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Effect of different planting dates on growth and yield of transplanted pigeonpea in Chhattisgarh plain region

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Abstract
A field experiment was conducted at College of Agriculture and Research Station, IGKV, Bemetara (Chhattisgarh) to effect of different planting dates on growth and yield of transplanted pigeonpea in Chhattisgarh plain region during kharif season of 2016. An experiment comprising of seven treatments i.e. dates of transplanting *viz.,* 10th July (T1) 20th July (T2) 30th July (T3), 9th August (T4), 19th August (T5), 29th September (T6) and 8th September (T7) laid out in randomized complete block design with three replication. Results revealed that all the growth and yield attributes of pigeonpea influenced significantly due to varying dates of planting. Crop planted on 7th July resulted in taller plants with a maximum height of 199.57 cm coupled with greater number of branches (35.70 plant^{-1}), nodule counts (55.12 plant^{-1}), dry matter accumulation (175.32 g plant^{-1}) and LAI (3821.25). Superior yield attributes such as pods (201.00 plant^{-1}), as well as total seeds (793.34 plant^{-1}) were also recorded from early transplanted crop *i.e.* 7th July among all the dates of transplanting. The better growth and yield attributes of pigeonpea planted on 7th July resulted in highest grain (2094 kg ha^{-1}) and stover (9186 kg ha^{-1}) yields from transplanted pigeonpea compared to rest of treatments.

Keywords: Transplanted pigeonpea, date of sowing, kharif, growth characters and yield

Introduction

Pigeonpea is the second most important pulse crops of India after chickpea which is grown predominantly under rain fed conditions. India accounts for 90% of world's pigeonpea growing area and 85 percent of world's production. It is grown an area of 3.88 M ha with the production of 3.17 MT and productivity of 849 kg ha^{-1}. In Chhattisgarh it occupied an area of 134.43 thousands ha with production of 90.06 thousands tones and productivity of 670 kg ha^{-1} (Anonymous, 2014). The excess moisture or water logging conditions during monsoon season creates un-favourable conditions for its growth by reducing aeration, nutrient uptake, nodulation, and creates favourable environment for disease incidence resulting in reduced crop stand and poor yield (Kantwa *et al.,* 2006) [5]. As a consequence of both abiotic and biotic stresses and seedling mortality, the plant population gets considerably reduced (Praharaj, 2013). Thus, maintaining adequate plant population/crop productivity in presence of both *abiotic* and *biotic* stresses pose a major challenge which needs to be tackled up strategically. Another constraint is delayed planting due to late onset of rains. Time of sowing has a prominent influence on both vegetative and reproductive growth phases of pigeonpea as it determine the time available for vegetative growth before the onset of flowering which is mainly influenced by photoperiod. Thus, appropriate and proper time of sowing is one of the basic requirements for obtaining maximum yield and high return of any crop. Optimum plant population needs to maintained in order to exploit maximum natural resources such as nutrient, sunlight, soil moisture and to ensure satisfactory yield (Sharifi *et al.,*2009) hence they are known to affect crop environment, which influence the yield and yield components. Pigeonpea suffers more when sowing is delayed (Padhi, 1995). Early sowing of pigeonpea *i.e.,* in the month of May, ensures higher yield (Shankaralingappa and Hegde, 1989). But in dry land areas, especially in Chhattisgarh, farmers are unable to sow pigeonpea in the month of May-June regularly because of non-receipt of sufficient rains and there is a stray cattle menace in the field damaging the early sown pigeonpea crop, as no other crop is available in the field. Because of these two constraints, the benefits of early sowing (May) of pigeonpea could not be realized. Other alternative method of establishing pigeonpea in early season is, therefore, very much required for improving the productivity of pigeonpea.

In order to ensure timely sowing on account of delayed onset of monsoon, the transplanting of pigeonpea seedlings will be one of the better agronomic measures to overcome delayed.

sowing. This technique involves raising of seedlings in the polythene bags in the nursery for a period of one month and then transplanting those seedlings in main field, immediately after soil wetting rains. The transplanted hybrid pigeonpea recorded significantly higher yield attributes, grain and stalk yield as compared to dibbled pigeonpea in Karnataka (Mallikarjun *et al.,* 2014). An established seedlings can picks up growth quickly under field conditions and can be more competitive. Moreover, raising seedlings well in advance and transplanting in the field later on receipt of good rains would help in reaping the benefits of early sowing with higher yield than direct seeded pigeonpea.

Pigeonpea seedlings can also be raised at the optimum time of sowing in eco-friendly bags like poly bag for 15 days and then seedlings are transplanted in the main field with the onset of monsoon after the soil profile is uniformly wet. This is typical low- cost and eco- friendly technique, which gives higher yields with minimum resources (Sahai, 2003). Therefore, maintaining optimum plant population per unit area through transplanting of pigeonpea seedling in the main field appears to be viable options to compensate the yield losses caused by delayed sowing of pigeonpea during kharif season. The information on performance of transplanted pigeonpea in the context of different dates of planting is very much lacking especially for the agro-ecological conditions of Chhattisgarh Plains.

Materials and Methods

A field experiment was conducted at College of Agriculture and Research Station, IGKV, Bemetara (Chhattisgarh) during kharif season of 2016 to effect of different planting dates on growth and yield of transplanted pigeonpea in Chhattisgarh plain region under varying dates of planting. Experiment comprising of seven treatments i.e. dates of transplanting *viz.*, 10th July (T1) 20th July (T2) 30th July (T3), 9th August (T4), 19th August.

(T5), 29th September (T6) and 8th September (T7) laid out in randomized complete block design with three replication. The soil of the experimental site was neutral in reaction, low in available nitrogen (195.45 kg ha^{-1}), medium in available phosphorus (18.68 kg ha^{-1}) and high in available potassium (285.56 kg ha^{-1}). The crop was planted as per treatments. In order to prevent the crop from seed and soil borne pathogens, seeds were treated with Carbendazim @ 2.5 g kg^{-1} seed followed by inoculation with suitable *Rhizobium* and phosphate solubilizing bacteria culture @ 5.0 g kg^{-1} of seed. Then treated seeds were dried in shade for 3-4 hours before sowing. In all the treatments, the seedlings were raised in eco-friendly bags (poly bag) as per treatments. Thereafter, 20 days old seedlings were transplanted in the main field from 10th July to 8th September, 2016 (10 days intervals) along with poly bags keeping soil boll intact with roots of seedling as per the treatments in rows with planting geometry of 60 cm x 15 cm. The recommended fertilizers dose were applied @ 20:50:20 kg N:P2O5:K2O ha^{-1} respectively through urea, single super phosphate and muriate of potash. The whole amounts of fertilizers were applied as basal. The pigeonpea crop received total rainfall of 892.8 mm during its growing period. Observations on various growth and yield attributes, grain and straw yields were recorded and data were analyzed statistically.

Results and Discussion

Growth attributes

Plant height is an important morphological character that acts as a potent indicator of availability of growth resources in its vicinity. The pigeonpea planted on 10th July (T1) tended to attain maximum plant height of 199.57cm (Table 1) at harvest stages which was significantly higher over those recorded with all the dates of planting which was at par with 20th July (T2) and 30th July (T3). The crop planted on 9th August (T4) where plant height remained on par with each other to 19th August (T5), 29th August (T6) and 8th September (T). However, the dates of planting differed markedly. Among the dates of planting, September planted crop attained lowest plant height in all the treatments. Though, plant height observed under 8th September (T) was found to be significantly lower than the transplanting performed on 19th August (T), 29th August (T) but it resulted in 56 significantly taller plants in comparison to the plant height shown by the crop transplanted on or after July. The results concur with the findings of Egbe *et al.,* (2013) [3]. The results further exhibited that plant height of pigeonpea decreased progressively with the successive delay in planting time compared to normal date of planting (10th July). Malla Reddi *et al.,* (2012) also observed a drastic reduction in plant height under delayed sowing. The magnitude of decrease in plant height at harvesting with every 10 days delay in sowing was 2.5, 11.6, 32.2, 35.8, 38.1 and 47.5% during 20th July, 30th July, 9th August, 19th August, 29th August and 8th September, respectively over that of planting accomplished on 10th July. It was mainly attributed to the shortening of growing period owing to decline in temperature as well as day length during August and September months.

The highest number of branches (35.70 $plant^{-1}$) at harvest recorded in pigeonpea transplanted on 10th July (T) which was significantly superior over other dates of transplanting. However, number of branches per plant emerged in the crop transplanted on

10th July gave statistically similar number of branches as that of crop planted on 20th July. It might be due to availability of sufficient time and favorable environment for the vegetative growth and development in case of the early sown crop. The results are in line with the findings of Egbe *et al.,* (2013) [3]. The lower number of branches produced by late (August-September) planted pigeonpea as compared to July might be because of the short period. Similarly, Kumar *et al.,* (2008) [6] and Hari Ram *et al.,* (2011) recorded lower plant growth in case of delayed sowing. Pigeonpea planted on July 10th resulted in significantly highest number of nodules (55.12 $plant^{-1}$) at 120 DAT over those found due to other dates of planting might be due to longer vegetative lag phase and improvement in growth parameters especially leaf area and dry matter accumulation on account of favourable temperature and moisture during the grand growth period of pigeonpea. These results are accordance to the findings of Nagamani *et al.,* (2015). However, this value stands on par with planting done on 20th July. Significantly maximum amount of dry matter *viz.* 175.32 g $plant^{-1}$ at harvest was accumulated by the crop planted 10th July among all the dates of planting which was significantly superior over delayed transplanting as well as planting on 20th July. On other hand, dry matter accumulation in transplanted pigeonpea was decreased progressively with each delay in planting dates and lowest of it were noticed in the crop planted on 8th September. The higher values of leaf area in early planted pigeonpea resulted in increased production of photosynthates contributing to higher dry matter production as well as its partitioning to reproductive parts owing to increased growing

degree days. The result corroborates the earlier findings of Chaudhary *et al.*, (1994) and Pavan *et al.*, (2011). The leaf area index is measure of proportionate canopy coverage over ground. Leaf area and LAI of pigeonpea measured at 120 DAT as influenced by varying planting dates. It is obvious from the data that maximum leaf area (3821.25 cm2) as well as LAI (2.72) was estimated from the crop when transplanted on 10th July, which was significantly greater than those obtained under delayed dates of transplanting as well as direct seeding of pigeonpea. Higher number of branches in earlier planting (10th July) might have facilitated to increase the leaf number and their size which subsequently increased the LAI. These results are in close conformity with the findings of Chaudhary *et al.*, (1994).

Table 1: Growth attributes of transplanted pigeon pea as affected by various date of planting

Treatments	Plant height (cm)	Branches plant^{-1}	(at 120 DAS)	Dry matter accumulation at harvest (g plant^{-1})	Leaf area (at 120 DAS)	Leaf area index (at 120 DAS)
T1- Transplanting on 10th July	199.57	35.70	55.12	175.32	3821.25	2.72
T2- Transplanting on 20th July	194.56	31.70	49.68	154.25	3391.84	2.36
T3- Transplanting on 30th July	192.24	28.10	45.13	128.72	2878.45	2.06
T4- Transplanting on 09th August	135.89	26.70	43.56	114.80	2486.29	1.87
T5- Transplanting on 19th August	127.79	25.90	38.68	93.40	1985.37	1.45
T6- Transplanting on 29th August	124.25	18.60	36.12	83.90	1542.18	1.12
T7- Transplanting on 08th September	106.79	13.80	31.76	72.23	1129.48	0.81
SEm±	9.32	1.76	2.73	7.01	146.50	
CD (P=0.05)	28.81	5.42	8.22	21.65	439.68	

Table 2: Yield attributes and yield of transplanted pigeonpea as affected by various date of planting

Treatments	Pods Plant^{-1}	Seeds Plant^{-1}	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T1- Transplanting on 7th July	201.00	793.34	2094	9186.00
T2- Transplanting on 17th July	181.00	704.26	1889	7954.00
T3- Transplanting on 27th July	162.00	562.09	1688	7226.00
T4- Transplanting on 06th August	152.00	512.78	1659	6152.00
T5- Transplanting on 16th August	126.00	397.09	1521	4935.00
T6- Transplanting on 26th August	115.00	355.84	965	4112.00
T7- Transplanting on 05th September	102.00	349.88	762	2955.00
SEm±	8.52	31.20	89.68	528.65
CD (P=0.05)	27.30	94.67	275.17	1593.84

Yield attributes and yield

Plant growth behavior can be determined by number of pods per plant. Number of pods per plant depends on the number of flowering nodes per plant, branches per plant and number of flowers per node and its retention. Number of pods per plant was found to be the highest (201 plant^{-1}) and number of seeds plant^{-1} (793.34 plant^{-1}) in case of early transplanted crop *i.e.* 10th July which was significantly superior among all other dates of transplanting which was at par with transplanted on 20thJuly. Similar views were recently expressed by Egbe *et al.*, (2013) [3]. Maximum number of pods plant^{-1} and number of seeds plant^{-1} in earlier date of planting may be due to higher number of branches and flower plant^{-1} with adequate supply of soil moisture and nutrients and better balance between vegetative phase and sufficient time available for pod setting. Early sowing provided better vigour to crop and it also encountered less weed competition consequently resulted in to higher pods per plant (Malik and Yadav, 2014). Among different dates of planting, higher seed yields (2094 kg ha^{-1}) and stover yield (9186 kg ha^{-1}) were realized (Table 2) under normal transplanting performed on 10th July (T) followed by the seed yield (1889 kg ha^{-1}) and stover yield (7954 kg ha^{-1}) obtained from the crop planted on 20th July (T) compared to delayed plantings. The growth and yield parameters such as branches, dry matter accumulation per plant, LAI, pods and seeds per plant in early planted crop influenced significantly over delayed planting as well as direct seeded pigeonpea due to enhanced photosynthetic activity and efficient transfer of metabolites in the seed with the resultant increase in seed and stover yield. These results are in accordance with the findings of Padhi (1995), Narendra Kumar *et al.*, (2008) and Hari Ram *et al.*, (2011) [5].

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