International Journal of Forestry and Crop Improvement
Volume 3 | Issue 2 | December, 2012 | 76-79

Research Article

Effect of fertilizer management on economics and yield advantages of pigeonpea and sunflower intercropping system

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ABSTRACT : A field experiment was conducted at Agricultural College Farm, Raichur during *Kharif* 2008 to find out optimum dose of fertilizer to intercropping system and to assess the economic feasibility and assessment of yield advantages *viz.*, pigeonpea equivalent yield, land equivalent ratio and area time equivalent ratio. The experiment was laid out in Randomized Block Design (RBD) with three replications. There were 11 treatment combinations. Application of 100 per cent recommended dose of fertilizer to both the component crops in pigeonpea + sunflower intercropping system significantly increased the yields of both the crops over unfertilized control and other lower doses of fertilizers. The maximum pigeonpea equivalent yield (25.82 and 26.77 q ha^{-1}), land equivalent ratio (1.61 and 1.66),area time equivalent ratio (1.21 and 1.25), gross returns (Rs. 77,448.00 and Rs. 80,302.00 ha^{-1}), net returns (Rs. 59,718.00 and Rs. 62,308.00 ha^{-1}) and benefit cost ratio (3.37 and 3.46) were recorded when full recommended dose of fertilizer was applied to the both the component crops of the system (T_2 and T_9, respectively).

KEY WORDS : Intercropping, Land equivalent ratio, Pigeonpea equivalent yield, Economics

How to cite this Article : Vishwanatha, S., Anilkumar, S.N., Koppalkar, B.G., Pujari, B.T. and Desai, B.K. (2012).Effect of fertilizer management on economics and yield advantages of pigeonpea and sunflower intercropping system, *Internat. J. Forestry & Crop Improv.,* **3** (2) : 76-79.

Article Chronical : Received : *12.01.2012;* Revised : *01.08.2012;* Accepted : *08.08.2012*

INTRODUCTION

Pulses and oilseeds are considered as second and third major agricultural crops in Indian agrarian economy. Normally pulse and oilseed crops are raised under rainfed conditions with low input and poor management practices leading to lower productivity level. Therefore, the need for introducing new technologies for increasing and sustaining the yields in rainfed areas can hardly be over emphasized. Intercropping system is one such method which offers great scope for sustainability in the overall productivity and profitability under dryland conditions. Many scientists working on intercropping system proved that this practice is remunerative and gives yield advantages over sole crops provided, it is properly planned and crops are not competitive to each other (Tarhalkar and Rao, 1975). Due to energy crisis and poor purchasing power of small and marginal farmers, it is very difficult to meet the demand of plant nutrients through fertilizers. Small farmers cannot offered to invest more on due to high fertilizer cost. Hence, these should be used judiciously, economically and low cost technology should be developed for higher productivity and sustaining soil fertility. Hence, the present study was undertaken to study the economics and yield advantage under intercropping system involving pigeonpea and sunflower.

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EXPERIMENTAL METHODS

The soil of the experimental field was medium black having bulk density of 1.32 mg m^{-3}. The soil had 8.49, 0.16 dS/m and 0.49 per cent of pH, electrical conductivity and organic carbon, respectively. The soil had fertility status of 226.90 kg nitrogen ha^{-1}, 37.85 kg phosphorus ha^{-1} and 283.53 kg potassium ha^{-1}. The distribution of rainfall was normal during the crop season (463.3 mm).

The experiment comprised of 11 fertilizer treatments (9 intercropped treatments and 2 sole crop treatments).The experiment was laid out in randomized block design with three replications. The gross plots was 7.2 m x 6.0 m and net plot size of intercropped treatments , sole pigeonpea and sole sunflower was 4.8 m x 5.4 m , 5.4 m x 5.2 m and 6.0 m x 5.4 m, respectively.

Pigeonpea (ICPL-8863) and sunflower (RSFH-130) were sown in 1:1 row ratio by giving 90 cm x 20 cm spacing for sole pigeonpea, 60 cm x 30 cm for sole sunflower and in the intercropping 30 cm was given as intra row space for sunflower and 15 cm for intra row space for pigeonpea.

The fertilizers were applied as per the treatment on the basis of actual population occupied by component crop considering their recommended dose of fertilizers.The fertilizer was applied 5 cm away from the seed line. Observations on growth and yield attributes were recorded for both the component crops.

Data on yield parameters were collected and economics of cropping system was estimated. Pigeonpea equivalent yield, land equivalent ratio, area time equivalent ratio and benefit cost ratio was computed by using yield data to know the yield advantage in the intercropping system.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been discussed in detail under following heads :

Yield of pigeonpea and sunflower:

Intercropping reduced the yield of pigeonpea and sunflower when compared to sole crop yields of both the crops. Among the different fertilizer treatments, the treatments which received 100 per cent RDF to both the crops gave significantly higher seed yield of pigeonpea (13.96 and 14.66 q ha^{-1} in T_2 and T_9, respectively). Seed yield of sunflower (13.68 and 13.97 q ha^{-1} in T_2 and T_9, respectively) when compared to unfertilizer control (T_1)(Table 1). This was due to availability of optimum amount of nutrients at the disposal of pigeonpea and sunflower and reducing the competition between both the crops which enhanced better root development and greater dry matter production by the crops under an adequate and balanced

Table 1 : Productivity, land equivalent ratio and area time equivalent ratio of pigeonpea and sunflower intercropping (1:1) system influenced by fertilizer management

Treatments		Pigeonpea yield (q ha^{-1})	Sunflower yield (q ha^{-1})	PEY (q ha^{-1})	LER	ATER
T_1	Control (No fertilizer application to both the crops)	7.38	6.88	13.34	0.83	0.63
T_2	100 per cent RDF to pigeonpea and 100 per cent RDF to sunflower as basal dose based on population	13.96	13.68	25.82	1.61	1.21
T_3	100 per cent RDF to pigeonpea and no fertilizer to sunflower	10.71	8.11	17.74	1.09	0.86
T_4	100 per cent RDF of pigeonpea to all rows of both the crops + 100 per cent RDK to sunflower rows based on population	9.41	9.40	17.56	1.09	0.82
T_5	125 per cent RDF of pigeonpea to all rows of both crops + 100 per cent RDK to sunflower rows based on population	9.26	9.78	17.74	1.11	0.82
T_6	100 per cent RDF to pigeonpea and 50 per cent RDF to sunflower as basal dose based on population	12.31	11.23	22.04	1.37	1.04
T_7	T_6 + 50 per cent RDN as top dress at 45 DAS to sunflower based on population	12.54	12.50	23.37	1.46	1.09
T_8	100 per cent RDF to pigeonpea and 50 per cent RDN only to sunflower as basal dose based on population	12.10	10.03	20.79	1.29	0.99
T_9	100 per cent RDF to pigeonpea + 100 per cent RDPK and 50 per cent RDN to sunflower as basal + 50 per cent RDN as top dress at 45 DAS to sunflower based on population	14.66	13.97	26.77	1.66	1.25
T_{10}	Sole pigeonpea with 100% RDF	17.33	--	17.33	1.0	1.0
T_{11}	Sole sunflower with 100% RDF	--	17.08	14.80	1.0	1.0
	S. E.±	0.40	0.38	0.89	0.04	0.01
	C.D.(P=0.05)	1.20	1.14	2.68	0.12	0.03

PEY - Pigeonpea equivalent yield; LER - Land equivalent ratio; ATER-are time equivalent ratio
Pigeonpea - RDF (Recommended Dose of Fertilizer): 25: 50: 00 kg N, P_2O_5 and K_2O ha^{-1}
Sunflower - RDF (Recommended Dose of Fertilizer): 60: 75: 60 kg N, P_2O_5 and K_2O ha^{-1}

nutritional environment. Similar results were reported by Jain *et al*. (2001), Itnal *et al*. (1994), Paslawar *et al.* (1997) and Gupta and Rathore (1995).

Pigeonpea equivalent yield:

The intercropping system had a significant influence in obtaining higher pigeonpea equivalent yield over either of sole cropping except unfertilized control. This was to the extent of one to 54 per cent over sole cropped pigeonpea. Among the intercropping treatments, T_2 and T_9 indicated significantly higher pigeonpea equivalent yield over other treatments (25.82 and 26.77 q ha^{-1}) (Table 1).This was due to higher seed yields of component crops owing to optimum nutrient availability (100 % RDF to both the crops) coupled with higher price of both the crops contributed to higher pigeonpea equivalent yield. Similar results were obtained by Gupta and Rathore (1995); Yadav *et al.* (1996) and Sharma and Rajput (1996).

Land Equivalent Ratio (LER) and Area Time Equivalent Ratio (ATER):

The land equivalent ratio and area time equivalent ratio revealed the merits and demerits of intercropping system. All the intercropped fertilized treatments recorded significantly higher land equivalent ratio over sole cropping except unfertilized control (T_1). Higher land equivalent ratio of 1.61 and 1.66 was obtained in the treatment T_2 and T_9, respectively. Thus, the yield advantage of about 9 to 66 per cent was obtained due to fertilization of pigeonpea and sunflower intercropping over their sole cropping. Higher area time equivalent ratio of 1.25 was obtained in the treatments, T_9 (100 per cent RDF to pigeonpea + 100 per cent RDPK and 50 per cent RDN to sunflower as basal + 50 per cent RDN as top dress at 45 DAS to sunflower based on population).These values indicated that intercropping system was highly efficient in utilizing the growth resources than sole cropping of both crops (Table 1).Land equivalent ratio and area time equivalent ratio obtained in unfertilized control suggested that without proper fertilizer management in intercropping system yield advantages cannot be achieved. Similar results of higher LER and ATER were reported by several workers (Billore *et al*., 1993; Jain *et al.,* 2001; Agasimani *et al.,* 1994; Sharma and Rajput, 1996; Yadav *et al.,* 1995; Verma *et al.,* 2005).

Economics:

In the present investigation all the intercropped fertilized treatments obtained significantly higher gross returns, net returns and benefit cost ratio over sole crops except the unfertilized control, T_1 and T_3. The treatment T_9 obtained significantly higher gross returns (Rs. 80,302.00 ha^{-1}), net return (Rs. 62,308.00 ha^{-1}) and benefit cost ratio (3.46). This was closely followed by T_2 (Rs. 77,448.00, Rs. 59,718.00 ha^{-1} and 3.37 of gross returns, net returns and benefit cost ratio, respectively)

Table 2 : Economics of pigeonpea and sunflower intercropping (1:1) system influenced by fertilizer management

Treatments		Economics (Rs. ha^{-1})			B: C
		Gross return	Cost of cultivation	Net return	
T_1	Control (No fertilizer application to both the crops)	40,028.00	14,208.00	25,819.00	1.82
T_2	100 per cent RDF to pigeonpea and 100 per cent RDF to sunflower as basal dose based on population	77,448.00	17,729.00	59,718.00	3.37
T_3	100 per cent RDF to pigeonpea and no fertilizer to sunflower	53,216.00	16,051.00	37,164.00	2.32
T_4	100 per cent RDF of pigeonpea to all rows of both the crops + 100 per cent RDK to sunflower rows based on population	52,670.00	16,262.00	36,407.00	2.24
T_5	125 per cent RDF of pigeonpea to all rows of both crops + 100 per cent RDK to sunflower rows based on population	53,208.00	16,509.00	36,698.00	2.22
T_6	100 per cent RDF to pigeonpea and 50 per cent RDF to sunflower as basal dose based on population	66,128.00	16,926.00	49,201.00	2.91
T_7	T_6 + 50 per cent RDN as top dress at 45 DAS to sunflower based on population	70,120.00	17,189.00	52,930.00	3.08
T_8	100 per cent RDF to pigeonpea and 50 per cent RDN only to sunflower as basal dose based on population	62,378.00	16,486.00	45,891.00	2.78
T_9	100 per cent RDF to pigeonpea + 100 per cent RDPK and 50 per cent RDN to sunflower as basal + 50 per cent RDN as top dress at 45 DAS to sunflower based on population	80,302.00	17,993.00	62,308.00	3.46
T_{10}	Sole pigeonpea with 100% RDF	51,990.00	12,443.00	39,547.00	3.18
T_{11}	Sole sunflower with 100% RDF	44,408.00	11,122.00	33,285.00	2.99
	S.E.±	-	-	1095	0.06
	C.D. (P=0.05)	-	-	3285	0.20

Pigeonpea - RDF (Recommended Dose of Fertilizer): 25: 50: 00 kg N, P_2O_5 and K_2O ha^{-1}
Sunflower - RDF (Recommended Dose of Fertilizer): 60: 75: 60 kg N, P_2O_5 and K_2O ha^{-1}

(Table 2). At a fixed level of fertilizer to pegeonpea (100 per cent RDF) and decreasing fertilizer dose to sunflower (varied reduction) reduced the net income and benefit cost ratio significantly and application of even 50 per cent RDF to sunflower significantly improved the net income and benefit cost ratio of intercropping system. Similarly higher remunerative returns were observed in intercropping system over sole cropping by several workers (Jain *et al.,* 2001; Agasimani *et al.,* 1994; Yadav *et al.,* 1995; Rathod *et al.,* 2004; Verma *et al.,* 2005; Patil *et al*., 2007).

Conclusion :

The intercropping not only helps to solve the problem of pulses and oilseed production but also helps to bring additional income to farmers and to get higher benefits with lower cost of cultivation and helps to utilize the growth resources, time (duration) very efficiently and numerically the land usage can be intensified.

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