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Evaluation of Feasibility and Possibility of Transplanted Pigeonpea under various Dates of Planting in Bemetara District, Chhattisgarh, India

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A B S T R A C T

A field experiment was conducted at College of Agriculture and Research Station, IGKV, Bemetara (Chhattisgarh) to evaluate the feasibility and possibility of transplanted pigeonpea under varying dates of planting during kharif season of 2015. An experiment comprising of seven treatments including one farmers practice of direct seeding on 14th July (T_1) and six dates of transplanting *viz.*, 14 th July (T_2) 24 th July (T_3), 03rd August (T_4), 13th August (T_5), 23rd August (T_6) and 2nd September (T_7) 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 14th July resulted in taller plants with a maximum height of 183.07 cm coupled with greater number of branches (33.70 plant^{-1}), nodule counts (52.11 plant^{-1}), dry matter accumulation (158.10 g plant^{-1}) and LAI. Superior yield attributes such as pods (486.83 plant^{-1}), as well as total seeds (849.47 plant^{-1}) were also recorded from early transplanted crop *i.e.* 14th July among all the dates of transplanting as well as with direct seeded pigeonpea. The better growth and yield attributes of pigeonpea planted on 14th July resulted in highest grain (2268.52 kg ha^{-1}) and stover (9754.63 kg ha^{-1}) yields, as well as net returns (89187 ha^{-1}) and B:C ratio (3.73) from transplanted pigeonpea compared to rest of treatments.

Introduction

Pigeonpea is the second most important pulse crops of India after chickpea which is grown predominantly under rainfed conditions. India accounts for 90 per cent of world's pigeonpea growing area and 85 per cent 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 unfavourable 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). 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, an 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 dryland 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 2015 to evaluate the feasibility and possibility of transplanted pigeonpea under varying dates of planting. Experiment comprising of seven treatments including one farmers practice of direct seeding on 14th July (T_1) and six dates of transplanting *viz.*, 14th July (T_2) 24th July (T_3), 03rd August (T_4), 13th August (T_5), 23rd August (T_6) and 2nd

September (T_7) 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 sown/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 except farmers practice, 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 14th July to 2nd September, 2015 (10 days intervals) along with poly bags keeping soil boll intact with roots of seedling as per the treatments. In farmer's practice treatment, direct seeding were done on 14th July in rows with planting geometry of 60 cm x 15 cm. The recommended fertilizers dose were applied @ 20:50:20 kg $N:P_2O_5:K_2O$ 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 916.6 mm during its growing period. Observations on various growth and yield attributes, grain and straw yields and economics 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 14th July (T_2) tended to attain maximum plant height of 183.07cm (Table 1) at harvest stages which was significantly higher over those recorded with all the dates of planting other than the crop planted on 24th July (T_3) where plant height remained on par with each other.

However, both the dates of planting differed markedly over rest of the dates of planting. Among the dates of planting, September planted crop attained lowest plant height in all the treatments. Though, plant height observed under direct seeded pigeonpea (T_1) was found to be significantly lower than the transplanting performed on 14th and 24th July but it resulted in significantly taller plants in comparison to the plant height shown by the crop transplanted on or after August. The results concur with the findings of Egbe *et al.,* (2013).

The results further exhibited that plant height of pigeonpea decreased progressively with the successive delay in planting time compared to normal date of planting (14th 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 2.0, 32.2, 35.8, 38.1 and 47.5 % during 24th July, 3rd August, 13th August, 23rd August and 2nd September, respectively over that of planting accomplished on 14th July. It was mainly attributed to the shortening of growing period owing to declined in temperature as well as day length during August and September months.

The highest number of branches (33.70 $plant^{-1}$) at harvest recorded in pigeonpea transplanted on 14th July (T_2) which was significantly superior over other dates of transplanting and also found to be superior over direct seeding of pigeonpea accomplished on 14th July. However, number of branches per plant emerged in the crop transplanted on 14th July gave statistically similar number of branches as that of crop planted on 24th July.

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

Treatments	Plant height (cm)	Branches plant^{-1}	Nodules 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- Farmers practice (Direct seeding on 17th July)	189.22	27.10	44.11	108.70	2876.49	**2.04**
T2-Transplanting on 17th July	197.55	33.70	52.11	158.10	3621.22	**2.57**
T3-Transplanting on 27th July	193.55	29.70	47.67	136.10	3091.83	**2.19**
T4-Transplanting on 06th August	133.89	25.70	41.55	104.80	2476.09	**1.76**
T5-Transplanting on 16th August	126.78	24.90	37.67	83.40	1964.35	**1.39**
T6-Tranplanting on 26th August	122.22	17.60	34.11	73.90	1522.13	**1.08**
T7-Transplanting on 05th September	103.78	12.80	30.77	68.00	1109.49	**0.79**
SEm±	**9.30**	**1.74**	**2.63**	**6.86**	**145.52**	
CD (P=0.05)	**28.66**	**5.37**	**8.11**	**21.15**	**436.58**	

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- Farmers practice (Direct seeding on 17th July)	152.00	551.99	1660	**7206.00**
T2-Transplanting on 17th July	198.00	790.33	2074	**9142.00**
T3-Transplanting on 27th July	171.00	682.22	1878	**7855.00**
T4-Transplanting on 06th August	142.00	502.77	1630	**6052.00**
T5-Transplanting on 16th August	124.00	395.99	1495	**4913.00**
T6-Tranplanting on 26th August	111.00	345.89	921	**4098.00**
T7-Transplanting on 05th September	107.00	341.89	744	**2947.00**
SEm±	**8.54**	**30.47**	**88.65**	**526.60**
CD (P=0.05)	**26.32**	**93.89**	**273.16**	**1591.80**

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). 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) and Hari Ram *et al.,* (2011) recorded lower plant growth in case of delayed sowing.

Pigeonpea planted on July 14th resulted in significantly highest number of nodules (52.11 plant^{-1}) at 90 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 that of farmer's practice at with planting done on 24th July. Significantly maximum amount of dry matter *viz.*158.10 g plant^{-1} at harvest was accumulated by the crop planted 14th July among all the dates of planting which was significantly superior over delayed transplanting as well as direct seeded pigeonpea.

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 2nd 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 (3621.22 cm^2) as well as LAI (2.57) was estimated from the crop when transplanted on 14th 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 (14th 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).

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 (486.83 plant^{-1}) and number of seeds plant^{-1} (849.47 plant^{-1}) in case of early transplanted crop *i.e.* 14th July which was significantly superior among all other dates of transplanting as well as with direct seeded pigeonpea.

Moreover, direct seeding of pigeonpea on 14th July more higher number of pods (328.47 plant^{-1}) number of seeds (733.33 plant^{-1}), when compared with those produced by the crop planted beyond 24th July.

Similar views were recently expressed by Egbe *et al.,* (2013). 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 (2268.52 kg ha^{-1}) and stover yield (9754.63 kg ha^{-1}) were realized (Table 2) under normal transplanting performed on 14th July (T_2) followed by the seed yield (1857.14 kg ha^{-1}) and stover yield (8355.00 kg ha^{-1}) obtained from the crop planted on 24th July (T_3) 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).

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