated and 14.0% saturated fatty acids. Lauric and myristic acids account for 5.4%, stearic acid 4.8%, arachidic and ligneceric acids 0.48%. Among the unsaturated acids, oleic acid 38.7% and linoleic acid 51.6% are the major ones.

The digestible nutrients in niger seed cake include fats 5.2%; protein 29.8%; carbohydrates 21.7%; and fiber 3-9%. Niger seed cake is also used as a manure. The manure value is as follows: 1) Nitrogen: 4.73% 2) Phosphate: 1.83% 3) Potash: 1.31%

Niger is a rainfed crop that is grown in resource-poor and risk-prone areas. Because of this, the area and production of niger vary according to the patterns of rainfall in the growing regions. Additionally, the productivity of niger fluctuates depending on the prevailing weather conditions during the crop season. Niger is often considered a poor man's crop and is grown on poor lands in hilly regions by tribal farmers. Traditional varieties are typically grown with little attention and no or limited use of fertilizers or other agrochemicals, resulting in low crop yields. Research has shown that the productivity of niger can be significantly improved by growing improved crop varieties and using fertilizers. Niger responds variably to the application of nutrients, as it is grown in heterogeneous agro-climatic conditions. This study critically reviews these research findings to identify the appropriate nutrient management for improving the productivity of niger. The effect of integrated nutrient management on the growth and yield of Niger (*Guizotia abyssinica* L.) was the subject of an experiment.

Materials and Methods

An agronomic analysis was carried out to determine the impact of integrated nutrient management on the growth and yield of niger during the kharif season of 2021–2022 at the Experimental Farm of the Department of Agronomy, College of Agriculture, Latur. The experimental site had a clay-like texture and reacted slightly alkalinely. The soil's available nitrogen content was lower (227 kg ha^{-1}), its available phosphorus content was average (16.90 kg ha^{-1}), and its available potassium content was higher (434 kg ha^{-1}). The soil had adequate water retention capacity and was well-drained.

Nine treatments were duplicated three times in the randomized block design (RBD) experiment. The treatments were T_1: Control, T_2: 50% RDF + *Azotobacter* + PSB, T_3: 75% RDF + *Azotobacter* + PSB**,** T_4: 50% RDF + Vermicompost + PSB**,** T_5: 75% RDF + Vermicompost + PSB**,** T_6: 50% RDF + Vermicompost + *Azotobacter* + PSB**,** T_7: 75% RDF + Vermicompost + *Azotobacter* + PSB**,** T_8: 50% RDF + Neem seed cake + *Azotobacter* + PSB, T_9: 75% RDF + Neem seed cake + *Azotobacter* + PSB. Each experimental unit's gross and net plot sizes were 5.4 m × 4.5 m and 4.5 m x 3.9 m, respectively. On July 17, 2021, seeds were sown using the dibbling method with a seed rate of 5 kg ha^{-1}. 40: 20: 00: kg NPK ha^{-1} was the RDF for the niger crop. Gross plot dimensions for each experimental unit in the study were 5.4 by 4.5 meters, while net plot dimensions were 4.5 by 3.9 meters. On July 17, 2021, as per the protocols, pure seed of the niger variety GNNIG-3 was sowed using the dibbling technique. The harvest took place on October 24, 2021.

Results & Discussion

Growth Attributes

Treatments had a substantial impact on growth-related characteristics such as plant height, number of functional leaves, leaf area in dm2, dry matter, number of branches and number of flower heads At all phases of the crop's growth, the treatment T_7 (75% RDF + Vermicompost + Azotobacter + PSB) had considerably greater plant height, functional leaf count, leaf area, dry matter, and branch count. It was much better than the remaining treatments and at par with treatments T^9 (75% RDF + Neem seed cake + Azotobacter + PSB) and T^5 (75% RDF + Vermicompost + PSB). The good impact of the prescribed fertilizer dose, which provided the necessary nutrients at the appropriate rate at each stage of the crop's growth, can be blamed for the increase in plant height.

From inorganic fertilizer and organic vermicompost, neem seed cake (as nitrification inhibitor), *Azotobacter* as nitrogen fixer and PSB makes inorganic phosphate available; which ensure more nutrient element available due to which growth attributing characters were more. These findings are supported by Sharma *et al*. (2014) [8], Kulkarni *et al*. (2018) [4], Mane *et al*. (2019) [6], Deshmukh *et al*. (2010) [1], Malode (2003) [5], Kausale *et al*. (2009) [3].

Yield Attributes

The percentage of mature flower head $plant^{-1}$ (%), the number of seeds per flower head, seed yield $plant^{-1}$ (g), test weight in (g), weight of stalk in (kg/ ha), and grain yield in (kg/ha) were the yield-attributing characteristics of niger that were significantly altered by various treatments (Table 2.) Maximum number of mature flower heads (80.73), seeds per flower head (28), seed yield per plant (2.15 g), weight of grains per plant (37.17 g), test weight in (4.95 g), weight of stalk (3291 kg ha^{-1}), and grain yield (527 kg ha^{-1}) were all recorded. was observed with the 75% RDF + Vermicompost + Azotobacter + PSB (T_7), which was shown to be significantly better than the other treatments and at par with the 75% RDF + Neem seed cake + Azotobacter + PSB (T9) and 75% RDF + Vermicompost + PSB (T_5). From inorganic fertilizer and organic vermicompost, neem seed cake (as nitrification inhibitor), *Azotobacter* as nitrogen fixer and PSB makes inorganic phosphate available; which ensure more nutrient element available due to which growth attributing characters were more. These findings are supported by Sharma *et al*. (2014) [8], Kulkarni *et al*. (2018) [4], Mane *et al*. (2019) [6], Shaikh *et al*. (2010) [10], Paikaray *et al*. (1997) [7], Gayatri *et al*. (2017) [2], Trivedi *et al*. (1992) [9].

Table 1: Effects of several treatments on the niger's growth-related characteristics

Treatments	Plant Height (cm) at Harvest	No. of functional leaves at 75 DAS	Leaf area plant^{-1} (dm2) at 75 DAS	Dry matter plant^{-1} (g) at Harvest	No. of branches plant^{-1} at Harvest	No. of flower head plant^{-1}
T_1 Control	128.47	28.3	10.89	8.59	7.42	66.00
T_2 50% RDF + *Azotobacter* + PSB	139.64	28.5	11.20	9.51	8.12	68.67
T_3 75% RDF + *Azotobacter* + PSB	141.63	29.2	11.71	11.34	8.77	67.33
T_4 50% RDF + Vermicompost + PSB	141.48	30.0	11.62	10.30	8.38	68.33
T_5 75% RDF + Vermicompost + PSB	155.32	32.4	15.54	14.45	10.47	71.00
T_6 50% RDF + Vermicompost + *Azotobacter* + PSB	154.23	29.1	13.63	13.31	9.87	69.00
T_7 75% RDF + Vermicompost + *Azotobacter* + PSB	170.86	34.1	15.74	16.21	11.06	70.67
T_8 50% RDF + Neem seed cake + *Azotobacter* + PSB	151.16	29.8	12.15	12.56	9.20	69.33
T_9 75% RDF + Neem seed cake + *Azotobacter* + PSB	161.50	32.8	15.71	15.12	10.98	72.33
S.Em ±	6.08	1.2	0.59	-	0.47	3.00
CD at 5%	18.22	3.7	1.78	-	1.42	NS
General Mean	149.37	30.5	13.13	12.34	9.36	69.19

Table 2: Effect of different treatments on yield attributing characters and yield of niger

Treatments	Percent of mature flower head plant^{-1} (%)	No. of seed per capsul	Seed yield (g) plant^{-1}	Test weight (g)	Grain Yield (kg / ha)	Stalk Yield (kg ha^{-1})
T_1 Control	64.76	22.26	1.44	4.22	413	2065
T_2 50% RDF + *Azotobacter* + PSB	69.86	22.87	1.67	4.35	432	2150
T_3 75% RDF + *Azotobacter* + PSB	70.90	23.68	1.78	4.45	451	2271
T_4 50% RDF + Vermicompost + PSB	70.47	23.43	1.66	4.77	447	2171
T_5 75% RDF + Vermicompost + PSB	76.35	27.41	1.86	4.89	510	3007
T_6 50% RDF + Vermicompost + *Azotobacter* + PSB	71.46	24.02	1.80	4.90	465	2549
T_7 75% RDF + Vermicompost + *Azotobacter* + PSB	80.73	27.79	2.10	4.95	527	3291
T_8 50% RDF + Neem seed cake + *Azotobacter* + PSB	70.97	23.89	1.79	4.91	455	2413
T_9 75% RDF + Neem seed cake + *Azotobacter* + PSB	77.90	27.51	2.09	4.97	516	3023
S.Em ±	2.94	1.16	0.14	0.36	19.30	99.23
CD at 5%	8.81	3.48	0.42	1.08	57.86	297.50
General Mean	72.60	24.76	1.80	4.71	468	2549

Conclusion

The application of 75% RDF + Vermicompost + Azotobacter + PSB (T7) had a substantial impact on growth metrics such plant height (cm), number of leaves, leaf area, and dry matter, according to the results of the current experiment, which lasted one year. The number of filled seeds, test weight, weight of seeds per plant, biological yield, harvest index, seed yield, (NMR) net monetary return, and benefit-cost ratio, or (B:C), were other yield characteristics that were significantly impacted.

According to the findings of a year's worth of research, applying 75% RDF, vermicompost (2.5 t ha^{-1}), azotobacter (10 ml/kg), and PSB (10 ml/kg) boosts niger's quantitative and qualitative yield

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