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INTEGRATED NUTRIENT MANAGEMENT IN NIGER (*Guizotia abyssinica* L.)

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ABSTRACT

A field experiment was conducted during rabi 2025–26 at the Agronomy Farm, College of Agriculture, Nagpur, Maharashtra, India, to study integrated nutrient management in niger (*Guizotia abyssinica* L.) cv. Phule Karala (IGPN2004-1) with emphasis on yield, quality and economics. The experiment comprised three fertilizer levels and three foliar treatments in a 3×3 factorial randomized block design with three replications. Fertilizer levels were F_1 : 100% RDF (25:50:00 kg NPK ha⁻¹), F_2 : 125% RDF (31.25:62.50:00 kg NPK ha⁻¹) and F_3 : 150% RDF (37.50:75:00 kg NPK ha⁻¹), foliar treatments were S_1 : 2% urea, S_2 : 2% DAP and S_3 : PDKV Grade II. F_3 (150% RDF) recorded the highest yield attributes, seed yield, straw yield, biological yield, oil yield and protein yield. Seed yield reached 690 kg ha⁻¹ under F_3 (150% RDF) compared with 606 and 586 kg ha⁻¹ under F_2 (125% RDF) and F_1 (100% RDF), respectively. Among foliar treatments, application of PDKV Grade II recorded the highest seed yield (663 kg ha⁻¹), straw yield (4612 kg ha⁻¹), biological yield (5275 kg ha⁻¹), oil yield (256 kg ha⁻¹) and protein yield (128 kg ha⁻¹). Oil and protein contents were statistically non-significant, although numerical increases were observed with higher fertilizer levels and micronutrient application. 150% RDF recorded the highest gross monetary return, net monetary return and B:C ratio, while application of 150% RDF i.e. (37.50:75:00 kg NPK ha⁻¹) was superior among foliar treatments. Fertilizer and foliar interaction was non-significant for the evaluated yield, quality and economic parameters. The results demonstrate the potential of integrated soil-applied fertilizer and foliar nutrition for improving productivity and profitability of niger cv. Phule Karala.

Keywords: Niger, *Guizotia abyssinica*, Phule Karala, Fertilizer levels, Foliar nutrition, Yield attributes, Oil, Protein, Economics

Introduction

Niger (*Guizotia abyssinica* L.) is an important minor oilseed crop cultivated mainly under rainfed and marginal production conditions. Its adaptability to relatively poor soils and variable moisture environments makes it relevant to diversified and resource-constrained farming systems. However, productivity remains modest where fertilizer use is inadequate or unbalanced.

Nutrient availability is a major determinant of crop growth, reproductive development and seed productivity. Nitrogen is closely associated with vegetative growth and photosynthetic capacity, while phosphorus is important in energy transfer, root development and reproductive processes. An appropriate fertilizer dose can therefore improve biomass production and the formation of yield components.

Foliar nutrition provides an additional pathway for nutrient delivery during periods of high crop demand. Foliar application can complement soil fertilization by supplying nutrients directly to actively growing tissues and may improve nutrient utilization during reproductive development.

Previous studies have reported beneficial effects of integrated nutrient management, different fertilizer application and foliar nutrition on niger growth and productivity. Improved growth, yield and economics under integrated nutrient management, positive responses of niger to foliar nutrition and micronutrients. Nevertheless, location-specific information on combining different fertilizer levels with foliar nutrition for Phule Karala (IGPN2004-1) is limited.

Therefore, the present study was undertaken to evaluate the individual and combined effects of different fertilizer levels and foliar spray application on growth, yield attributes, productivity, oil and protein yield, economics of niger cv. Phule Karala (IGPN2004-1) under the agro-ecological conditions of Nagpur.

Material and methods

The experiment was conducted during rabi 2025–26 at the Agronomy Farm, College of Agriculture, Nagpur. The soil was a Vertisol with clayey texture and slightly alkaline reaction (pH 7.65). Organic carbon was 0.58%. Initial available nitrogen, phosphorus and potassium were 255.80, 22.13 and 369.20 kg ha⁻¹. The crop was sown on 30 October 2025 and harvested on 3 March 2026. During the crop period 50.6 mm rainfall

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was received, maximum temperature reached 41.5 °C and minimum temperature declined to 4.1 °C. Relative humidity varied considerably during the season.

The experiment was laid out in a Factorial Randomized Block Design (FRBD) with three fertilizer levels and three foliar spray applications giving nine different treatment combinations replicated three times (27 plots). Gross plot size was 4.5 × 3.6 m and net plot size was 3.6 × 3.2 m. Variety used was Phule Karala (IGPN2004-1) was sown at 30 × 10 cm spacing using a seed rate of 5 kg ha⁻¹. The treatments were

Treatment details

Sr.No.	Symbol
A	Factor A – Fertilizer levels (F)
1	100% RDF (25:50:00 kg NPK ha ⁻¹) F ₁
2.	125% RDF (31.25:62.50:00 kg NPK ha ⁻¹) F ₂
3.	150% RDF (37.50:75.00:00 kg NPK ha ⁻¹) F ₃
B	Factor B – Foliar sprays (S)

Sr.No.	Symbol
1	2% urea at vegetative and flowering stages S ₁
2	2% DAP at vegetative and flowering stages S ₂
3	PDKV Grade II at vegetative and flowering stages S ₃

The growth and yield attributing characters were recorded with quality studies

At harvest, capitula plant⁻¹, seeds capitulum⁻¹, test weight, seed yield plant⁻¹, straw yield plant⁻¹. Seed yield ha⁻¹, Straw yield ha⁻¹, harvest index, oil content, oil yield, protein content, protein yield, gross monetary returns (GMR), net monetary returns (NMR) and B:C ratio were determined. NMR was calculated by subtracting cost of cultivation from GMR, and B:C ratio was calculated as GMR divided by cost of cultivation.

Results and discussion

Yield attributes

Table 1. Mean yield attributes of niger as influenced by fertilizer levels and foliar sprays

Treatment	Capitula plant ⁻¹	Seeds capitulum ⁻¹	Test weight (g)	Seed yield plant ⁻¹ (g)	Straw yield plant ⁻¹ (g)
Fertilizer levels (F)					
F ₁ (100% RDF)	38.95	29.92	3.87	1.84	12.87
F ₂ (125% RDF)	40.11	30.89	3.95	1.94	13.49
F ₃ (150% RDF)	42.99	32.69	4.02	2.19	15.32
SE (m) ±	0.55	0.48	0.06	0.03	0.21
CD at 5%	1.64	1.44	NS	0.09	0.64
Foliar sprays (S)					
S ₁ (2% urea)	38.51	29.46	3.91	1.88	13.09
S ₂ (2% DAP)	40.22	31.04	3.94	1.99	13.76
S ₃ (PDKV Grade II)	43.32	33.00	3.98	2.11	14.83
SE (m) ±	0.55	0.48	0.06	0.03	0.21
CD at 5%	1.64	1.44	NS	0.09	0.64
Interaction (F × S)					
Interaction (F × S)	0.95	0.83	0.10	0.05	0.37
CD at 5%	NS	NS	NS	NS	NS
G.M.	40.68	31.17	3.95	1.99	13.89

The yield attributes showed a favourable response to increasing fertilizer levels. The number of capitula plant⁻¹ increased from 38.95 under (F₁) 100% RDF to 40.11 under (F₂) 125% RDF and 42.99 under (F₃) 150% RDF. Similarly, the number of seeds capitulum⁻¹ increased from 29.92 (F₁) 100% RDF to 30.89 (F₂) 125% RDF and 32.69 (F₃) 150% RDF. Test weight showed only a slight numerical increase from 3.87 g under 100% RDF to 3.95 g under 125% RDF and 4.02 g under (F₃) 150% RDF, and the effect was non-significant. Straw yield plant⁻¹ also increased progressively from 12.87 g under 100% RDF to 13.49 g under 125% RDF and 15.32 g under 150 % RDF. The improvement in reproductive and biomass attributes under 150% RDF application may be attributed to greater nutrient availability, which promoted vegetative growth, assimilate production and reproductive development.

Foliar application produced a similar and consistent response. The number of capitula plant⁻¹ was 38.51 under (S₁) 2% urea, 40.22 under (S₂) 2% DAP and 43.32 under (S₃) PDKV Grade II, while the number of seeds capitulum⁻¹ increased from 29.46 (S₁) 2% urea to 31.04 (S₂) 2% DAP and 33.00 (S₃) PDKV Grade II. Test weight was 3.91, 3.94 and 3.98 g under (S₁) 2% urea, (S₂) 2% DAP and (S₃) PDKV Grade II, respectively, with the differences being non-significant. Straw yield plant⁻¹ increased from 13.09 g under (S₁) 2% urea to 13.76 g under (S₂) 2% DAP and 14.83 g under (S₃) PDKV Grade II. Thus, application of PDKV Grade II recorded the highest values for all the attributes, followed by 2% DAP and 2% urea application. Although ap-

plication of micronutrient recorded the highest numerical values it's superiority may be attributed to improved micronutrient availability and enhanced reproductive development.

The interaction was found to be non-significant overall for all yield attributes.

Seed yield, straw yield (kg ha⁻¹) and harvest index (%)

Seed yield plant⁻¹ increased progressively with increasing levels of RDF i.e. 100%, 125% and 150% RDF recording 1.84, 1.94 and 2.19 g plant⁻¹, respectively. Similarly, seed yield increased from 586 kg ha⁻¹ under 100% RDF to 606 kg ha⁻¹ under 125% RDF and 690 kg ha⁻¹ under 150% RDF. Straw yield plant⁻¹ also increased from 12.87 g under 100% RDF to 13.49 g under 125% RDF and 15.32 g under 150% RDF, while straw yield ha⁻¹ increased from 4106 to 4233 and 4792 kg ha⁻¹, respectively. The higher productivity under 150% RDF may be attributed to improved growth, greater dry matter accumulation and better development of yield attributes under enhanced nutrient availability.

Foliar application also favourably influenced crop productivity. Seed yield plant⁻¹ was 1.88, 1.99 and 2.11 g under S₁ (2% urea), S₂ (2% DAP) and S₃ (PDKV Grade II), respectively, while seed yield ha⁻¹ was 594, 624 and 663 kg ha⁻¹, respectively. Similarly, straw yield plant⁻¹ increased from 13.09 g under 2% urea application to 13.76 g under 2% DAP and 14.83 g under PDKV Grade II application, with corresponding straw yields of 4160, 4357 and 4612 kg ha⁻¹. The

higher yields under application PDKV Grade II micronutrient may be associated with improved micronutrient availability and efficient nutrient utilization during crop growth and reproductive development. Harvest index showed only a narrow numerical variation among fertilizer levels, recording 12.54, 12.56 and 12.64% under F_1 (100% RDF), F_2 (125% RDF) and F_3 (150% RDF), respectively. Similarly, the foliar treatments recorded 12.54, 12.58 and 12.62% under S_1 (2% urea), S_2 (2% DAP) and S_3 (PDKV Grade II), respectively.

Consequently, biological yield reached 5481 kg ha⁻¹ under application of 150% RDF, followed by 125% RDF and 100% RDF reaching 4839 kg ha⁻¹, 4691 kg ha⁻¹, while the foliar treatments recorded 4754 kg ha⁻¹, 4982 kg ha⁻¹ and 5275 kg ha⁻¹ under S_1 (2% urea), S_2 (2% DAP) and S_3 (PDKV Grade II). The differences were statistically non-significant, indicating that although higher fertilizer levels and foliar nutrition increased seed and biomass production

Table 2. Mean seed, straw and Harvest index (%) of niger as influenced by fertilizer levels and foliar sprays

Treatment	Seed yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	Harvest index (%)
Fertilizer levels				
F_1 (100% RDF)	586	4106	4691	12.54
F_2 (125% RDF)	606	4233	4839	12.56
F_3 (150% RDF)	690	4792	5481	12.64
SE (m) ±	7.86	62.33	67.89	-
CD at 5%	23.55	186.87	203.54	-
Foliar sprays				
S_1 (2% urea)	594	4160	4754	12.54
S_2 (2% DAP)	624	4357	4982	12.58
S_3 (PDKV Grade II)	663	4612	5275	12.62
SE (m) ±	7.86	62.33	67.89	-
CD at 5%	23.55	186.87	203.54	NS
Interaction (F × S)				
Interaction (F × S)	13.61	107.96	117.59	-
CD at 5%	NS	NS	NS	-
G.M.	626.96	4376.73	5003.70	12.58

Oil and protein content and yield

The Oil content was statistically non-significant but showed a numerical increase from 37.63% under 100% RDF to 38.63% with the application of 150% RDF, with 125% RDF recording 37.82%. Oil yield, which integrates seed yield and oil concentration, increased from 219 kg ha⁻¹ under 100% RDF to 267 kg ha⁻¹ with the application of 150% RDF, with 125% RDF recording 235 kg ha⁻¹. Among foliar treatments application of PDKV Grade II recorded 38.62% oil and 256 kg ha⁻¹ oil yield, compared with 37.72% 2% urea application and 224 kg ha⁻¹ under S_1 (2% urea) and 37.74% and 235 kg ha⁻¹ under S_2 (2% DAP). The higher oil yield under (F_3) 150% RDF and (S_3) PDKV Grade II was mainly associated with their greater seed productivity.

Protein content was statistically non-significant but showed a numerical increase from 18.22% under (F_1) 100% RDF to 19.29% under (F_3) 150% RDF, with (F_2) 125% RDF recording 18.53%. Protein yield, which is influenced by both seed yield and protein concentration, increased from 107 kg ha⁻¹ under 100% RDF to 133 kg ha⁻¹ with application of 150% RDF, while 125% RDF recorded 112 kg ha⁻¹. Among foliar treatments application of PDKV Grade II recorded the highest protein content (19.33%) and protein yield (128 kg ha⁻¹), followed by (S_2) 2% DAP application (18.40% and 115 kg ha⁻¹) and (S_1) 2% urea (18.31% and 108 kg ha⁻¹), respectively. The higher protein yield under (F_3) 150% RDF and (S_3) PDKV Grade II was mainly associated with greater seed productivity.

Table 3. Mean oil and protein content and yield of niger as influenced by fertilizer levels and foliar sprays

Treatment	Oil content (%)	Oil yield (kg ha ⁻¹)	Protein content (%)	Protein yield (kg ha ⁻¹)
Fertilizer levels				
F_1 (100% RDF)	37.63	219	18.22	107
F_2 (125% RDF)	37.82	229	18.53	112
F_3 (150% RDF)	38.63	267	19.29	133
SE (m) ±	0.58	3.27	0.59	1.98
CD at 5%	NS	9.82	NS	5.94
Foliar sprays				
S_1 (2% urea)	37.72	224	18.31	108
S_2 (2% DAP)	37.74	235	18.40	115
S_3 (PDKV Grade II)	38.62	256	19.33	128
SE (m) ±	0.58	3.27	0.59	1.98
CD at 5%	NS	9.82	NS	5.94
Interaction (F × S)				
Interaction (F × S)	1.01	5.67	1.02	3.43

(continued on next page)

Treatment	Oil content (%)	Oil yield (kg ha ⁻¹)	Protein content (%)	Protein yield (kg ha ⁻¹)
CD at 5%	NS	NS	NS	NS
G.M.	38.03	238.24	18.68	117.32

Gross monetary returns, net monetary returns and B:C ratio

Gross monetary return increased progressively with increasing levels of fertilizer application. Highest GMR was under 150% RDF i.e. ₹75,345. Similarly, the highest net monetary return was recorded ₹54,398 ha⁻¹ with the application of 150% RDF. The B:C ratio also improved from 3.11 under (F₁) 100% RDF to 3.19 under (F₂) 125% RDF and 3.60 for (F₃) PDKV Grade II. The higher economic returns obtained under 150% RDF were mainly attributed to greater seed and straw productivity, which resulted in enhanced monetary returns from the harvested produce. The interaction effect between fertilizer levels and foliar sprays was found to be non-significant.

Foliar nutrition also influenced the economic performance of the crop. PDKV Grade II recorded the highest GMR (₹72,423 ha⁻¹), NMR (₹51,293.01 ha⁻¹) and B:C ratio (3.43), followed by (S₂) 2% DAP with ₹68,268 ha⁻¹, ₹47,452.84 ha⁻¹ and 3.28, respectively, and (S₁) 2% urea with ₹64,949 ha⁻¹, ₹44,573.93 ha⁻¹ and 3.19, respectively. The higher economic efficiency with the application of foliar micronutrient i.e. PDKV Grade II corresponded with its superior seed and straw productivity. Thus, PDKV Grade II proved to be the most beneficial foliar treatment economically, with the overall response consistency and being the most remunerative foliar treatment, followed by 2% DAP and 2% urea.

Table 4. Economics of niger as influenced by fertilizer levels and foliar sprays

Treatment	GMR (₹ ha ⁻¹)	NMR (₹ ha ⁻¹)	B:C ratio
Fertilizer levels			
F ₁ (100% RDF)	64,066	43,468	3.11
F ₂ (125% RDF)	66,228	45,454	3.19
F ₃ (150% RDF)	75,345	54,398	3.60
SE (m) ±	958.33	958.33	-
CD at 5%	2873.08	2873.08	-
Foliar sprays			
S ₁ (2% urea)	64,949	44,573.93	3.19
S ₂ (2% DAP)	68,268	47,452.84	3.28
S ₃ (PDKV Grade II)	72,423	51,293.01	3.43
SE (m) ±	958.33	958.33	-
CD at 5%	2873.08	2873.08	-
Interaction (F × S)			
Interaction (F × S)	1659.88	1659.88	0.08
CD at 5%	NS	NS	NS
G.M.	68,546.92	47,773.26	3.30

Interaction effect

The interaction between fertilizer levels and foliar sprays was non-significant for the yield attributes, seed and straw productivity, quality parameters and economic variables evaluated. Numerically, combinations involving F₃ and S₃ tended to produce the highest values

Conclusion

Application of 150% RDF (F₃) produced the highest yield attributes, seed and straw yield, biological yield, oil yield, protein yield and economic returns of niger cv. Phule Karala. Among foliar treatments, PDKV Grade II (S₃) was consistently superior to 2% DAP and 2% urea for yield and productivity. Oil and protein contents were not significantly altered, but their yields increased because of greater seed productivity. The treatment combination effects were non-significant under the experimental conditions. Under the conditions of this experiment, 150% RDF (F₃) and PDKV Grade II (S₃) are to be considered promising practices for improving niger productivity and profitability.

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