STUDIES ON PLANTING PATTERNS OF MAIZE (*ZEA MAYS* L.) FACILITATING LEGUMES INTERCROPPING

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ABSTRACT

Effect of planting patterns and intercropping of legumes in maize was studied at Agronomic Research Area, University of Agriculture, Faisalabad on a sandy clay loam soil during autumn 2004. The planting pattern of maize comprised 60 cm spaced single rows, 90 cm spaced double row strips, 90 cm spaced single rows and 135 cm spaced double row strips, while intercrops were mungbean and soybean. The results revealed that soybean + maize in 90 cm spaced double row strips gave maximum maize grain yield (6.71 t/ha). Maximum land equivalent ratio (1.62) was also recorded in 90 cm spaced double row strips, intercropped with soybean. Similarly all intercropping systems gave substantially higher net income over mono-cropping with higher net income (Rs. 56043.50/ha) in case of maize + soybean followed by sole crop of maize (Rs. 52653.50 t/ha).

KEYWORDS: *Zea mays;* soybeans; mung beans; spacing; intercropping; Pakistan.

INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crop of the world after wheat and rice. It is used as food for human beings, feed for livestock and poultry, forage for milch and draft animals. Maize fodder can safely be fed at all stages of growth without any danger of oxalic acid, prussic acid as in case of sorghum or bajra fodders. Maize is the most suitable fodder crop for making silage. Therefore, it is called the king of crops suitable for silage as reported by Muhammad *et al*. (7).

In Pakistan area under this crop is 941 thousand hectares with an annual production of 1771 thousand tons (1). Fischer and Palmer (2) stated that potential yield of maize is larger than that of either wheat or rice and we can expect maize to assume a proportionally larger and more important role in

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world food production. According to Harris (4) in spite of high yield potential, yield recovery at farmer's field in Pakistan is very low, because of inadequate use of inputs and lack of appropriate crop management technology.

Ghosh (3) stated that intercropping offers to farmers the opportunity to engage nature's principle of diversity at their farms. Spatial arrangements of plants, planting rates and maturity dates must be considered when planning intercrops. Intercrops can be more productive than growing pure stands. Pest management benefits can also be realized from intercropping due to Increased diversity. Multiple cropping systems are also prevalent in many parts of the world and farmers in the temperate region have used alternating strips of corn and soybeans (10).

Intercropping is used by subsequent farmers primarily to increase diversity of products and stability of annual output at their farms. However, with rapid increase in farms population and less chance of bringing new lands under cultivation, intercropping seems to be the only way to increase productivity and intensify land use. Most of the farmers have small holdings and are unable to manage their diversified needs from limited area. This situation warrants to develop an appropriate technique of growing field crops in association with each other without too much intercrop interference and competition. Multiple cropping is a solution as presence of multiple crops in a single field also reduces the amount of herbicides or fertilizers applied to that field at any time.

The present study was designed to explore the possibility of intercropping of legumes in maize at different planting patterns in irrigated environment at Faisalabad.

MATERIALS AND METHODS

The study was conducted at Agronomy Research Farm, University of Agriculture, Faisalabad during autumn 2004 on a sandy clay loam soil. The planting patterns of maize comprised 60 cm spaced single rows (P_1), 90cm spaced double row strips (P_2), 90 cm spaced single rows (P_3) and 135 cm spaced double row strips (P_4), while intercrops were mungbean (I_1) and soybean (I_2). The plant population was kept constant and optimum in all four planting geometric arrangements. Replicated thrice, the experiment was laid out in randomized complete block design with spilt plot arrangement randomizing planting patters in main plots and intercrops in sub-plots. Net plot size was measured as 3.60 x 6.00 meters. Maize was sown on a well-

prepared seedbed with single row hand drill on August 7, 2004. Intercrops were sown in space between rows / strips of maize on same day with a single row hand drill. The crops were fertilized @ 150 kg N + 75 kg P_2O_5 per hectare. All P_2O_5 and half of N were applied at sowing by drilling while remaining half of N was top dressed just before tassel initiation. First irrigation was given after three weeks of sowing and subsequent irrigations were given when required. In all six irrigations were given. The crops were kept free from weeds through inter-culture. All other agronomic practices were kept normal and uniform for all treatments. Monoculture of each crop was maintained to calculate land equivalent ratio (LER) using formula described by Willey (11).

$$LER = LER\ (maize) + LER\ (legume)$$

where $LER\ (maize) = \frac{\text{Grain yield of intercropped maize}}{\text{Grain yield of sole maize}}$

and $LER\ (legume) = \frac{\text{Grain yield of intercropped legume}}{\text{Grain yield of sole legume}}$

RESULTS AND DISCUSSION

Grain yield

The data indicated significant differences among various planting patterns, intercropping system and treatment combinations. Maize crop planted in 90cm spaced double row strips produced significantly higher grain yield (6.71 t/ha) as compared to rest of treatments (Table 1). This high grain yield was due to two rows having a suitable space for full light and nutrient absorption. Therefore, this treatment was suitable for high grain production.

Table 1. Maize grain yield as affected by planting pattern and intercropping system.

Intercrops	60 cm spaced single rows	90 cm spaced double row strips	90 cm spaced single rows	135 cm spaced double row strips	Mean
Mungbean	6.46b	6.07d	6.26c	5.63f	6.03B
Soybean	5.95de	6.71a	5.86e	5.58f	6.10A
Mean	6.20B	6.39A	6.06C	5.60D	

Any two means not sharing same letter differ significantly from each other at 0.05 probability level (LSD).

Apparently minimum grain yield (5.60 t/ha) was recorded in 135 cm spaced double row strips. However, grain yield per hectare of maize varied from 5.58

to 6.71 tons. Sharma and Sowley (9) reported that greater row spacing gives more yield of maize in intercropping.

Net income

Maximum net farm income of Rs. 56043.50 was obtained from maize planted at 90 cm spaced double row strips, intercropped with soybean.

Table 2. Net income from different maize-based intercropping systems.

Treatments	Maize yield (t/ha)	Value (Rs.)	Intercrops yield (t/ha)	Value (Rs.)
Maize alone	7.46	67140	-	-
Maize + Mungbean (P_1I_1)	6.46	58140	0.11	3080.0
Maize + Mungbean (P_2I_1)	6.21	55890	0.13	3640.0
Maize + Mungbean (P_3I_1)	6.26	56340	0.09	2520.0
Maize + Mungbean (P_4I_1)	5.63	50670	0.08	2240.0
Maize + Soybean (P_1I_2)	5.82	52380	0.25	6500.0
Maize + Soybean (P_2I_2)	6.71	60390	0.39	10140.0
Maize + Soybean (P_3I_2)	5.86	52740	0.29	7540.0
Maize + Soybean (P_4I_2)	5.25	47250	0.38	9880.0

Gross income (Rs.)	Extra expendt. intercrops (Rs.)	Gross expendt. (Rs.)	Net returns (Rs./ha)
67140.0	-	14486.50	52653.50
61220.0	2029.00	16515.50	44704.50
59530.0	2057.00	16543.50	42986.50
58860.0	2001.00	16487.50	44373.50
52910.0	1987.00	16473.50	38423.50
58880.0	2862.50	17348.50	44393.50
70530.0	2953.50	17440.00	56043.50
60280.0	2888.80	17375.30	45793.50
57130.0	2947.00	17433.50	42643.50

Maize = Rs. 9000/ton, Mungbean = Rs. 28000/ton, Soybean = Rs. 26000/ton

Minimum income Rs. (38423.50) was recorded from 135 cm spaced double row strips, intercropped with mungbean (P_4I_1) followed by 135 cm spaced double row strips + soybean (P_4I_2) (Table 2). Maximum income from 90 cm spacing with double row strips intercropped with soybean was due to better combination and suitable space to absorb light and nutrients from soil.

Land equivalent ratio (LER)

LER values were greater than one in all intercropping systems with different planting patterns which indicated yield advantage of intercropping over sole cropping of maize.

Table 3. Land equivalent ratio of maize-legume intercropping system in different planting patterns.

Treatment	Land equivalent ratio (LER)			
	Maize	Mungbean	Soybean	Total
Maize alone	1.00	1.00	-	1.00
Mungbean alone	-	-	-	1.00
Soybean alone	-	0.20	1.00	1.00
Maize + Mungbean (P_1I_1)	0.86	0.24	-	1.06
Maize + Mungbean (P_2I_1)	0.83	0.16	-	1.07
Maize + Mungbean (P_3I_1)	0.84	0.15	-	1.00
Maize + Mungbean (P_4I_1)	0.76	-	-	0.91
Maize + Soybean (P_1I_2)	0.78	-	0.47	1.25
Maize + Soybean (P_2I_2)	0.89	-	0.73	1.62
Maize + Soybean (P_3I_2)	0.78	-	0.54	1.32
Maize + Soybean (P_4I_2)	0.75	-	0.71	1.41

Maximum LER (1.62) was found in maize intercropped at 90-cm double row strips with soybean (P_2I_2) followed by P_4I_2 (1.41). On the contrary, minimum LER (0.91) was recorded in maize 135 cm double row strips + mungbean (P_4I_1) (Table 3). The results indicated that intercropping of maize + soybean gave higher land use efficiency than mono-cropping of maize. Higher LER in intercropping than mono-cropping has been reported in maize + pigeaonpea by Patra *et al.* (8), maize + soybean by Kalia *et al.* (5) and maize + groundnut by Mandimba (6).

CONCLUSION

It can be concluded that soybean should be sown as an intercrop in 90 cm spaced double row strips of maize to get maximum net income.

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