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On-farm study on intercropping of hybrid maize with short duration vegetables

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Abstract

The experiment was conducted at Multi Location Testing (MLT) site, Netrakona during *rabi* season of 2009-10 and 2010-11 to study the feasibility of intercropping of hybrid maize with different short duration vegetables and economic returns. Three intercrop combinations of hybrid maize along with sole maize were arranged in Randomized Complete Block Design replicated six times. There were four treatments viz., T_1- Sole crop of maize, T_2 - Three rows of red amaranth (25 cm apart) in between two (75 cm apart) rows of Maize, T_3 - Three rows of bush bean (25 cm apart) in between two (75 cm apart) rows of Maize and T_4 -Three rows of garden pea (25 cm apart) in between two (75 cm apart) rows of Maize. Yield contributing characters and yield of maize did not varied significantly due to intercropping with vegetables. The grain yield of maize in intercropped combination varied from 7.30-7.43 t/ha. But the highest grain yield (7.68 t/ha) was in sole maize. Maize equivalent yields in the intercrops ranged from 10.67-14.96 t/ha. The highest maize equivalent yield (14.96 t/ha), gross return (Tk. 224400/ha), gross margin (Tk.166830/ha) and benefit cost ratio (3.90) were obtained in maize + garden pea combination. The lowest maize equivalent yield (7.68 t/ha), gross return (Tk. 115200/ha), gross margin (Tk. 64128/ha) and benefit cost ratio (2.26) were obtained from sole crop of maize.

Keywords: Intercropping, Maize, Vegetables, Yield, Cost-benefit

Introduction

Maize is a very common, popular and multi uses cereal crop at present situation. Every year a huge amount of maize grain is required as feed and fodder for poultry and livestock sector and most of them are imported. The climate of Bangladesh is suitable for maize cultivation. It is generally grown in our country during winter season. The rate of seed germination and seedling growth are very slow due to prevailing low temperature in that time. The space between two rows of maize at early stage may be utilized by planting any short stature crop as intercrop. On the other hand, maize is a long duration crop which takes about five months. So, by this time short duration vegetable crops with maize could be grown in between maize rows to get quick return.

Vegetables like red amaranth, bush bean and garden pea are grown in the marginal lands and their yields are low. In Netrakona district, maize is a cereal crop generally grown as sole crop. Now-a days, maize is grown sporadic and in some pocket areas due to expansion of boro rice cultivation. So, to increase the production of vegetables as intercrop with maize may be profitable practice. Vegetables are the main component of human food that supplies proteins, carbohydrates, fats, vitamins and minerals. At present, vegetable production is much less than the requirement. However, there is a limited scope of bringing additional land for vegetable cultivation. So, alternate option is to grow vegetables per unit area through intercropping system.

Intercropping has several advantages over monoculture, such as enhancement of efficient use of environmental factors (e.g., light, nutrient, and soil moisture) and labours, reduces the adverse effect of various biotic and abiotic stress, provides diversity of food, generates more income, offers insurance against crop failure, higher return and total productivity per unit area (Akanda and Quayyum, 1982). Intercropping like other form of multiple cropping can play an important role in increasing vegetable production (Rashid, 1987). So, suitable crop combinations need to be identified through better compatibility. Besides, intercropping increased total production (Rahman, 1999 and Mondol *et al.,* 1999) and greater profit margin and utilize higher resource use efficiency (Hashem and Moniruzzaman, 1986).

So, maize and vegetables can be grown as intercrop in the same piece of land for higher benefit. However very few studies, on intercropping maize with short duration vegetables have been reported in this context. Therefore, this experiment was designed to study the feasibility and agro-economic performance of maize intercropping with different short duration vegetable crops.

Materials and Methods

The experiment was conducted at MLT site Netrakona during *rabi* season of two consecutive years of 2009-10 and 2010-11. The experiment was laid out in a Randomized Complete Block Design with six dispersed replications. The unit plot size was 8m $\times$ 5m Three rows (25 cm apart) of red amaranth, bush bean and garden pea in between two rows of maize as intercrop were compared with sole maize (75 cm apart rows).The spacing for sole and intercropping maize was 75 cm $\times$ 25 cm. Fertilizers were applied at the rate of 250-50-100-45-2 kg NPKS and B/ha, respectively along with 5.0 t/ha of cow dung. One third of Urea and all other fertilizers and Cow dung were applied as basal. Rest part of Urea was top dressed in two equal splits at 36 and 80 DAS. Seeds of Maize (var. BARI hybrid maize-5), red amaranth (BARI lalshak-1), bush bean (BARI Jhar seem-1) and garden pea (BARI motor shuti-3) were sown on 2 December 2009 and 4 December 2010. Irrigation was done after 25-30 DAS and 85-90 DAS. Weeding and other intercultural operations were done as per requirement. The intercrops of red amaranth were harvested during 35-40 DAS, bush bean and garden pea were harvested during 60-65 DAS. The maize crop was harvested on 26 April 2010 and 28 April 2011. At maturity, 10 randomly selected plants were uprooted from inner rows of each plot for recording data on yield and yield contributing characters. Crops were harvested on whole plot basis for pod yield and yield attributing characters. Data of two years were analyzed statistically for stable recommendation and mean comparison was done by LSD test.

The relative yield was obtained by dividing the intercrop yield of a crop with the respective sole crop yield of that crop using the formula (Dewit and Vander Bergh, 1965).

$$\text{The relative yield of a crop} = \frac{\text{Yield of component crops}}{\text{Yield of sole crop}}$$

Maize equivalent yield was calculated by converting the yield of red amaranth, bush bean and garden pea into the yield of maize on the basis of prevailing market prices using the formula of Anjaneyulu *et al.* (1982).

$$\text{Maize equivalent yield (for vegetables)} = \text{Ym} + \frac{\text{Yint} \times \text{Pint}}{\text{Pm}}$$

Ym= Yield of Maize, Pm= Sale price of maize, Yint = Yield of intercrop (red amaranth, bush bean and garden pea) and Pint= Sale price of intercrop

Results and Discussion

Effect on yield and yield components of maize

Pooled analysis was done as there was no difference in characters in years. Yield and yield contributing characters of intercropped maize were not statistically significant (Table 1). However, agronomic performance of sole maize was a little bit better than that of other treatments. Plant height ranged from 174.1-176.5 cm, number of cobs/plant ranged from 1.1-1.3, number of grains/cob ranged from 404-413, 1000-grain weight ranged from 306-310 g in different treatments. The highest grain yield (7.68 t/ha) was recorded from sole maize, which could be due to higher no. of grains/cob and 1000-grain weight. The grain yield of maize in intercropped combination varied from 7.30-7.43 t/ha. Stover yield in different treatments ranged from 10.76-11.27 t/ha. The yield data indicated that due to intercropping, there was not significant yield loss of maize.

Table 1. Yield and yield contributing characters of maize under different intercropping situation at Netrakona (Pooled data of 2 years)

Crop combination	Plant height (cm)	No. of cobs / plant	No. of grains / cob	1000-grain weight (g)	Grain yield (t/ha)	Stover yield (t/ha)
Sole maize	176.5	1.2	413	310	7.68	11.27
Maize+ Red amaranth	174.5	1.1	411	307	7.43	11.06
Maize+Bushbean	174.1	1.3	404	306	7.32	10.94
Maize+Garden Pea	175.0	1.1	404	307	7.30	10.76
LSD (0.05)	NS	NS	NS	NS	NS	NS
CV (%)	1.57	3.81	2.11	1.62	3.75	3.83

NS= Non significant

Effect of intercrops

The intercrop yield of red amaranth, bush bean and garden pea were influenced significantly by different intercropping combinations (Table 2). The highest vegetable (red amaranth) yield was recorded from maize + red amaranth intercropping combination followed by bush bean combination. The lowest yield was obtained from maize + garden pea intercropping combination.

Relative yield

Relative yield determines competitive ability of component crops in intercropping system. Greater value of relative yield showed more competitive ability in intercrop situation compared to its monoculture (Juskiw *et al.,* 2000). The relative yields of maize were 0.97, 0.95, and 0.95 when maize was intercropped with red amaranth, bush bean and garden pea, respectively (Table 2). This indicates that maize yield was reduced by 3%, 5%, and 5% of sole crop when it was intercropped with red amaranth, bush bean and garden pea, respectively. The lower relative yield of maize in intercropping indicated that the crop faced competition for space, nutrients, light, and water with vegetables. The findings are in agreement with that of Singh (1993) and Rahman (1999).

Maize equivalent yield

All the intercropped combinations showed higher maize equivalent yield than sole maize in all cases. Among the treatments, significantly the highest maize equivalent yield (14.96 t/ha) was obtained from maize + garden pea intercrop combination (Table 2). The lowest maize equivalent yield (10.67 t/ha) was obtained from maize + red amaranth intercrop combination. Although maize yield was 3%, 5% and 5% lower than sole crop when it was intercropped with red amaranth, bush bean and garden pea. But maize equivalent yield from maize + red amaranth, maize + bush bean and maize + garden pea intercrop combination showed 39%, 65% and 95% higher yield advantage over the sole maize respectively. This result showed that maize + garden pea was the best intercrop combination in respect of total yield advantage.

Table 2. Grain yield of sole maize, intercrop yield, relative yield and equivalent yield of maize as influenced by intercropping with vegetables at Netrakona

Treatments	Grain yield (t/ha)	Intercrop yield (t/ha)	Relative yield of maize	Maize equivalent yield (t/ha)
Sole maize	7.68	-	1.00	7.68
Maize+ Red amaranth	7.43	4.86	0.97	10.67
Maize+Bush bean	7.32	3.99	0.95	12.64
Maize+ Garden pea	7.30	3.83	0.95	14.96

Monetary advantage

An analysis on cost and return of intercropping maize with different short duration vegetables has been presented in Table 3. Higher gross return was obtained from all intercrop combinations than sole crop. Among the combinations, the highest gross return was obtained from maize + garden pea intercropping system, which was 95% higher than sole maize. Almost similar trend was followed in case of gross margin. The higher benefit-cost ratio (BCR) was recorded from maize + garden pea combination followed by maize + bush bean.

Table 3. Monetary advantage analysis of maize intercropping with vegetables at Netrakona (average of 2 years)

Treatments	Gross return (Tk./ha)	*TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
Sole maize	115200	51072	64128	2.26
Maize+ Red amaranth	160050	53480	106570	2.99
Maize+Bushbean	189600	57570	132030	3.29
Maize+ Garden pea	224400	57570	166830	3.90

*TVC includes cost of seed, fertilizer, insecticide, irrigation, man and animal labour cost. Price: Maize seed: Tk.50.00/kg, Maize non-seed Tk.15.00/kg, Maize stover: Tk.0.50/kg, Red amaranth: Tk.10.00/kg, Bush bean: Tk.20.00/kg, Motorshuti: Tk.30.00/kg

Conclusion and Recommendation

From these results, it revealed that maize grown as intercrop with short duration vegetables like red amaranth, bush bean and garden pea may be profitable than sole maize. All of the intercrop combinations are agronomically and economically viable than sole cropping. The results finally suggest the possibility of obtaining a reasonably good yield and profitable economic return from intercropping maize with garden pea having the planting geometry of three rows of garden pea in between two rows of maize.

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