

Effect of sowing date and nitrogen levels on growth, yield attributes, yield and nitrogen-use efficiency of niger (*Guizotia abyssinica*) under rainfed condition

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ABSTRACT

An experiment was conducted for 3 pre-rabi season during 1989–92 to find out the effect of sowing date and nitrogen level on yield of niger (*Guizotia abyssinica* Cass.). Sowing on 15 August gave the highest yield. The crop responded favourably up to 30 kg N/ha with the highest net profit (Rs 3,735/ha) and return/rupee investment (Rs 17). Interaction effect between sowing dates and N on niger was significant.

Key words : Niger, N-use efficiency, Base temperature, Sowing date

Niger has very low productivity mainly due to lack of knowledge about optimum time of sowing and non-use of fertilizer especially nitrogen. Since information on effect of sowing date and nitrogen in niger is meagre for this agro-climatic zone, the experiment was conducted.

MATERIALS AND METHODS

The experiment was conducted during the pre-rabi seasons of 1989–92 at Ghumusar Udayagiri. The soil was red sandy-loam (typic haplustulf) with pH 5.8, low in organic carbon (0.47%), low in total N (0.048%), medium in available P (17.5 kg/ha) and low in available K (105.6 kg/ha). Split-plot design was followed. Seeds of 'IGP 76' niger with 4 levels of N (0, 15, 30, 45 kg/ha) sown in lines 30

cm apart in subplots on 4 different sowing dates (30 July; 15, 30 August; and 15 September) taken in main plots. The experiment was replicated 4 times. The crop received P @ 8.8 kg and K @ 16.6 kg/ha through single superphosphate and murate of potash respectively at the time of final land preparation. Nitrogen as per the treatment was applied—half at sowing and another half at 21 days after sowing. Thinning of plants was done at 15 days after sowing to keep intra-row spacing of 10 cm. On an average total rainfall received by the crop was 706, 572, 487 and 385 mm in 30 July, 15 and 30 August and 15 September sowings respectively. The following equation was used to calculate thermal time (degree-days) between different phenological stages.

$$\text{Degree-days} = \sum_{\text{Stage a}}^{\text{Stage b}} \frac{\text{Minimum temperature} + \text{maximum temperature} - \text{base temperature}}{2}$$

where stage a and b are developmental phases between phenological stages. The base temperature of 5°C was taken for calculation considering development of plant below 5°C was not possible.

RESULTS AND DISCUSSION

Seed yield

Crop sown on 15 August gave maximum

Table 1. Effect of date of sowing and nitrogen on seed yield of niger

Treatment	Seed yield (q/ha)			
	1989-90	1990-91	1991-92	Pooled
<i>Sowing date</i>				
30 July	2.80	3.37	2.90	2.99
15 August	5.75	6.05	6.31	6.04
30 August	3.54	3.10	3.12	3.25
15 September	2.28	2.90	2.49	2.56
CD (P = 0.05)	0.49	0.30	0.23	0.25
<i>N (kg/ha)</i>				
0	2.20	1.84	1.85	1.97
15	2.98	3.08	3.22	3.06
30	5.41	6.09	5.55	5.74
45	3.77	4.20	4.25	4.08
CD (P = 0.05)	0.46	0.31	0.20	0.22

seed yield and there was a significant reduction in yield in earlier and later sowings, giving the lowest seed yield with 15 September sowing in all the years (Table 1). The average reduction in seed yield was 50.5, 46.2 and 57.6% due to sowing on 30 July, 30 August and 15 September respectively compared with 15 August sowing. Nayak and Paikaray (1991) reported sharp decrease in seed yield of niger with delayed sowings beyond 15 August. The nitrogen-use efficiency was maximum with 15 August sowing (Table 2). Application of N significantly increased the seed yield up to 30 kg/ha (Table 1). The average increase in yield over the control due to 15, 30 and 45 kg N/ha was 55.3, 191.4 and 107.1% respectively. But there was a significant (28.9%) reduction in seed yield with 45 kg N/ha due to maximum reduction in branches/plant, and test weight accompanied by less number of capitula/plant and seeds/capitulum than 30 kg N/ha. The results are in agreement with those of Paikaray *et al.* (1990), Singh *et al.* (1990) and Sharma and Kewat (1994). The nitrogen-use efficiency was 7.27, 12.57 and 4.67 at 15, 30, and 45 kg N/ha respectively (Table 2).

Yield attributes

Sowing dates and N levels caused significant difference in plant height, branches/

Table 2. Effect of date of sowing and nitrogen on growth, yield components, N-use efficiency and economics of niger (pooled data of 3 years)

Treatment	Plant height (cm)	Branches/plant	Capitula/plant	Seeds/capitulum	1,000-seed weight (g)	N-use efficiency (kg/kg N)	Additional return (Rs/ha)	Return/rupee spent (Rs)
<i>Sowing date</i>								
30 July	137.97	4.13	13.77	25.51	3.46	4.50	1,145	5.40
15 August	114.33	5.66	24.37	25.95	3.96	17.10	4,512	33.40
30 August	111.65	5.40	20.82	27.00	3.04	6.26	1,746	7.90
CD (P = 0.05)	18.91	0.95	3.89	4.80	0.22			
<i>N (kg/ha)</i>								
0	106.35	4.64	17.62	20.83	3.07			
15	112.62	4.93	20.55	22.28	3.31	17.27	1,034	9.40
30	116.18	5.25	20.62	25.22	3.35	12.57	3,735	17.00
45	121.51	4.87	19.74	24.02	3.09	4.69	1,885	5.70
CD (P = 0.05)	5.60	0.37	NS	NS	0.14			

plant, capitula/plant, seeds/capitulum and 1,000-seed weight (Table 2). The results confirm the findings of Belayneh *et al.* (1986) and Sharma and Kewat (1994). The branches/plant, capitula/plant and 1,000-seed weight were the highest in 15 August sowing, which declined sharply with the earlier and later sowings, giving the lowest number of branches/plant and capitula/plant with 30 July sowing and 1,000-seed weight with 15 September sowing. The results support those of Belayneh *et al.* (1986), Nayak and Paikaray (1991). The plant height was maximum with 30 July sowing which declined progressively to a minimum with 15 September sowing. Application of 30 kg N/ha recorded the maximum branches/plant, capitula/plant, seeds/capitulum and 1,000-seed weight which acted additively to produce the highest seed yield. Paikaray *et al.* (1990) also reported similar results. Plant height was maximum with 45 kg N/ha. There was poor development of yield attributes at higher and lower levels of N as compared to 30 kg N/ha.

In 15 August sowing optimum mean diurnal temperature of 22 and 20°C and well-distributed rainfall of 394 mm in 23 rainy days and 178 mm in 6 rainy days during sown to flowering and flowering to maturity, respectively, favoured the crop to complete 55 days of vegetative phase and 50 days of reproductive phase. This favoured optimum development of yield attributes which resulted in highest seed yield. But high temperature (24 and 23°C) and rainfall (413.6 mm in 20 days and 292 mm in 16 days) in 30 July sowing and low temperature (20 and 16°C) and rainfall (291 mm in 16 days and 94 mm in 5 days) in 15 September sowing during vegetative and reproductive phases respectively reduced the duration of both the phases. This enhanced the vertical growth of the plant at the cost of lateral growth in earlier sowing and affected plant population and seed setting in later sow-

ing with significant reduction in yield attributes and seed yield compared with 15 August sowing.

Accumulated degree-days during vegetative phase correlated significantly and positively with seed yield ($r = 0.91^*$) on all the dates of sowing. The 15 August sown crop accumulated more degree-days during vegetative and reproductive phase, which resulted in maximum seed yield. However, accumulation of less degree-days during vegetative and reproductive phase by 30 July- and 15 September-sown crop resulted in production of higher and fewer seeds which consequently gave low seed yield compared with the crop sown on 15 August.

In 15 August sowing, seed yield showed a significant quadratic relationship with applied N i.e. $Y = 2.426 + 0.339 X - 0.0051 X^2$ ($R = 0.99^{**}$), where Y is the seed yield of crop (q/ha) and X is levels of nitrogen (kg/ha). This response function could explain 99% of variation in the seed yield of niger through the variation of N levels. The economic optimum dose of N was 32.55 kg/ha with optimum seed yield of 8.05 q/ha. It gave a yield response of 17.28 kg seed/kg applied N. Singh *et al.* (1991) also opined alike. The additional net return at optimum N dose was Rs 5,666/ha with an out turn of Rs 24/ invested on N.

The interaction effect of sowing dates and

Table 3. Seed yield of niger as influenced by sowing date and nitrogen (pooled data of 3 years)

Sowing date	Seed yield (q/ha)			
	0	15	30	45
30 July	2.01	2.44	4.65	2.84
15 August	2.66	5.98	8.45	7.07
30 August	1.85	2.29	5.75	3.13
15 September	1.35	1.52	4.09	3.27
<i>Difference between</i>	<i>CD (P = 0.05)</i>			
<i>Date means at the</i>	<i>0.41</i>			
<i>same level of N</i>				
<i>Nitrogen means at</i>	<i>0.42</i>			
<i>the same level of sowing date</i>				

N levels was significant which showed that niger sown on 15 August recorded the highest seed yield at all the levels of N (Table 3). Application of 30 kg N/ha recorded the maximum seed yield on all the dates of sowing. Nitrogen-use efficiency was higher at 15 kg N/ha than at 30 kg N/ha which explained the maximum use of N even at lower level over control at optimum time of sowing (Table 2).

Economics

Application of 30 kg N/ha recorded the highest additional seed yield (Table 1) and profit than the control, with a return of Rs 17/ rupee spent on N (Table 2). In 15 August sowing an additional seed yield of 4.5 q/ha (Table 3) and profit of Rs 4,512 with a return of Rs 23/ rupee invested was obtained by the application of N over the control.

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