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Effect of Sowing Dates and Crop Geometry on Yield Attributes and Yield of Chickpea

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Abstract

Field experiment was conducted at JNKVV, College of Agriculture, Tikamgarh (Madhya Pradesh) during rabi 2020-21 to study the effect of sowing dates and crop geometry on yield attributes and yield of chickpea. The experiment was conducted in split-plot design with three replications and comprised of three sowing dates viz., D1: 5 Nov., D2: 25 Nov. and D3: 15 Dec. as main plot treatments and four crop geometry viz., G1: 30x10 cm, G2: 45x10 cm, G3: 30x15 cm and G4: 45x15 cm as sub-plot treatments. Results indicated that crop sown on 5 Nov produced significantly more number of pods plant^{-1} (106) and higher seed index (16.84g) followed by 25 Nov (74 and 16.55, respectively) and 15 Dec (31 and 14.87, respectively). However, sowing dates were failed to significantly influence the number of seeds pod^{-1}. Similarly, the significantly higher seed yield (2134 kg ha^{-1}), straw yield (3501 kg ha^{-1}), biological yield (5635 kg ha^{-1}) and harvest index (37.9%) were also recorded under 5 Nov and the significant lowest (1184 kg ha^{-1}, 2726 kg ha^{-1}, 3910 kg ha^{-1} and 30.3%, respectively) under 15 Dec sown chickpea crop. Among crop geometry, crop sown with geometry of 45x15cm resulted into significantly more numbers of pods plant^{-1} (78) followed by 30x15cm (74), 45x10 (66) and the lowest with crop geometry of 30x10cm (63). Crop geometry were failed to significantly influence the number of seeds pod^{-1} and seed index. Whereas, the significantly higher seed yield (1775 kg ha^{-1}), biological yield (4934 kg ha^{-1}) and harvest index (35.9%) were recorded with crop geometry of 30×10cm and the lowest (1437 kg ha^{-1}, 4388 kg ha^{-1} and 32.4%, respectively) with crop geometry of 45×15cm.

Key words: chickpea, crop geometry, sowing date, yield, yield attributes

Introduction

Chickpea (*Cicer arietinum* L.) is an important winter season pulse crop in India grown as a dry pulse crop or as a green vegetable. Due to economical and high protein content, it is one of favorite pulse of weaker class of the societies in the developing world[17]. It is nutritionally dense with 18-22% protein, 60-62% carbohydrate and a considerable amount of fat; additionally it is a rich source of Calcium, Iron, vitamin-c and fiber. Chickpea being a leguminous crop promote soil fertility by fixing of atmospheric nitrogen in accessible form (NH_3 and NH_4) in the root through symbiosis. India is the leading producer of chickpea in the world giving out 65% area and 70% of total global production. India is the principle chickpea producing country in the world with a total production of 10.13 million tonnes and cultivated area of 9.44 million hectare with an average yield of 1073 kg ha^{-1}. In Madhya Pradesh, it is cultivated over an area of 3.43 million hectare and total production of 4.61 million tonnes with an average yield of 1344 kg ha^{-1}.

There are many factors responsible for the low yield of chickpea. Amongst the various agronomic practices, ideal sowing time of chickpea is a critical factor in determining the environmental conditions at planting, flowering, pod filling and drying. Different planting dates subject the vegetative and reproductive stages of the plant to various temperature, solar

radiation and day length[20]. Chickpea is usually sown between mid October to early November. However, sowings are often delayed when grown in sequence with *kharif* crops. The exposure of crop to low temperatures during germination and seedling establishment and to high temperature during flowering and seed formation phases under delay-sown chickpea results in drastic reduction in yield. Yield loss in chickpea can vary between 30% and 60% depending on genotype, sowing time, location, and climatic conditions during sowing season. Early or late sowing caused drastic reduction in yield and net profit compared with timely sowing[14]. Therefore, sowing date can be important in determining the success of the crop and in maximizing seed yield[3]. Furthermore, choosing the right crop geometry and population for a specific genotype are critical aspects that determine crop production. Proper planting geometry tailored to a certain genotype will go a long way toward maximizing limited growth resources and consequently stabilizing production. Crop shape is also crucial for maximizing photosynthesis rates by facilitating aeration and light penetration into the plant canopy. Keeping these facts in view, an experiment was conducted to study the effect of sowing dates and crop geometry on yield attributes and yield of chickpea.

Materials and Methods

Field experiment was conducted at Agronomy Research Area, J.N.K.V.V., College of Agriculture, Tikamgarh, Madhya Pradesh (24°43' N latitude and 78°49' E longitude at an altitude of 358m above mean sea level) during *rabi* 2020-21. The experimental site is of sub-tropical climate characterized by hot dry summers and cool dry winter lies in the Bundelkhand Zone (Agro-climatic Zone-VIII). The soil of experimental field was medium to deep black and clayey loam in texture having pH 7.1, EC 0.12 dS m^{-1}, organic carbon 0.5%, available N 265 kg ha^{-1}, available P_2O_5 26 kg ha^{-1} and available K_2O 260 kg ha^{-1}. The average annual rainfall of this region is about 1000 mm, which is mostly received between June to September and a little rainfall of 90 mm is also obtained during October to May. The average temperature ranges between 4.5°C to 45°C. The experiment was conducted in split-plot design with three replications and comprised of three sowing dates *viz*., D1: 5 Nov, D2: 25 Nov and D3: 15 Dec as main plot treatments and four crop geometry *viz*., G1: 30x10 cm, G2: 45x10 cm, G3: 30x15 cm and G4: 45x15 cm as sub-plot treatments. The full recommended doses of nitrogen (20 Kg N ha^{-1}), phosphorus (40 Kg P_2O_5 ha^{-1}) and potassium (20 kg K_2O ha^{-1}) were applied at sowing. The chickpea variety JG 36 was sown in lines 30 cm apart using a seed rate of 80 kg ha^{-1}. All other agronomic and plant protection measures were applied as per recommendations. Yield attributes were recorded from the five plants sample collected at the time of harvest. The crop harvested from net plot area was threshed after 4-5 days of sun drying and the seed yield of net plot was then converted into kg ha^{-1}. Before threshing of the crop harvested from net plot, the sun dried whole plant samples were weighed and then converted into kg ha^{-1} to obtain biological yield. Straw yield is obtained by subtracting seed yield (kg ha^{-1}) from biological yield (kg ha^{-1}). The results were analyzed statistically to draw suitable inference as per standard ANOVA technique[4].

Results and discussion

Effect of sowing dates on yield attributes and yield

Data pertaining to yield attributes (Table 1) and seed yield (Table 2) was significantly influenced due to different sowing dates except number of seeds pod^{-1}. Crop sown on 5 Nov. exhibited significantly higher number of pods plant^{-1} (106) and higher seed index (16.84g) followed by 25 Nov. (74 and 16.55g, respectively) and 15 Dec. (31 and 14.87g, respectively). However, different sowing dates were failed to significantly affect the number of seeds pod^{-1}. Optimum weather conditions favour growth and development of plants which leads in more number of pod plant^{-1} and seed size compared to unfavourable condition occurred under delayed sowing resulting in lesser growth and development period[6,15].

Table 1 Effect of sowing dates and crop geometry on yield attributes of chickpea

Treatments	Number pods plant^{-1}	Number seeds pod^{-1}	Seed index (g)
Sowing dates			
D1: 5 November	106	2.01	16.84
D2: 25 November	74	1.97	16.55
D3: 15 December	31	1.78	14.87
S.Em ±	1.09	0.05	0.40
CD (P=0.05)	4	NS	1.38
Crop geometry			
G1 : 30x10cm	63	1.96	15.59
G2 : 45x10cm	74	1.81	15.76
G3 : 30x15cm	66	1.93	16.72
G4 : 45x15cm	78	1.97	16.08
S.Em ±	1.20	0.05	0.44
CD (P=0.05)	4	NS	NS

Table 2 Effect of sowing dates and crop geometry on yield of chickpea

Treatments	Seed yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
Sowing dates				
D1: 5 November	2134	5635	3501	37.9
D2: 25 November	1521	4488	2967	33.9
D3: 15 December	1184	3910	2726	30.3
S.Em ±	39	64	43	0.62
CD (P=0.05)	136	222	150	2.16
Crop geometry				
G1 : 30x10cm	1775	4934	3159	35.9
G2 : 45x10cm	1557	4701	3144	33.1
G3 : 30x15cm	1683	4687	3004	35.3
G4 : 45x15cm	1437	4388	2951	32.4
S.Em ±	41	59	50	0.71
CD (P=0.05)	122	176	NS	2.11

The highest seed and biological yield (kg ha^{-1}) were recorded in 5 Nov. sowing followed by 25 Nov. and 15 Dec. (Table 2). The higher seed yield of 2134 kg ha^{-1} produced by 5 Nov. sowing might be attributed to improved yield attributing *i.e.*, number of pods (plant^{-1}) and seed size. The favourable effect of early sowing (5 Nov.) on sink component could be attributed to better development of the plants in terms of plant height and dry matter production leading to increase bearing capacity due to optimum growth on account of favourable temperature during early vegetative phase[13]. Consecutive 20 days delay in sowing from 5 Nov. to 25 Nov. and 15 Dec. caused a loss in seed yield 14.1% and 26.3%, respectively. The decreased in seed yield ha^{-1} with delay in sowing occurred primarily due to lower biomass build up which led to reduced bearing capacity owing to slower growth on account to lower temperatures seed filling span and sink strength (pods number) [1]. The late sowing usually causes a decline in growth, leaf area and faster maturation thus, decreasing seed yield. Delay-sown chickpea face unfavourable weather conditions at its reproductive phase and gave low yield. The reduction in seed yield under late sowing due to shortening of life span coupled with lesser biomass production in chickpea crop had been reported by other workers[18,11].

The extreme reduction in seed yield (1184 kg ha^{-1}) under 15 Dec. sowing could also be attributed to shorter of reproduction phase caused by forced maturity because of sudden rise in temperature during early maturity phase. This resulted in poor number of pod (plant^{-1}), which ultimately decrease the seed yield the seed yield (kg ha^{-1}). For optimum crop yield in an environment, it is necessary for the rates of development and growth to be carefully matched. The reduction in seed yield under delayed sowing could also be due to less translocation of current photosynthesis toward reproductive parts, rapid initiation of inflorescence, flowering, fruiting and maturity, less number of pods and less pod felling duration because of non-fulfillment to temperature demands under late sowing. High temperatures and long days accelerated rapid maturity and lower seed yield[8].

The biological yield (kg ha^{-1}) was also significantly higher in 5 Nov. (5635 kg ha^{-1}) sowing. The reduction in straw and biological yield under delayed sowing occurred primarily due to slower growth on account of lower temperature during early vegetative growth phase and the overall shorter life span of crop caused reduction biomass production[1]. Similarly, the significantly higher harvest index under early sowing 5 Nov. was due to relatively significant seed index as compared to 25 Nov. and 15 Dec. sowings. Similar result was finding by other worker[7].

Effect of crop geometry on yield attributes and yield

Crop sown with crop geometry of 45x15cm resulted into significantly more numbers of pods (74 plant^{-1}) followed by 30x15cm (74 plant^{-1}), 45x10cm (66 plant^{-1}) and the lowest with 30x10cm (63 plant^{-}) crop geometry. This was ascribed mainly due to the increase in assimilate supply to the individual plant due to more free space of ground area, adequate moisture, nutrients availability and sunlight for better overall growth in sparse spaced plant geometry than dense crop geometry. These results corroborate the findings of other workers in chickpea[10]. However, number of pod plant^{-1} and seed index (g) did not differ significantly among different

crop geometries. Similar results were also reported by other worker in chickpea[10].

The significantly higher seed yield (1775 kg ha^{-1}), straw yield (3159 kg ha^{-1}), biological yield (4934 kg ha^{-1}) were recorded with crop geometry of 30x10cm and the lowest (1437 kg ha^{-1}, 2951 kg ha^{-1} and 4388 kg ha^{-1}, respectively) with crop geometry of 45x15cm. The significantly highest grain yield (kg ha^{-1}) under dense crop geometry (30x10cm) compared to sparse spaced crop geometry (45x15cm) could be due to more plant population per unit area in dense crop geometry. On the other hand, the significantly lowest seed yield (kg ha^{-1}) under sparse crop geometry might be attributed due to the fact that significantly higher number of pods $plant^{-1}$ and seed index (100 seeds weight) under sparse spacing could not compensate the yield loss due to less plant population. Similar results have also been reported by other workers in chickpea[19,12,16,2,9]. The significantly highest harvest index was recorded in dense spaced crop geometry (30x30cm) compared to sparse crop geometry. Similar variation in harvest index with different crop geometry was also reported by other workers[5]. They reported highest harvest index from the sparse spaced crop geometry of chickpea than dense crop geometry.

Conclusion

Investigation concluded that timely sown crop on 5 Nov. exhibited significantly higher seed yield (2134 kg ha^{-1}) compared to 25 Nov. (1521 kg ha^{-1}) and 15 Dec. (1184 kg ha^{-1}). Consecutive 20 days delay in sowing from 5 Nov. to 25^{th} Nov. and 15 Dec. cause a loss in seed yield 14.1% and 26.3%, respectively. Similarly, crop geometry of 30×10cm (dense crop) recorded significantly higher seed yield over 45×10cm, 30×15cm and 45×15cm.

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