SHORT COMMUNICATION

EFFECT OF PLANT DENSITY ON YIELD AND ECONOMICS OF PIGEONPEA [*CAJANUS CAJAN* (L.) MILL SP.]

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Abstract: An experiment was conducted during the kharif season of 2020-21to find out the effect of optimum plant density / geometry on yield and economics of pigeonpea. Pigeonpea crop sown at 80 and 60 cm inter row with 30 or 20 cm intra row spacing gave significantly higher seed yield, biological and stalk yield over rest of the plant densities. The lowest yields of seed, biological yield and stalk yield were found under broadcast @15 kg seeds ha^{-1} (0.97 lakh plants ha^{-1}) closely followed by broadcast @12 kg seeds ha^{-1} (0.78 lakh plants ha^{-1}), 40 x 30 cm (0.83 lakh plants ha^{-1}) and 40 x 20 cm (1.25 lakh plants ha^{-1}). Maximum harvest index (19.45) was recorded under wider spacing 80 x 30 cm (0.41 lakh plants ha^{-1}) and it was lowest (18.06) under broadcast @12 kg seeds ha^{-1}. Significantly higher gross return (Rs 87400), net return (Rs 58363) and benefit cost ratio (2.01) were found at spacing of 80 x 30 cm followed by 80 x 20 cm, 60 x 30 cm and 60 x 20 cm spacing.

Keywords: Pigeon pea, Plant density, Yield, Economics

INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.) Mill sp.] is the second most important pulse crop of India after chickpea. India stands 1st position in production of pigeonpea in the world having production of 4.29 million tons from an area 4.44 million ha with an average productivity 967 kg ha^{-1}, respectively, (Anonymous 2019, a).

Three important pigeon pea growing states are Maharashtra, Karnataka and Madhya Pradesh, which contributes about 63 % of the total pigeonpea production in the country. In Chhattisgarh area, production and productivity of pigeon pea was 63.25 thousand ha, 25.75 thousand tons and 407 kg ha^{-1}, respectively,(Anonymous, 2019b)which was for below than the national productivity 967 kg ha^{-1}.

To augment higher crop yield per unit area, optimum plant density is most important factor, which cause marked effect on growth and eventually the yield of a crop. Plant density controls the growth and development affects the yields. Various plant geometry or plant population have been found optimum for different varieties (Ahuja (1984), Dubey *et al*., (1991), Siag *et al*., (1993), Meena *et al*.,(2011) and Sharma *et al*., (2019)). Inadequate plant population, random planting reduce the crop yield. Higher and lower population has the adverse effects on yields. The arrangement of plant population in a given area is equally important for better growth and development of a crop. This may be manipulated/ adjusted by increasing or decreasing the inter-or intra- row spacing of plants. Since the information in thisaspects is scanty under the agro-climatic conditions of northern hills zone of Chhattisgarh, therefore, the present study was undertaken.

MATERIALS AND METHODS

The experiment was laid out in randomized block design with eight plant densities and three replications. The eight plant densities were 40 x 20 cm (1.25 lakh plants ha^{-1}), 40 x 30 (0.83 lakh plants ha^{-1}), 60 x 30 (0.55 lakh plants ha^{-1}), 80 x 20 (0.62 lakh plants ha^{-1}), 80 x 30 (0.41 lakh plants ha^{-1}), Broadcast @ 12 Kg/ha (0.78 lakh plants ha^{-1}) and Broadcast @ 15 Kg/ha (0.97 lakh plants ha^{-1}). The pigeon pea variety Rajeev lochan was used. The crop was sown on 15th July, 2020. The crop received common dose of nitrogen, phosphorus, and potash @ 18, 48 and 24 Kg ha^{-1}, respectively, through NPK 12:32:16 at the time of sowing as basal dose. The soil of the experimental site was sandy loam having pH 5.7, low in nitrogen and phosphorus 270 and 15 kg ha^{-1}, respectively, and medium in available potassium (302 kg ha^{-1}). The total rainfall was 690.8 mm during the crop season (15July, 2020 to January, 2021). The crop was harvested on 23th January, 2021. Observations on growth, yield contributing characters and yields were recorded and analyzed statistically to evaluate the treatment effects on pigeon pea.

RESULTS AND DISCUSSION

The total biomass, seed and stalk yield were significantly influenced by plant geometry (Table 1). Over all, genetic makeup, fertilization and other agronomic practices are the important factor for obtaining good yields. Amongst them, plant density is one of the most important non monitoring input which influences the plant growth and ultimately the yields under field conditions. Perusal of the data clearly indicated that pigeon pea crop sown at 80 x30 cm, 80 x 20 cm, 60 x 30 cm and 60 x 20 cm spacing gave significantly higher biological yield (kg ha^{-1}),

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seed yield (kg ha^{-1}) and stalk yield (kg ha^{-1}) over rest of the treatments and the differences were found no significant among themselves. The higher seed yields were obtained under 80 x 30 cm (1280 kg ha^{-1}) and 80 x 20 cm (1206 kg ha^{-1}) spacing and it was lowest under broadcast @15 kg ha^{-1} (967 kg ha^{-1}) which was 32.37 and 24.71 per cent, respectively, higher over broadcast. This could be attributed due to higher growth and yield attributes, which may be responsible of better source- sink relationship. Values for all the three parameters were lower under broadcast method and narrow spacing i.e. 40 x 30 cm and 40 x 20 cm spacing. It may be due to less availability of space under high plant population that is ultimately affected the growth and yields of pigeonpea. Wider spacings provides more soil space for growth and development due to less plant competition both above and below the ground resulted better root proliferation and higher canopy development which finally results in higher nutrients up take, seed filings and more seed weight. The findings of Legha and Dhingra (1992) and Karle and Pawar (1998) also support these results. The different inter and intra row spacing and broadcast method of sowing didn't show significant variation for harvest index. It was ranged from 18.06 to 19.45 per cent. Maximum harvest index 19.45 per cent was recorded under 80 x 30 cm spacing and lowest was 18.06 per cent under broadcast @12 kg seeds ha^{-1}.

Table 1. Effect of plant density on Yields and harvest index of pigeonpea

Treatments Spacing (cm)/ Plant Density (lakh ha^{-1})	Total biological yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Seed yield (kg ha^{-1})	Harvest index (%)
40 x 20 / 1.25	5490	4500	990	18.03
40 x 30 / 0.83	5655	4622	1033	18.27
60 x 20 / 0.83	5953	4833	1120	18.81
60 x 30 /0.55	6183	5000	1183	19.01
80 x 20 /0.62	6468	5262	1206	18.64
80 x 30 /0.41	6580	5300	1280	19.45
Broadcast @ 12 Kg/ha:0.78	5370	4400	970	18.06
Broadcast @ 15 Kg/ha:0.97	5267	4300	967	18.35
S.Em. ±	**285**	**221**	**63**	**1.09**
C.D. (P=0.05)	**866**	**669**	**192**	**NS**

Economics

Data pertaining to cost of cultivation, gross return (Rs ha^{-1}), net return (Rs ha^{-1}) and B.C. ratio have been presented in table 2. Cost of cultivation varied under different planting geometry and broadcast method of sowing mainly due to seeds used in different treatments. Pigeonpea sown at 80 x 30 cm spacing fetched higher gross income (Rs 87400 Rs ha^{-1}), net income (58363 Rs ha^{-1}), benefit: cost ratio (2.01) and economic efficiency (307.17 Rs ha^{-1}day^{-1}) over the rest of the treatments. The second best treatment was the same inter row spacing with reducing 10 cm intra row spacing i.e. 80 x 20 cm spacing, which accrued net returns of 53593 Rs ha^{-1} and benefit : cost ratio of 1.83. The lowest gross income, net income, B:C ratio and economic efficiency was under both the broadcast method of sowing and both the closer spacing 40 x 20 cm and 40 x 30 cm. This could be ascribed to higher seed yield and stalk yield at wider spacing. Similar results of such economic traits of pigeon pea were also reported by Karle and Pawar (1998), and Uttamrao (2014).

Table 2. Effect of plant density on Economics of pigeonpea cultivation

Treatments Spacing (cm)/ Plant	Cost of cultivation	Gross income	Net Income	B:C Ratio	Economic efficiency
40 x 20 / 1.25	30111	68400	38289	1.27	201.52
40 x 30 / 0.83	29543	71243	41700	1.41	219.47
60 x 20 / 0.83	29543	76867	47324	1.60	249.07
60 x 30 /0.55	29205	81000	51795	1.77	272.60

80 x 20 /0.62	29290	82883	53593	1.83	282.07
80 x 30 /0.41	29037	87400	58363	2.01	307.17
Broadcast @ 12 Kg/ha:0.78	28991	67000	38009	1.31	200.04
Broadcast @ 15 Kg/ha:0.97	29231	66600	37369	1.28	196.67
S.Em. ±	**-**	**3970**	**3969**	**0.13**	**-**
C.D. (P=0.05)	**-**	**12041**	**12041**	**0.41**	**-**

CONCLUSION

From the above study, it was inferred that cultivation of pigeon pea variety Rajeev lochan sown either at 80 or 60 cm inter row with 30 or 20 cm intra row spacing was found superior during *Kharif* season in terms of yields and net income.

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