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Yield and profitability of Niger [*Guizotia abyssinica* (L. f.) Cass] as influenced by crop geometry

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Abstract
A field experiment was carried out during *kharif* season of 2021 at at Research Farm, Raj Mohini Devi College of Agriculture and Research Station, Ajirma, Ambikapur, Chhattisgarh, to find out the various growth, yield characters, yield and optimum crop geometry of niger for getting higher yield and net returns for northern hills zone of Chhattisgarh. The experiment was conducted in a randomized block design with seven plant densities and replicated three times. The seven plant densities were 15 x 5 cm (13.33 lakh plants ha^{-1}), 15 x 10 cm (6.67 lakh plants ha^{-1}), 22.5 x 10 cm (4.44 lakh plants ha^{-1}), 22.5 x 5 cm (8.88 lakh plants ha^{-1}), 30 x 5 cm (6.66 lakh plants ha^{-1}), 30 x 10 cm (3.33 lakh plants ha^{-1}) and Broadcast method of sowing (14.85 lakh plants ha^{-1}). The result shows that growth and yield attributes, seed yield, straw and stalk yield and biological yield were influenced significantly by impose of different crop geometry (plant density). Significantly the maximum values of growth and yield attributes were recorded with wider spacing of 30 x 10 cm (3.33 lakh plants ha^{-1}) and the yields and gross returns (₹ 42345 ha^{-1}) were higher with narrow spacing of 15 x 5 cm (13.33 lakh plants ha^{-1}), while net returns (₹ 29244 ha^{-1}), B: C (2:3) ratio and economic efficiency (308 ₹ ha^{-1} day^{-1}) were higher under broadcast method of sowing (14.85 lakh plants ha^{-1}). This study suggest that the appropriate crop geometry can significantly increase the yield of the niger crop.

Keywords: Niger, crop geometry, plant density, oilseed

1. Introduction
Niger is a minor oilseed crop and it comes under the edible oilseed category. Niger belongs to the Compositae family. It is extensively grown on marginal and sub-marginal lands with minimum care and input in tribal areas under rainfed conditions and on hill slopes. Niger seed is principally used for the extraction of edible oil and its seed contains 37 to 47% oil (Tomar *et al.*, 2011) [5]. The oil of Niger is used for pharmaceutical purposes, soap making, paints, and cosmetics. Niger cake contains 4.7% nitrogen, 1.8% Phosphorus, and 1.3% potassium and it is free from any toxins and is suitable for cattle feeding. India is a major Niger growing country accounting for more than 50% of the world's Niger area and production. In India Niger grown in an area of 1.362 lakh ha with a production of 0.413 lakh tonnes with an average productivity of 303 kg ha^{-1}. In the Chhattisgarh area, production and productivity of the Niger crop were 0.36 lakh ha, 0.069 lakh tonnes, and 190 kg ha^{-1}, respectively. Niger crop has wider adaptability and may be grown in poor condition and it has resistant to drought. The major constraints of low productivity are growing of this crop on light textured soil having very steep to gentle slope, nutrient losses, inadequate crop stand, poor growth due to low input and traditional variety and generally delayed sowing due to continuous rains during the optimum sowing time (Mid July to last week of August) coupled with occasional drought during grain filling stage. It is usually broadcasted without any fertilizer application and almost without weed management. The productivity may be enhanced by using improved varieties and improved package of practices. Sharma and Kewat (1994) [4] reported significant improvement in the yield (4.32 q ha^{-1}) when both N and P_2O_5 applied @ 20 kg/ha over no use of fertilizer (1.98 q ha^{-1}).

To obtain a higher crop yield per unit area optimum plant density is the most significant factor which influences the growth and the yield of crops. Higher and lower population affects the yield adversely. The arrangement of plant population in a given area is an important for better growth and development of a crop. This may be adjusted by increasing or decreasing the inter and intra- row spacing of plants. Increased plant density decreased number of branches, capitula/plant, seed index, and seed yield/plant, but due to greater number of plants/unit area (higher population densities) there was increased seed yield $unit^{-1}$ area and the highest seed

Yield (13.38 q ha^{-1}) was obtained with 5.0 lakh plant density over rest of the plant densities (Khare and Rao, 1985) [3].

2. Materials and Methods

The present experiment was conducted during *kharif* 2021 at Research Farm, Raj Mohini Devi College of Agriculture and Research Station, Ambikapur which is situated $23^0 9'$ North latitude and $87^0 7'$ East longitude having an altitude of 623 meter above mean sea level and represents the northern hills agro-climatic zone of Chhattisgarh. The soil of the experimental site was sandy loam having pH 5.8, low in nitrogen and phosphorus 265 and 14 kg ha^{-1}, respectively, and medium in available potassium (308 kg ha^{-1}). The experiment was laid out in randomized block design with seven plant densities and replicated three times. The seven plant densities were 15 x 5 cm (13.33 lakh plants ha^{-1}), 15 x 10 cm (6.67 lakh plants ha^{-1}), 22.5 x 10 cm (4.44 lakh plants ha^{-1}), 22.5 x 5 cm (8.88 lakh plants ha^{-1}), 30 x 5 cm (6.66 lakh plants ha^{-1}), 30 x 10 cm (3.33 lakh plants ha^{-1}) and Broadcast method of sowing (14.85 lakh plants ha^{-1}). The crop was sown on 2nd September (2021), 'JNC-9' variety of niger was used. Thinning was done for obtaining desirable plant population according to treatments, thinning operation was done after 17 DAS in all the treatments except in broadcast method of sowing.

The crop was supplied with a common dose of nitrogen, phosphorus, and potash @ 30, 20 and 10 Kg ha^{-1}, respectively, through fertilizer N:P:K (12:32:16) and urea. Full dose of P_2O_5 and K_2O and half dose of N was applied at the time of sowing as basal dose and half dose of N at 25 DAS as top dressing. The seed rate of 5 kg ha^{-1} was common for all the seven treatments. Ten plants were randomly selected from in each plot to record plant height. Whereas, five plants were randomly selected from each plot to record other growth parameters of niger *viz*. number of branches (at 30 DAS, 60 DAS and at harvest) and dry matter accumulation (at 30, 60 DAS and at harvest). Five plants were randomly selected at time of harvesting from each net plot (as per the treatments) for recording yield attributes *viz.,* number of capitula $plant^{-1}$, weight of capitula $plant^{-1}$, number of seeds $capitulum^{-1}$ and test weight of seeds. The crop was harvested at maturity on 7th December (95 DAS). Harvesting was done manually by sickle. The sun dried bundle of individual plots was threshed with wooden sticks. Seeds were cleaned by the process of winnowing to separate out the threshed capitula and other materials from seeds. After threshing and winnowing total seed yield of net plot (treatment and replication wise) was weighed and it was converted in kg ha^{-1} by multiplying with treatment wise conversion factor to get seed yield for statistical analysis. After threshing and separation of seed yield from each net plot the by-product (stalk and straw yield) was recorded and analyzed. The cost of cultivation of each treatment was calculated considering the current local charges of operations and input involved during experimentation. For significant treatment effects, standard error of mean (S.Em ±) and critical differences were calculated at 5 percent level of significance.

3. Result and Discussion

3.1 Growth parameter

The differences in plant height at 30 DAS was non significant though it was maximum (46.1 cm) under highest plant density (14.85 lakh plants ha^{-1}) and lowest (35.5 cm) under 30 x 10 cm spacing (3.33 lakh plants ha^{-1}). Later on at 60 DAS and at harvest taller plants were also recorded under broadcast method followed by 15 x 5 cm, 22.5 x 5 cm and 15 x 10 cm spacing. The smallest plants (103.4 and 110.4 cm) were recorded under 3.33 lakh plants ha^{-1} followed by plant density 4.44 lakh plants ha^{-1} (105.5 and 111.9 cm). It shows that plant height increased with increased plant density. This is because of the crowding of plants in per unit area and owing to that there is less availablity of space for lateral growth, thereby, elongation of internodes takes place which results in taller plants under increased plant density. Significantly higher number of branches (7.7) were found under 30 x 10 cm followed by 22.5 x 10 cm, 30 x 5 cm and 15 x 10 cm, respectively. The values were the lowest under broadcast method (5.5) and narrow spacing 15 x 5 cm (5.8) at 60 DAS. Similarly, number of branches per plant were significantly maximum under 30 x 10 cm (10.5) followed by 22.5 x 10 cm (10.2) and 30 x 5 cm (9.7) at 75 DAS. Number of branches were lower under 15 x 5 cm row spacing and broadcast method of sowing at all the stages. The reduction in branches was 44.8 and 47.6 per cent with 15 x 5 cm spacing and broadcast method, respectively, over 30 x 10 cm. Number of branches decreased with increased plant density.

The spacing 30 x 10 cm produced significantly higher dry matter per plant at all the stages. Further, it was recorded that the dry matter per plant was at par with 22.5 x 10 cm at 30, 60 DAS and at harvest. Almost similar pattern was recorded for CGR. Higher crop growth rate on the basis of plant dry weight 0.19 g day^{-1} $plant^{-1}$ was recorded under 30 x 10 cm spacing which was statistically at par with 22.5 x 10 cm, 30 x 5 cm and 15 x 10 cm spacing at 0-30 DAS. At 30-60 DAS it was significantly higher (0.74 and 0.73 g day^{-1} $plant^{-1}$) under wider spacing of 30 cm and 22.5 cm inter row spacing with 10 cm intra row spacing over rest of the treatments. It was lowest under highest plant density of 15 lakh plants ha^{-1} followed by 13.33 lakh plants ha^{-1} at 0-30 and 30-60 DAS.

3.2 Yield attributes

All the yield attributes were significantly lower in broadcast method and narrow spacing of 15 x 5 cm as compared to wider spacing. Number of capitula 53.6, 52.4, number of seeds $capitulum^{-1}$ 23.1, 22.6 and weight of capitula $plant^{-1}$ 5.1 and 4.9 (g) were recorded in 30 x 10 cm and 22.5 x 10 cm spacing, respectively, which were significantly higher over rest of the treatments. Similarly, seed yield per plant 3.25, 3.12 (g) and 1000 seed weight 3.88, 3.81 (g) were also significantly higher under the spacing of 30 and 22.5 cm inter row spacing x10 cm intra row spacing. This might be due to more availability of space, sunlight and nutrient for individual plants at wider spacing and less competition as compared to narrow spacing and broadcast method of sowing where plant population ranged between 13.33 to 14.85 lakh plants ha^{-1}.

3.3 Yields

The total biomass, seed, stalk and straw yield were significantly influenced by crop geometry (Table 4). Yield is an outcome of plant growth and yield attributes. Genetic constitution, fertilization, and cultivation practices are important factors in order to achieve good yield. Amongst them, plant density is one of the most prominent non monitoring operation which has an effect on plant growth and yield under field conditions. The presented data clearly indicated that niger crop sown at 15 x 5 cm spacing, broadcast method of sowing, 22.5 x 5 cm, 15 x 10 cm spacing gave

significantly higher biological yield (kg ha^{-1}), seed yield (kg ha^{-1}), stalk and straw yield (kg ha^{-1}) over rest of the treatments and the differences were found non significant among themselves. The higher seed yields were obtained under plant density of 13.33 lakh plants ha^{-1} (529 kg ha^{-1}) and broadcast method of sowing (522 kg ha^{-1}) and it was lowest under lowest plant density of 3.33 lakh plants ha^{-1} (395 kg ha^{-1}). The yields obtained under 13.33 lakh plants ha^{-1} and broadcast method were 33.92 and 32.15 per cent, respectively, higher over 3.33 lakh plants ha^{-1} (30 x 10 cm). Under wider spacing i.e. 30 x10 cm and 22.5 x 10 cm values for all three parameters were lower. Almost all of the growth and yield parameters measured in this study were higher under wider spacing of 30 x 10 cm and 22.5 x 10 and seed yield per plant was also higher under wider spacing but it was not enough to compensate the yield on per unit area basis which resulted in lower seed yield.

4.3 Economics of Niger

Data containing cost of cultivation, gross return (₹ ha^{-1}), net returns (₹ha^{-1}) and B.C. ratio presented in table 4. Maximum total cost (₹ 16101 ha^{-1}) was involved in all the line sowing treatments (T_1 to T_6) which was higher as compare to broadcast method of sowing (₹ 12601 ha^{-1}). Higher cost incurred in line sowing treatments was mainly due to sowing cost ₹2000 ha^{-1} and thinning for obtaining desired plant density Rs 1800 ha^{-1}, however, in broadcast method of sowing only ₹300 ha^{-1} was incurred and no cost involved for thinning. Thus, additional cost ₹ 3500 ha^{-1} was involved in all the line sown treatments. Maximum gross returns (₹42345 ha^{-1}) obtained in 15 x 5 cm spacing followed by broadcast method (₹41845 ha^{-1}). This might be due to marginal increased in yields. Significantly maximum net returns (₹29244 ha^{-1}) were realized from broadcast method of sowing (14.85 lakh plants ha^{-1}) and gave an additional income of ₹3000 ha^{-1} over next best treatment 15 x 5cm spacing (13.33 lakh plants ha^{-1}). Economic efficiency (308 ₹ha^{-1} day^{-1}) and net returns per rupee invested (2.3) were also maximum in broadcast system followed by line sowing at 15 x 5cm spacing mainly owing to higher yields in both the treatments and lower cost of cultivation in broadcast method of sowing.

Table 1: Effect of different crop geometry on growth character of Niger.

Treatments spacing (cm)/Plant Density (lakh ha^{-1})	Plant height (cm)	No. of branches plant^{-1}		Dry matter accumulation (g plant^{-1})			Crop growth rate (g day^{-1} plant^{-1})	
	At Harvest	60 DAS	At harvest	30 DAS	60 DAS	At harvest	0-30 DAS	30-60 DAS
15 x 5 /13.33	119	5.8	8.7	2.6	21.8	22.3	0.08	0.66
15 x 10 /6.67	116.7	6.4	9.2	3.8	25.2	26.2	0.13	0.71
22.5 x 10 / 4.44	111.3	7.3	10.2	5.33	27.2	31.1	0.18	0.73
22.5 x 5 / 8.88	118.3	6.1	9	3.1	23.3	24.7	0.10	0.67
30 x 5 / 6.66	114.5	6.7	9.7	4.4	26.1	28.8	0.15	0.72
30 x 10 /3.33	110.4	7.7	10.5	5.7	28	32	0.19	0.74
Broadcast: 14.85	120.1	5.5	8.3	1.8	20.2	21.7	0.06	0.59
S.Em. ±	0.5	0.08	0.11	0.15	0.29	0.91	0.02	0.09
C.D. (P=0.05)	1.53	0.26	0.34	0.46	0.89	2.79	0.06	-

Table 2: Effect of different crop geometry on yield attributes of niger.

Treatments Spacing (cm)/Plant Density (lakh ha^{-1})	Number of capitula plant^{-1}	Number of seeds capitulum^{-1}	capitula weight plant^{-1} (g)	seed yield plant^{-1}(g)	1000 seed weight(g)
15 x 5 / 13.33	46.3	17.4	3.9	2.68	3.42
15 x 10 / 6.67	49.4	21.3	4.2	2.8	3.67
22.5 x 10 /4.44	52.4	22.6	4.9	3.12	3.81
22.5 x 5 / 8.88	48.2	19.5	4.1	2.73	3.52
30 x 5 / 6.66	51.1	22.0	4.4	3.10	3.73
30 x 10 / 3.33	53.6	23.1	5.1	3.25	3.88
Broadcast: 14.85	44.2	15.1	3.8	2.54	3.35
S.Em. ±	0.29	0.76	0.02	0.03	0.03
C.D. (P=0.05)	0.91	2.34	0.05	0.09	0.1

Table 3: Effect of different crop geometry on yields of Niger

Treatments Spacing (cm)/Plant Density (lakh ha^{-1})	Total biological yield (Kg ha^{-1})	Stalk yield (Kg ha^{-1})	Seed yield (Kg ha^{-1})	Harvest index (%)
15 x 5 / 13.33	2424	1895	529	21.8
15 x 10 / 6.67	2344	1847	496	21.2
22.5 x 10 / 4.44	2163	1732	431	19.9
22.5 x 5 / 8.88	2389	1879	510	21.3
30 x 5 / 6.66	2183	1727	456	20.9
30 x 10 / 3.33	2056	1661	395	19.2
Broadcast: 14.85	2412	1890	522	21.6
S.Em. ±	2.58	1.86	2.04	0.09
C.D. (P=0.05)	7.95	5.73	6.3	0.28

Table 4: Effect of different crop geometry on economics of niger.

Treatments Spacing (cm)/Plant Density (lakh ha^{-1})	Cost of cultivation (₹ ha^{-1})	Gross income (₹ ha^{-1})	Net income (Rs ha-^{1})	B:C Ratio (%)	Economic efficiency (₹ ha^{-1} day^{-1})
15 X 5 /13.33	16101	42345	26244	1.6	276
15 X 10 / 6.67	16101	39914	23813	1.5	251
22.5 X 10 /4.44	16101	35064	18963	1.2	200
22.5 X 5/8.88	16101	40980	24879	1.5	262
30 X 5 /6.66	16101	36782	20681	1.3	218
30 X 10 / 3.33	16101	32357	16256	1	171
broadcasted: 14.85	12601	41845	29244	2.3	308
S.Em. ±	_	143.81	143.89	0.01	_
C.D. (P=0.05)	_	443.13	443.37	0.04	_

Conclusion

According to the one year finding significantly maximum net returns (₹ 29244 ha^{-1}) were realized from broadcast method of sowing (14.85 lakh plants ha^{-1}) which gave an additional income of Rs 3000 ha^{-1} over next best treatment 15 x 5 cm spacing (13.33 lakh plants ha^{-1}). Economic efficiency (308 Rs ha^{-1} day^{-1}) and net returns per rupee invested (2.3) were also maximum in broadcast system followed by line sowing at 15 x 5 cm spacing mainly owing to higher yields in both the treatments and lower cost of cultivation in broadcast method of sowing.

References

1. Anonymous. Department of Agriculture, Cooperation and Farmers Welfare Ministry of Agriculture & Farmers Welfare Government of India. 2019-20a.
2. Anonymous. Agriculture Development and Farmer Welfare and Bio-Technology Department. 2019-20b.
3. Khare AK, Rao S. Effect of varying plant densities on yield and yield components in niger.Journal of oilseeds Res. 1985;2:299-302.
4. Sharma RS, Kewat ML. Effect of sowing date and fertilizer on yield attributes and seed yield of niger (*Guizotia abyssinica*) under rainfed condition. Indian J. Agron. 1994;39(1):148-150.
5. Tomar GS, Taunk SK, Choudhary JL. Science of crop production.1st edition., Kushal Publications and Distributors. Varanasi, 2011, 369-378.
6. Trivedi SJ, Ahlawat RPS. Effect of nitrogen and phosphorus on growth and yield of Niger (*Guizotia abyssinica*). Indian J. Agron. 1991;36(3):432-33.