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EFFECT OF PLANTING SYSTEMS AND NITROGEN LEVELS ON GRAIN YIELD OF MAIZE INTERCROPPED WITH MUNGBEAN

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Abstract

An experiment was conducted at the central research station of BARI, Joydebpur, Gazipur during April to July of 1985 to study the effects of planting systems and nitrogen on grain yield, economic performance and weed infestation in maize (cv Sadaf) and mungbean (cv Mubarik) grown under monoculture and intercrop situation. The planting systems [uniform row (UR) and paired row (PR)] and two levels of N (120 and 60 kg/ha) were tested at constant maize density of 53,333 plants/ha. The highest maize equivalent (5.26 t/ha), LER (1.49), net return (Tk. 14,200.00/ha), benefit cost ratio (2.50), and lowest weed biomass (37.69 g/m^2) were obtained from intercropping of maize and mungbean in PR systems at 120 kg N/ha.

Key words : Maize, Mungbean, Intercrop, Planting system, Nitrogen.

Introduction

Intercropping provides the opportunity to exploit time and space in a land scarce situation like Bangladesh. In the early summer, when there is very limited scope for crop diversification and crop production, intercropping of maize with different summer legumes like mungbean, blackgram, groundnut may be of successful.

Good combination for intercropping in a cereal legume mixture can provide one crop component high in carbohydrates and the other rich in proteins (Bressani, 1975) and help to maintain and improve the soil fertility (Willey 1979 a; 1979 b). Maximum benefits in intercropping occur when component crops are so arranged as to subject them to least competition from the dominant crops by either narrowing the distances between their rows or by widening the row space of the tall crop component of the mixture without altering their plant populations. Therefore, the technique of "paired row" planting has been developed to

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harness the maximum advantage from an intercropping system (Singh, 1983). No information in this aspect is yet available under Bangladesh condition. There is a postulation that non-legumes benefit from their association with legumes (De, 1979; Hashem and Maniruzzaman, 1987). If so, nitrogen requirement may be reduced for maize-legume intercropping system. In kharif season severe crop-weed competition reduces yield of crops. Intercropping reduces weed growth through competition (Enyi, 1973).

This study was undertaken to test the effect of planting systems of maize and nitrogen levels on the yield, economic return and weed infestation in maize-mungbean intercropping.

Materials and Methods

The experiment was carried out at the Central Research Station of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during April to July 1985. The experimental design used was a randomized complete block with four replications. The soil of the experimental site was silty clay loam with p^H 5.4. The soil belongs of the Chiata series of Grey Terrace soils. The following seven treatments (Tr) were tested:

A. Sole maize in uniform row (UR) with 120 kg N/ha.
B. Sole maize in paired row (PR) with 120 kg N/ha.
C. Maize UR + mungbean with 60 kg N/ha.
D. Maize UR + mungbean with 120 kg N/ha.
E. Maize PR + mungbean with 60 kg N/ha.
F. Maize PR + mungbean with 120 kg N/ha.
G. Sole mungbean with 30 kg N/ha.

The seeds were sown in line on April 5, 1985 and emerged on April 9, 1985. Maize cv. Sadaf was planted in two different planting systems namely uniform row (UR) and paired row (PR) systems. In UR system, maize was spaced 75 cm and in PR system two maize rows were spaced at 37.5 cm and two such pairs placed 112.5 cm apart. Distance between maize plants within row was 25 cm. In intercrops, UR systems had two rows of mungbean (cv. Mubarik) between the maize rows while PR systems (37.5/112.5 cm) had four rows of mungbean between the two such pairs of maize rows. In all the treatments, the constant plant population of maize (53,333 plants/ha) and mungbean (only in sole) 3,33,333 plants/ha were maintained. In intercrops, population of mungbean was 66% of the monoculture. Fertilizers were used at the rate of 60-50-20-5 kg P_2O_5, K_2O, S and Zn/ha. Maize received 120 kg N/ha in monoculture and mungbean received 30 kg N/ha in monoculture. Intercrop maize received two levels of N viz. 60 and 120 kg N/ha. Thirty kg N and full dose of all other fertilizers were incorporated into soil in rows of maize and mungbean at the time of seeding. The rest of nitrogen was sidedressed in two splits on maize rows in both sole and intercrops at 20 and 40 days after emergence (DAE). All plots were weeded once at 18 DAE.

An area of 12 m^2 was harvested from both sole and intercrops. Mungbean was harvested at 63 and 75 DAE by handpicking and maize at 95 DAE. Grain weight was adjusted to 12% moisture. Weeds were collected from an area of one square meter from each treatment at 45 DAE and the dry weights were recorded.

Land equivalent ratio (LER), total maize equivalent, relative yields and economic performance of different treatments were computed. Total maize equivalent was computed by converting the yield of mungbean into the yield of maize on the basis of prevailing market price (Bandyopadhyay, 1984).

Results and Discussion

Grain yield of maize

The highest grain yield of maize 4.30 t/ha was obtained from the sole maize in UR planting system with 120 kg N/ha (Tr. A) followed by 4.15 t/ha from sole maize in PR planting system with 120 kg N/ha (Tr. B). These two treatments did not differ significantly indicating that maize yield was not reduced in PR. Maintaining a constant plant population of 1,80,000 plant/ha, De *et al.* (1978) found no significant difference in sorghum yield by 30/60 or 30/90 cm paired row planting system as compared to the normal sorghum row distance of 45 cm. In intercropped situation, the highest grain yield of maize 3.76 t/ha was found in PR maize mungbean with 120 kg N/ha (Tr. F). The higher rate of nitrogen i.e. 120 kg N/ha yielded higher grain than 60 kg N/ha in mixture. Similar result was also reported by Gangwar and Kalra (1984) in maize + mungbean intercropping where higher dose of nitrogen (120 kg/ha) increased grain yield over lower dose (80 kg/ha). The planting systems had no significant effect on the grain yield of maize in monoculture. The yield differences were mainly due to the variation in number of kernels/cob. (Table 1).

Grain yield of mungbean

Grain yield of Mungbean was significantly affected by treatments (Table 2). The highest grain yield (1.09 t/ha) was obtained from the sole mungbean (Tr. G) followed by (0.68 t/ha) from PR maize + mungbean with 120 kg N/ha (Tr. F). The lowest yield (0.55 t/ha) was found from UR maize + mungbean with 60 kg N/ha. These were mainly due to the variation in plant population and number of seed per pod. Planting systems of maize influenced mungbean grain yield. With 66% normal population of mungbean in PR maize + mungbean scored 62% relative yield of mungbean compared to the 56% relative yield of mungbean in UR maize + mungbean. Thus, the superiority of paired row planting system of maize in intercropped situation is established. Higher rate of nitrogen significantly increased the grain yield of mungbean.

Evaluation of intercropping system

The intercropping system were evaluated on the basis of maize equivalent yield

Table 1. Effect of planting systems and nitrogen levels on grain yield and yield contributing characters of maize intercropped with mungbean.*

Treatments	Plant height (m)	Cob length (cm)	Number of Kernel/cob	1000 grain wt (g)	Shelling percent	Grain yield t/ha
A.M(S) UR 120N	2.40 a	20.64 a	402.50 a	239.60 a	77.64 a	4.30 a
B.M(S) PR 120N	2.36 a	19.17 ab	384.75 a	237.24 a	76.61 a	4.15 ab
C.M+Mu UR 60N	2.26 a	16.95 bc	310.25 b	230.39 a	75.35 a	3.12 e
D.M+Mu UR 120N	2.36 a	18.48 abc	345.50 ab	233.14 a	76.26 a	3.61 cd
E.M+Mu PR 60N	2.19 a	16.53 c	309.25 b	231.83 a	75.36 a	3.17 de
F.M+Mu PR 120N	2.28 a	18.41 abc	348.25 ab	232.14 a	76.36 a	3.76 a
G.Mu(S) 30N	-	-	-	-	-	-
CV(%)	4.51	8.19	10.53	3.09	3.41	7.70

* Means followed by the same letter(s) are not significantly different at 5% level by DMRT, M-Maize, S-Sole, UR-Uniform row, Mu-Mungbean, N-Nitrogen, PR-Paired row.

Table 2. Effect of planting systems and nitrogen levels on grain yield and yield contributing characters of mungbean when intercropped with maize.*

Treatments	Plant height (cm)	Number of pods/plant	Pod length (cm)	Number of seeds/pod	1000 grain wt. (g)	Grain yield t/ha
A.M(S) UR 120N	-	-	-	-	-	-
B.M(S) PR 120N	-	-	-	-	-	-
C.M+Mu UR 60N	82.62 a	16.80 a	6.70 b	5.91 b	26.61 a	0.55 c
D.M+Mu UR 120N	89.07 a	18.95 a	6.95 b	6.47 ab	26.91 a	0.61 bc
E.M+Mu PR 60N	81.50 a	17.15 a	7.05 b	6.45 ab	26.99 a	0.60 bc
F.M+Mu PR 120N	84.56 a	19.65 a	7.15 ab	7.22 a	25.08 a	0.68 b
G.Mu(S) 30N	77.91 a	19.80 a	7.61 a	7.52 a	25.58 a	1.09 a
CV(%)	5.72	9.45	4.47	9.48	4.50	10.11

* Means followed by the same letter(s) are not significantly different at 5% level by DMRT, M-Maize, S-Sole, UR-Uniform row, Mu-Mungbean N-Nitrogen, PR- Paired row

(Bandyopadhyay, 1984), LER (Willey, 1979 a), relative yeild, and net monetary return per hectare. All intercrop treatments recorded higher maize equivalent than the sole maize (Table 3). Maximum maize equivalent (5.26 t/ha) was obtained from PR maize + mungbean with 120 kg N/ha (Tr. F) and the lowest (2.42 t/ha) from the sole mungbean (Tr. G). The maize equivalent of PR maize mungbean with 120 kg N/ha (Tr. F) were 22 and 21% higher than the sole maize in UR and PR planting systems, respectively.

The highest LER (1.49) was obtained from PR maize + mungbean with 120 kg N/ha (Tr. F) and the lowest (1.23) from UR maize + mungbean with 60 kg N/ha (Table 3). The LER value of 1.49 means that by intercropping maize and mungbean in PR planting system with 120 kg N/ha, one could produce 3.76 t/ha of maize and 0.68 t/ha of mungbean from one ha of land

Table 3. Relative yield, land equivalent ratio, maize equivalent yield and dry wt. of weeds.

Treatments	Maize		Mungbean		LER	Maize equivalent yield (t/ha)	Dry wt. weeds/m^2 at 45 DAE (g)
	Grain yield (t/ha)	Relative yield	Grain yield (t/ha)	Relative yield			
A.M(S) UR 120N	4.30	1.00	-	-	1.00	4.30	102.14 a
B.M(S) PR 120N	4.15	-	-	-	-	4.15	106.39 a
C.M+Mu UR 60N	3.12	0.73	0.50	1.23	1.23	4.33	65.11 b
D.M+Mu UR 120N	3.61	0.84	0.61	0.56	1.40	4.96	72.76 b
E.M+Mu PR 60N	3.17	0.74	0.60	0.55	1.29	4.50	42.58 c
F.M+Mu PR 120 N	3.76	0.87	0.68	0.62	1.49	5.26	37.69 c
G.Mu(S) 30N	-	-	1.09	1.00	1.00	2.42	42.77 c
	Average intercropped treatments				1.35		CV(%) 14.29

Price : Maize Tk. 4,500.00/ton, Mungbean Tk. 10,000.00/ton, M-Maize, S-Sole, UR-Uniform row, Mu-Mungbean, N-Nitrogen, PR-Paired row

Table 4. Economic analysis of different treatments.

Treatments	Grain yield (t/ha)		Gross return Tk./ha			Total variable cost (Tk./ha)	Net return (Tk./ha) 7=(5-6)	B/C* Ratio (Tk/Tk)
	Maize (1)	Mungbean (2)	Maize (3)	Mungbean (4)	Total 5=(3+4)	(6)		8=(5-6)
A.M(S) UR 120N	4.30	-	19,345	-	19,345	8,697	10,648	2.22
B.M(S) PR 120N	4.15	-	18,675	-	18,675	8,585	10,090	2.18
C.M+Mu UR 60N	3.12	0.55	14,026	5,470	19,496	8,988	10,508	2.17
D.M+Mu UR 120N	3.61	0.61	16,236	6,060	22,296	9,429	12,867	2.36
E.M+Mu PR 60N	3.17	0.60	14,247	6,020	20,267	8,960	11,960	2.26
F.M+Mu PR 120N	3.76	0.68	16,915	6,770	23,685	9,485	14,200	2.50
G.Mu (S) 30N	-	1.09	-	10,900	10,900	6,420	4,480	1.70

M-Maize, S-Sole, UR-Uniform row, Mu-Mungbean, N-nitrogen, PR-Paired row,
* Benefit cost ratio is based on the total variable cost only.

to obtain the same total yield as one could obtain it from 1.49 ha of land (0.87 ha for maize or 0.62 ha for mungbean). Similar result was also reported earlier (IRRI, 1973). At IRRI, it was found that a corn + legume mixture (mungbean, green soybean and groundnut) increased LER by 30 to 60% over monoculture corn. Hashem and Maniruzzaman (1986) also found higher LER in mixture of maize and cowpea than in monoculture.

Relative yield of maize and mungbean revealed that both the component crops lost part of their individual yields but their combined yield was higher (Table 3). In PR with 120 kg N/ha, the grain yield of maize was 87% of its sole crop yield and mungbean was 62% instead of its expected 66%. The observed yield reduction in maize and mungbean in mixture was, perhaps, due to shading of maize on mungbean and higher interspecific competition.

Economic analysis showed that the highest gross return (Tk. 23,685 /ha), net return (Tk. 14,200/ha) and benefit cost ratio (BCR) (2.5) were recorded from PR maize + mungbean with 120 kg N/ha (Tr F). The lowest gross return (Tk. 10,900/ha), net return (Tk. 4480/ha) and BCR (1.70) were obtained from sole mungbean. Akanda and Quayyum (1982) also reported that they found highest BCR (2.08) from intercrop combination of maize + groundnut.

Weed infestation

Weed infestation in intercropping situation was less than the sole maize. Maximum weed biomass (106.39 g/m^2) was obtained from PR sole maize with 120 kg N/ha and the lowest (37.69 g/m^2) from PR maize + mungbean with 120 kg N/ha (Table 3). Sole maize both in UR and PR had the highest weed infestation. In intercropping situation, weeds were significantly suppressed in PR planting system. It was mainly due to the rapid growth of the mungbean and its fast leaf canopy expansion. De (1974) reported that in corn and mungbean or cowpea intercropping system, fast initial growth of the legume crop kept the weed under control.

The results indicate that by intercropping maize with mungbean in PR planting system with 120 kg N/ha gave higher net monetary return than monoculture of maize and mungbean. Weed was suppressed in intercropping systems.

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