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Quality attributes and economics of pigeon pea (*Cajanus cajan* (L.) Millsp.) influenced by irrigation and plant geometry

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Abstract

The present investigation was conducted to know Quality attributes and economics of pigeon pea (*Cajanus cajan* (L.) Millsp.) influenced by irrigation and plant geometry. 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 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. 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 (I₂) treatment than two irrigation (I₁) and rainfed pigeon pea (I₀). 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. Different plant geometries did not show any significant impact on quality parameters like protein content (%) and test weight (g) during both the years of experimentation. Treatment combination of three irrigations (I₂) with 75-150 x 45 cm plant geometry recorded significantly higher net monetary returns (Rs ha⁻¹) and benefit to cost ratio during both the years.

Keywords: pigeon pea, plant geometry, irrigation, paired row planting

Introduction

Pigeon pea (*Cajanus cajan* (L.) Millsp, 2n = 22) commonly known as red gram 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 dryland agriculture. India is producing 14.76 million tons 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 (Anonymous, 2013). In paired row planting system each third row is removed and crops are grown in paired row cropping system. It is suitable for dryland 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 affect 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 assess 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

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planting under different irrigation schedules will help the farmers to enhance the productivity of pigeon pea by adopting appropriate combination.

Materials and Methods

The field experiments were conducted at the Research Farm, Department of Agronomy, Vasant Rao 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 Vasant Rao 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 rainfed 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% P₂O₅).

Results and Discussion

Irrigation

Quality studies

Protein content in per cent was not influenced significantly with the application of irrigation at various stages of crop during both the years. So, the differences found among treatments were non-significant though the higher per cent of protein observed with three irrigation treatment followed by two irrigation treatment. Least protein content was observed with rainfed pigeon pea during both the years of study. Similar findings are related with Kapoor *et al.* (1987) [2].

Economic studies

Three irrigations given at bud initiation, flowering and pod development stage recorded significantly higher gross

monetary returns (Rs ha⁻¹), net monetary returns (Rs ha⁻¹) and benefit cost ratio over two irrigation treatment given at bud initiation and pod development stage. Rainfed treatment recorded significantly lower values during both the year and in pooled results. The comparative economic analysis revealed that irrigation to pigeon pea was found economically viable with higher net returns and benefit cost ratio than rainfed condition. It might be attributed to maximum seed yield and straw yield in irrigated pigeon pea finally reflected in higher net returns and benefit cost ratio compared to rainfed pigeon pea. In this context, increased net returns and benefit cost ratio due to irrigation in pigeon pea were reported by Kaswala *et al.* (1998) [3] and Reddy *et al.* (2008) [7]

Plant geometries

Experimental findings regarding effect of plant geometries on growth, yield attributes, yield, quality parameters and economic studies have been discussed under different heads.

Quality studies

Protein content (%) was not influenced significantly due to different plant geometries during 2012-13 and 2013-14. It might be due to quality parameters are governed by genetic makeup of variety and these cannot be differed by different plant densities.

Economic studies

The trend of increased seed yield (q ha⁻¹) in plant geometry of 75-150 x 45 cm was also observed in gross monetary returns (Rs ha⁻¹), net monetary returns (Rs ha⁻¹) and benefit cost ratio. The gross monetary returns (65399, 76131 and 70765 ` ha⁻¹), net monetary returns (41453, 51124 and 46288 ` ha⁻¹) and benefit cost ratio (1.71, 2.01 and 1.86) were significantly higher in plant geometry of 75-150 x 45 cm compared to other plant geometries during 2012-13, 2013-14 and in pooled analysis, respectively. Lowest values for GMR, NMR and benefit cost ratio were recorded by 60-120 x 60 cm plant geometry during both the year and in pooled analysis. Similar results were reported by Meena *et al.* (2013) [4] Pavan *et al.* (2011) [5] Zote *et al.* (2010) Islam *et al.* (2008) and Ravikumar *et al.* (2013) [6].

Table 1: Mean weight of pods plant⁻¹ (g), seed yield plant⁻¹ (g) and test weight (g) of seeds of pigeon pea 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. ±	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. ±	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. ±	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. ±	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. ±	0.52	0.60	0.45
C.D. at 5 %	1.54	1.79	1.41
Interaction (I x S)			
S.E. ±	0.90	1.04	0.78
C.D. at 5 %	NS	NS	NS
General mean	14.19	15.95	15.07

Table 3: Mean protein content in seeds of pigeon pea as influenced by different treatments during 2012-13 and 2013-14.

Treatments	Protein content	
	2012-13	2013-14
Irrigation (I)		
I ₀ - Rainfed	18.50	18.11
I ₁ - Two irrigations	19.26	19.15
I ₂ - Three irrigations	20.17	19.88
S.E. ±	0.39	0.47
C.D. at 5 %	NS	NS
Plant geometries (S)		
S ₁ - (120 X 45) cm	19.75	19.43
S ₂ - (60-120 X 60) cm	19.15	18.93
S ₃ - (75-150 X 45) cm	18.90	18.66
S ₄ - (90-180 X 45) cm	19.44	19.17
S.E. ±	0.52	0.49
C.D. at 5 %	NS	NS
Interaction (I x S)		
S.E. ±	0.91	0.85
C.D. at 5 %	NS	NS
General mean	19.31	19.05

Table 4: Gross monetary returns (Rs ha⁻¹), Net monetary returns (Rs. ha⁻¹) and B:C ratio of pigeon pea as influenced by different treatments during 2012-13, 2013- 14 and in pooled analysis.

Treatments	Gross Monetary Returns (Rs ha ⁻¹)			Net Monetary Returns (Rs ha ⁻¹)			B:C ratio		
	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled	2012-13	2013-14	Pooled
Irrigation (I)									
I ₀ - Rainfed	38852	49187	44020	18248	28157	23202	0.88	1.33	1.10
I ₁ - Two irrigations	60404	70020	65212	36379	45118	40748	1.52	1.80	1.66
I ₂ - Three irrigations	74288	83686	78987	48186	56021	52104	1.85	2.03	1.94
S.E. ±	1213.3	1479.1	245.23	1338.0	1470.1	519.86	0.07	0.06	0.06
C.D. at 5 %	3599.3	4388.1	762.14	3969.4	4361.3	1615.6	0.22	0.17	0.20
Plant geometries (S)									
S ₁ - (120 X 45) cm	56420	65800	61110	33017	41418	37218	1.37	1.66	1.51
S ₂ - (60-120 X 60) cm	51494	60260	55877	28248	36228	32238	1.17	1.48	1.33
S ₃ - (75-150 X 45) cm	65399	76131	70765	41453	51124	46288	1.71	2.01	1.86
S ₄ - (90-180 X 45) cm	58079	68333	63206	34365	43626	38996	1.42	1.74	1.58
S.E. ±	2235.0	2564.2	263.74	2372.5	2507.2	395.16	0.09	0.08	0.03
C.D. at 5 %	6630.4	7606.9	819.66	7038.4	7437.9	1228.1	0.28	0.25	0.11
Interaction (I x S)									
S.E. ±	3871.1	4441.2	456.81	4109.3	4342.6	684.44	0.18	0.17	0.07
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS
General mean	57848	67631	62740	34271	43099	38685	1.42	1.72	1.57

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