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Productivity and water use efficiency of niger (*Guizotia abyssinica*) genotypes under different dates of sowing

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ABSTRACT

A field experiment was conducted for 3 consecutive years from 1989 to 1991 to find out the effect of sowing time on productivity and water use efficiency of niger (*Guizotia abyssinica* Coss.) genotypes. 'GA 10' produced the highest seed yield of 497.4 kg/ha which was 3.8 and 21.3% more over 'IGP 76' and 'UN 4', respectively. The crop sown on 20 August recorded higher yield (571.9 kg seed/ha) than earlier or later sown crops. The moisture use efficiency was maximum for 'GA 10' (16.08 kg seed/ha/mm and 98.5 kg total yield/ha/mm. Sowing of the crop on 20 August proved efficient in utilizing soil moisture towards seed yield (19.78 kg/ha/mm) while 21 July sown crop resulted in the highest water use proved efficiency for total biomass yield (117.27 kg/ha/mm). 'GA 10' showed the maximum moisture use efficiency for its seed yield when sown on 20 August.

Key words : Niger, Date of sowing, Genotypes, Water use efficiency

Among 9 oilseed crops, India occupies the first position in area as well as production of niger in world. Orissa is the largest niger producing state in India. Non-availability of high yielding cultivars and untimely sowing are 2 most important reasons for low yield of niger. Sowing time has a prominent effect on yield of rainfed upland crops because of prevailing weather conditions at a particular stage during crop growth period (Pawar *et al.*, 1976). Similarly, the characteristics of crop genotypes play an important role for getting optimum yield with available soil moisture under rainfed upland situation.

Keeping these in view, an experiment was conducted to find out the effect of date of sowing on productivity and water use efficiency of different niger genotypes.

MATERIALS AND METHODS

A field experiment was conducted at Semiliguda during the rainy seasons (*kharif*) of 1989-90, 1990-91 and 1991-92 in a factorial randomized block design with 3 replications. The soil was red sandy loam with available N, P_2O_5 and K_2O at 190, 12 and 260 kg/ha respectively, with pH 5.4. The soil moisture content was 18.5% at field capacity and 5.6 % at permanent wilting point. Three genotypes of niger ('UN 4', 'GA 10' and 'IGP 76') were tested under 6 sowing dates (21 July, 31 July, 10 August,

Table 1. Rainfall data

Year	July	August	September	October	November	December
1989-90	471.7	272.9	163.8	162.7		0.2
	(20)	(18)	(8)	(3)		(1)
1990-91	383.2	197.9	139.3	99.8	62.4	0.7
	(25)	(22)	(12)	(14)	(7)	(1)
1991-92	697.7	413.5	140.6	110.0	55.2	2.5
	(18)	(24)	(13)	(9)	(4)	(1)

Figures in parentheses indicate the number of rainy days

20 August, 30 August and 10 September) in rainfed condition. The crop was fertilized with 20 kg each of N and P_2O_5/ha. Full dose of P and half N were applied at sowing and remaining half N was top dressed 25 days after sowing. All other recommended package of practices were followed for the crop.

The soil moisture contents in the experimental plot from 0-60 cm depth was determined gravimatrically at 15 days interval. The consumptive use of water was calculated as per the procedure of soil moisture depletion (Dastane, 1972). Then moisture use efficiency was determined separately for the seed yield and total

Table 2. Yield and yield attributes of niger genotypes as affected by sowing dates (pooled data of 3 years)

Treatment	Seed yield (kg/ha)	Stalk yield (kg/ha)	Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches/ plant	Capitula/ plant	Seeds/ capitulum
Genotpye								
'UN 4'	410.1	2,177	62	115	141.5	5.5	22.0	15.4
'GA 10'	497.4	2,598	68	125	157.6	5.8	23.8	16.9
'IGP 76'	479.4	2,451	65	119	140.5	5.8	23.4	16.4
CD (P = 0.05)	54.8	170			7.7	NS	NS	1.2
Sowing date								
21 July	499.4	3,642	73	131	179.5	6.1	22.3	13.7
31 July	518.5	3,035	70	127	146.1	5.7	23.4	14.9
10 August	520.3	2,684	67	124	156.6	5.4	24.6	16.0
20 August	571.9	2,382	65	119	149.2	6.0	24.7	18.4
30 August	417.2	1,743	62	111	131.2	5.4	20.2	14.1
10 September	246.2	965	58	106	116.8	5.7	16.8	13.6
CD (P = 0.05)	77.5	422			10.9	NS	4.6	3.7

Table 3. Interaction effect of dates x genotypes on moisture use and moisture use efficiency (1989-90 to 1991-92)

Date	Moisture use (mm)				Water use efficiency (Kg/ha/mm)							
					Seed yield				Total Yield			
	'UN 4'	'GA 10'	'IGP 76'	Mean	'UN 4'	'GA 10'	'IGP 76'	Mean	'UN 4'	'GA 10'	'IGP 76'	Mean
21 July	342.6	362.2	353.4	352.7	12.50	15.00	14.90	14.13	108.35	124.32	119.15	117.27
31 July	312.8	330.6	322.2	321.8	14.70	17.17	16.35	16.07	103.44	115.18	112.25	110.29
10 August	291.6	312.2	306.8	303.5	16.08	18.09	17.17	17.11	100.44	110.08	106.98	105.83
20 August	280.2	296.4	289.2	283.6	17.62	21.23	20.49	19.78	92.53	108.35	105.76	102.21
30 August	260.1	277.2	270.1	269.1	14.86	16.11	15.48	15.43	74.53	86.75	79.24	80.17
10 September	242.5	261.5	251.6	251.8	9.16	8.88	11.32	9.78	45.94	46.36	52.06	48.12
Mean	288.3	306.6	298.8		14.15	16.08	15.95		87.53	98.50	95.90	

CD (P = 0.05) for

Water use	Water use efficiency (seed yield)	Water use efficiency (total yield)
Date 32.24	Date 4.32	Date 4.84
Genotype 8.86	Genotype 1.36	Genotype 4.72
Date × genotype 70.44	Date × genotype 6.72	Date × genotype 20.12

biomass yield of niger. The rainfall received during the cropping seasons in different years is given below in Table 1.

RESULTS AND DISCUSSION

Yield and yield attributes

Niger genotypes and its sowing dates significantly influenced the seed yield (Table 2). 'GA 10' produced the highest yield of 497.4 kg/ha closely followed by 'IGP 76' (479.4 kg/ha). The seed yield of 'GA 10' was 3.8 and 21.3% higher than 'IGP 76' and 'UN 4', respectively. This could be attributed to taller plant, more number of branches and capitula/plant and also more seeds/capitulum of 'GA 10'. The crop sown on 20 August recorded significantly higher yield and yield attributes over the crop sown on later dates. The reduction in seed yield was 37.1 and 132.3% over 30 August and 10 September respectively. Earlier date sown crops also produced less yield but were at par with 20 August. The yield reduction was 14.5, 10.3 and 9.9% for the crops sown on 21 July, 31 July and 10 August respectively, over 20 August. This might be due to more of vegetative growth of early sown crops and reduction in vegetative growth period and less expression of yield attributing characters of late sown crop. This confirms the earlier report of Misra and Sahu (1988).

Water use

Among the crop genotypes, 'GA 10' utilized significantly higher moisture of 306.6 mm which was at par with 'IGP 76'. This indicated that these genotypes were more efficient in extracting moisture from the soil than other genotype ('UN 4') over a range of sowing dates. This might be due to longer maturity period in the field.

Sowing of all niger genotypes on 21 July utilized the highest soil moisture (352.7 mm) which was significantly higher than all other crops except 31 July sown crop (Table 3). This might be due to more number of rainy days and ample availability of moisture during the crop duration compared with delayed sowing. The decreasing trend in moisture use due to delayed sowing was also observed by Dhoble *et al.* (1987) for other *kharif* crops.

Water use efficiency

Niger genotype 'GA 10' was the most efficient in utilizing the moisture by recording significantly higher moisture use efficiency (16.08 kg seeds/ha/mm and 98.50 kg of total yield/ha/mm) which was at par with 'IGP 76' (15.95 kg of seeds/ha/mm and 95.90 kg total yield/ha/mm). The lowest moisture use efficiency was recorded by 'UN 4'. Sowing of the crop on 20 August proved efficient in utilizing the soil moisture towards the seed yield and recorded significantly higher moisture use efficiency. This was at par when the crop was sown on 10 August and 31 July. Delayed sowing significantly reduced the moisture use efficiency of the crop. Total yield (kg/ha/mm) decreased with delayed sowing from 21 July. This might be due to more of vegetative growth at earlier dates. Similar trend of moisture use efficiency due to delayed sowing in different *kharif* crops was observed by Sukhadia (1992). However, niger genotype 'GA 10' when sown on 20 August resulted in the highest moisture use efficiency (21.23 kg of seeds/ha/mm).

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