*Mysore J. Agric. Sci., 56 (2) : 60-64 (2022)*

# Optimization of Nutrients for Seed Yield and Economics of Seed Production in Niger [*Guizotia abyssinica* (L. f.) Cass.]

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ABSTRACT

A field experiment was conducted at Zonal Agricultural Research Station, UAS, GKVK, Bengaluru during 2019-20, to optimize the nutrients for seed yield and economics of seed production in niger. The experiment was laid out in RCBD and replicated thrice with eight treatment combinations. The results revealed that, treatment applied with FYM @ 5 t ha$^{-1}$ along with NPK @ 40:40:30 kg ha$^{-1}$ ($T_8$) recorded higher growth and seed yield parameters *viz*., plant height (205.26 cm at harvest), number of primary and secondary branches (13.20 and 26.40, respectively), number of capitula per branch (11.48), number of capitula per plant (113.06), number of seeds per capitula (13.29), seed yield per plant (5.67 g), seed yield per plot (330.33 g), seed yield per hectare (5.35 q ha$^{-1}$) with gross returns Rs. 535000 ha$^{-1}$ and B:C ratio of 1.56:1 followed by treatment FYM 5 ton ha$^{-1}$ along with 40:40:20 NPK kg ha$^{-1}$ ($T_7$) with gross returns of Rs.52900 ha$^{-1}$ and B:C ratio of 1.70:1. However, among all the treatments, application of FYM @ 5 t ha$^{-1}$ and seeds treated with *Azotobacter* and PSB at 20 g each per kg of seed ($T_4$) registered highest B:C ratio of 1.85:1 with gross returns of Rs.39,500 ha$^{-1}$ and net returns Rs.18196.80 ha$^{-1}$.

*Keywords* : Seed treatment, Nutrient management, Economics of seed production

NIGER [*Guizotia abyssinica* (L.f.) Cass.] is one of the important oilseed crops of India belonging to family *Asteraceae*. It is known by various names *viz.*, Noog in Ethiopia and Ramtil or Kalatil in India. Niger seeds are small, spindle-like and shiny black having good quality edible oil. It is mainly grown in tribal pockets with minimum agro-inputs, particularly fertilizers leading to very low productivity (Sharma, 1993). The genus *Guizotia* has six species. All the species are native to tropical Africa and five are found in Ethiopia (Hiremath and Murthy, 1992). There is evidence that introgression of genes from the weedy species into cultivated niger can occur. Cultivated niger has been reported to hybridize easily with *Guizotia scabra* subsp. *Schimperi* and sets viable seeds, but rarely (Murthy, 1992). Besides Ethiopia and India, it is cultivated in Nepal, Myanmar, Bangladesh and some other countries of eastern and central Asia. There is evidence that introgression of genes from the weedy species into cultivated niger can occur. Cultivated niger has been reported to hybridize easily with *Guizotia scabra* subsp. *Schimperi* and sets viable seeds, but rarely with other wild species. The niger seed contains up to 40 per cent edible semi-drying oil, 20.9 per cent carbohydrate and 27.8 per cent protein (Naik and Murthy, 2009; Getinet and Sharma, 1996). Niger oil has a fatty acid composition with linoleic acid being the dominant fatty acid. The linoleic acid content of niger oil is approximately 55 per cent in seed grown in India (Nasirullah *et al*., 1982) and 75 per cent in seed grown in Ethiopia (Alemaw and Wold, 1995). Niger seed is principally used for extraction of edible oil and contains 35-40 per cent oil which is pale yellow with a nutty taste and pleasant odor. The oil is used for culinary purposes, manufacturing of paints, soft soaps, lubrication and as a drying oil. The oil is a good absorbent of the fragrance of flowers due to which it is used as base oil by the perfume industry and also used as a green manure crop (Belayneh, 1991). Niger plant is consumed by sheep but not by cattle to which only niger silage can be fed (Chavan, 1961).

In India, the area under niger is 156.46 thousand ha with the production of 45.42 thousand tonne and productivity of 290 kg ha$^{-1}$ and in Karnataka, area under niger is 0.99 thousand ha with the production of

0.20 thousand tonne and productivity of 200 kg $ha^{-1}$ (2018-19). Madhya Pradesh, Maharastra, Chattisgarh, and Odisha contribute to more than 80 per cent of area and production. Other states where niger is grown are Andhra Pradesh, Bihar, West Bengal and Union Territory of Dadra and Nagar Haveli (Anonymous, 2019).

In India, niger is grown on poor shallow soils, usually planted on hill sides under rainfed conditions as an intercrop or mixed crop with minimum agro-inputs, consequently producing less yield (Getinet and Sharma, 1996). Application of recommended dose of fertilizers helps in producing optimum yield with feasible returns, when niger is grown as an intercrop or mixed crop. Application of 50 kg Urea + 50 kg SSP and 50 kg MOP per ha along with top dressing urea at 3-4 weeks after transplanting showed superiority with respect to growth, yield and contributing characters in finger millet (Sumalata *et al.,* 2017). But when it is grown as a sole crop, it is necessary to optimize nutrients level with a view of producing better seed yield and quality under suitable agro-climatic conditions. Hence, application of balanced nutrition contributes for production of superior yield with good quality seeds. Besides, higher yield and good quality seeds, it is important to focus on securing good returns per rupee of expenditure by employing minimum factors of production. Thus the present investigation was undertaken to optimize nutrients for better seed yield and to evaluate economics of seed production.

## Material and Methods

The field experiment was conducted in 2019 at ZARS, GKVK, Bengaluru. The experimental site is situated between $13^0$15' N latitude and $77^0$32' East longitudes, at 930 m altitude above Mean Sea Level (MSL). Niger variety KBN 1 which is early maturing and high yielding variety was sown during *kharif* with spacing of 30×10 cm at a depth of 2-3 cm. The experiment was laid out in randomized complete block design and replicated in three times with eight treatments, $T_1$: Control (Recommended dose of fertilizer 20:40:20 NPK kg / ha + FYM 5 ton / ha), $T_2$: Farmers Practice (FYM 5 ton / ha), $T_3$: $T_1$ + Gypsum 500 kg / ha, $T_4$: FYM 5 ton / ha + Seed Treatment with *Azotobacter* + PSB at 20 g each per kg of seed, $T_5$: FYM 5 ton / ha + 30:40:20 NPK kg / ha, $T_{6:}$ FYM 5 ton / ha + 30:40:30 NPK kg / ha, $T_7$: FYM 5 ton / ha + 40:40:20 NPK kg / ha, $T_8$: FYM 5 ton / ha + 40:40:30 NPK kg / ha. Observations on growth and yield parameters were recorded using five randomly selected plants from each net plot.

## Results and Discussion

The data on growth as well as yield parameters as influenced by the nutrients are presented in Table 1. The statistical analysis and interpretation of the experimental data was done by using Fishers method of Analysis of Varience technique as outlined by Gomez and Gomez (1984). Level of significance used in F test was at p=0.05. Critical difference values were calculated whenever F test was significant.

Though there was significant difference among treatments for plant height, $T_3$, $T_4$, $T_5$, $T_6$, $T_7$ and $T_8$ are on par with each other. However, numerically highest plant height of 205.26 cm at harvest was recorded in treatment FYM @ 5 t $ha^{-1}$ along with NPK @ 40:40:30 kg $ha^{-1}$ ($T_8$). The lowest plant height of 178.10 cm at harvest was observed in treatment FYM @ 5 t $ha^{-1}$ ($T_2$). Higher plant height was due higher level of NPK which might have contributed to the increased availability of macronutrients and also slow release of micro and macronutrients from farmyard manure resulted in the cell division and cell elongation leading to increase in the number of internodes as well as inter nodal length thereby maximizing the plant height. The highest number of primary branches (13.20) and secondary branches (26.40) was recorded in treatment FYM @ 5 t $ha^{-1}$ along with NPK @

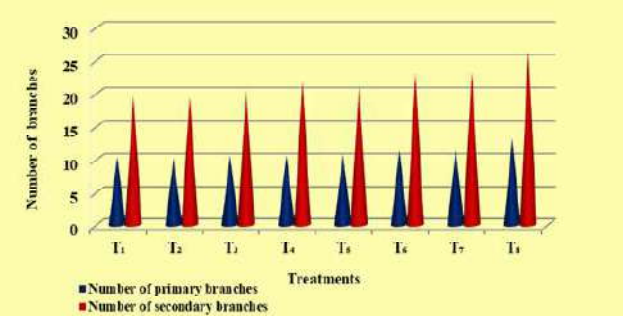


Fig. 1 : Effect of nutrients on number of primary branches and secondary branches at flowering in niger

TABLE 1

Influence of nutrients on growth and yield parameters in niger

| Treatments | Plant height at harvest (cm) | Number of primary branches | Number of secondary branches | Number of capitula plant$^{-1}$ | Number of seeds capitula $^{-1}$ | Seed yield plant$^{-1}$ (g) |
|---|---|---|---|---|---|---|
| $T_1$ : Control (RDF 20:40:20 NPK kg / ha + FYM 5 ton / ha) | 182.20 | 10.40 | 19.60 | 86.73 | 10.37 | 2.79 |
| $T_2$ : Farmer's Practice (FYM 5 ton/ha) | 178.10 | 10.20 | 19.53 | 84.13 | 9.75 | 2.40 |
| $T_3$ : $T_1$ + Gypsum 500 kg / ha | 187.53 | 10.60 | 20.53 | 89.07 | 11.11 | 3.49 |
| $T_4$ : FYM 5 ton/ha + Seed Treatment with *Azoto bacter* + PSB at 20 g each per kg of seed | 189.23 | 10.60 | 21.80 | 90.73 | 11.61 | 3.75 |
| $T_5$ : FYM 5 ton / ha + 30:40:20 NPK kg/ha | 191.50 | 10.86 | 21.26 | 106.20 | 11.90 | 4.20 |
| $T_6$ : FYM 5 ton/ha + 30:40:30 NPK kg/ha | 193.06 | 11.40 | 23.00 | 108.27 | 12.42 | 4.69 |
| $T_7$ : FYM 5 ton/ha + 40:40:20 NPK kg/ha | 196.00 | 11.46 | 23.33 | 108.40 | 12.53 | 5.27 |
| $T_8$ : FYM 5 ton/ha + 40:40:30 NPK kg/ha | 205.26 | 13.20 | 26.40 | 113.06 | 13.29 | 5.67 |
| S. Em. ± | 4.79 | 0.68 | 1.26 | 4.02 | 0.56 | 0.17 |
| C.D (p = 0.05) | 14.54 | NS | 3.81 | 12.2 | 1.72 | 0.52 |
| CV (%) | 4.36 | 10.7 | 9.92 | 7.09 | 8.45 | 7.36 |

*Note* : FYM- Farm yard manure, RDF- Recommended dose of fertilizer, PSB- Phosphorus solubilising bacteria.

40:40:30 kg ha$^{-1}$ ($T_8$) (Fig. 1). Lowest number of primary branches (10.20) and secondary branches (19.53) recorded in treatment FYM @ 5 t ha$^{-1}$ ($T_2$). Combination of FYM and inorganic fertilizers provided sufficient amount of nutrients and increased fertilizer use efficiency promoting the growth of the plant. Farmyard manure enhances soil health, soil texture and biological properties of soil, helping in proper infiltration and percolation promoting easy and sufficient supply of nutrients to the plants and besides, might have helped in mineralization of applied nitrogen and phosphorus, which in turn enhanced growth attributes (Kumar *et al*., 2017).

Yield parameters *viz*., number of capitula plant$^{-1}$, seeds capitula$^{-1}$ and seed yield plant$^{-1}$ found to vary with significant difference among them. Numerically highest number of capitula plant$^{-1}$ (113.06) (Fig. 2), seeds capitula$^{-1}$ (13.29) and seed yield plant$^{-1}$ (5.67 g) recorded in treatment FYM @ 5 t ha$^{-1}$ along with NPK @ 40:40:30 kg ha$^{-1}$ ($T_8$). Lowest number of capitula plant$^{-1}$ (84.13), seeds capitula$^{-1}$ (9.75) and seed yield plant$^{-1}$ (2.40 g) recorded in $T_2$. Application of farmyard manure along with inorganic fertilizers might have increased the availability of nutrients considerably and resulted in the positive effect, producing more capitula per plant and more seeds per capitula which directly contribute for increase in seed yield.

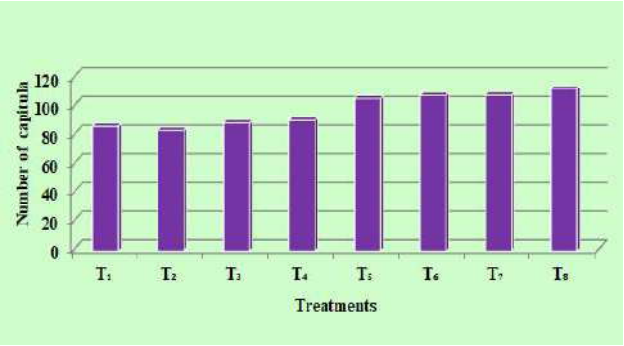


Fig. 2 : Effect of nutrients on number of capitula per plant in niger

TABLE 2

Influence of nutrients on yield parameters and economics in niger

| Treatments | Seed yield plot$^{-1}$ (g) | Seed yield hectare$^{-1}$ (q ha$^{-1}$) | Gross expenditure (Rs.ha$^{-1}$) | Gross returns (Rs.ha$^{-1}$) | Net returns (Rs.ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|---|---|
| $T_1$ : Control (RDF 20:40:20 NPK kg/ha + FYM 5 ton / ha) | 226.00 | 3.67 | 29967.09 | 36700 | 6732.91 | 1.22 |
| $T_2$ : Farmer's Practice (FYM 5 ton/ha) | 172.33 | 2.79 | 20679.68 | 27900 | 7220.32 | 1.34 |
| $T_3$ : T1 + Gypsum 500 kg / ha | 239.33 | 3.88 | 38308.41 | 38800 | 491.59 | 1.01 |
| $T_4$ : FYM 5 ton/ha + Seed Treatment with Azoto bacter + PSB at 20 g each per kg of seed | 243.66 | 3.95 | 21303.20 | 39500 | 18196.80 | 1.85 |
| $T_5$ : FYM 5 ton/ha + 30:40:20 NPK kg/ha | 246.66 | 4.00 | 30473.89 | 40000 | 9526.11 | 1.31 |
| $T_6$ : FYM 5 ton/ha + 30:40:30 NPK kg/ha | 294.33 | 4.79 | 34104.57 | 47900 | 13795.43 | 1.40 |
| $T_7$ : FYM 5 ton/ha + 40:40:20 NPK kg/ha | 326.67 | 5.29 | 30981.21 | 52900 | 21918.79 | 1.70 |
| $T_8$ : FYM 5 ton/ha + 40:40:30 NPK kg/ha | 330.33 | 5.35 | 34198.53 | 53500 | 19301.47 | 1.56 |
| S. Em. ± | 11.54 | 0.20 | | | | |
| C.D (p = 0.05) | 35.03 | 0.58 | | | | |
| CV (%) | 7.69 | 7.96 | | | | |

*Note*: FYM- Farm yard manure; RDF- Recommended dose of fertilizer; PSB- Phosphorus solubilising bacteria

There was significant difference among the treatments for seed yield per plot and hectare (Table 2). Treatment FYM @ 5 t ha$^{-1}$ along with NPK @ 40:40:30 kg ha$^{-1}$ ($T_8$) recorded highest seed yield plant$^{-1}$ (330.33 g) and lowest (172.33 g) was recorded in treatment applied with 5 ton ha$^{-1}$ FYM only ($T_2$). Highest seed yield per hectare (Fig. 3) was 5.35 q ha$^{-1}$, obtained upon applying FYM @ 5 t ha$^{-1}$ along with NPK @ 40:40:30 kg ha$^{-1}$ ($T_8$) which was on par (5.29 q ha$^{-1}$) with treatment FYM @ 5 t ha$^{-1}$ along with NPK @ 40:40:20 kg ha$^{-1}$ ($T_7$) . An optimum amount and balanced nutrition are required to achieve greater seed yield in niger. The crop had responded well to balanced nutrient supply through the application of higher rates of NPK fertilizers and farmyard manure. Majorly, macronutrients like N, P, K might showed a significant effect in producing more number of branches per plant, capitula per plant and seeds per plant which in turn resulted in enhancing seed yield per plot and per hectare. Results obtained are in line with Shehu (2014) in sesame. Lowest seed yield ha$^{-1}$ (2.79 q ha$^{-1}$) recorded in $T_2$.

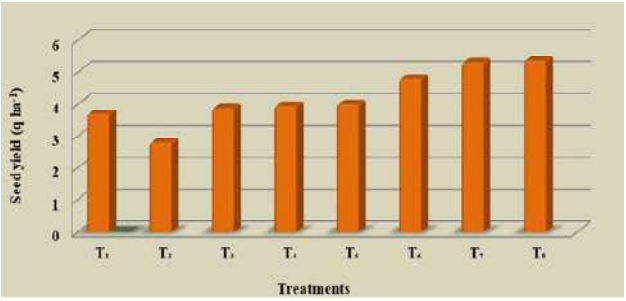


Fig. 3 : Effect of nutrients on seed yield per hectare in niger

The data on economics of niger as influenced by nutrients is presented in Table 2. Among all the treatments highest gross returns (Rs.53,500/- ha$^{-1}$) was obtained in treatment FYM @ 5 t ha$^{-1}$ along with NPK @ 40:40:30 kg ha$^{-1}$ ($T_8$) with the B:C ratio 1.56 which was on par with the treatment applied with FYM @ 5 t ha$^{-1}$ along with NPK @ 40:40:20 kg ha$^{-1}$ ($T_7$) showing gross returns (Rs.52900/- ha$^{-1}$), highest net returns (Rs.21918.79/- ha$^{-1}$) and B:C ratio of 1.70.



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However, highest B:C ratio (1.85:1) was observed in treatment applied with FYM @ 5 t $ha^{-1}$ and seeds treated with *Azotobacter* and PSB at 20 g each per kg of seed ($T_4$) with gross returns (Rs.39,500/- $ha^{-1}$) and net returns (Rs.18196.80/- $ha^{-1}$) while lowest net returns (Rs.491.59/- $ha^{-1}$) and B:C ratio of 1.01 was observed in treatment applied with FYM @ 5 t $ha^{-1}$ along with NPK @ 20:40:20 kg $ha^{-1}$ and gypsum @ 500 kg $ha^{-1}$ ($T_3$).

Highest B:C ratio observed in $T_4$ was due to lower cost of cultivation (Rs.21303.20/- $ha^{-1}$) however, highest gross returns (Rs.53,500/- $ha^{-1}$) obtained in $T_8$ (FYM 5 ton / ha + 40:40:30 NPK kg / ha) due to more seed yield (Table 2) which is contributed by the more number of capitula per plant, seeds per capitula and seed yield per plant. The findings are in conformity with Dalie *et al.* (2014) and Sumanth Kumar *et al.* (2021) obtained the higher green fodder yield with the higher nitrogen content due to better growth of crop supported by favorable climatic conditions.

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(*Received :* October 2021 *Accepted :* March 2022)