

Intercropping compatibility of different crops with winter maize (*Zea mays*)

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ABSTRACT

A field experiment was conducted during the winter seasons of 1989–90 and 1990–91 to study the productivity, land-equivalent ratio and economics of winter maize (*Zea mays* L.) at Ghagharaghat. The grain yield of maize in both the years was the highest in paired sowing (sole), but the total grain equivalent of maize was highest in paired-sown maize + French bean (*Phaseolus vulgaris* L.) in ratio of 1 : 2. This treatment also gave the highest net return (Rs 10,032/ha) and monetary advantage (Rs 11,941/ha), followed by paired-sown maize + lentil (*Lens culinaris* Medikus) in ratio of 1 : 3. The latter treatment, however, had the highest land-equivalent ratio (1.77) and benefit : cost ratio (2.37). The seed yields of French bean, wheat (*Triticum aestivum* L. emend. Fiori & Paol.), lentil and linseed (*Linum usitatissimum* L.) were reduced by intercropping.

Winter maize (*Zea mays* L.) owing to its high yield is preferred to rainy-season maize and other winter crops. In the crop, the growth up to the middle of December remains normal and thereafter due to low temperature growth almost ceases till January. Therefore during this phase of growth, there is an ample scope for growing intercrops in between the rows of maize to get more return from unit area of land.

Row arrangement and intercropping with legumes like lentil (*Lens culinaris* Medikus), French bean (*Phaseolus vulgaris* L.) and broad bean (*Vicia faba* L.) had an added advantage over sole cropping. Planting pattern or geometry not only helps maximum utilization of natural resource like sunlight but also helps arrange higher plant population, which in turn contributes to higher yield of crops (Prasad and Prasad, 1988). Keeping in view the economic status

and smaller holding of the farmers and nitrogen-fixing characteristics of legumes, cereal–legume and cereal–cereal combinations have been tried by many workers (Ahlawat *et al.*, 1981; Singh and Verma, 1985). Hence there is need to study the production potential of different winter (*rabi*) crops in winter maize under 2 crop geometries. Therefore the present experiment was planned.

MATERIALS AND METHODS

The experiment was conducted during 1989–90 and 1990–91 at Ghagharaghat. The soil was sandy loam with pH 8.2, organic carbon 0.35%, P_2O_5 @ 23.7 kg/ha and available K_2O @ 299.0 kg/ha. The mean precipitation received during the respective season was 70.5 and 81.2 mm. The crops were irrigated at knee-high, tasselling and grain-formation stages, which were concided

with the application of top-dressing of N. Seventeen treatments were undertaken in randomized block design with 4 replications (Table 1). The maize ('Deccan 103') was sown in the second week of October in both years. The plant population of maize in both planting systems was maintained. One row of broad bean ('Local') and French bean ('PDR 14') and 2 rows of wheat ('HUW 234'), lentil ('PL 406') and linseed ('Mukta') were taken in between 2 rows of paired-sown maize. Recommended fertilizer was applied to the all crops. Monetary-advantage index and land-equivalent ratio were also computed (Willey, 1979).

RESULTS AND DISCUSSION

Yield of winter maize and intercrops

The highest yield of maize crop was obtained with sole paired planting (40/80 cm) and the lowest when the maize was intercropped with wheat in normal planting (Table 1). Maize grown under paired planting combinations, gave higher grain yield than normal maize intercropping system, because of lesser competition for light, water, space and nutrients faced by intercrops. The grain yield of maize decreased due to intercropping in either planting system. The reduction in maize yield compared with pure crop recorded was 6.3% in broad bean, 4.1% in French bean, 21.1% in wheat, 8.3% in lentil and 10.5% in linseed in normal planting and 5.9, 2.9, 20.1, 8.0 and 11.3% in respective crops under the paired planting of maize.

Sole crops of broad bean, French bean, wheat, lentil and linseed gave higher seed yields per hectare than when grown as intercrop. The increase in yields was mainly due to higher plant density under the sole cropping compared with intercropping combinations.

Maize equivalent

The highest maize-grain equivalent was recorded under intercropping system of paired maize + French bean (76.02 and 75.53 q/ha) during 1989-90 and 1990-91 respectively, and the lowest in sole broad bean in both the years. In general, all the sole crops gave lower maize-grain-yield equivalent than all the intercropping treatments in both the years. Among the intercropping treatments, paired-sown maize + French bean under 1 : 2 row arrangement gave the highest mean maize equivalent (75.78 q/ha), followed by paired maize + lentil (1 : 3) and paired maize + French bean (1 : 1) ratio. This may be attributed to N-fixing behaviour of legumes and higher canopy cover, resulting in the reduced evapotranspiration (Shah *et al.*, 1991). However, additional advantage of intercrop yield and higher economic value of French bean, lentil, wheat and linseed than winter maize were responsible for higher maize equivalent.

The land-equivalent ratio was significantly affected by the intercropping treatments during both the years (Table 1). Paired maize + lentil in 1 : 3 ratio gave the high mean land-equivalent ratio (1.78), followed by paired maize + French bean in 1 : 2 ratio. Further, the land-equivalent ratio calculated from combined intercrops yield was always higher compared with sole crop. This indicates the greater biological efficiency of intercropping treatments. The mean lowest value of land-equivalent ratio was 1.55 under normal sown maize (60 cm) + wheat (1 : 2). The reason being the severe competition in earlier stage amongst each other, reducing the yield of both crops. Contrary to this, the growth of maize was slow in the beginning and offered least competition to French bean and lentil.

Table 1. Grain yield, maize equivalent, land-equivalent ratio and economics of maize-based intercropping systems (mean of 2 years)

Treatment	Grain yield (q/ha)		Maize equivalent (q/ha)	Land-equivalent ratio	Cost (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	Benefit : cost ratio
	Main	Intercrop						
Maize (60 cm) + broad bean (1 : 1)	36.57	19.35	53.39	1.65	6,098	12,280	6,182	2.01
Maize (60 cm) + French bean (1 : 1)	37.32	8.33	71.70	1.62	7,297	16,492	9,193	2.26
Maize (60 cm) + wheat (1 : 2)	32.11	25.83	59.09	1.55	7,390	13,580	6,190	1.84
Maize (60 cm) + lentil (1 : 2)	35.90	9.66	63.18	1.70	6,213	14,532	8,319	2.34
Maize (60 cm) + linseed (1 : 2)	35.18	8.50	56.61	1.63	6,293	13,020	6,727	2.07
Maize (60/80 cm) + broad bean (1 : 2)	37.84	20.23	55.43	1.68	6,297	12,750	6,453	2.02
Maize (40/80 cm) + French bean (1 : 2)	38.96	8.92	75.78	1.69	7,398	17,430	10,032	2.35
Maize (40/80 cm) + wheat (1 : 3)	33.38	27.42	61.99	1.60	7,491	14,258	6,767	1.90
Maize (40/80 cm) + lentil (1 : 3)	37.13	10.27	66.15	1.78	6,515	15,214	8,799	2.37
Maize (40/80 cm) + linseed (1 : 3)	36.03	9.51	60.68	1.71	6,519	13,802	7,283	2.11
Sole maize (60 cm)	38.89		38.89	1.00	4,098	8,944	4,846	2.18
Sole maize (40/80 cm)	40.11		40.11	1.00	4,098	9,226	5,128	2.25
Sole broad bean		27.29	23.73	1.00	2,597	5,458	2,861	2.10
Sole French bean		12.45	51.42	1.00	3,996	11,828	7,832	2.96
Sole wheat		35.48	37.02	1.00	4,472	8,315	4,043	1.90
Sole lentil		12.38	34.98	1.00	2,711	8,048	5,337	2.97
Sole linseed		11.66	29.39	1.00	2,819	6,760	3,941	2.39
CD (P = 0.05)	0.91		1.95	0.06		300	305	

Economics

Paired-sown maize + French bean in 1 : 2 ratio gave the highest gross and net returns, followed by paired-sown maize + lentil in 1 : 3 ratio. The higher gross returns were the result of more total produce and higher support prices of French bean and lentil. The lowest net returns were recorded under sole broad bean. French bean (sole) gave the higher net return than linseed, broad bean and wheat grown either as an intercrop with normal planting or as paired planting of maize in both the years. The highest benefit : cost ratio was obtained under sole lentil during 1989–90 and sole French bean during 1990–91, whereas the lowest under maize (60 cm) + wheat grown in 1 : 2 ratio.

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