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PRODUCTION POTENTIAL OF PIGEONPEA (*CAJANUS CAJAN* (L.) MILLSP.) AS INFLUENCED BY PLANT GEOMETRY AND IRRIGATION SCHEDULES

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Abstract- A field experiment was conducted at Agronomy Farm, College of Agriculture, Parbhani during *kharif* season of 2012-13 and 2013-14. The experiment was laid out in split plot design with three main plot treatments and four sub plot treatments. The main plot treatments were irrigation schedules as rain fed (no irrigation), two irrigations (at bud initiation and pod development stage) and three irrigations (at bud initiation, flowering and pod development stage). Sub plot treatments were four plant geometries i.e. 120 x 45 cm, 60-120 x 60 cm, 75-150 x 45 cm and 90-180 x 45 cm. All the growth, yield and yield attributes *viz*., plant height, number of functional leaves, leaf area, number of branches, dry matter production, number of pods plant^{-1}, seed yield (q ha^{-1}), straw yield (q ha^{-1}), gross monetary returns (Rs ha-1), net monetary returns (Rs ha-1)and benefit to cost ratio were significantly higher with application of three irrigation (I_2) treatment than two irrigation (I_1) and rain fed pigeon pea (I_0).The plant geometry of 90-180 x 45 cm recorded significantly higher number of functional leaves, leaf area, number of branches, dry matter, pods plant^{-1}, pod weight (g) and seed yield plant^{-1} during both the years but plant height, seed yield (q ha^{-1}), straw yield (q ha^{-1}), gross monetary returns (Rs ha-1), net monetary returns (Rs ha-1)and benefit to cost ratio were higher with plant geometry of 75-150 x 45 cm than any other due to higher plant population ha^{-1}. Treatment combination of three irrigations (I_2) with 75-150 x 45 cm plant geometry recorded significantly higher seed yield (q ha^{-1}), net monetary returns (Rs ha^{-1})and benefit to cost ratio during both the years. Interaction effects of irrigation and plant geometries on different growth, yield and yield attributes were not visible during both the years of experimentation.

Keywords- Pigeon pea, Plant geometry, Irrigation, Paired row planting

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Introduction

Pigeon pea (*Cajanus cajan* (L.) Millsp, 2n = 22) commonly known as redgram or arhar or tur in India originated in South Africa in the areas of Angola and Nile river. Pigeon pea is short day; often-cross pollinated avenue crop belongs to family leguminosae. The ability of pigeon pea to produce economic yield in soil characterized by moisture deficit makes it an important crop of dry land agriculture. India is producing 14.76 million tones of pulses from an area of 23.63 million hectare, which is one of the largest pulses producing countries in the world. However, about 2-3 million tons of pulses are imported annually to meet the domestic consumption requirement accounting 21.50 per cent of total food imports. Thus there is need to increase production and productivity of pulses in the country by more interventions [1].

In paired row planting system, each third row is removed and crops are grown in paired row cropping system. It is suitable for dry land region and objective is to conserve soil moisture and account for higher yield. It is different from skip cropping where a line is left unsown in the regular row series of sowing. Hence, it is essential to standardize a paired row planting system at a particular spacing in pigeon pea.

Water is the most important inputs essential for the production of crops. Plants need it continuously during their life and in huge quantities. It profoundly influences photosynthesis, respiration, absorption, translocation and utilization of mineral nutrients. Both its shortage and excess affects the growth and development of a plant directly. The rainfall of our country is dependent on the monsoons. In order to grow food crops and agricultural products in large quantities to feed the growing millions, intensive farming with extensive irrigation is essential. Lack of irrigation facilities and improper planting patterns are the major constraints attributing to lower productivity of pulses especially pigeon pea. As a long durational crop, its reproductive growth occurs on residual moisture and lack of moisture at reproductive and terminal stages affects the stability of the yield resulting in lower productivity. In view of the above facts the present investigation was undertaken to asses the interaction effect of paired row planting systems in increasing and stabilizing the yield of BSMR-736, a wilt and sterility resistant variety of pigeon pea released by Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani under different irrigation schedules. The knowledge of row spacing in paired row planting under different irrigation schedules will help the farmers to enhance the productivity of pigeon pea by adopting appropriate combination.

MaterialsandMethods

The field experiments were conducted at the Research Farm, Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *kharif* seasons of 2012-13 and 2013-14. The experiment was laid out in split plot design with three main plot treatments and four sub plot treatments. The main plot treatments were irrigation schedules as rainfed (no irrigation), two irrigations (at bud initiation and pod development stage) and three irrigations (at bud initiation, flowering and pod development stage). Sub plot treatments were four plant geometries i.e. 120 x 45 cm, 60-120 x 60 cm, 75-150 x 45 cm and 90-180 x 45 cm. Seeds of pigeon pea variety (BSMR-736) released by Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani were used for experimental purpose. The seeds were sown by dibbling as per treatments at 120 cm x 45 cm, 60-120 cm x 60 cm, 75-150 cm x 45 cm and 90-180 cm x 45 cm spacing during 2012-13 and 2013-14 respectively, under rain fed conditions. The fertilizers were applied, as per standard dose of 25: 50 (N:P) kg ha^{-1}. As pigeon pea is a leguminous crop, full dose of fertilizer was applied as basal dose. The sources of nutrients were urea (46% N) and di-ammonium phosphate (18% N, 46% P_2O_5).

Results and Discussion

Irrigation

Three irrigations in pigeon pea improved significantly all the growth attributes *viz.*, plant height, number of branches plant^{-1}, functional leaves, leaf area and dry matter production plant^{-1} as compared to two irrigations and rain fed treatment during both the years.

The yield attributes *viz.*, number of pods plant^{-1}, weight of pods plant^{-1} and seed yield plant^{-1} were improved significantly with three irrigations as compared to two irrigations and rain fed treatment during both the year. [2-4] reported the similar results.

Table-1 *Mean weight of pods plant^{-1} (g), seed yield plant^{-1} (g) and test weight (g) of seeds of pigeonpea as influenced by different treatments during 2012-13 and 2013-14*

Treatments	2012-13			2013-14		
	Weight of pods plant^{-1} (g)	Seeds yield plant^{-1} (g)	Test weight (g)	Weight of pods plant^{-1} (g)	Seeds yield plant^{-1} (g)	Test weight (g)
Irrigation (I)						
I_0- Rainfed	87.75	55.71	102.19	105.04	66.68	103.68
I_1- Two irrigations	135.89	84.93	103.68	150.30	93.93	104.93
I_2- Three irrigations	168.40	104.05	104.67	180.68	111.90	105.78
S.E. $\pm$	1.27	1.37	0.91	1.45	1.95	2.84
C.D. at 5 %	3.79	4.08	NS	4.31	5.81	NS
Plant geometries(S)						
S_1 - (120 X 45)	125.55	78.43	103.51	139.54	87.20	104.98
S_2 - (60-120 X 60)	115.01	71.50	103.49	128.10	80.04	104.71
S_3 - (75-150 X 45)	135.77	84.83	103.52	150.85	94.28	104.92
S_4 - (90-180 X 45)	146.39	91.48	103.53	162.87	101.82	104.59
S.E. $\pm$	4.94	2.94	3.47	5.60	3.66	2.55
C.D. at 5 %	14.68	8.73	NS	16.62	10.87	NS
Interaction (I x S)						
S.E. $\pm$	8.57	5.09	6.01	9.70	6.34	4.41
C.D. at 5 %	NS	NS	NS	NS	NS	NS
General mean	**130.68**	**81.56**	**103.51**	**145.34**	**90.84**	**104.80**

Table-2 *Mean seed yield (q ha^{-1}) of pigeon pea as influenced by different treatments during 2012-13, 2013-14 and in pooled analysis.*

Treatments	Seed yield (q ha^{-1})		
	2012-13	2013-14	Pooled analysis
Irrigation (I)			
I_0- Rainfed	9.44	11.52	10.48
I_1- Two irrigations	14.79	16.52	15.66
I_2- Three irrigations	18.34	19.81	19.07
S.E. $\pm$	0.30	0.34	0.15
C.D. at 5 %	0.91	1.03	0.47
Plant geometries (S)			
S_1 - (120 X 45) cm	13.80	15.51	14.66
S_2 - (60-120 X 60) cm	12.58	14.19	13.38
S_3 - (75-150 X 45) cm	16.04	17.98	17.01
S_4 - (90-180 X 45) cm	14.34	16.12	15.23
S.E. $\pm$	0.52	0.60	0.45
C.D. at 5 %	1.54	1.79	1.41
Interaction (I x S)			
S.E. $\pm$	0.90	1.04	0.78
C.D. at 5 %	NS	NS	NS
General mean	**14.19**	**15.95**	**15.07**

Similarly, the improvement in yield attributes were also reflected in seed yield (q ha^{-1}) wherein three irrigations produced significantly higher seed yield of 18.34, 19.81 and 19.07 q ha^{-1} during 2012-13, 2013-14 and in pooled analysis, respectively compared to two irrigations and rain fed treatment. The increasing trend in straw yield due to irrigation in pigeon pea was also observed and it was significantly higher than rain fed during both the year. Similar findings are related with [5-7].

The harvest index values were maximum in irrigated (I_1 and I_2 both) pigeon pea as compared to rain fed during both the years of experimentation. The test weight and quality parameter like protein content (%) were not influenced significantly due to irrigation treatments during both the year.

Three irrigations given to pigeon pea were found economically viable and recorded significantly higher gross monetary returns, net monetary returns and benefit cost ratio compared to two irrigations and rain fed pigeon pea.

Plant geometries

The growth characters *viz.*, plant height (cm), number of functional leaves plant^{-1}, leaf area (dm^2), number of branches plant^{-1} and dry matter accumulation plant^{-1} (g) were substantially influenced by plant geometries.

The plant geometry of 75-150 x 45-cmrecorded significantly higher plant height followed by plant geometry of 90-180 x 45 cm than any other plant geometry. The number of functional leaves, leaf area, number of branches plant^{-1} and dry matter accumulation plant^{-1} was influenced significantly with plant geometry of 90-180 x 45 cm as compared to other plant geometries except 75-150 x 45 cm plant geometry, which was found at par with it during both the year. Similar findings are related with [8-10].

All the growth attributing characters except plant height were improved with increase in inter and intra row plant spacing. The plant height was increased with decrease in inter and intra row spacing.

The plant geometry of 90-180 x 45 cm recorded significantly higher number of pods plant^{-1}, pod weight, seed yield plant^{-1} as compared to other plant geometries except 75-150 x 45 cm plant geometry which was found at par with it. Although, seed yield plant^{-1} was higher in 90-180 x 45 cm plant geometry, seed yield (q ha^{-1}) was found significantly higher in 75-150 x 45 cm plant geometry due to higher plant population ha^{-1} than 90-180 x 45 cm plant geometry. Similarly, straw yield (q ha^{-1}), biological yield (q ha^{-1}) and harvest index were also significantly more with plant geometry of 75-150 x 45 cm than any other plant geometry during both the year. Different plant geometries did not show any significant impact on protein content (%) and test weight (g) during both the years of study [11, 12] are similar results.

The gross monetary returns, net monetary returns and benefit cost ratio were significantly influenced by different plant geometries in individual years and in pooled data. The plant geometry of 75-150 x 45 cm was found economically viable and recorded significantly higher gross monetary returns, net monetary returns and benefit to cost ratio than 90-180 x 45, 120 x 45 and 60-120 x 60 cm plant geometries.

Table-3 *Mean straw yield (q ha-1), biological yield (q ha-1) and harvest index of pigeon pea as influenced by different treatments during 2012-13 and 2013-14.*

Treatments	2012-13			2013-14		
	Straw yield (q ha-1)	Biological yield (q ha-1)	Harvest index	Straw yield (q ha-1)	Biological yield (q ha-1)	Harvest index
Irrigation (I)						
I_0- Rainfed	29.17	38.61	24.42	35.94	47.46	24.24
I_1- Two irrigations	41.13	55.93	26.42	46.43	62.96	26.21
I_2- Three irrigations	48.62	66.96	27.36	53.10	72.92	27.14
S.E. ±	0.83	1.14	0.68	0.98	1.33	0.51
C.D. at 5 %	2.48	3.40	2.02	2.93	3.96	1.52
Plant geometries(S)						
S_1 - (120 X 45)	38.93	52.74	25.89	44.33	59.85	25.69
S_2 - (60-120 X 60)	36.10	48.69	25.56	41.24	55.43	25.36
S_3 - (75-150 X 45)	43.70	59.74	26.58	49.66	67.65	26.37
S_4 - (90-180 X 45)	39.83	54.18	26.23	45.40	61.52	26.03
S.E. ±	1.24	1.64	0.10	1.37	1.97	0.09
C.D. at 5 %	3.76	4.96	0.32	4.12	5.94	0.28
Interaction (I x S)						
S.E. ±	2.16	2.85	0.18	2.37	3.41	0.16
C.D. at 5 %	NS	NS	NS	NS	NS	NS
General mean	**39.64**	**53.84**	**26.07**	**45.16**	**61.11**	**25.86**

Interaction

During both the years, the interaction between irrigation schedules and plant geometries were found to be non-significant for all the growth, yield attributing, yield, quality and economical characters at all the stages of crop growth.

Conflict of Interest: None declared

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