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Productivity and Economics of Maize and Pigeonpea Intercropping Under Rainfed Condition in Northern Transitional Zone of Karnataka*

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Abstract : A field experiment was conducted during kharif season of 2004 at Main Agricultural Research Station, Dharwad (Karnataka) to study the feasibility and adaptability of intercropping of maize and pigeonpea in 1:1,2:1,2:2,3:1 and 4:2 row proportions with 50 and 100% pigeonpea population levels. Sole crop of maize and pigeonpea recorded significantly higher grain yield (6337 and 1090 kg ha^{-1} respectively) over intercropping systems. Among intercropping systems, intercropping of maize and pigeonpea at 4:2 row ratio with 50 per cent pigeonpea population resulted in maximum maize equivalent yield (8076 $kgha^{-1}$), net returns (Rs. 30492 ha^{-1}) and B:C ratio (2.75) over other intercropping systems and sole crops.

Keywords : Maize, pigeonpea, Intercropping, land equivalent ratio, equivalent yield.

Introduction

The main concept of intercropping is to get increased total productivity per unit area and time, besides equitable and judicious utilization of land resources and farming inputs including labour. One of the main reasons for higher yields in intercropping is that the component crops are able to use natural resources differently and make better overall use of natural resources than grown separately (Willey, 1979). A careful selection of crops having different growth habit can reduce the mutual competition to a considerable extent.In the present investigation both maize and pigeonpea provides an opportunity to grow them together as they have different growth habit and maturity period (Singh and Singh, 1980). The pigeonpea being deep rooted and slow growing in its early growth stage, during which the more rapidly growing crop like maize can be conveniently intercropped to utilize the natural resources more efficiently.

Material and Methods

A field experiment was conducted during kharif season of 2004-05 at the Main Agricultural Research Station, Dharwad on medium deep black soil with pH 7.2. The available nitrogen, phosphorous and potassium content of the soil were 212.78,31.74 and 326.23 Kg ha^{-1} respectively. There were 12 treatment combinations comprising sole crop of maize (Cv.DMH-2) and pigeonpea (Cv.Asha) and five intercropping system involving row proportions of 1:1, 2:1, 2:2, 3:1 and 4:2 of maize and pigeonpea with 50 and 100 per cent population of pigeonpea. The experiment was laid out in a randomized block design with three replications with a gross plot size of 7.2 m x 5.4 m. The population of maize was maintained at 100 per cent of its sole optimum (55,555 plants/ha) whereas that of pigeonpea at 50 and 100 per cent of its sole optimum (55,555 plants ha^{-1}) in all the intercropping treatments by adjusting the intra-row spacing. The sole crops of maize and pigeonpea were sown at a spacing of 60 cm x 30 cm. The recommended dose of fertilizers for maize (100:50:25 N, P_2O_5 and K_2O kg ha^{-1}) and pigeonpea (25:50 N, P_2O_5 kg ha^{-1}) were applied as basal dose in the form of urea, diammonium phosphate and muriate of potash independently as per plant population. For maize crop N was applied in two splits, 50 per cent as basal dose and remaining 50 per cent at the time of tasseling stage. The crops were sown on 16-07-2004 and the required plant population was maintained. Maize and pigeonpea crops were harvested on 21.11.2004 and 20.01.2005 respectively. Weeding and plant protection measures were taken up as per the package. The total rainfall received during the crop growth period was 472.8 mm as against the 50 years average rainfall of 564.2 mm.

Results and Discussion

The data on grain yield of maize, pigeonpea, maize equivalent yield, land equivalent ratio (LER), area time equivalent ratio (ATER), net returns and B:C ratio obtained from sole crops as well as intercropping system of maize + pigeonpea in different row proportions are presented in table 1. The results showed that, sole maize and sole pigeonpea recorded significantly higher grain yield (6337 and 1090 kg per ha respectively) while the yield of the component crops was reduced significantly in the intercropping system. Among intercropping systems, maize + pigeonpea (50%) at 3:1 row ratio recorded higher maize grain yield (5833 kg/ha) compared to other intercropping treatments. This treatment has recorded 3.88 to 26.83 per cent higher seed yield over remaining row ratios. This was mainly due to higher dry matter production, number of grains per cob and grain weight per plant (Table 2). Lower grain yield of maize was recorded in other row proportions and the extent of reduction was lower in 2:1 and 4:2 row proportion as compared to 1:1 and 2:2 row proportion.

Pigeonpea yield also varied significantly due to different row proportions. Maize + Pigeonpea at 2:2 row ratio

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Table 1. Yield, economics and competitive indices of maize based cropping system as influenced by intercropping of maize and pigeonpea

Treatments	Maize grain yield (kg/ha)	Pigeonpea grain yield (kg/ha)	Maize equivalent yield (kg/ha)	Net returns (Rs./ha)	B:C ratio	Land equivalent ratio	Area time equivalent ratio
Maize + pigeonpea (100%) (1:1)	4599 e	770 bc	7191 b	24110 c	1.76 d	1.41a	1.18 ab
Maize + pigeonpea (50%) (1:1)	4752 e	725 cd	7237 ab	26917 bc	2.42 b	1.41a	1.16 ab
Maize + pigeonpea (100%) (2:1)	5121 cde	684 de	7513 ab	25562 bc	1.87 cd	1.43 a	1.15 ab
Maize + pigeonpea (50%) (2:1)	5311 bcd	638 ef	7542 ab	28282 ab	2.55 ab	1.46 a	1.13 ab
Maize + pigeonpea (100%) (2:2)	4735 e	814 b	7526 ab	25875 bc	1.89 cd	1.49 a	1.23 a
Maize + pigeonpea (50%) (2:2)	4867 de	781 bc	7424 ab	28541ab	2.57 ab	1.48 a	1.14 ab
Maize + pigeonpea (100%) (3:1)	5617 bc	602 f	7681 ab	26695 bc	1.95 cd	1.49 a	1.13 ab
Maize + pigeonpea (50%) (3:1)	5833 b	508 g	7570 ab	28677 ab	2.58 ab	1.38 a	1.10 b
Maize + pigeonpea (100%) (4:2)	5461 bc	716 cd	8027 ab	27929 ab	2.04 c	1.51a	1.24 a
Maize + pigeonpea (50%) (4:2)	5615 bc	672 de	8076 a	30492 a	2.75 a	1.49 a	1.20 ab
Sole maize	6337 a	-	6254 c	24071 c	2.61ab	1.00 b	1.00 c
Sole pigeonpea	-	1090 a	3639 d	10849 d	1.23 e	1.00 b	1.00 c
Sem±	163.88	21.05	252.65	1025.22	0.08	0.04	0.04
CD (0.05)	483.37	62.08	740.92	3006.55	0.23	0.13	0.12

Table 2. Growth and yield components of maize and pigeonpea as influenced by intercropping system

Treatments	Maize			Pigeonpea		
	Total dmp* at harvest plant^{-1}(g)	No of grains per cob	Grain weight plant^{-1}(g)	Total dmp at harvest plant^{-1} (g)	No. of pods per plant	Grain weight plant^{-1} (g)
Maize + pigeonpea (100%) (1:1)	284.71 e	397 e	104.58 g	87.32 d	114.30 c	24.72 bcd
Maize + pigeonpea (50%) (1:1)	291.26 de	418 de	110.48 d	90.01 cd	117.50 c	26.36 bc
Maize + pigeonpea (100%) (2:1)	317.93 bcd	459 bcd	123.60 bc	71.06 e	96.16 def	18.86 e
Maize + pigeonpea (50%) (2:1)	321.59 bcd	471bc	127.00 b	74.09 e	99.93 de	21.78 cde
Maize + pigeonpea (100%) (2:2)	294.49 cde	413 de	111.72 d	98.23 c	133.83 b	25.77 bc
Maize + pigeonpea (50%) (2:2)	302.98 b-e	424 cde	113.73 cd	109.63 b	137.76 b	26.77 b
Maize + pigeonpea (100%) (3:1)	325.33 bc	494 b	126.81b	54.66 f	87.53 f	18.83 e
Maize + pigeonpea (50%) (3:1)	330.10 b	504 b	131.91 ab	60.38 f	90.13 ef	20.38 de
Maize + pigeonpea (100%) (4:2)	318.18 bcd	471 bc	124.01 bc	73.66 e	97.83 def	21.32 cde
Maize + pigeonpea (50%) (4:2)	323.27 bcd	481 b	126.28 b	76.04 e	102.30 d	21.46 cde
Sole maize	360.23 a	556 a	141.49 a	--	--	--
Sole pigeonpea	--	--	--	129.36 a	150.21 a	33.92 a
SEm+	9.90	15.04	3.45	2.94	3.19	1.52
CD (0.05)	29.22	44.38	10.17	8.67	9.40	4.51

* dmp - Dry matter production

with 100 per cent pigeonpea population recorded significantly higher grain yield (814 kg/ha) over other systems but was on par with same row ratio at 50 per cent pigeonpea population and 1:1 row ratio at 100 per cent pigeonpea population. The higher grain yields of pigeonpea with 2:2 row ratio was mainly attributed to higher growth and yield components viz., dry matter production, number of pods per plant and grain weight per plant. The lower grain yield was recorded with 3:1 row ratio. These results are in agreement with the findings of Rathod *et al*. (2004) and Sutaria and Mehta (2000). Pigeonpea population level had significant influence on the maize grain yield. Irrespective of row proportions, maize yields were higher with 50 per cent pigeonpea population compared to 100 per cent pigeonpea population level in the intercropping system. This might be due to lesser competitions from pigeonpea for natural resources at 50 per cent population than 100 per cent population level. Madar (2001) also recorded higher yield of maize under lower population level (50%) of pigeonpea in maize, pigeonpea and cowpea intercropping system.

Intercropping of maize + pigeonpea (50%) at 4:2 row ratio gave significantly higher maize equivalent yield (8076 kg/ha) compared to sole crop of maize (6254 kg/ha) or pigeonpea (3639 kg/ha). The maize equivalent yield obtained under intercropping system was 29.13 and 121.9 per cent higher over that of sole maize and pigeonpea, respectively. The higher maize equivalent yield with this treatment was due to higher yield of both the component crops in the system. Similar results were reported by Madar (2001). The land equivalent ratio (LER) and area time equivalent ratio (ATER) are also considered as one of the measures to judge the efficiency of the intercropping system. In the present investigation, it was observed that intercropping of maize + pigeonpea at 4:2 row proportion with 100 per cent pigeonpea population recorded higher LER and ATER values (1.51 and 1.24, respectively) compared to other intercropped treatments. Higher LER and ATER under intercropping of maize and pigeonpea indicated that not only the efficient use of land, but efficient use of time also. Sarkar and Shit (1990) and Quiroz and Marin (2003)

recorded higher LER and ATER in maize based intercropping system compared to sole cropping. Net returns and B:C ratio were also higher with intercropping systems compared to sole crops. Maize + pigeonpea (50%) in 4:2 row ratio gave higher net income and B:C ratio (Rs.30492/ha and 2.75, respectively) compared to sole crops and other intercropped treatments. The higher net income and B:C ratio with this treatment was due to higher complimentarity between these two component crops which produce higher biological out put and their by more net returns. These results are in conformity with the findings of Crasta and Dixit (1990) and Madar (2001). It can be concluded from the study that intercropping of maize + pigeonpea (50%) at 4:2 row proportion is more productive and remunerative than sole crop of maize or pigeonpea and other intercropping systems under rainfed conditions of northern transitional zone of Karnataka.

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