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Influence of Sowing Time and Methods on Growth and Yield of Rainfed Chickpea

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A field experiment was conducted during *Rabi* 2017-18, to evaluate different sowing time and methods for enhancing the productivity of rainfed chickpea. The experimental design used was strip plot and the treatment combinations were replicated thrice. Sowing time and methods were taken as vertical and horizontal factors, respectively. Sowing time includes October last week, November first week, November second week and November third week and sowing methods comprises of broadcast, line, seed drill and country plough sowing. November first week sown crop produced the higher plant height (38.4 cm) dry matter production (2046 kg. ha^{-1}), number of pods per plant (12.3) and grain yield of 861 kg. ha^{-1}. Among sowing methods, country plough sowing resulted in the maximum plant height (38.9 cm), dry matter production (2006 kg. ha^{-1}), number of pods per plant (12.9) and grain yield (808kg. ha^{-1}).

Key words: Chickpea, Sowing time, Sowing methods, Grain yield.

Chickpea also known as bengal gram or gram (*Cicer arietinum* L.), a winter pulse which is widely grown in the arid and semi arid regions of the world. It acts as a major nutritive legume crop in the developing world since it contains 18 to 22 per cent protein, 52 to 70 per cent carbohydrate, 4 to 10 per cent fat, minerals and vitamins. Apart from being the cheapest source of protein, chickpea plays an important role in sustainable agriculture by fixing atmospheric nitrogen.

India ranks first in production and consumption of chickpea in the world and about 70 per cent area is under rainfed condition. In Tamil Nadu it is cultivated in an area of 4876 ha with production and productivity 3176 tonnes and 652 kg. ha^{-1}, respectively (Season and crop report of Tamil Nadu, 2015-16). Its production largely depends on the availability of residual soil moisture during the post monsoon period.

Selection of suitable time and method of sowing plays an important role in improving the productivity of chickpea. Sowing time has a noticeable effect on the productivity as it decides the biotic and abiotic conditions to which various phenological stages of the plant is subjected to. Date of sowing can be used as a strategy to improve the yield through avoidance of cold temperature during flowering and to reduce the incidence of disease (Ray *et al.,* 2017).

Method of sowing has an effect on germination, growth, development and yield of chickpea (Kumar *et al.*, 2015). One of the reasons behind the low productivity of chickpea could be the broadcast method of sowing. Under broadcast method, it is difficult to maintain desired plant population per unit area and it will result in overcrowding. Therefore, for higher yield a suitable method of sowing should be adopted.

There are many factors that responsible for the low yield of chickpea under the rainfed condition of Tamil Nadu, but among those factors, improper time of sowing and broadcast method of sowing is of main concern. Hence a study was undertaken to evaluate the sowing time methods for enhancing the productivity of rainfed chickpea.

Material and Methods

The experiment was conducted during *Rabi* 2017-18 in strip plot design with three replications at Eastern Block field of Tamil Nadu Agricultural University, Coimbatore. The experimental site is geographically situated in the Western agro-climatic zone of Tamil Nadu at 11°N latitude and 77°E longitude and at an altitude of 426.7 meters above mean sea level (MSL). The soil of the experimental field was sandy clay loam in texture. The nutrient status of the soil during the start of the experiment was medium in available nitrogen (252 kg. ha^{-1}), high in available phosphorus (24 kg. ha^{-1}) and potassium (670 kg. ha^{-1}).

The trial consisted of 16 treatment combinations with four time of sowing *viz.,* October last week (D_1), November first week (D_2), November second week ($D_{3)}$ and November third week (D_4) and four sowing methods comprises of broadcast (S_1), line (S_2), seed drill (S_3) and country plough (S_4) sowing. The field was made into good tilth after ploughing with tractor drawn mould board plough once, followed by two harrowing.

Chickpea variety JG 11 was sown after treating with carbendazim @ 2g kg^{-1}. Sowing was taken according to the treatments during each week with

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the anticipation of rainfall using different methods. A spacing of 30 x 10 cm was maintained under line and seed drill sowing. TNAU tractor drawn pulse seeder and animal drawn country plough were used for the seed drill and country plough sowing, respectively. Seed rate was varied according to the method of sowing. The recommended doses of nitrogen, phosphorus and potassium were given at the time of sowing as basal application. The source of nitrogen and phosphorus were urea and single super phosphate, respectively and source of potassium was muriate of potash (MOP).

Observations on growth characters *viz.*, plant height, and dry matter production (DMP), number of pods per plant, grain yield and haulm yield were recorded at the time of harvest. Leaf are index (LAI) also worked out. Height of five tagged plants from the ground to the tip of the main stem was measured and the mean values were expressed in cm. For DMP estimation, five plants were collected at random along with roots from the sampling row, sun dried for three days followed by oven drying at 60^0 C till constant weight has attained and dry matter production was expressed in kg. ha^{-1}. Pods present in the tagged plants were counted and average was calculated to obtain the number of pods per plant. Cleaned and sun dried grains of net plot area was weighed and grain yield was computed and expressed in kg. ha^{-1}. The LAI was calculated. The experimental data were subjected to statistical analysis using standard procedures.

Result and Discussion

Growth attributes

Sowing time and methods significantly influenced the plant height and dry matter production (DMP) of chickpea (Table 1). At harvest, the taller plants with plant height 38.4 cm and higher dry matter production of 2046 kg. ha^{-1} were obtained when the crop was sown during November first week followed by November second week and the least height (32.9 cm) and DMP (1334 kg. ha^{-1}) were reported under October last week sowing. The increased per plant height might be due to the favourable weather conditions especially rainfall distribution during the earlier stages of crop growth. The increased plant height and more leaf area per plant resulted in more photosynthetic accumulation, which in turn enhanced the production of higher biomass under November first week sown chickpea. Kabir *et al.* (2009) also reported similar results earlier.

Table 1. Effect of sowing time and methods on growth and yield of chickpea

Treatment	Growth attributes at harvest		Yield	
	Plant height (cm)	DMP (kg. ha^{-1})	Seed yield (kg. ha^{-1})	Haulm yield (kg. ha^{-1})
Sowing time				
D_1 - October 25th – 31st	32.9	1334	604	1245
D_2 - November 1st – 7th	38.4	2046	861	1716
D_3 - November 8th - 14th	36.6	1735	713	1451
D_4 - November 15th – 21st	34.3	1579	685	1405
SEd	1.55	31.1	27.3	79.9
CD(p=0.05)	4.94	98.8	86.7	254.1
Sowing methods				
S_1 - Broadcast sowing	32.7	1412	603	1295
S_2 - Line sowing	36.2	1736	763	1511
S_3 -Seed drill sowing	34.4	1541	690	1409
S_4 Country plough sowing	38.9	2006	808	1601
SEd	1.35	36.7	30.9	66.6
CD(p=0.05)	4.31	116	98.4	482.9
Interaction	NS	NS	S	NS

The higher plant height of 38.9 cm and DMP of 2006 kg. ha^{-1} were produced when chickpea was sown behind the country plough followed by line sowing. The increased plant height and DMP might be due to the increased depth of sowing which leads to moisture extraction from deeper layers of soil and also due to better soil aeration for the crop sown behind the country plough. Sowing of chickpea by broadcast method produced the shorter plants (32.7 cm) with the lower DMP of 1412 kg. ha^{-1}. The increased population under broadcast method might have resulted in competition for available resources. Hamid *et al.* (2002) also reported that shorter plants and lower DMP were produced under broadcast sowing of soybean.

Leaf area index

Leaf Area Index (LAI) is an indicator of photosynthetic and translocation. LAI was significantly influenced by sowing time and methods (Fig.1). Among sowing times, higher Leaf Area Index of 1.26 at 60 DAS was registered when the crop was sown

on November first week followed by November second week. However, considerably lesser LAI was reported by October last week sown chickpea at 60 DAS. This might be due to better water availability, more absorption of soil moisture and nutrients which resulted in production of higher leaf area per plant and LAI under November first week sown crop. The higher amount of solar radiation received during the cropping season might have also contributed to more leaf area. November first week sown crop received an average of 344 Cal cm^{-2} day^{-1}while, October last week received an average of 338 Cal cm^{-2} day^{-1}. Similar findings were reported by Mansur *et al.* (2010).

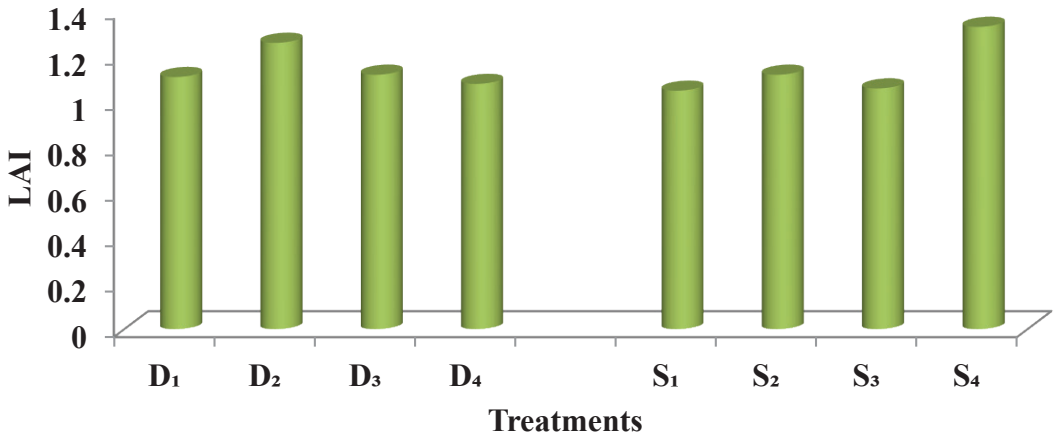

Fig.1. Effect of sowing time and methods on LAI at 60 DAS of chickpea

Conspicuously, higher LAI of 1.33 was recorded with country plough sowing followed by line sowing. This might be due to increased sowing depth under country plough which in turn results in utilization of soil moisture and nutrients from deeper layers. Country plough sowing also ensures better aeration of soil as compared to other sowing methods. The least LAI was recorded under broadcast sowing. Increased population and there by reduced incidence of solar radiation under broadcast sowing might be the reason for lower leaf area of chickpea. The findings of Ahmed *et al.* (2012) who observed decreased leaf area per plant under broadcast sowing is in support of the present findings.

Number of pods

The number of pods per plant and was significantly influenced by sowing time and methods (Fig. 2). Among different sowing times, sowing on November first week resulted in more number of pods per plant (12.3) followed by November second week sown crop with 10.9 pods per plant. However, October last week sowing registered the lesser number of pods per plant (9.22). Chaitanya and Chandrika (2006) also reported that number of pods per plant was produced when chickpea sown during first week of November.

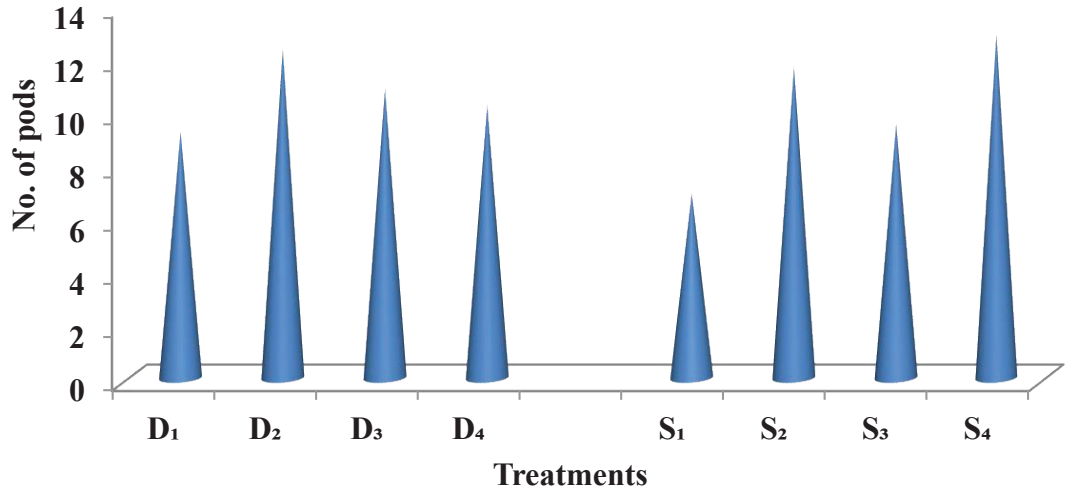

Fig. 2. Effect of sowing time and methods on number of pods of chickpea

With regard to sowing methods, country plough sowing recorded the higher number of pods per plant (12.8) followed by line sowing (11.7). The lesser number of pods per plant (6.93) was produced when the crop was sown by broadcast method. This might be due to the closer plant spacing under broadcasting method, which results in competitions for light, space and nutrients and therefore, it resulted in the lower values of yield attributing characters. These results are in agreement with Younis *et al*. (2017) in brassica.

Among sowing times, even though sowing on November first week recorded the maximum seed index (22.90 g) followed by November third week (22.63 g), the difference did not show any significant variation. With respect to sowing methods, sowing using country plough registered the highest seed index (23.09 g) followed by line sowing (22.53 g). However, the difference did not reach the level of significance.

Yield

The significantly higher grain yield (861 kg. ha^{-1}) and haulm yield (1716 kg. ha^{-1}) were obtained under November first week sowing followed by sowing on November second week. However, the lower grain yield (604 kg. ha^{-1}) and haulm yield (1245 kg. ha^{-1}) were resulted when the chickpea was sown during October last week. The reason could be due to the beneficial effects of favourable weather condition which might have paved the way for the production of more leaf area per plant, nodules and branches per plant, which in turn enhanced the photosynthesis and resulted in the production of more photosynthates that favouring to the sink. This result is in conformity with the results of Ehsanullah *et al*. (2017).

Country plough sowing recorded higher grain yield (808 kg. ha^{-1}) and haulm yield (1601 kg. ha^{-1}) followed by line sowing. Sowing by broadcasting resulted in the lower grain yield (603 kg. ha^{-1}) and haulm yield of 1295 kg. ha^{-1} compared to other sowing methods. Similar result was reported by Soomro *et al.* (2009) in wheat. Seed drill sowing resulted in 14.6 and 9.57 per cent yield reduction than country plough sowing and line sowing, respectively. Country plough sowing recorded 34 per cent increased yield over broadcasting method. This might be due to the higher plant height, leaf area, DMP and also good aeration under country plough sowing. Overcrowding under broadcast sowing resulted in decreased plant height and other growth attributes which consequently resulted in the lower yield attribute and yield under broadcast sowing.

Conclusion

From the present investigation, it could be concluded that sowing of chickpea on November first week using country plough is the best practices to obtain maximum yield under rainfed condition of western zone of Tamil Nadu.

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