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Response of varieties on different sowing dates on growth and yield of chickpea (*Cicer arietinum* L.)

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Abstract

Chickpea (*Cicer arietinum* L.) a legume popularly known as “Gram” or “Bengal gram” plays an important role in Indian economy. It belongs to family *Leguminosae* being a rich and cheap source of protein, can help people to improve the nutritional quality of their diet. A field experiment was conducted during Rabi 2023-2024 at the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). Entitled on “Response of varieties on different sowing dates on growth and yield of chickpea”, experiment was laid out in Randomized Block Design and there were 9 treatments each being replicated thrice. To study treatments consisting of three varieties viz. JG-11, NBeG-47, NBeG-49 and Sowing Dates viz. 25th October, 5th November, 15th November. The results revealed that significant and higher plant height (56.65 cm), Maximum No. of branches/plant (8.07), Maximum No. of Nodules/plant (13.13), higher plant dry weight (44.14 g), higher number of pods/plant (38.53), test weight (25.23g) higher seed yield (1.79 kg/ha), higher stover yield (3.63 kg/ha), maximum gross returns (1,26,539.00 INR/ha), maximum net returns (87091.00 INR/ha) and maximum B:C ratio (2.21) was recorded in treatment-1 [V₁- JG-11 + 25th October]. It is concluded that, the different combinations of V₁-JG-11 along with sowing date at 25th October in treatment-1 has performed better in growth parameters and yield of chickpea, which also was proven economically profitable.

Keywords: Varieties, sowing dates, JG-11, growth, yield, economics, chick pea

Introduction

Chickpea (*Cicer arietinum* L.) a legume popularly known as “Gram” or “Bengal gram” plays an important role in Indian economy. It belongs to family *Leguminosae* being a rich and cheap source of protein, can help people to improve the nutritional quality of their diet. Globally, the acreage of Chickpea is 11.15 M/ha, production is 9.2 Mt and productivity is 826 kg/ha. (FAO,2009). India is contributing highest share in area (65.3%) and production (67.2%) in the world (FAO, 2009). India is the largest acreage holder and producer of chick pea in the world. In India, it covers 10.56 million hectares cultivated area and 11.23 million tonnes an annual production with productivity of 1063 kg/ha in 2017-18 (GOI, 2018). In Rajasthan, it covers 15.97 lakh hectares area and produced 18.67 lakh tonnes with the productivity 1169 kg/ha in 2018-19 (GOR 2019).

Chickpea is a cheap and important source of protein for those people who cannot afford animal protein or who are largely vegetarian. Furthermore, chickpea is also a good source of minerals (calcium, phosphorus, magnesium, zinc and iron), unsaturated fatty acids, fibre and β -carotene). Chickpea also plays an important role in maintaining soil fertility by fixing nitrogen at rates of up to 140 kg/ha/year (Flowers *et al.*, 2010) [3].

Sowing time had a marked effect on yield and quality of chickpea. Optimum sowing time provides more time for growth and development of plant which is favourable for higher yield whereas both early and late sowing hinder the growth and development with lowest yield potential. The early sown crop grows luxuriantly followed by less number of pods and seeds production thus limits yield. Late sowing also results in lower yield, the growth is hampered and the seed development period is shortened. To reduce the yield losses of chickpea, seeds should be sown as early as possible, but sometimes delayed sowing may help to escape from diseases and unfavourable planting condition.

So, proper sowing time, a non-monetary input can help to get a higher yield of chickpea.

JG-11 a drought tolerant Bengal gram variety was introduced in Karnataka during Rabi 2005-06. It had shown 14 percent increase in yield over the local Annigeri variety as per the information from officer of Joint Director of Agriculture, Yadgir. Farmers received fair price by cultivating JG-11 variety because of bold size. Even in drought condition the performance of JG-11 was good as expressed by the farmers compared to Annigeri variety. JG-11 had given yield of 15-20 q/ha this has very much attracted other farmers also and under irrigation just by two irrigations the yield can be increased upto 25%. Also, JG-11 is tolerant to wilt and drought. It comes to maturity one week earlier than Annigeri. Department of Agriculture has distributed JG11 seeds to around 200 farmers of in Yadgir district the reaction of these farmers could be analyzed with respect to performance.

Materials and Methods

A field experiment was conducted during *Rabi 2023-2024* at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36%), high in available N (171.48 kg/ha), high in available P (15.2 kg/ha) and high in available K (156.44 kg/ha). The treatments consisting of three levels of varieties JG-11, NBeG-47, NBeG-49 and Sowing Dates *viz.* 25th October, 5th November, 15th November. There were 9 treatments each being replicated thrice and laid out in Randomized Block Design. The treatment combinations T₁- V₁- JG-11 + 25th October, T₂ - V₁- JG- 11 + 5th November, T₃- V₁- JG-11 + 15th November, T₄- V₂ - NBeG-47 + 25th October, T₅- V₂ - NBeG-47 + 5th November, T₆- V₂ - NBeG-47 + 15th November, T₇- V₃ - NBeG-49 + 25th October, T₈- V₃ - NBeG-49 + 5th November, T₉- V₃ - NBeG-49 + 15th November. The growth parameters and yield, production was recorded at harvest from randomly selected plants in each plot. The data was computed and analysed by following statistical method of Gomez and Gomez (1984)^[5].

Result and Discussion

Response of varieties and different sowing dates on growth attributes

In the present investigation, observations of plant height, number of branches, number of nodules, plant dry weight were recorded during experiment. These attributes showed an increasing trend with increase in crop age and maximum was obtained at 100 DAS with application of sowing of JG-11 variety on 25th October. Following observations have been recorded and summed up in Table 1.

Plant height was increase with crop age and highest was observed at 100 DAS. In the present investigation significantly higher plant height (56.65 cm) was recorded in the treatment with T₁ in JG-11 variety with date of sowing at 25th October at 100 DAS which was found to be significant. However, the T₇ in NBeG-49 variety with date of sowing at 25th October, was found to be statistically at par with T₁ in JG-11 variety with date of sowing at 25th October. Significant and higher plant height was observed with the sowing of JG-11 variety on 25th October might be due to coincidence of favorable weather conditions, such as temperature, light, soil moisture and humidity during active crop growth stage resulted in luxurious growth. The reduction in plant growth with late sowing compared to early sowing was due to less favorable conditions as noticed by Reddy *et al.*, 2007. JG- 11 recorded the significantly higher in plant

height compared to other varieties Nandyal Gram-47 and Nandyal Gram-49. Variation in plant height among varieties might be genetic character. Plant height was significantly influenced by dates of sowing and interaction between varieties and dates of sowing reported by Neenu *et al.* 2014^[9].

Number of branches/plant was increase with crop age and highest was observed at 100 DAS. In the present investigation significantly maximum number of branches/plant (8.07) was recorded in the treatment with T₁ in JG-11 variety with date of sowing at 25th October, which was found to be significant. However, the T₄ in NBeG-47 variety with date of sowing at 25th October, was found to be statistically at par with T₁ in JG-11 variety with date of sowing at 25th October. Significant and higher number of branches was observed with the sowing of JG-11 variety on 25th October might be due to the favorable climatic condition available to the crop when sown on 25th October which accelerated vegetative growth in terms of taller plants and more number of secondary branches per plant also contributed towards remarkable increase in number of brances per plant. The results are closely related with the findings of Alam *et al.* 2015^[1]. JG-11 variety might be due to increase in the number of branches and leaves which worked as an efficient photosynthesis structure and produced high amount of carbohydrates in the plant system. Which resulted in more number of branches/plant in JG-11 variety of chickpea as reported by Mashke and Chaturvedi, 2021^[7].

Number of nodules/plant was increase with crop age and highest was observed at 100 DAS. In the present investigation significantly maximum number of branches/plant (13.13) was recorded in the treatment with T₁ in JG-11 variety with date of sowing at 25th October, which was found to be significant. However, the T₄ in NBeG-47 variety with date of sowing at 25th October, was found to be statistically at par with T₁ in JG-11 variety with date of sowing at 25th October. Significant and higher number of nodules was observed with the sowing of JG-11 variety on 25th October might be due to planting different chickpea varieties on different sowing dates affected the crop, the maximum number of nodules per plant can be attributed to amount of nodules is significantly influenced by the sowing dates. The results are reported by Sah *et al.* 2019. At all the growth stage, variety JG- 11 produced significantly maximum number of nodules over the remaining varieties. The differences among the varieties with respect to branches formation may be owing to inheritance of genetic divergence of the varieties. Further, the differential behaviour among the varieties could be explained by the variation in their genetic makeup and their differential behavior under different climatic conditions. Similar findings were reported by Mhaske and Chaturvedi 2021^[7].

Plant dry weight (g) was increase with crop age and highest was observed at 100 DAS. In the present investigation significantly the maximum dry matter accumulation (44.14 g) was recorded with treatment with T₁ in JG-11 variety with date of sowing at 25th October, which was found to be significant. However, the T₄ in NBeG-47 variety with date of sowing at 25th October, was found to be statistically at par with T₁ in JG-11 variety with date of sowing at 25th October. This may be due to favorable environmental conditions like temperature, rainfall, sunshine period etc., conducive for growth and development of the crop. Late sown crop could not accumulate sufficient dry matter because of lesser vegetative and reproductive period. Timely sown crop accumulated more photo synthates. The results are reported by Rao *et al.* 2018. JG-11 variety significantly higher in plant dry weight might be due to increase in the plant height, number of leaves and number of branches/plant which worked

as an efficient photosynthesis structure and produced high amount of carbohydrates in the plant system. More number of branches, leaves and root length which borne more number of flowers, which resulted increased in plant dry weight of crop. Similar results were reported by Mashke and Chaturvedi, 2021 [7].

Response of different sowing dates and varieties on yield parameter

In the present investigation, number of pods/plant/m² were counted, seed index, grain yield and stover yield were recorded post-harvest. Treatment T₁, where T₁ (sowing of JG-11 variety on 25th October) application was found to be promising amongst all other treatments and results are put in Table 2.

Number of pods/plant the data observed that, significantly the maximum number of pods/plant (38.53) was recorded with treatment with T₁ in JG-11 variety with date of sowing at 25th October, which was found to be significant. However, the treatments T₄ in NBeG-47 variety with date of sowing at 25th October, was found to be statistically at par with T₁ in JG-11 variety with date of sowing at 25th October. This might be attributed to favourable weather condition for plant growth and development while crop sown at October 25th, which reflected into more number of pod/plant and number of seed/pod. Variation in sowing time beyond optimum was found to decrease the number of pods/plant and it was also reported by Tiwari and Meena 2012.

Seed Index the data revealed that, significantly higher seed index (25.23 cm) was recorded in the treatment with T₁ in JG-11 variety with date of sowing at 25th October, which was found to be significant. However, the T₄ in NBeG-47 variety with date of sowing at 25th October, was found to be statistically at par with T₁ in JG-11 variety with date of sowing at 25th October. Significantly higher seed index was observed in sowing of JG-11 variety on 25th October might be due to favourable climatic conditions temperature, rainfall, sunshine period etc, each delayed sowings recorded significantly lower 100 seed weight which indicated better seed development in earlier sowings. The similar results were reported by Thombre *et al.* 2019 [16]. The variety JG-11 recorded the highest seed index compared to other varieties. This might be due to optimum moisture availability during the grain filling stage at these sowing times.

Seed yield (t/ha) the data revealed that, Significantly Maximum seed yield (1.79 t/ha) was recorded with the T₁ in JG-11 variety with date of sowing at 25th October, which was found to be significant. However, the T₄ in NBeG-47 variety with date of sowing at 25th October, was found to be statistically at par with T₁ in JG-11 variety with date of sowing at 25th October. The

increase in the number of pods per plant and seeds per pod may be caused by the soil having enough nutrients during pod formation and pod filling to produce productive pods and seeds in plants. Significantly and statistically, seed yield (t/ha) rises. The varieties used and the different sowing times have a significant impact on the seed yield (t/ha) which is observed to vary significantly. The similar results were reported by Thombre *et al.* 2019 [16]. Significantly sowing of JG-11 variety on 25th October expressed that the characteristics; bold grains, higher flowering and seed setting, resistance to wilt, comes up well in dry land and high yielding capacity as positive ones. By cultivating JG-11 variety because of bold size of grains which results in higher yield. Even in drought condition the performance of JG-11 was good as expressed. Similar results were reported by Moulasab *et al.*, 2019 [8].

Stover yield (t/ha) the data revealed that, Significantly Maximum stover yield (3.63 t/ha) was recorded with the T₁ in JG-11 variety with date of sowing at 25th October, which was found to be significant. However, the treatments T₇ in NBeG-49 variety with date of sowing at 25th October, was found to be statistically at par with T₁ in JG-11 variety with date of sowing at 25th October. The drastic increase in stover yield might also be due to the fact that sowing on 25th October enjoyed higher amount of moisture and nutrients as well as higher total leaf area per plant which intercepted more sunlight and improvement in the rate of photosynthesis resulted in production of more photosynthates and better translocation of photosynthates from source to sink lead to remarkable increase in stover yield. Similar results were reported by Singh *et al.* 2017 [14]. In JG-11 variety, the plants were shorter in stature but the plant density, root length, number of branches per plant and number of pod per plant were higher. Hence, it recorded the highest stover yield compared to other varieties. The varieties showing drought tolerance recorded higher stover yield due to the production of more number of branches and pods per plant, maximum filling of pods and production of bold seeds. Similar results were reported by Sangeetha *et al.* 2020 [13].

Response of different sowing dates and varieties on Economics

In the present investigation made, Gross return, Net return and benefit cost ratio of different treatments are depicted in (Table 3). Integration of sowing dates and varieties the decreasing cost of cultivation. Higher grain yield and straw yield in T₁ (sowing of JG-11 variety on 25th October) resulted in higher gross returns (1,26,539.00 INR/ha), net returns (87091.00 INR/ha) and B:C ratio (2.21) (Table 3).

Table 1: Response of varieties on different sowing dates on growth attributes of chickpea

S. No.	Treatment combinations	AT 100 DAS				During 80-100 DAS	
		Plant Height (cm)	Number of Branches/plant	Number of Nodules/plant	Dry Weight (gm/plant)	Crop Growth Rate (g/m ² /day)	Relative Growth Rate (g/g/day)
1	V ₁ - JG-11 + 25 th October	56.65	8.07	13.13	44.14	10.49	0.0250
2	V ₁ - JG-11 + 5 th November	54.64	7.60	11.67	41.52	10.67	0.0126
3	V ₁ - JG-11 + 15 th November	49.77	6.73	10.07	38.17	12.29	0.0157
4	V ₂ - NBeG-47 + 25 th October	55.43	7.93	12.40	43.40	10.93	0.0165
5	V ₂ - NBeG-47 + 5 th November	52.47	7.47	10.93	40.63	12.08	0.0151
6	V ₂ - NBeG-47 + 15 th November	50.38	6.87	9.87	37.47	11.66	0.0161
7	V ₃ - NBeG-49 + 25 th October	55.72	7.80	12.20	43.16	10.86	0.0150
8	V ₃ - NBeG-49 + 5 th November	53.54	6.93	9.93	39.04	10.09	0.0124
9	V ₃ - NBeG-49 + 15 th November	49.72	6.60	9.13	35.74	9.55	0.0145
	F- test	S	S	S	S	NS	NS
	SEm(±)	0.67	0.22	0.34	0.44	0.79	0.001
	CD (p=0.05)	2.03	0.67	1.02	1.34	-	---

Table 2: Response of varieties on different sowing dates on yield attributes and yield of chickpea

Post-harvest							
S. No.	Treatments	Number of Pods/plant	Number of Seeds/pod	Seed Index (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1	V ₁ -JG-11 + 25 th October	38.53	1.43	25.23	1.79	3.63	33.70
2	V ₁ -JG-11 + 5 th November	34.20	1.27	23.70	1.59	3.07	34.19
3	V ₁ -JG-11 + 15 th November	32.17	1.13	22.37	1.48	2.76	33.99
4	V ₂ -NBeG-47 + 25 th October	36.60	1.33	24.87	1.70	3.21	34.27
5	V ₂ -NBeG-47 + 5 th November	33.40	1.20	21.60	1.45	2.93	33.15
6	V ₂ -NBeG-47 + 15 th November	32.73	1.00	21.50	1.31	2.57	32.49
7	V ₃ -NBeG-49 + 25 th October	35.80	1.30	22.70	1.68	3.26	33.48
8	V ₃ -NBeG-49 + 5 th November	33.37	1.07	22.63	1.46	2.82	33.21
9	V ₃ -NBeG-49 + 15 th November	30.93	1.00	20.53	1.33	2.61	32.92
	F – Test	S	NS	S	S	S	NS
	SEm±	1.11	0.75	0.94	0.04	0.14	0.49
	CD (p=0.05)	3.34	--	2.80	0.14	0.43	--

Table 3: Response of varieties on different sowing dates on economics of chickpea

S. No.	Treatments	Cost of Cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	Benefit: Cost Ratio (B:C)
1.	V ₁ - JG-11 + 25 th October	39448	1,26,539.00	87091.00	2.21
2.	V ₁ -JG-11+ 5 th November	39448	1,11,169.00	71721.10	1.82
3.	V ₁ -JG-11 + 15 th November	39448	1,03,521.00	64072.90	1.62
4.	V ₂ -NBeG-47 + 25 th October	38398	1,18,806.10	80408.10	2.09
5.	V ₂ -NBeG-47 + 5 th November	38398	1,01,633.00	63235.00	1.65
6.	V ₂ -NBeG-47 + 15 th November	38398	91,457.10	53059.10	1.38
7.	V ₃ -NBeG-49 + 25 th October	38048	1,17,341.00	79293.00	2.08
8.	V ₃ -NBeG-49 + 5 th November	38048	1,02,174.10	64126.10	1.69
9.	V ₃ -NBeG-49 + 15 th November	38048	92,794.00	54746.10	1.44

Conclusion

Based on the conducted experimental trial, it is deduced that different sowing dates and varieties plays a crucial role in growth and development of the crop. The early sowing provides favorable environmental conditions like temperature, rainfall, sunshine period etc. and late sown crop could not accumulate sufficient crop growth rate because of lesser vegetative and reproductive period. Notably, sowing of JG- 11 variety on 25th October, which is enhance higher yields are produced by using suitable varieties and sowing at the right time. These elements aid in making use of resources like nutrient- and moisture-rich soil left overs. Thus, sowing of JG-11 variety on 25th October gives a better response in terms of growth, yield and cost benefits as compared to all other treatments.

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