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Climate Resilient Agro Technological Intervention to Boost up Pigeon pea Production in Chhattisgarh

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Abstract:-*The present investigation entitled with "Climate resilient agro technological intervention to boost up pigeonpea (Cajanuscajan L.)production in Chhattisgarh" was carried out at Research Cum Instructional Farm, Indira Gandhi KrishiVishwavidyalaya, Raipur during rabi season 2013-14. The field experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications. The treatment consisted of six genotypes viz., Asha, Rajeevlochan, Laxmi, RPS-2008-4, RPS-2007-10 and RPS- 2007-106 in main plots with two planting geometry viz., 45 cm x 10 cm (S_1) and 60 cm x 10 cm (S_2) in sub plots. Results revealed that among the different genotypes tested, Asha (1281 kg ha^{-1}) recorded significantly highest seed yield over rest of genotypes while the yield was on par with genotypes Rajeevlochan (1268 kg ha^{-1}), RPS- 2007-106 (1226 kg ha^{-1}) and Laxmi (1220 kg ha^{-1}). Among the planting geometry significantly maximum seed yield of 1235 kg ha^{-1} was recorded with narrow panting geometry of 45 cm x 10 cm (2, 22,222.22 plants ha^{-1}) and yield was 13.82 % higher than the yield (1085 kg ha^{-1}) recorded with planting geometry of 60 cm x 10 cm (plant population of 166666.66 plants ha^{-1}). Genotype Asha gave maximum net return (Rs. 35228 ha^{-1}) and Benefit:Cost ratio (2.27) over rest of the genotypes tested. Pigeonpea sown with narrow geometry of 45 cm x 10 cm gave maximum net return (Rs.33603 ha^{-1}) and Benefit:Bost ratio (2.13) over wider spacing of 60 cm x 10 cm. There is scope to grow Pigeonpea in mid rabi season also which would not only help to increase pulse production in the state as well as country but also possible to increase productivity per unit area. It was also noticed that maturity period reduced by 25 day in Rabi sowing as compared to Kharif sowing.*

I. Introduction

Pulses form an integral part of vegetarian diet in Indian subcontinent. In India, pulses have been cultivated since time immemorial under rainfed situations which is characterized by poor soil fertility and moisture stress. In India total pulse occupies 25.43 m ha area and contributes 17.21 m tonnes production with an average productivity of 679 kg ha^{-1} (Anonymous, 2012a). In Chhattisgarh it is occupying an area of 35 lakh ha with a production of 19 lakh tonnes with an average productivity of 753 kg ha^{-1}(Anonymous, 2012b). During the last four decades, the total area under pulses in the country remained virtually stagnant (22 to 24 million ha) with almost stable production (12 to 14 million tonnes), even though the population has been increased manifold. As a result, per capita availability of pulses has been declined from 64 g per day in 1951-56 to less than 40 g per day as against FAO/WHO's recommendation of 80 g per day (Ashtana and Chaturvedi, 1999). It has led to the severe shortage of pulses in India, which has aggravated the problem of malnutrition in large section of vegetarian population.

Genotype plays an important role in determining the crop yields. The potential yield of genotypes within its genetic limit is set by environment where it is grown. Genotypes are different in their yield potential depending on many complex physiological processes taking place in different parts of the plant, which are controlled by both genetic makeup of plant and the environment. In Chhattisgarh pulsed occupies an area of 52.85 thousands ha with production of 23.68 thousand tones with average productivity 448 kg ha^{-1} (Anonymous, 2012c).

Pigeonpea is grown in kharif season throughout the country. To explore the possibility of growing pigeon pea in within season a sincere affort is required with new released photo insensitive cultivar. This crop is biannual in nature.Therefore, there is possibility to harvest good crop in rabi season also. Thus, there is an urgent need to increase the production of pulses to meet the increasing demand by adopting the appropriate production technologies. Keeping the all above fact in mind, an investigation was carried out.

II. Materials And Methods

A field experiment was carried out during the winter season of 2013-14 at the Instructional Cum Research Farm, I.G.K.V., Raipur (C.G.). The soil of the experimental field was clayey in texture (Vertisols) locally known as "Bharri". The soil was neutral in pH and had low nitrogen and medium phosphorus and high in potassium content. The experiment was laid out in factorial randomized block design with three replications. The treatment consisted of six genotypes viz. – Asha, Rajeev lochan, Laxmi, RPS-2008-4, RPS-2007-10 and RPS- 2007-106 as factor one and two planting geometry viz. 60 cm x 10 cm and 45 cm x 10 cm as factor two. A recommended dose of nutrients N:P_2O_5:K_2O:S @ 20:50:20:20 kg/ha was applied. Weeds were controlled by applying Stomp 30 EC (pendimethalin) @ 2.5 l/ha within 2 days after sowing of the crop and left-over weeds were removed by hand-weeding in 40 and 65 days after sowing of crop. For control of insects two sprey of Curacron 10 % (profenophos) 1 l/ha/sprey was done at 50 and 80 days after sowing. Date of sowing of Pigeonpea was done on 23rd November, 2013 and harvested during 5th to 10th May, 2014 as per genotype. The crop was harvested manually with the help of sickle when grain almost matured and straw had turned yellow and data on grain and straw yield were recorded. The cost of cultivation and returns were calculated by taking into account the prevailing cost of inputs and prices of output.

III. Results And Discussion

Number of seeds pods^{-1} is an important factor that directly imparts in exploiting potential yield recovery in pigeonpea crop. Among the pigeonpea genotypes, significantly maximum same number of seeds pods^{-1} (4.23) was recorded in genotype Asha and Rajeevlochan over rest of the genotypes tested, which was statistically at par with the response obtained from genotypes Rajeevlochan (4.22 pod-^{1}), Laxmi (3.83 pod^{-1}) and RPS-2007-106 (3.94 pod^{-1}). The lowest number of seeds pods^{-1} was recorded under genotype RPS-2008-4 (3.28). Similar results were also noted by Bhaviet al. (2007), Kashyapet al. (2003). Significantly maximum number of seeds pods^{-1} (4.05) was recorded under 60 cm x 10 cm (S_2) planting geometry over narrow planting geometry of 45 cm x 10 cm (3.59 pod^{-1}). Similar findings have been reported by Kashyapet al. (2003). Close observation of data indicates that Asha (V_1) recorded significantly higher number of pod plant^{-1} (132 plant^{-1}) over other genotype tested in the experiment (Table 1), which was statistically at par with genotypes Rajeevlochan (129.33 plant^{-1}), Laxmi (123.22 plant^{-1}) and RPS-2007-106 (127.50 plant^{-1}). Genotype RPS-2008-4 (95.50 plant^{-1}) recorded lowest number of pod plant^{-1}. Variation in number of pods plant^{-1} might be due to genetic makeup of genotypes and response of other growth factors. Similar observations have also been recorded by Tikle and Gupta (2006).It is quite clear from the data that significantly maximum number of pods plant^{-1} (124.50) was recorded from the plot where crop was planted in 60 cm x 10 cm (S_2) over planting geometry of 45 cm x 10 cm. Maximum number of pods plant^{-1} in 60 cm x 10 cm (S_2) planting geometry might be due to higher number of branches and flowers plant^{-1} with adequate supply of soil-moisture and nutrients. Similar results were also recorded by Antaravalliet al. (2002), Islam et al. (2008) and Giramallappaet al.(2012).As regards to pigeonpea genotypes, significantly highest number of seeds plant^{-1} (557) was recorded in genotype Asha over rest of the genotypes, which was statistically at par with genotypes Rajeevlochan (545 plant^{-1}). The lowest number of seeds plant^{-1} was recorded under genotype RPS-2008-4. Similar findings were noted by Kashyapet al. (2003).Among the planting geometry, significantly maximum number of seeds plant^{-1} (496.67) was recorded under 60 cm x 10 cmplanting geometry. While the minimum number of seeds plant^{-1} was observed in 45 cm x 10 cm planting geometry. Similar results were also reported by karhaneet al. (1997-1989).The weight of hundred seeds is an important attribute of yield. Data indicates that genotype Asha recorded significantly highest 100-seed weight (11.22 g), which was statistically at par with genotypes Rajeevlochan (11.16 g), Laxmi (10.90 g) and RPS-2007-106 (11.09 g). The lowest 100-seed weight was recorded under genotype RPS-2008-4. This might be due to varietal characteristics of the genotypes. Similar results have also been reported by Soomrao and Khan (2003), Kashyap (2003), Singh and Sekhon (2007) and Mondalet al.(2012).Among the planting geometry, significantly the highest 100-seed weight (3.96) was found in wider spaced crop with a planting geometry of 60 cm x 10 cm over narrow planting geometry of45 cm x 10 cm. This might be due to availability of optimum space and other growth resources resulted healthy and vigorous plant growth as well as maximum photosynthesis of individual plant and rational partitioning of photosynthates from source to sink. Similar findings have been reported by Das et al. (1996), Kashyap (2003).

Genotype Asharecorded significantly higher seed yield (1281.42 kg ha^{-1}) over other genotypes of pigeonpea tested in the experiment (Table 2). It was statistically comparable with Rajeevlochan (1268.48 kg ha^{-1}), Laxmi (1220.10 kg ha^{-1}) and RPS-2007-106 (1226.47 kg ha^{-1}). Asha recorded 18.03 % and 28.89 % higher seed yield than RPS-2007-10 and RPS-2008-4, respectively. This might be due to higher number of pods plant^{-1}, more number of seeds pod^{-1}, number of seeds plant^{-1} and higher 100-seed weightresulting into higher yield in Asha. The lowest seed yield was recorded under genotype RPS-2008-4 which was at par with RPS-2007-10.Another possible reason of higher seed yield in Asha might be due to higher number branches plant^{-1}, number of pods plant^{-1}, number of seeds pods^{-1} and number of seeds plant^{-1}. Each genotypes has their own yield potential which expressed in shape of plant growth and ultimately to seed yield. Similar findings have also been reported by Pahwaet al. (2013), Tikle and Gupta (2010).Among the spacing treatments, the crop planted with row spacing of 45 cm and plant to plant 10 cm recorded significantly higher grain yield (1234.80 kg ha^{-1}) over wider row spacing 60 cm x 10 cm narrow planting of pigeonpea (45 cm x 10 cm) recorded 12.16 % more yield over wider row spacing of 60 cm x 15 cm.The seed yield is the chain reaction of growth parameters and yield attributing character. In the present investigation wider spacing recorded higher value of vegetative and reproductive growth parameter of individual plants over narrow spacing. However, in terms of seed yield and stover yield narrow spacing was statistically found superior over wider spacing might be due to the fact that total number of plants (2.22 lakh plants ha^{-1}) per unit area was higher over wider spacing and this higher number of plants per unit area neutralized the effect of vegetative and reproductive parameter registered in wider spaced crops. Optimum plant population is a pre-requisite for obtaining high yields. The results are in accordance with the findings of Panwar and Sirohi (1987) and Ali et al. (2011).

Asha produced the significantly higher stover yield (5887.50 kg ha^{-1}) over rest of other genotypes tested in the investigation. However, it was comparable with results obtained from Rajeevlochan, Laxmi and RPS-2007-106. The lowest stover yield was obtained under genotype RPS2008-4 (4070.48). The superiority of growth characters viz. plant height, branches, LAI and dry matter accumulation may be the possible reasons for the production of higher stover yield under Asha genotype. Among the planting geometry, significantly higher stover yield (6172.72 kg ha^{-1}) was recorded from the 45 cm x 10 cm planting geometry, while the lowest stover yield (4383.35 kg ha^{-1}) was recorded in wider spacing 60 cm x 10 cm planting geometry. It might be due to more number of plants per unit area in 45 cm x 10 cm planting geometry.Similar results have also been reported byPawanet al. (2011), Garimallappaet al. (2012), Kashyapet al. (2003) and Umeshet al. (2013).Harvest index is a measure of physiological productivity potential of crop genotypes. It is the ability of a plant to convert the dry matter into economic yield. The difference in harvest index (%) due to genotypes was found non-significant.Significantly maximum value of harvest index (19.87 %) was recorded under 60 cm x 10 cm planting geometry, over narrow planting geometry of 45 cm x 10 cm (16.67). The data indicates that on an average all the 4 genotypes i.e. Asha, Rajeevlochan, Laxmi, RPS-2008-4, RPS-2007-10 and RPS-2007-106 reached to 50% flowering in between 83 to 90 DAS and completed their maturity in between 149 to 157 DAS. Among the genotypes, Rajeevlochan took maximum days for 50% flowering and maturity. On the other land, genotype Laxmi, RPS-2008-4, RPS-200710 and RPS-2007-106 took same maximum day for 50% flowering and maturity. The flowering and maturity of the crop is governed by its genetic makeup and its interaction with environment. In the present investigation too, the differential behaviour showed by different genotype might be due to its genetic makeup and its interaction with environmental factor.

To examine the economic feasibility and viability of different treatment under investigation, economics of pigeonpea production in terms of gross and net returns and Benefit: Cost ratio was calculated for pigeonpea genotypes (Table 3) under different planting geometry.The data revealed that the significantly maximum gross return (Rs. 50737 ha^{-1}), net return (Rs. 35228 ha^{-1}) and B: C ratio (2.27) was received under genotype Asha. The above economic parameters were found lowest under genotype RPS-2008-4. The gross return and net return was higher in Asha obviously due to higher seed and stover yields.Higher gross return (Rs. 49391 ha^{-1}), net return (Rs. 33603 ha^{-1}) and B:C ratio (2.13) were recorded with crop sown in 45 cm x 10 cm spacing over geometry of 60 cm x 10 cm planting geometry (Rs. 42344 ha^{-1}, Rs. 27114 ha^{-1} and 1.78, respectively). Similar observations were noted by Giramallappaet al. (2012).

Table 1: Yield attributing characters as influenced by pigeonpea genotypes and planting geometry

Treatment	No. of seed pod^{-1}	No. of pod plant^{-1}	No. of seed plant^{-1}	100 Seed weight (g)
Genotype				
Asha	4.23	132.00	557.27	11.22
Rajeevlochan	4.22	129.33	544.69	11.16
Laxmi	3.83	123.22	471.98	10.90
RPS-2008-4	3.28	95.50	312.29	9.84
RPS-2007-10	3.44	105.19	361.89	10.08
RPS-2007-106	3.94	127.50	502.49	11.09
SEm±	0.20	4.7	17.27	0.35
CD (P=0.05)	0.58	13.8	50.66	1.01
Planting geometry				

S_1 : 45 cm x 10 cm	3.59	113.08	420.20	10.33
S_2 : 60 cm x 10 cm	4.05	124.50	496.67	11.10
SEm±	0.11	2.7	9.97	0.20
CD (P=0.05)	0.33	8.0	29.25	0.58
Interaction	NS	NS	NS	

Table 2: Seed yield, stalk yield, harvest index, days to 50 % flowering and maturity as influenced by pigeonpea genotypes and planting geometry

Treatment	Seed yield (kg/ha)	Stalk yield (kg/ha)	Harvest index (%)	Days to 50% flowering	Days to 50% Maturity
Genotype					
Asha	1281.42	5887.50	18.14	84	150
Rajeevlochan	1268.48	5784.17	18.32	83	149
Laxmi	1220.10	5578.82	18.33	87	153
RPS-2008-4	911.27	4070.48	18.33	90	157
RPS-2007-10	1050.38	4750.33	18.30	90.	157
RPS-2007-106	1226.47	5596.93	18.21	90	157
SEm±	63.4	295.4	0.09		
CD (P=0.05)	185.9	866.5	NS		
Planting geometry					
S_1 : 45 cm x 10 cm	1234.80	6172.72	16.67		
S_2 : 60 cm x 10 cm	1084.60	4383.35	19.87		
SEm±	36.6	170.6	0.09		
CD (P=0.05)	107.4	500.3	NS		
Interaction	NS	NS	NS		

Table 3: Economics of winter pigeon pea genotypes as influenced by planting geometry

Treatment	**Cost of cultivation (Rs ha^{-1})**	**Gross return (Rs ha^{-1})**	**Net return (Rs ha^{-1})**	**B:C ratio**
Genotype				
Asha	15509	50737	35228	2.27
Rajeevlochan	15509	50181	34672	2.23
Laxmi	15509	48282	32773	2.11
RPS-2008-4	15509	35965	20456	1.31
RPS-2007-10	15509	41514	26005	1.67
RPS-2007-106	15509	48523	33014	2.12
Planting geometry				
S_1 : 45 cm x 10 cm	15788	49391	33603	2.13
S_2 : 60 cm x 10 cm	15230	42344	27114	1.78

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