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Ricebean (*Vigna umbellata*) Productivity under various Maize-Ricebean Intercropping Systems

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ABSTRACT

Studies to determine a suitable maize-ricebean intercropping system were carried out at the Agronomic Research Area, University of Agriculture, Faisalabad during 1995 and 1996. The experiment was laid out using randomized complete block design with four replications. The experimental treatments were: Maize alone, ricebean alone, maize + one row of ricebean, maize + two rows of ricebean and maize + three rows of ricebean. Maize was planted in 90 cm apart double row strips and ricebean was intercropped between the strips. Various intercropping systems resulted in lower yield of both the component crops than sole crops but the income ha^{-1} was increased due to intercropping. Maximum monetary benefits (benefit cost ratio 3.03) over sole cropping were obtained from maize intercropped with rows of ricebean.

Key Words: Ricebean; Maize; Intercropping system; Benefit cost ratio; Sole crops

INTRODUCTION

The consumption and production of food legumes in the country has resulted in a wider gap leading to importing pulses from other countries on large scale to meet the country's requirements. Multiple cropping offers one of the best ways of increasing production per unit area in both irrigated and non-irrigated crop husbandry and in this system two crops of dissimilar growth habit can be grown in the same field with little intercrop competition (Saxena, 1972).

Traditionally, intercropping is being used by small farmers to increase the density of their products and stability of their output. However, with rapid increase in population and reduction in cultivated area, intercropping is being looked upon as an important strategy for intensifying land use and for absorbing surplus farm labour.

Ricebean (*Vigna umbellata*) a new introduction in the country, is a versatile crop. It is a good food grain, a fodder, and a cover crop. However, its economic utility and complete production technology is yet to be determined (Ahmad & Ashiq, 1992). Ricebean is reported to produce 3000 kg seed and upto 8000 kg ha^{-1} dry herbage to meet scarcity of green forage during lean periods i.e. April-June and November-December (Mukherjee *et al*., 1980). Ricebean seeds, besides being a good source of proteins upto 24% (Chandel *et al*., 1978) have a very high in vitro digestibility upto 82-85% (Rodriguez & Mendoza, 1991).

Intercropping being a unique asset of tropical and sub-tropical areas is more popular among small farmers (Finlay, 1975). Grain legumes are an integral part of many polycropping systems for good grain production throughout the world (ICRISAT, 1981). Effective and efficient utilization of nutrients and water, better interception of solar radiation, risk reduction and a high exploration of the growth factors in an intercropping system has also been reported (Faris *et al*., 1976). Maize-legume intercropping is one of the best practices for increased of pulses. Maximum benefits could be obtained when the component crops have least competition, i.e. growing them in widely spaced rows without reducing their population density. The present studies were, therefore, undertaken to determine a suitable intercropping system for ricebean for harvesting the maximum benefits per unit area.

MATERIALS AND METHODS

Studies pertaining to see the effect of various maize-ricebean intercropping systems on the performance of component crops were conducted at the Agronomic Research Area, University of Agriculture, Faisalabad on a sandy clay loam soil during 1995 and 1996. The experiment was laid out using randomized complete block design with four replications and net plot size was 3.6 x 5 m. The experimental treatments were: Maize alone ricebean alone, maize + one row of ricebean, maize + two rows of rice bean and maize + three rows of ricebean. Maize variety Golden was planted in 90 cm apart double row strips and ricebean was intercropped in one, two or three rows. Both the crops were sown simultaneously in the first week of August. All other cultural practices were kept uniform for all the treatments. The observations were recorded on different plant parameters of both the component crops using standard procedures. Both the crops were harvested in the last week of November each year at full maturity. The data collected were analysed using Fisher's

analysis of variance technique. Least significant difference (LSD) test at 0.05 P was used to compare the differences among the treatment's means (Steel & Torrie, 1984).

The pooled experimental data were analysed using the methodology described in economics training manual (CIMMYT, 1988). The net benefits and benefit cost ratio (BCR) values were calculated to determine the economic efficiency of the intercropping systems.

RESULTS AND DISCUSSION

Main crop (Maize). The data in Table I reveal that ricebean caused significant reduction in number of plants m^{-2} of maize crop. However, maize in different associated cultures had statistically the same plant population. Reduction in plant population due to intercropping has also been reported by Ahmad (1984) in wheat crop. Intercropping had also significant effect on maize plant height. Maximum plant height (212.1 cm) was recorded in maize alone, that however, did not differ statistically from maize + one row of ricebean. The minimum plant height (186.9 cm) was observed in treatment where ricebean was intercropped in three rows. Reduction in plant height may be due to intense intercrop competition for various growth resources. Similar results have also been reported by Karamullah (1989).

Intercrop ricebean had significant effect on crop growth rate (CGR) of associated maize crop (Table I). Maximum CGR (20.83 g m^{-2} d^{-1}) was recorded in maize planted alone while the minimum CGR (15.81 g m^{-2} d^{-1}) was noted in maize intercropped with ricebean in three rows. Reduction in CGR due to intercropping had also been reported by Lima and Mafra (1980). Number of grains/cob were, however, not affected significantly by the intercrop competition. Similarly, intercropping have non-significant effect on the 1000-grain weight of maize crop which is contradictory to the Karamullah (1989) who reported that 1000-grain weight of main crop was decreased due to intercropping.

Intercropping significantly affected grain yield of maize crop. A substantial reduction in grain yield of associated maize crop was observed as compared to maize alone. The minimum grain yield was recorded from plots where maize was intercropped with three rows of ricebean. Khalil (1990) and Himayatullah (1992) also reported reduction in grain yield of maize due to intercropping.

Intercrop (Ricebean). Intercrop ricebean resulted in maximum number of plants m^{-2} (11.87) when planted in three rows-between maize while minimum plants m^{-2} (4.70) were noted where one row of ricebean was intercropped in maize (Table II). This variation existed because of the variable number of rows of ricebean maintained under different intercropping systems. Intercropping treatments reduced plant height of ricebean significantly compared with ricebean alone.

Intercropping caused significant reduction in number of pods per plant compared with sole crop of ricebean producing the maximum (83.55) number of pods $plant^{-1}$. Reduction in number of pods due to intercropping has also been reported by Galal *et al.* (1979) who intercropped soybean in maize.

1000-grain weight of intecrop ricebean was significantly lower than the ricebean alone. All the intercropped treatments produced statistically similar 1000-grain weight than the sole crop. Similar findings have also been reported by Lima and Mafra (1980).

Grain yield of ricebean under intercropping was significantly low as compared with the ricebean sole crop (Table II). Intercropping of one, two and three rows of ricebean between rows of maize resulted in 67.74, 64.20 and 68.23% reduction of grain yield of ricebean,

Table I. Growth and yield characteristics of maize as influenced by intercropping of ricebean

Treatments	No. of plants (m^{-2})	Plant height (cm)	Crop Growth rate (gm^{-2} d^{-1})	No. of grains/cob	1000-grain weight (g)	Grain yield (kg/ha)
Maize alone	6.60 a	212.1 a	20.83 a	355.42 NS	251.26 NS	6629 a
Maize + One row of ricebean	5.94 b	203.0 ab	17.49 bc	357.32	245.15	5649 b
Maize + Two rows of ricebean	5.71 b	193.9 bc	19.55 ab	403.15	244.11	5736 b
Maize + Three rows of ricebean	5.69 b	186.9 c	15.81 c	355.97	219.60	5035 c

Table II. Growth and yield characteristics of intercrop ricebean as influenced by various intercropping system

Treatments	No. of plants (m^{-2})	Plant height (cm)	No. of pods/plant	1000-grain weight (g)	Grain yield (kg/ha)	Grain protein content (%)
Ricebean alone	10.05 b	158.4 a	83.55 a	51.03 a	1979.0 a	21.58 a
Maize + One row of ricebean	4.70 d	111.3 b	47.70 b	45.85 b	650.0 b	19.99 b
Maize + Two rows of ricebean	8.77 c	104.3 b	45.85 b	46.45 b	704.4 b	20.34 b
Maize + Three rows of ricebean	11.87 a	95.4 b	40.90 b	45.25 b	644.7 b	19.19 c

Table III. Economic Analysis

Treatments	Maize yield (kg/ha)		Ricebean yield (kg/ha)		Ricebean income (Rs.)		Ricebean income (Rs.)		Gross income (Rs.)	Total expenditure (Rs.)	Net income (Rs.)	Increase over sole cropping	B.C.A.
	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover					
Intercropping Systems													
Maize alone	6629	10708	-	-	38952	2140	-	-	41092	14887	26205	-	2.76
Maize + One row of rice-bean	5649	10689	650.0	3952	34386	2135	8986.02	213	45720.02	15314.50	30405.52	4200.52	2.98
Maize + Two rows of rice-bean	5736	10301	704.4	4335.6	34734	2060	9966.45	206	46966.45	15457	31509.45	5304.45	3.03
Maize + Three rows of rice-bean	5035	9203	644.7	3379	31542	1840	8849.25	184	42515.25	15742	26673.25	468.25	2.69

Cost of production/ha = Rs. 14887

respectively compared with ricebean alone. Competition for light may have effect on bean yield in maize-bean intercropping (Fisher *et al*., 1986).

Intercropping significantly affected the protein contents in rice bean grain. Ricebean grown in various intercropping combinations cultures exhibited substantially lower protein contents than ricebean alone. Low grain protein content in intercropped ricebean may be due to intense intercrop competition for various growth resources such as light, nutrients and water.

Economic analysis. An estimate of the economic aspects of the present studies indicated that the maize-ricebean intercropping systems gave considerably high net income per hectare than sole cropping. The maximum net income (Rs. 31509.45 ha^{-1}) with the highest BCR (3.03) was obtained in case of maize + two rows of ricebean intercropping system.

CONCLUSION

For achieving maximum yield advantages and net income ha^{-1}, maize should be planted in 90 cm spaced double row strips and intercropped with ricebean in two rows between the strips.

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