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RESEARCH PAPER

Yield, yield parameters and economics of hybrid pigeonpea (cv. Icph-2671) as influenced by planting methods and geometry

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Abstract : A field experiment was conducted at Agricultural Research Station, Annigeri (district Dharwad) during *Kharif*, 2011 to evaluate the performance of the planting methods and geometry of recently released pigeonpea hybrid ICPH-2671. The results revealed that the transplanted hybrid pigeonpea recorded significantly higher seed yield (1899 kg ha^{-1}) and net returns (Rs. 36,005 ha^{-1}) as compared to dibbled hybrid pigeonpea (1376 kg ha^{-1}, Rs. 23,531 ha^{-1}, respectively).

Key Words : Planting methods, Planting geometry, Yield, Hybrid pigeonpea, Economics

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INTRODUCTION

Pigeonpea [C*ajanus cajan* (L.) Millsp.] is commonly known as redgram or arhar or tur in India, it is tropical crops predominantly grown during the *Kharif* season both as a sole and intercrop under wide range of agro-ecological situations. The plant owes a large measure of its popularity to the fact that, it possesses valuable properties as restorative of nitrogen to the soil and adds lot of organic matter to the soil and thus, pigeonpea finds a promising place in crop rotation and crop mixtures. The deep rooting system helps in extracting the nutrients and moisture from deeper soil layers, thus making it suitable for rainfed conditions. Deeper root system of the crop also helps in breaking the plough pans and improving soil structure and hence it is called as 'Biological plough'. India accounts for 90 per cent of the pigeonpea area and production of the world. It is grown in an area of 3.86 m ha with an annual production of 2.90 m tones and productivity is 751 kg ha^{-1} (Anonymous, 2011). It is mainly grown in Maharashtra, Uttar Pradesh, Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu.

These states constitute 90 per cent of the area and production. It is the most important pulse crop of Karnataka having an area of 6.8 lakh ha with a production of 4.8 lakh tones and productivity of 712 kg ha^{-1} (Anonymous, 2011). Time of sowing determines the time available for vegetative growth before the onset of flowering which is mainly influenced by photo period. Most of the varieties of pigeonpea are sensitive to photoperiod. Sowing time determines the plant height, number of branches, height at which branching starts, flowering and pod bearing habits. Thus, the time ofsowing has a prominent influence on both vegetative and reproductive growth phages of pigeonpea. The yield of pigeonpea is greatly influenced by a number of factors such as agronomic,

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pathogenic, entomological, genetic and their interaction with environment. Among the different agronomic practices, choice of a suitable planting geometry (spacing) and plant population for a particular genotype are the most important factors, responsible for enhancing the yield. In dry farming areas of Northern Karnataka, the rainfall is not only scanty but also erratic. Thus, soil moisture becomes the most limiting factor in production of pigeonpea. In order to ensure timely sowing under 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 the main field, immediately after soil wetting rains. The work on performance of transplanted pigeonpea under different planting geometry particularly in hybrid pigeonpea is very much lacking. In Karnataka, the varieties cultivated by the farmers are low yielding and susceptible to pests and diseases. The high yielding hybrids helps in increasing the productivity and some of the hybrids are being released for cultivation in India. Among the hybrids released by different institutes, ICPH-2671 is recently released from ICRISAT, Hyderabad found promising. It is not only high yielder but also tolerant to pests and diseases as compared to popular pigeonpea cultivar Maruthi (ICP-8863).

MATERIAL AND METHODS

The field experiment was conducted at Agricultural Research Station, Annigeri (Dharwad) during 2011 *Kharif* season to evaluate the performance of the planting methods (Transplanting and dibbling) and planting geometry of hybrid pigeonpea and cv. MARUTHI as check. There were 12 treatment combinations (P_1S_1 = Dibbling + 90 cm x 30 cm, P_1S_2 = Dibbling + 90 cm x 60 cm, P_1S_3 = Dibbling + 90 cm x 90 cm, P_1S_4 = Dibbling + 120 cm x 30 cm, P_1S_5 = Dibbling + 120 cm x 60 cm, P_1S_6 = Dibbling + 120 cm x 90 cm, P_2S_1 = Transplanting + 90 cm x 30 cm, P_2S_2 = Transplanting + 90 cm x 60 cm, P_2S_3 = Transplanting + 90 cm x 90 cm, P_2S_4 = Transplanting + 120 cm x 30 cm, P_2S_5 = Transplanting + 120 cm x 60 cm and P_2S_6 = Transplanting + 120 cm x 90 cm) and 2 controls (Maruthi, both in transplanting and dibbling conditions at planting geometry of 90 cm x 20 cm) with recommended package of practices. The treatments were replicated three times and laid out in Factorial Randomized Block Design. Experimental field was located at 'A' block of Agricultural Research Station, Annigeri, University of Agricultural Sciences, Dharwad. Annigeri is located at a latitude of 15^0 08' N and longitude of 75^0 07' E and at an altitude of 624.8 m above mean sea level. The experimental site has a typical chromustert soil (Order: Vertisol). Composite soil samples from 0-30 cm depth were collected from the site before laying out the experiment and analyzed for various physical and chemical properties The recommended dose of fertilizer for pigeonpea (25:50 N: P_2O_5 kg ha^{-1}) along with recommended dose of $ZnSO_4$ (15 kg ha^{-1}) was applied as basal dose at the time of sowing in the form of urea and DAP. The fertilizer mixture was applied five cm deep and five cm away from the seed line and mixed thoroughly in the soil. Two to three bold and healthy seeds of pigeonpea (hybrid and variety) were sown on 4th June, 2011 in polythene bags (8" × 5") having 3/4th of soil and 20 g of vermicompost. The polythene bags were watered regularly. Only one seedling per bag was maintained by thinning excess seedlings. After one month, the seedlings were transplanted in the main field on 07-07-2011 and seeds were also sown on the day of transplanting by dibbling two to three seeds up to 4 to 5 cm depth in the rows. Observations on yield and yield components like Number seeds pod^{-1}, Pod weight $plant^{-1}$ (g), Seed weight $plant^{-1}$ (g), 100 seed weight (g), Seed yield (q ha^{-1}), Stalk yield (q ha^{-1}) and Harvest index (HI) was estimated as per the formula suggested by Donald (1962) and expressed as percentage. The five tagged plants were pulled out at the time of harvesting from the net plot area and yield parameters were recorded.

RESULTS AND DISCUSSION

The results obtained from the present investigation are presented below :

Planting methods :

In the present study, the transplanted hybrid pigeonpea recorded significantly higher (1899 kg ha^{-1}) seed yield (Table 1) as compared to dibbled hybrid pigeonpea (1376 kg ha^{-1}). The yield increase due to transplanting was to the tune of 27.54 per cent. Significantly higher yield obtained under transplanted method was due to positive association between yield attributing characters. Significantly higher number of seeds pod^{-1} (3.52 pod^{-1}), pod weight $plant^{-1}$ (178.8 g $plant^{-1}$) and seed weight $plant^{-1}$ (126.7 g $plant^{-1}$) were recorded in transplanted method compared to dibbling method (3.43 pod^{-1}, 149.0 g $plant^{-1}$ and 104.7 g $plant^{-1}$, respectively) and was higher to an extent of 2.62, 19.96 and 21.05 per cent, respectively over dibbling method (Table 1). Significantly higher test weight (10.3 g) and harvest index (23.0 %) were recorded with transplanting as compared to dibbling (9.6 g and 22.3%, respectively) (Table 2). This might be due to early planting of pigeonpea seedlings and also utilization of natural resources very effectively *viz.*, solar radiation, soil moisture, space, and nutrients. These results are in accordance with the findings of Pavan *et al.* (2009), Potdar *et al.* (2010) and Salakinkoppa and Patil (2010).

Planting geometry :

The planting geometry of 120 cm × 90 cm produced significantly higher seed yield over 90 cm × 30 cm and it was at par with planting geometry of 90 cm × 90 cm (Table 1). The planting geometry of 120 cm × 90 cm has given 26.16 per cent higher seed yield over 90cm × 30cm planting

geometry. The higher yield in wider planting geometry might be due to better performance of crops with respect to yield parameters like pod weight plant^{-1}, seed weight plant^{-1}, test weight and harvest index (Tables 1 and 2). The better performance of wider row spacing might be due to better availability of growth resources like water, nutrients, air, better cultural practices and effective weed control, Potdar *et al.* (2010) and Salakinkoppa and Patil (2010). Further, it might have improved the rate of photosynthesis, dry matter accumulation and its translocation to pods as referred in terms of higher values of growth and yield components that resulted in higher seed yield of hybrid pigeonpea with wider row spacing. These results are in conformity with the findings of Narasareddy and Nivedeta (1989), Malik (2009) and Bhanu Kumar *et al.* (2011). The planting geometry of 90cm × 90cm being at par with 120cm × 90cm recorded as yield increase to an extent of 23.83 per cent over planting geometry of 90 cm × 30 cm.

Table 1: Yield components of pigeonpea as influenced by planting methods and planting geometry

Planting geometries (S)	Planting methods (P)														
	Seed yield (kg ha^{-1})			Stalk yield (kg ha^{-1})			Number of seeds pod^{-1}			Pod weight plant^{-1} (g)			Seed weight plant^{-1} (g)		
	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean
S_1 - (90 cm × 30 cm)	1279	1549	1414	5316	6045	5681	3.20	3.33	3.27	92.2	110.3	101.2	64.8	77.5	71.1
S_2 - (90 cm × 60 cm)	1375	1622	1498	4966	5787	5377	3.43	3.43	3.43	135.3	160.7	147.9	94.7	112.6	103.6
S_3 - (90 cm × 90 cm)	1419	2082	1751	4750	6800	5775	3.60	3.67	3.63	178.7	215.3	197.0	129.0	152.0	140.5
S_4- (120 cm × 30 cm)	1360	1990	1675	4824	7564	6194	3.23	3.47	3.35	138.0	171.0	154.5	92.7	119.8	106.2
S_5 - (120 cm × 60 cm)	1390	2017	1703	4864	6282	5573	3.50	3.53	3.52	167.3	197.7	182.5	116.1	142.2	129.2
S_6 - (120 cm × 90 cm)	1431	2136	1784	4203	5743	4973	3.63	3.70	3.67	183.0	218.0	200.5	130.8	156.3	143.5
Mean	1376	1899		4821	6370		3.43	3.52		149.0	178.8		104.7	126.7	
C_1- (90 cm × 20 cm)	1039	–		4595	–		2.93	–		75.0	–		56.3	–	
C_2- (90 cm × 20 cm)	–	1215		–	5151		–	3.07		–	93.6		–	70.8	
For comparison of means	S.E. ±	C.D. (P=0.05)		S.E. ±	C.D. (P=0.05)		S.E. ±	C.D. (P=0.05)		S.E. ±	C.D. (P=0.05)		S.E. ±q	C.D. (P=0.05)	
Method of planting (P)	7	23		41	122		0.05	NS		0.8	2.4		0.6	1.9	
Spacing (S)	13	40		72	211		0.09	0.26		1.4	4.1		1.1	3.3	
Interaction (P × S)	19	57		102	299		0.12	0.36		2.0	5.8		1.6	4.7	
Control Vs. treatments	19	55		96	281		0.12	0.35		2.1	6.2		1.6	4.7	

P_1 – Hybrid dibbled P_2 – Hybrid transplanted C_1 – Maruthi dibbled C_2 – Maruthi transplanted

Table 2: Yield components and Economics analysis of hybrid pigeonpea cultivation as influenced by planting methods and geometry

Planting geometries (S)	Planting methods (P)											
	Test weight (g)			Harvest index (%)			Net returns (Rs.ha^{-1})			B : C ratio		
	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean
S_1 - (90 cm × 30 cm)	9.0	9.3	9.1	19.4	20.4	19.9	20523	25400	22961	2.15	2.20	2.18
S_2 - (90 cm × 60 cm)	9.3	9.5	9.4	21.7	21.9	21.8	23443	27614	25528	2.32	2.31	2.31
S_3 - (90 cm × 90 cm)	9.9	11.0	10.4	23.0	23.4	23.2	24816	41456	33136	2.40	2.97	2.68
S_4- (120 cm × 30 cm)	9.4	9.8	9.6	22.0	20.8	21.4	23087	38752	30919	2.30	2.85	2.57
S_5 - (120 cm × 60 cm)	9.6	10.7	10.1	22.3	24.3	23.2	24017	39592	31804	2.36	2.89	2.62
S_6 - (120 cm × 90 cm)	10.5	11.5	11.0	25.4	27.1	26.2	25304	43220	34262	2.43	3.07	2.75
Mean	9.6	10.3		22.3	23.0		23531	36005		2.33	2.72	
C_1- (90 cm × 20 cm)	8.6	–		18.4	–		13852	–		1.80	–	
C_2- (90 cm × 20 cm)	–	9.0		–	19.0		–	15827		-	1.77	
For comparison of means	S.E.±	C.D. (P=0.05)		S.E.±	C.D. (P=0.05)		S.E.±	C.D. (P=0.05)		S.E.±	C.D. (P=0.05)	
Method of planting (P)	0.1	0.3		0.1	0.3		238	700		0.01	0.04	
Spacing (S)	0.2	0.6		0.2	0.6		413	1213		0.02	0.06	
Interaction (P × S)	0.2	0.8		0.3	0.9		584	1715		0.03	0.09	
Control Vs. treatments	0.2	0.7		0.3	0.9		576	1675		0.03	0.09	

P_1 – Hybrid dibbled P_2 – Hybrid transplanted C_1 – Maruti dibbled C_2 – Maruti transplanted

Interaction effect of planting methods and planting geometry:

Higher seed yield of pigeonpea hybrid (2136 kg ha^{-1}) was obtained with interaction effect of transplanting method and wider planting geometry (120 cm × 90 cm) over dibbling with closer planting geometry of 90 cm × 30 cm (Table 1). The higher yield was mainly due to positive association between yield parameters mainly pod weight plant^{-1}, seed weight plant^{-1} and test weight (Tables 1 and 2). The results are in conformity with Bhanu Kumar *et al.* (2011).

Performance of hybrid v/s variety :

The results indicated that the transplanted hybrid pigeonpea ICPH-2671 produced significantly higher seed yield (1899 kg ha^{-1}) as compared to Maruthi both in transplanted (1215 kg ha^{-1}) and dibbling conditions (1039 kg ha^{-1}). The yield increase was attributed to better utilization of growth resources by the hybrid with well developed root system as well as hybrid vigour over variety Maruthi (Bhanu Kumar *et al.*, 2011). Higher seed yield with ICPH-2671 was due to significantly higher yield parameters *viz*., pod weight plant^{-1} (178.8 g plant^{-1}), seed weight plant^{-1} (126.7 g plant^{-1}), test weight (10.3 g) and harvest index (23 %) over Maruthi (93.6g plant^{-1}, 70.8g plant^{-1}, 9.0g and 19.0 %, respectively).

Net returns (Rs. ha^{-1}) :

Among the planting methods, transplanted hybrid pigeonpea was recorded significantly higher net returns (Rs. 36005 ha^{-1}) as compared to dibbled hybrid pigeonpea (Rs. 23531 ha^{-1}). Within the different planting geometries, significantly higher net returns was recorded with planting geometry of 120 cm x 90 cm (Rs. 34262 ha^{-1}) as compared to rest of the planting geometry. Among the interactions, the treatment combination of Transplanting + 120 cm x 90 cm was recorded significantly higher net returns (Rs. 43220 ha^{-1}) as compared rest of the treatment combinations. The control, cv. MARUTI in dibbled condition recorded significantly lower net returns (Rs. 13852 ha^{-1}) as compared to transplanted and dibbled hybrid pigeonpea and cv. MARUTI under transplanted condition (Rs. 36005, Rs. 23531 and Rs. 15827 ha^{-1}, respectively). The variation in the treatment was due to variation in yield and cost of cultivation (Table 2).

B : C ratio :

Among the planting methods, transplanted hybrid pigeonpea was recorded significantly higher B : C ratio (2.72) as compared to dibbled hybrid pigeonpea (2.33). Among the different planting geometries significantly higher B : C ratio was recorded with planting geometry 120 cm x 90 cm (2.75) as compared to rest of the geometries. Within the interactions, the treatment combination of Transplanting + 120 cm x 90 cm was recorded significantly higher B : C ratio (3.07) as compared rest of the treatment combinations. The control, cv. MARUTI in transplanted condition recorded significantly lower B : C ratio (1.77) as compared to transplanted and dibbled hybrid pigeonpea (2.72 and 2.33, respectively). Whereas, cv. MARUTI under dibbled condition (1.80) was at par with cv. MARUTI under transplanted condition. The variation in the treatment was due to variation in yield and cost of cultivation (Table 2).

It could be incurred from the above study that hybrid pigeonpea ICPH-2671 produced significantly higher seed yield under transplanted condition in wider planting geometry over dibbling method. Significantly higher seed yield was produced by hybrid pigeonpea ICPH-2671 as compared to variety Maruthi. The net returns and B : C ratio followed the similar trend. Similar work related to the present investigation was also carried out by Nagamani *et al.* (1995); Nedunzhiyan and Reddy (1993) and Ravikumar (2007).

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