Original Research Article

Effect of varieties and graded levels of fertilizer on quality of niger under rainfed condition of Assam

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Abstract

During the *rabi* season of 2019-20, a field experiment entitled "Effect of varieties and graded levels of fertilizer on quality of niger under rainfed condition of Assam" was conducted at Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat to assess the effect of graded levels of NPK and varieties on qualityof niger.The experiment was laid out in a Randomized Block Design (Factorial) with three replications. The treatments consisted of four varieties viz., V_1: NG-1, V_2: GA-10, V_3: JNS-9 and V_4: NB-1 and four grades of NPK viz., F_1: 10-5-5 kg N-P_2O_5-K_2O/ha, F_2: 20-10-10 kg N-P_2O_5-K2O/ha, F_3: 30-15-15 kg N-P_2O_5-K_2O/ha and F_4: 40-20-20 kg N-P_2O_5-K_2O/ha. Experimental findings revealed that the variety GA-10 produced significantly higher oil content (38.76%) and protein content (16.65%) which was at par with JNS-9. Different variety did not bring any significant change in the iodine value and saponification value of oil. The highest oil content was recorded due to the application of 30-15-15 kgN-P_2O_5-K_2O /ha. Significantly higher seed protein content was registered with 40-20-20 kgN-P_2O_5-K_2O /ha which was at par with 30-15-15 kgN-P_2O_5-K_2O /ha. However, graded levels of NPK did not influence the iodine and saponification value of oil.

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KeyWords: Niger, Oil content, Protein content, Iodine value, Saponification value

INTRODUCTION

Niger is one of the most important minor oilseed crop grown in India. In India, it is cultivated in an area of 1.36 lakh hectare with a production of 0.41 lakh tones and productivity of 303 kg/ha (Anon., 2019-20a). Although a minor oilseed crop but its seeds contain 37-47% oil. The oil is pale yellow in colour with nutty taste and pleasant odour. The oil has higher amount of unsaturated fatty acid (oleic acid 38% and linoleic acid 51.6%) and is free from toxins and fit for human consumption (Gogoi, 2019). Niger oil contains high essential unsaturated fatty acid,

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linoleic acid (85%); high amount of cysteine and has great ability to reduce blood cholesterol level (Ramdan, 2012). Its commercial importance lies in manufacturing soaps, paints, perfumes, varnish, grease and cosmetics. The oil is also used for lighting, cooking and other culinary purposes. The oilcake is used as manure and also as valuable cattle feed.In Assam, it is cultivated in an area of 5.72 thousand hectare with a production of 3.19 thousand tones and its productivity is 558 kg/ha (Anon., 2019-20b). Few recommended varieties of niger for Assam and low input application contributes to low productivity of the crop. A good variety is the pre-requisite for successful cultivation of any crop because the genetic potentiality to sustain a high yield lies with the variety. A variety expresses its full genetic potentialities when it is grown in a proper environment.The selection/identification of a variety for a specific environment is essential in order to obtain an optimum yield from that given set of environmental conditions.Theproductivity of niger can be boosted by growing promising niger varieties with proper input application.Therefore, the present study with four varieties viz., V_1: NG-1, V_2: GA-10, V_3: JNS-9 and V_4: NB-1 and four grades of NPK viz., F_1: 10-5-5 kg N-P_2O_5-K_2O/ha, F_2: 20-10-10 kg N-P_2O_5-K2O/ha, F_3: 30-15-15 kg N-P_2O_5-K_2O/ha and F_4: 40-20-20 kg N-P_2O_5-K_2O/hawas conducted to study the comparative efficiency of these varieties under different fertility levels so as to sort out suitable variety/ varieties for rainfed upland situations of Assam.

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MATERIALS AND METHODS

The experiment entitled “Effect of varieties and graded levels of fertilizer on quality of niger under rainfed condition of Assam” was carried out during *rabi* season of 2019-20 at Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat. The site is situated at 26°46' N latitude and 94°13' E longitude, with an altitude of 87 meter above the mean sea level. The climatic condition of Jorhat is sub-tropical humid with warm summers and cold winters. The maximum and minimum temperature of Jorhat generally ranges between 34-37°Cand 8-10°C during summer and winter, respectively. The average rainfall of Jorhat is 2244 mm. The soil of the experimental site had a pH 5.43 with sandy loam texture, medium organic matter content (0.56%), medium available N (283.14 kg/ha), low available P (18.65 kg/ha) and medium available K (156.55 kg/ha). The experiment was laid out in Randomized Block Design (Factorial)and replicated thrice with sixteen treatment combination *viz*.,four levels of NPK:F_1:10-5-

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5, F_2:20-10-10, F_3:30-15-15 and F_4:40-20-20 N-P_2O_5- K_2O kg/ha and four varieties:NG-1, GA-10, JNS-9 and NB-1, respectively. Sowing was done in lines on 8th November, 2019 manually at a spacing of 25 cm x 10 cm and depth 3-4 cm with seed rate of 8 kg/ha in individual plot having dimension of 4m x 3m. As per treatment, the fertilizers were appliedfollowing broadcasting method of application and incorporated into the soil by light hoeing to the plots one day before sowing as urea, SSP and MOP. Thinning was done whenever necessary after the emergence of seedlings to maintain proper plant to plant distance. Manual weeding was done after 20 and 30 days of sowing to control weeds and no chemical was used for controlling weed. To determine the seed oil content, the oil was extracted from seed samples each having 10g from all the plots. The seeds were crushed and the crushed sample was placed in a thimble and extracted with light petroleum ether for 2 hours in a Soxhlet extraction unit as per method described by AOAC (1960). The extract was transferred to weighed flask, the solvent distilled off and by treating the flask at 100-150^0 C, the last traces of the solvent and moisture being removed. Then the flask was cooled and reweighed. The formula used for calculation of per cent oil content in seed was as follows:

$$\text{Percent oil} = \frac{W_2 - W_1}{X} \times 100$$

Where, W_1 = Weight of the empty flask (g)

W_2 = Weight of empty flask + weight of oil (g)

X = Weight of sample taken for extraction (g)

The percentage of seed protein was calculated by multiplying the per cent nitrogen value with 6.25.To determine the iodine value of oil into a 500 ml conical flask 0.5 g of oil was weighed out and 20 ml chloroform was added and the oil was dissolved completely to determine the iodine value of oil as per method described by Horowitz (1975a). To the sample, 25 ml of Hanus iodine solution was added and kept in dark for 30 minutes by inserting stopper to the vessel. After that 20ml of KI solution was added with occasional mixing. The sample was titrated against 0.1N $Na_2S_20_3$ by using starch as indicator with vigorous shaking and the iodine was extracted from the chloroform layer. Similarly a blank was carried out. The formula used for calculation of iodine value in oil was as follows:

$$\text{Iodine value of oil} = \frac{A \times N \times 0.1269 \times 100}{\text{Weight of oil (g)}}$$

Where, A = ml of $Na_2S_2O_3$ (Blank-Test)

N = Normality of $Na_2S_2O_3$ solution

1ml of 1.0N $Na_2S_2O_3$ = 0.1269g of iodine

To determine the saponification value of oil 2 grams of oil was weighed out into a 250ml conical flask and 25ml alcoholic KOH was added and the oil was dissolved completely to determine the saponification value of oil as described by Horowitz (1975b). An air condenser was connected to the flask and boiled for 30 minutes on a boiling water bath. After that the sample was cooled to room temperature and 2-3 drops of phenolphthalein indicator was added. The solution was titrated against standard 0.5N HCl till the pink colour disappeared. Similarly a blank was carried out. The formula used for calculation of saponification value in oil was as follows:

$$\text{Saponification value of oil} = \frac{(\text{Blank} - \text{Titre}) \times 28.06}{\text{Weight of oil (g)}}$$

Where, 1ml of 0.5N HCl = 28.06 mg KOH

RESULTS AND DISCUSSION

Different varieties influenced significantly oil content and protein content in seed. The highest value of oil content (%) was found with variety GA-10 (38.76%) which was at par with JNS-9 (37.80%). This might be due to variability in genetic characters among the varieties as oil content is typically a characteristic of species, cultivars and their genetic makeup. Singh *et al*. (2017) reported similar findings in mustard.Significantly higher protein content in seed was associated with the variety GA-10 (16.65%) which was at par with JNS-9 (16.60%). This may be attributed genetic trait of the varieties that helped to attain higher nitrogen content in seed (2.67% and 2.66% in GA-10 and JNS-9, respectively). Similar finding was reported by Kumar (2015) in *toria*.The data on iodine and saponification value of oil revealed that results were found to be non-significant for the effect of varieties.Although oil content is typically a characteristic of species, cultivars and their genetic makeup but environmental conditions and nutrition also affects its amount. The oil content increased with increasing levels of NPK and the highest oil content was obtained with application of 30-15-15 kgN-P_2O_5-K_2O /ha (F_3) (39.36%). The

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increase in oil content with increasing NPK levels upto 30-15-15 kgN-P_2O_5-K_2O /ha (F_3) might be due to better metabolic processes because increase in phosphorus levels positively influence biosynthesis of fatty acids. The synthesis of fatty acids in plant occurs through conversion of acetyl co-enzyme A to malonyl co-enzyme A in presence of ATP and phosphate. Also potassium plays very important role in the enzymatic system that control metabolism of photosynthates and their conversion to oil (Holmes, 1980). But the oil content showed decreasing trend with further increase of NPK level from 30-15-15 kgN-P_2O_5-K_2O /ha (F_3) to 40-20-20 kgN-P_2O_5-K_2O /ha (F_4). The reduction in oil content at higher supply of nitrogen appears to be due to conversion of more carbohydrate into protein and thus the amount of synthesized carbohydrates left for conversion into fats are relatively low as compared to other low nitrogen treated plants. Similar findings were reported by Kumar (2015) in *toria* and Singh *et al.* (2013) in linseed.Protein content in seed was also significantly higher with 40-20-20 kgN-P_2O_5-K_2O /ha (F_4) (16.88%) which was at par with 30-15-15 kgN-P_2O_5-K_2O /ha (F_3) (16.80%). This might be due to the more accumulation of nitrogen in seed under higher supplies of nutrients. This finding corroborates the findings of Kumar (2015) in *toria*.The iodine and saponification value of oil due to application of various NPK levels was non-significant.Significant interaction effect was observed between varieties and levels of NPK on seed oil content. Among all the combination, application of 30-15-15 kgN-P_2O_5-K_2O /ha (F_3) to variety GA-10 (V_2) obtained the highest oil content of 42.53% which was followed by application of higher dose of NPK *viz.*, 40-20-20 kgN-P_2O_5-K_2O /ha (F_4) to same variety GA-10 (V_2) (40.57%). Banga *et al.* (2013) reported that interaction effect of genotypes and fertility levels in terms of oil content showed significant decrease in oil content in RL-1359 and TAC-437 beyond 100% and in NRCDR-601 beyond 75% and it was not influenced significantly in the variety Kranti even up to 150% of recommended dose fertilizer.

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From the present study, it has been clearly seen that application of 30-15-15 kgN-P_2O_5-K_2O /ha (F_3) to variety GA-10 (V_2) was found to be advantageous in increasing productivity of niger in terms of oil content, whereasapplication of 40-20-20 kgN-P_2O_5-K_2O /ha to variety GA-10 increases protein content in seed under Jorhat condition of Assam.

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References

A.O.A.C. (1960). Official Method of Analysis (10th ed.). Association of Official Agricultural Chemist, Washington D.C.

Anonymous (2019-20a). Directorate of Economics and Statistic, Government of India.

Anonymous (2019-20b). Directorate of Economics and Statistic, Government of Assam.

Banga, R. S., Dhawan, K. and Singh, D. (2013). Quality and yield of Indian mustard genotypes as influenced by different fertility levels. *Oilseeds Section, Department of Plant Breeding, CCS Haryana Agricultural. University, Hisar (India)*.

Gogoi, B (2019). Rabi niger crop (*Guizotia abyssinica* L.) fits well under Assam condition. *Dimorian Review*, **6**(5).

Holmes, M.R.J. (1980). Nitrogen, phosphorus and potassium. Applied Science Publisher, Inc., England. pp. 21-100.

Horowitz, W. (ed.) (1975a). *Official Methods of Analysis of AOAC Association of Official Analytical Chemists*, Washington, 12th edn., p. 488.

Horowitz, W. (ed.) (1975b). *Official Methods of Analysis of AOAC Association of Official Analytical Chemists*, Washington, 12th edn., p. 490.

Kumar, R. (2015). Effects of NPKS on growth, yield and quality of late sown toria varieties (*Brassica rapa* L. var. toria) under rainfed condition of north-east India. *Bangladesh Journal of Botany*, **44**(4), 521-528.

Ramdan, M. F. (2012) Functional properties, nutritional value and industrial applications of niger oilseeds (*Guizotia abyssinica* Cass.). *Critical Reviews in Food Science and Nutrition*, **52**: 1-8.

Singh, S. P., Singh, R. A., Yadav, V. R., Chaudhary, S. and Kumar, A. (2017). Effect of Different Nutrient Combinations on Yield and Quality of Mustard Varieties (*Brassica juncea* L.). *International Journal of Current Microbiology and Applied Sciences*, **6**(2): 1343-1347.

Singh, D. N., Bohra, J. S. and Singh, J. K. (2013). Influence of NPK, S and variety on growth, yield and quality of irrigated linseed (*Linum usitatissimum*). *Indian Journal of Agricultural Sciences*, **83**(4): 456-458.

Table 1. Effect of varieties and levels of NPK on quality of niger

Treatments	Oil content (%)	Iodine value (g of I2/100g of oil)	Saponification value (mg KOH/g of oil)	N-content in seed (%)	Protein content in seed (%)
Varieties					
V_1: NG-1	37.04	127.20	185.76	2.52	15.72
V_2: GA-10	38.76	128.25	187.97	2.67	16.65
V_3: JNS-9	37.80	127.03	186.56	2.66	16.60
V_4: NB-1	33.82	125.14	185.57	2.50	15.62
S.Em (±)	0.46	1.17	1.62	0.03	0.20
CD (5%)	1.32	NS	NS	0.09	0.60
Levels of NPK (N-P_2O_5-K_2O kg /ha)					
F_1: 10-5-5	33.15	128.28	185.56	2.45	15.33
F_2: 20-10-10	36.89	127.47	185.67	2.49	15.58
F_3:30-15-15	39.36	127.29	187.01	2.69	16.80
F_4: 40-20-20	38.02	124.58	187.63	2.70	16.88

S.Em (±)	0.46	1.17	1.62	0.03	0.20
CD (5%)	1.32	NS	NS	0.09	0.60
Interaction (VxF)	*	NS	NS	NS	NS

NS=Non-significant

DAS=Days after sowing

Table 2. Interaction effect of varieties and levels of NPK on oil content (%)

Varieties	Levels of NPK (N-P_2O_5-K_2O kg /ha)			
	F_1: 10-5-5	**F_2: 20-10-10**	**F_3:30-15-15**	**F_4: 40-20-20**
V_1: NG-1	33.08	35.25	40.16	39.66
V_2: GA-10	33.32	38.91	42.53	40.28
V_3: JNS-9	32.75	39.91	40.57	37.98
V_4: NB-1	33.44	33.50	34.19	34.16
S.Em (±)	0.53			
CD (5%)	1.53			