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A PERFORMANCE OF CHICKPEA VARIETIES TO DIFFERENT INTER AND INTRA ROW SPACINGS IN RAINFED VERTISOLS

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ABSTRACT

A field experiment was conducted to study the performance of chickpea varieties to different inter and intra row spacings at Agricultural College Farm, Bapatla during *rabi* season, 2023-24. The experimental soil had neutral pH, normal in EC, low in OC and in available N, medium in available P_2O_5, high in available K_2O and sandy clay in texture. The experiment was laid out in split plot design with three main plots (Spacing) and four sub plots (Varieties) that were allocated randomly and replicated thrice. The main plot treatments were Spacings *i.e.,* 30 cm x 10 cm, 22.5 cm x 10 cm and 22.5 cm x 7.5 cm. The sub plot treatments were varieties of desi chickpea, which include JG-11, NBeG-452, NBeG-776 and NBeG-857. The package of practices was followed as per the recommendations. The results of the experiment revealed that, chickpea variety NBeG-857 recorded higher dry matter, seed yield, haulm yield, gross returns, net returns and B:C ratio, while NBeG-776 variety recorded higher plant height. Among the spacings investigated, M_2- 22.5 cm x 10 cm spacing recorded higher dry matter, seed yield, gross returns, net returns and B:C ratio, whereas M_3- 22.5 cm x 7.5 cm had taller plants and higher haulm yield.
Keywords **:** Spacing, chickpea, dry matter, inter and intra row.

Introduction

Pulses are the most important food crops that are known for their high protein content. They play a crucial role in the Indian diet, providing essential protein to complement a carbohydrate-rich food. Chickpea, also known as Bengalgram or Chana, is the major *rabi* pulse crop grown in India. Pulses are incredibly nutrient-dense, offering a dietary fiber, protein and essential nutrients such as potassium, folate and iron, as well as various bioactive compounds (Siddiq *et al*., 2022). Chickpea is a significant contributor to agricultural sustainability through nitrogen fixation and as a rotation crop allowing the diversification of agricultural production systems. Moreover, chickpea is well adapted to environmental stresses such as drought, high temperatures and other abiotic stresses. Therefore, chickpea is considered as an important food security crop for small land holding and resource-poor farmers in the semi-arid tropics. Chickpea productivity tends to be relatively low due to the use of local or low-yielding varieties, pest and disease infestations and poor agronomic practices like improper plant density, sowing windows and inadequate drainage systems. In chickpea, farmers are using heavy seed rate up to 125 kg ha^{-1}, which adversely affect the crop yield due to a greater number of plants unit $area^{-1}$ (Rani *et al*., 2022). In Andhra Pradesh, farmers believe that increased seed rates can result in higher yields as it can compensate for seedling mortality. But this will escalate the total cost of cultivation. A crop's ability for growth and yield in a given agro-climate is determined by the variety adopted. Based on their inherent capacity as well as the growing climate and soil situations, different chickpea cultivars may have varying production potentials.

Materials and Methods

The experiment was conducted at Agricultural College Farm, Bapatla, Acharya N. G. Ranga Agricultural University during *rabi*, 2023-24. The experimental site is situated at an altitude of 5.49 meters above mean sea level (MSL), 15^0 54' North latitude, 80^0 25' East longitude and about 8 km away from the Bay of Bengal in the Krishna Agro Climatic Zone of Andhra Pradesh, India. The experimental soil was sandy clay in texture, neutral in reaction, non-saline, low in organic carbon content (0.36 %), low in available nitrogen (216 kg ha^{-1}), medium in available phosphorous (54.3 kg ha^{-1}) and higher in available potassium (330 kg ha^{-1}). The experiment was laid out in split-plot design with three main plots, four sub plots replicated three times. The main plots include three different spacings (M_1- 30 cm x 10 cm, M_2- 22.5 cm x 10 cm and M_3- 22.5 cm x 7.5 cm) and sub plots includes four desi chickpea varieties (V_1- Jawahar gram 11 (JG-11), V_2- Nandyal gram 452 (NBeG-452), V_3- Nandyal gram 776 (NBeG-776) and V_4- Nandyal gram 857 (NBeG 857).

The Recommended Dose of Fertilizer was 20 kg N and 50 kg P_2O_5 ha^{-1}. Nitrogen and phosphorus were applied as basal through urea and Single Super Phosphate (SSP) respectively. Seeds were sown on well-prepared seed bed with proper care and management. Irrigation was given after sowing. The pre-emergence herbicide *i.e.,* Pendimethalin 38.7 % CS (Stomp xtra), was sprayed on the soil surface on the next day after sowing and hand weeding was done at 30 DAS to maintain weed free condition.

Growth parameters were recorded at harvest. Plant height was measured from the measured from ground level up to the growing tip at harvest and mean height was presented as centi meter. For dry matter accumulation in each treatment, one m^2 area was demarcated in the net plot with small pegs. The above ground portion of the plant was collected and dried in hot air oven at 65°C till the constant weight was obtained and were weighed separately, then converted to kg ha^{-1}. Plants in the net plot area were harvested separately in each plot threshed and seeds were separated, dried under sun and the seed yield per plot was recorded after cleaning. After threshing the seed, the remaining haulm was dried under sun and the yield per hectare was computed.

By using all the inputs, total cost of cultivation was calculated for each treatment. Based on prevailing market price of the output, gross returns were calculated. The net returns from each treatment were calculated by deducting the cost of cultivation worked out based on the prevailing costs of inputs incurred and labour wages from gross returns. The Benefit: Cost Ratio (BCR) for all the treatments was worked out on the basis of net returns in terms of rupees after deducting the cost of cultivation from gross returns. The data obtained on the different parameters were analyzed statistically by the method of analysis of variance as per the procedure outlined for split plot design given by Gomez and Gomez (1984). Statistical significance was tested by F value at 0.05 level of probability and critical difference was worked out where ever the effects were significant.

Results and Discussion

Effect of different spacings on plant height of chickpea varieties

At harvest, the highest plant height of chickpea was observed under the spacing of M_3- 22.5 cm x 7.5 cm (57.8 cm) which was on par with M_2- 22.5 cm x 10 cm (54.0 cm). The lowest plant height was noticed with spacing of M_1-30 cm x 10 cm (51.6 cm). Chickpea variety V_3- NBeG-776 (59.3 cm) has retained its superiority in attaining taller plant, which was found to be significantly superior to the rest of the varieties under investigation. The increase in plant height with narrow inter and intra row spacing might be due to the mutual shading at closer spacing have increased the height of the plants in order to intercept more solar radiation and thereby the stem elongated because of inter plant competition for light. Similar results have also been reported by Kumar *et al*. (2017) and Patel (2020). The increase in height of a variety might be due to its genetic character, soil and climatic conditions as reported by Gallani *et al*. (2005), Ozalkhan *et al*. (2010) and Shamsi (2010).

Effect of different spacings on dry matter production of chickpea varieties

Among the spacings, at harvest M_2- 22.5 cm x 10 cm (5120 kg ha^{-1}) was recorded with highest dry matter accumulation which is significantly superior to M_1- 30 cm x 10 cm (4268 kg ha^{-1}) and found statistically on par with M_3- 22.5 cm x 7.5 cm (4866 kg ha^{-1}). At harvest, among the varieties tested significantly the highest dry matter accumulation was recorded in V_4- NBeG-857 (5141 kg ha^{-1}) which is statistically on par with V_2- NBeG-452 (4874 kg ha^{-1}) and lower accumulation of dry matter was observed in V_1- JG-11 (4379 kg ha^{-1}). The more dry matter accumulation with M_2 - 22.5 cm x 10 cm might be due to better utilization of resources like moisture, nutrients and sunlight by an individual plant as optimum space was available for its development thereby translocation and accumulation of more photosynthates from source to sink. Similar result

was reported by Biswas *et al*. (2002) and Sathyamoorthi *et al*. (2008).

Effect of different spacings on seed index of chickpea varieties

The seed index of chickpea was not influenced significantly with spacings, varieties or with their interaction.

Effect of different spacings on seed yield and haulm yield of chickpea varieties

Seed yield

In chickpea among the spacings tested, M_2- 22.5 cm x 10 cm resulted in significantly higher seed yield (1863 kg ha^{-1}) followed by M_1- 30 cm x 10 cm (1579 kg ha^{-1}). Significantly the lowest seed yield was recorded in M_3- 22.5 cm x 7.5 cm (1557 kg ha^{-1}) spacing. Among the varieties, significantly higher seed yield was recorded with V_4- NBeG-857 (1849 kg ha^{-1}). Seed yield was recorded to be the lowest in V_1- JG-11 (1447 kg ha^{-1}) variety of chickpea. It might be due optimum plant population unit area^{-1} in dense crop geometry thereby utilizing all the resources efficiently and put forth higher yield. Similar results were observed by Munirathnam *et al.* (2015) and Nawange *et al*. (2018).

Haulm Yield

Among the different spacings, higher haulm yield was recorded with M_3- 22.5 cm x 7.5 cm (2981 kg ha^{-1}) which was statistically similar with M_2- 22.5 cm x 10 cm (2792 kg ha^{-1}) and significantly superior over M_1- 30 cm x 10 cm (2339 kg ha^{-1}). V_4- NBeG-857 variety of chickpea recorded higher haulm yield (2908 kg ha^{-1}) which was at par with V_2- NBeG-452 (2728 kg ha^{-1}) and V_3- NBeG-776 (2662 kg ha^{-1}). It might be due to the fact that closer crop spacing had the significantly more plant population unit area^{-1} and resulted in higher haulm yield over wider crop spacing. Similar results have also been reported by Shamsi (2010) and Chala *et al*. (2020).

Effect of different spacings on gross returns, net returns and Benefit- cost ratio of chickpea varieties

Gross Returns

Among different spacings under investigation, higher gross returns were obtained with M_2- 22.5 cm x 10 cm spacing (102909 Rs. ha^{-1}) which was found to be significantly superior over M_1- 30 cm x 10 cm (87191 Rs. ha^{-1}) and the lowest was recorded with M_3- 22.5 cm x 7.5 cm (86363 Rs. ha^{-1}). Among the desi chickpea varieties, V_4- NBeG-857 (102201 Rs. ha^{-1}) recorded significantly higher gross returns which was followed by V_2- NBeG-452 (94224 Rs. ha^{-1}) and the lowest was recorded with V_1- JG-11 (80093 Rs. ha^{-1}) variety in rainfed vertisols.

Net Returns

Significantly, higher net returns were recorded with M_2- 22.5 cm x 10 cm (56680 Rs. ha^{-1}) over the other spacings tested. Among the varieties under investigation, V_4- NBeG-857 (55719 Rs. ha^{-1}) recorded significantly higher net returns over V_2- NBeG-452, V_3- NBeG-776 and V_1- JG-11.

B: C Ratio

Among the spacings investigated of rainfed vertisols in chickpea, the higher B:C Ratio was noticed with M_2- 22.5 cm x 10 cm (1.23) which was statistically on par with M_1-30 cm x 10 cm (1.02) while, the lowest B:C ratio was observed in M_3-22.5 cm x 7.5 cm (0.72). V_4- NBeG-857 variety (1.21) of chickpea recorded significantly higher B:C ratio over V_2- NBeG-452, V_3- NBeG-776 while the lowest B:C was recorded with V_1- JG-11 (0.73) variety.

Conclusion

Chickpea grown with a spacing of 22.5 cm x 10 cm showed better performance and recorded higher yield and economics over 30 cm x 10 cm and 22.5 cm x 7.5 cm spacings. Among the desi chickpea varieties tested, NBeG-857 recorded higher growth parameters, yield and economics in rainfed vertisols.

Table 1: Plant height, dry matter accumulation, seed index, seed yield and haulm yield of chickpea varieties as influenced by different spacings.

Treatments	Plant height at harvest (cm)	Dry matter accumulation at harvest (kg ha^{-1})	Seed index (g)	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
Spacing					
M_1- 30 cm x 10 cm	51.6	4268	23.3	1579	2339
M_2- 22.5 cm x 10 cm	54.0	5120	22.8	1863	2792
M_3- 22.5 cm x 7.5 cm	57.8	4866	21.2	1557	2981
SEm±	1.2	163.9	0.4	52.0	82.0
CD (P = 0.05)	4.6	643	NS	204	322
CV (%)	7.4	11.9	6.6	10.8	10.5

Varieties					
V_1- JG-11	51.4	4379	21.9	1447	2518
V_2- NBeG-452	53.0	4874	22.8	1704	2728
V_3- NBeG-776	59.3	4611	22.0	1666	2662
V_4- NBeG-857	54.1	5141	22.9	1849	2908
SEm±	1.3	152.4	0.5	42.7	88.4
CD (*P*= 0.05)	3.8	453	NS	127	263
CV (%)	7.0	9.6	7.0	7.7	9.8
Interaction					
SEm±	2.2	263.9	0.9	73.9	153.2
CD at 5% M × V	NS	NS	NS	NS	NS
CD at 5% V× M	NS	NS	NS	NS	NS

Table 2: Economics of chickpea varieties as influenced by different spacings

Treatments	**Gross returns (Rs. ha^{-1})**	**Net returns (Rs. ha^{-1})**	**B:C ratio**
Spacing			
M_1- 30 cm x 10 cm	87191	44062	1.02
M_2- 22.5 cm x 10 cm	102909	56680	1.23
M_3- 22.5 cm x 7.5 cm	86363	36274	0.72
SEm±	2868.1	2868.1	0.07
CD (p = 0.05)	11262	11262	0.26
CV (%)	10.8	21.8	23.07
Varieties			
V_1- JG-11	80093	33610	0.73
V_2- NBeG-452	94224	47742	1.04
V_3- NBeG-776	92100	45618	0.99
V_4- NBeG-857	102201	55719	1.21
SEm±	2320.0	2320.0	0.05
CD (p = 0.05)	6893	6893	0.14
CV (%)	7.6	15.2	14.5
Interaction			
SEm±	4018.4	4018.4	0.08
CD at 5% M ×V	NS	NS	NS
CD at 5% V × M	NS	NS	NS

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