PERFORMANCE OF INTERCROPPING GRAIN MAIZE WITH TRITICALE AND GRASSPEA AS FORAGE CROPS

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Accepted for publication: September 18, 2008

ABSTRACT

Biswas Mrityunjoy, Ahmed I. M., Asaduzzaman M. and Sultana W. 2008. *Performance of Intercropping Grain Maize with Triticale and Grasspea as Forage Crops.* **Int. J. Sustain. Crop Prod. 3(6):34-37**

The experiment was conducted at the Regional Agricultural Research Station, Jamalpur during rabi 2007-2008 to find out forage production potentials and economic performance of intercropping grasspea and triticale with grain maize. The treatments were maize (75 cm x 25 cm) intercropped with triticale, maize (75 cm x 25 cm) intercropped with grasspea, sole maize, sole triticale and sole grasspea in the experiment. Maize was grown for grain while triticale and grasspea for forage production in all treatments. The results revealed that the highest green forage yield (14.89 t ha^{-1}) was obtained from triticale intercropped with maize which was statistically similar to sole triticale (14.22 t ha^{-1}). Grasspea produced the lowest green forage yield (4.86 t ha^{-1}) when intercropped with maize that was similar to sole grasspea (5.47 t ha^{-1}). Significantly the highest grain yield (7.20 t ha^{-1}) was obtained from sole maize which was at par with maize intercropped with grasspea and the lowest (5.54 t ha^{-1}) from maize intercropped with triticale. Sole maize and maize intercropped with grasspea gave maximum BCR values (3.06 and 3.03, respectively).

Key words: Intercropping, grain maize, triticale, grasspea, forage

INTRODUCTION

Shortage of quality fodder and feed is a major constraint for dairy farming in Bangladesh during the lean season from January to May (Saadullah 2002). Rice straw is by far the most important crop residue fed to ruminants in Bangladesh, contributing >90% of the feed energy available (Saadullah, 2002), but it has relatively low protein quality and energy value. Improved fodder and feed sources have great potential to raise milk production by small-scale dairy farms and enhance livelihoods. Triticale (X *Tricosecale* Wittmack) a well adapted winter cereal in Bangladesh can be cultivated during winter. Its straw is twice as nutritious as rice or wheat straw and its grain contains more protein than other cereals and has the ability to produce more biomass and high regrowth after grazing (Varughese *et al.,* 1997; Haque *et al*., 2006). Another pulse crop grasspea (*Lathyrus sativus* L.) has also the potential to produce a considerable quantity of green biomass with high nutritional value as animal feed. Demand of food grain is increasing enormously in Bangladesh because of the fast growing population. But food production is affected due to high input costs and increasing urbanization which leads to irrecoverable loss of arable land. Under this situation, there is a narrow scope for allocation of land for animal feed production. Intercropping cereals and forage crops can mitigate this problem to some extent. Intercropping is practiced in many parts of the world and contributes to significant yield increase (Francis, 1986; Fortin *et al*., 1994). Intercropping improves the utilization of available resources and cause yield advantages and increased yield stability (Willey, 1979; Ofori and Stern, 1987). Maize, one of the long duration exhaustive cereal crops planted in wider spacing can be intercropped with other forage crops. Both the forage crops grasspea (*Lathyrus sativus* L.) and triticale can be grown as intercrop with maize as they have short plant stature and quick growing potentials having lump quantity of biomass. Cereal crop residues supplemented with forage legumes significantly increase overall animal productivity. For example, maize residues tend to be high in carbohydrates but low in protein; therefore, adding leguminous plants will contribute to improved livestock nutrition. By biologically fixing nitrogen levels in the soil, legumes provide a relatively low-cost method of replacing nitrogen in the soil, enhancing soil fertility and boosting subsequent crops yields. November to February is the lean period for most popular fodder grasses like Napier and Para in Bangladesh. To meet the shortage of green fodder in the Rabi season, farmers can produce 6-15 t/ha of triticale fodder, followed by grain yields that are similar to those from wheat for cattle or poultry feed (Jahan *et al.,* 2001, Haque *et al.*, 2006). Fresh triticale forage (containing about 25 % crude protein), straw and grain are highly nutritious feeds in Bangladesh (Ahmed and Meisner 2002, Haque *et al*., 2006). The literature pertinent to intercropping maize with grasspea and triticale as forage crops is meagre. Hence, the experiment was conducted with the views to quantify the forage production potentials of triticale, grasspea and maize grain yield and to evaluate the economic performance of the systems.

MATERIALS AND METHODS

The experiment was conducted at the Regional Agricultural Research Station (RARS), Jamalpur during rabi 2007-08. The objective of the experiment was to study the potentiality of growing fodder crops like triticale and grasspea as intercrops with maize. The soil of the experiment field was silt clay loam in texture with pH 7.1 belonging to Sonatala series under AEZ 9. Five treatments viz. T_1 = Maize (75 x 25 cm) intercropped with triticale (fodder) cut at 40, 55 and 75 days after seeding (DAS), T_2 = Maize (75 x 25 cm) intercropped with grasspea (fodder) cut at 50 and 75 (DAS), T_3 = Sole maize, T_4 = Sole triticale (fodder) cut at 40, 55 and 75 DAS and T_5 = Sole grasspea (fodder) cut at 50 and 75 DAS included in the experiment. Maize was grown for grain production in all treatments. The experiment was laid out in a randomized complete block design with four replications. The unit plot size was 6.0 m x 3.75 m. Hybrid maize var. BARI hybrid maize-5 and the companion crops triticale var. BARI triticale-1 and grasspea var. Local were used in the experiment. Maize seeds were sown on 24 November, 2007 with 75 cm x 25 cm spacing. Triticale and grasspea were sown continuously in 20 cm apart solid line on same date. Three lines of triticale/grasspea were sown in between two lines of maize. Fertilizers were applied at the rate of $N_{250}P_{55}K_{110}S_{55}$ Zn B kg ha^{-1} for maize and intercrop; $N_{21}P_{17}K_{20}S_{10}$ Zn B kg ha^{-1} for sole triticale and $N_{20}P_{40}K_{20}$ kg ha^{-1} for sole grasspea in the form of urea, triple super phosphate (TSP), muriate of potash (MOP), gypsum, zinc sulphate and borax, respectively. One third of urea and full dose of other fertilizers were applied during final land preparation for all treatments. Remaining urea was top-dressed in two equal splits at 25 and 45 days after sowing (DAS) in maize rows (sole and intercrop) after irrigation. But for triticale and grasspea, remaining urea was top dressed in two equal splits at each cutting after irrigation. Cutting was done for green fodder leaving the plants 3-5 cm above the ground level to facilitate regeneration. Green biomass weight of fodder was taken immediately after cutting in the field. Maize was harvested at 155 DAS. At harvest 10 plants were randomly selected for collecting data on yield components. Grain yields were calculated on whole plot basis and adjusted at 12% moisture content. Local market price of the products at harvest was considered for calculation of maize equivalent yield and economic performances. The collected data were analyzed statistically and the means were compared using LSD test at 5% level of significance.

RESULTS AND DISCUSSION

Yield and yield attributes of maize

The results presented in Table 1 exhibited that plant height differed significantly among sole maize and intercrop treatments. The tallest plant was found in the intercrop combination maize + grasspea (T_2) which was statistically at par with sole maize. The intercrop combination maize + triticale produced the shortest plant. Significantly the highest number of cobs $plant^{-1}$ was obtained from sole maize while the lowest was obtained from the intercrop combination maize + triticale. Number of grains and 1000-grain weight did not differ significantly but grain yield differed significantly among the treatments (Table 1). It was observed that sole maize crop produced the highest grain yield which was similar to that of the intercrop combination maize + grasspea. The lowest grain yield of maize was obtained from the maize + triticale intercrop combination. In this treatment both the crops (main and inter) were cereal and the nutrient requirement of these crops was high. Possibly this may led to develop deficiency of nutrient supply resulting the lowest grain yield of maize in this treatment. Grasspea, a leguminous crop under intercrop situation may help to fix atmospheric nitrogen and hence, the grain yield of maize was not adversely affected in the treatment maize + grasspea. This observation was supported by Hussain *et al*. (2003) who stated that legume intercrop was superior by decreasing less yield of maize crop.

Table 1. Effect of intercropping triticale and grasspea with maize on the yield and yield attributes of maize during rabi 2007-08

Treatment	Plant height (cm)	Cob $plant^{-1}$ (no.)	Grain cob^{-1} (no.)	1000 grain weight (g)	Yield (t ha^{-1})
T_1	157.3 b	1.07 c	438.2	323.5	5.20 b
T_2	191.3 a	1.11 b	447.0	303.8	6.60 a
T_3	187.5a	1.25 a	443.4	313.8	7.20 a
T_4	-	-	-	-	-
T_5	-	-	-	-	-
CV (%)	8.08	4.74	3.47	6.49	9.53
LSD value	24.99	0.094	NS	NS	1.042

Forage yield

Green forage yield was significantly influenced by different intercropping treatments (Table 2). Grasspea yielded the lowest while triticale yielded about three times higher than grasspea in both sole and intercrop treatments. Triticale had the higher vegetative growth than grasspea which attributed to produce higher forage yield. Forage yield of triticale as intercrop with maize was similar to that of sole crop. Triticale may have the opportunity to uptake more nutrients under intercrop situation as higher rate of fertilizers was applied for maize which possibly enhanced the forage yield of triticale. Forage yield of grasspea was lower under intercrop situation than sole treatment. Welty *et al*. (1991) and Holland and Brummer (1999) reported that berseem clover yields were reduced about 50% when intercropped with oat.

Maize equivalent yield (MEY)

The highest MEY was obtained from the treatment combinations of maize + triticale and maize + grasspea. Sole maize had significantly lower MEY than the earlier two combinations. The lowest maize equivalent yield was obtained from sole grasspea.

Economic performance

Maximum gross and net returns were obtained from the treatment maize + grasspea. The intercrop combination maize + triticale had the second highest gross return while sole maize had the second highest net return. The treatments, sole maize and maize + grasspea gave the maximum BCR values.

Table 2. Green fodder yield, maize equivalent yield and economic return from intercropping triticale and grasspea with maize during rabi 2007-08

Treatment	Green forage yield (t ha^{-1})				Maize equivalent yield (t ha^{-1})
	Ist cut	2nd cut	3rd cut	Total	
T_1	8.86	5.58	0.46	14.89 a	8.18 a
T_2	2.15	2.71	-	4.86 b	8.13 a
T_3			-	-	7.19 b
T_4	8.02	5.86	0.84	14.22 a	2.95 c
T_5	2.27	3.19	-	5.47 b	1.75 d
CV (%)	-	-	-	11.76	8.76
LSD $_{0.05}$	-	-	-	1.854	0.761

Selling Price: Maize grain-12.50 Tk kg^{-1}, Forage: Triticale-2.50 Tk kg^{-1}; Grasspea-4.50 Tk kg^{-1}

Table 3. Economic performance of the intercropping triticale and khesari with maize during rabi 2007-08

Treatment	Total cost of cultivation (Tk)	Gross return (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1	38944	108900	66236	2.80
T_2	36784	111465	70961	3.03
T_3	33004	100890	67886	3.06
T_4	26686	35550	8864	1.33
T_5	19330	21880	2550	1.13

CONCLUSION

The results revealed that in lean season when forage quality and quantity is often limited for cattle feed, triticale and grasspea may be grown as intercrops with maize to mitigate the situation. The results obtained from the experiment also led to conclude that additional forage may be produced through intercropping maize with grasspea having similar grain yield to that of sole maize. Considering the soil health, the treatment combination maize + grasspea may be selected as the best combination for production of grain maize and forage. Further investigation is needed for determining optimum fertilizer rate for intercropping maize and triticale so that grain yield of maize may not be decreased.

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