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Productivity of Sugarcane with Wheat-Mungbean Intercropping Combination under Paired Row Planting System

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ABSTRACT

The experiment was conducted at Bangladesh Sugarcane Research Institute (BSRI) farm under irrigated condition during 2005-2006 cropping season to study the productivity of sugarcane with wheat-mungbean intercropping combination under paired row planting system. Six wheat varieties namely Kanchan, Akbar, Protiva, Sourav, Gourab and Shatabdi as first intercrops followed by mungbean as second intercrop in paired row cane (PRC) were grown. Wheat variety Akbar and Gourab slightly increased cane yield while Sourav, Kanchan, Protiva and Shatabdi decreased. However, variety Gourab and Sourav gave higher gross return compared to other varieties. Highest cane yield of 83.16 tha^{-1} was recorded from PRC + 0-mungbean followed by PRC + Akbar-mungbean (82.54 t ha^{-1}) and PRC + Gourab-mungbean (82.33 t ha^{-1}) while the lowest yield of 70.31 t ha^{-1} was obtained from PRC + Shatabdi-mungbean. Maximum benefit cost ratio of 2.34 was found from PRC + Gourab-mungbean combination. Growing mungbean as second intercrop with PRC earned an additional income and helped to improve soil health by fixing some atmospheric nitrogen and adding organic matter in soil. No significant difference in pol % cane among the treatments was observed in the study. Therefore, intercropping wheat variety like Gourab, Shatabdi, Sourav, Kanchan, Akbar and Protiva as the first intercrops and mungbean as the second intercrop grown in paired row transplanted sugarcane seems to be profitable intercropping combinations for sugarcane farming.

Key words: Transplanted sugarcane, Paired row Intercropping, Wheat, Mungbean

INTRODUCTION

Sugarcane (*Saccharum officinarum* L) is a long duratión crop. From planting to harvest it requires 12 to 14 months. The growth of sugarcane is slow in earlier stages and it takes about 3 to 5 months to establish the full canopy of the crop (Yadava, 1991). During the early stage of sugarcane growth, some short duration crops can be grown as intercrops in the vacant spaces between two cane rows. To make intercropping more profitable per unit area and time with sugarcane, it is necessary to produce more than one intercrop (Hossain *et al.*, 1995). Ali *et al.* (1989) observed that there was no significant adverse effect of row arrangement on the growth, yield and sucrose content of sugarcane. Growing various crops successfully with sugarcane as intercrops have been reported by many researchers (Behli and Narwal, 1977; Verma *et al.*, 1981 and Imam *et al.*, 1990). Potato, onion, garlic and cabbage were identified as most profitable intercrops with sugarcane might help to get an interim benefit for the poor farmers (Matin *et al.*, 2001 and Alam, 1999). Wheat is an important food crop in Bangladesh, which can play a vital role

to minimizing the food shortage for the increasing population and poultry farm of the country. Wheat is grown on about 0.83 million hectares producing 1.84 million metric tons including a deficit of 0.11 million tons (BBS, 2000). Some wheat varieties may be grown as intercrop with sugarcane to minimize the deficit. Paired row system of sugarcane planting has been designed to keep two rows of cane at 60 cm apart leaving 120-140 cm between two such paired rows for growing intercrops (Roach, 1977). The practice of intercropping may be more productive and economic through adoption of paired row system following spaced transplanting of sugarcane which provides desired optimum plant population and facilitates higher space for intercropping. Furthermore, the demand for wheat consumption is increasing day by day with rising population but there is a little scope for increasing wheat production by horizontal expansion of wheat growing area. Therefore, immediate initiatives are necessary for increasing wheat producing by manipulating cropping pattern. Intercropping wheat with sugarcane in paired row system may be an excellent alternate in this respect. In view of these considerations an experiment was designed to find out the ways to increase production of sugarcane with suitable wheat varieties as first and mungbean as second intercrop in paired row transplanted sugarcane.

MATERIALS AND METHODS

An experiment was conducted at Bangladesh Sugarcane Research Institute (BSRI) farm, Ishurdi, Pabna during 2005-2006 cropping season under irrigated condition. The site represents High Ganges River Floodplain under Agro-ecological Zone-11, with medium high land of typical sandy loam soil having pH 7.6. Six different wheat (*Triticum aestivum*) varieties as first intercrops viz. Kanchan, Akbar, Protiva, Sourav, Gourab and Shatabdi followed by a second intercrop mungbean (*Vigna radiata* L) variety Binamoog-5 were grown with sugarcane variety Isd 34 to find out the productivity of sugarcane with wheat as first intercrop followed by mungbean intercropping combination for sustainable sugarcane farming. All the wheat varieties were sown in 4 lines within two paired rows of cane. The experiment was laid out in randomized complete block design (RCBD) with three replications. The unit plot size was 8m x 6m and the treatment combinations were as follows:

T_1 : Paired row cane (PRC) only
T_2 : T_1 + wheat (Kanchan) – mungbean
T_3 : T_1 + wheat (Akbar) – mungbean
T_4 : T_1 + wheat (Protiva) – mungbean
T_5 : T_1 + wheat (Sourav) – mungbean
T_6 : T_1 + wheat (Gourab) – mungbean
T_7 : T_1 + wheat (Shatabdi) – mungbean
T_8 : T_1 + 0 – mungbean

Previously raised single budded soil bed sugarcane settlings were transplanted in each plot during mid November, 2005 with 30 cm interplant spacing in paired row of 60 cm apart. Spacing between two paired rows was 140 cm. For sugarcane Urea, TSP, MP, Gypsum and $ZnSO_4$ were applied @ 347, 244, 184, 222 and 9 kg ha^{-1} respectively (BARC, 1997). All TSP, Gypsum, $ZnSO_4$ and one third ($1/3^{rd}$) of MP were applied in trench and thoroughly mixed with soil before transplanting of settlings. One third of urea as basal dose was applied at 21 days after

transplanting (DAT) of settlings. The second dose of 1/3rd Urea and 1/3rd MP were applied as first top dressing at 90 DAT. Final top dressing of rest Urea and MP were applied at 150 DAT. Urea, TSP, MP and Gypsum @ 130, 110, 50 and 72 kgha^{-1} for wheat and only TSP and MP were applied @ 47 and 30 kg ha^{-1} for mungbean. To control insect pests, furadan 5G was applied @ 40 kg ha^{-1} in three splits in December, 2005, March and May, 2006. Other intercultural operations like irrigation, gap filling, weeding, mulching, earthing-up, tying, etc. were done in time. Collection of data on yield and various yield contributing parameters of cane and intercrops were done. The yields of first and second intercrops were recorded at harvest. Tiller population of sugarcane was recorded at 90, 120, 150 and 180 DAT. Millable cane and yield were recorded at harvest. The cane equivalent yield for the intercropped plot were calculated by adding the cane yield with the equivalent cane yield obtained from the intercrops on the basis of sale price. Economic and statistical analysis on different parameters for sugarcane and intercrops were done following the standard procedures.

Fig. 1. Sugarcane + Wheat (green stage)

Fig. 2. Sugarcane + Wheat (mature stage)

RESULTS AND DISCUSSION

Tiller and millable cane production

Tiller and millable cane production under different treatments are presented in Table 1. There was significant effect on tiller production among the different treatment combinations. Highest tiller population of 252.11 x10^3 ha^{-1} was found from T_8 (T_1 + 0-mungbean) where wheat was not intercropped followed by T_1 (PRC only), the lowest tiller was recorded from T_7 (T_1 + Shatabdi – mungbean). In case of millable cane production, no significant effect was found. Similar result was also reported by Matin *et al.*, 2001, in case of cauliflower, potato, carrot and knolkhol intercropped with paired row sugarcane. The maximum millable cane stalks (120.49 x10^3 ha^{-1}) was recorded from T_8 plot followed by T_5 (118.21 x10^3 ha^{-1}) and the minimum (103.40 x10^3 ha^{-1}) was recorded from T_7 plot. It means the intercropping of wheat slightly suppressed tiller and millable cane production. The taller plant structure may be the reason to exert such effect.

Table 1. Tiller, millable cane stalk, cane yield, intercrops yield, equivalent cane yield of intercrops and total adjusted cane yield under wheat-mungbean intercrop combinations at BSRI during cropping year 2005-2006.

Treatment	Tiller ($\times 10^3$ ha^{-1})	Millable cane ($\times 10^3$ ha^{-1})	Cane yield (t ha^{-1})	Intercrop yield (t ha^{-1})		Equivalent cane yield of intercrops (t ha^{-1})	Total adjusted cane yield (t ha^{-1})
				1st	2nd		
T_1 = Paired row cane only	235.66 a	115.03	81.01	-	-	-	81.01
T_2 = T_1 + Kanchan-mungbean	177.08 b	110.99	76.11	2.45 bc	0.35	45.10	121.21
T_3 = T_1 + Akbar-mungbean	189.86 b	111.60	82.54	2.08 c	0.30	38.50	121.04
T_4 = T_1 + Protiva-mungbean	191.11 b	104.72	74.27	2.41 bc	0.31	43.35	117.62
T_5 = T_1 + Sourav-mungbean	194.97 b	118.21	80.56	2.39 bc	0.33	43.75	124.31
T_6 = T_1 + Gourab-mungbean	194.52 b	112.17	82.33	2.51 b	0.32	47.72	130.05
T_7 = T_1 + Shatabdi-mungbean	167.19 b	103.40	70.31	3.02 a	0.35	53.05	123.36
T_8 = T_1 + 0-mungbean	252.11 a	120.49	83.16	-	0.45	15.00	98.16
LSD (5%)	32.6	ns	ns	0.38	0.06	-	-

Price of crops : Sugarcane : 1350.00 Tk t^{-1}, Wheat : 18500.00 Tk t^{-1}, Mungbean : 45000.00 Tk t^{-1}
Figures in a column with same letter do not differ significantly at the 5% lavel as per DNMR test.

Yield of cane

There was no significant difference on cane yield among the different treatments including control plot (Table 1), which indicates intercropping of wheat with sugarcane has no adverse effect on cane yield. However, due to intercropping some varieties of wheat like Kanchan, Protiva and Shatabdi showed 7.4 - 12.5 % reduction in cane yield. Such yield suppression may be caused by heavy growth, height, shading and dense population of wheat. These factors are responsible for reduction of initial tillers as well as millable cane production. Among different combinations, the highest cane yield of 83.16 t ha^{-1} was obtained in the treatment (T_8) where wheat was absent as first intercrop but the mungbean was grown as second intercrop. On the other hand, the lowest cane yield of 70.31 t ha^{-1} was recorded from T_7 where variety Shatabdi of wheat was intercropped. This wheat variety has vigorous growth in tillering stage, which suppressed tiller and millable cane population.

Intercrop yield and adjusted cane yield

Significant effect on intercrop yield was obtained in different wheat varieties-mungbean combinations. But the yields of different wheat varieties and mungbean were found satisfactory in all intercropped plots (Table 1). Highest wheat yield of 3.02 t ha^{-1} was obtained from the variety Shatabdi followed by Gourab (2.51 t ha^{-1}) and the lowest of 2.08 t ha^{-1} was recorded from the variety Akbar. Yield of second intercrop mungbean varied with different treatment combinations. Highest mungbean yield of 0.45 t ha^{-1} was obtained from T_8 treatment where first intercrop wheat was not grown followed by T_2 & T_7 (0.35 t ha^{-1}) while the lowest yield of 0.30 t ha^{-1} was recorded from T_3 treatment. Adjusted cane yield is an important parameters for determining the total yield potential of the intercropped plots (cane + intercrop) over the sole cane plot (Table 1). Highest adjusted cane yield of 130.05 t ha^{-1} was recorded from T_6 plot (T_1 + Gourab-mungbean) followed by T_5 (124.31 t ha^{-1}) (T_1 + Sourav-mungbean), T_7 (123.36 t ha^{-1}) (T_1 + Shatabdi-mungbean) and the lowest adjusted cane yield of 81.01 t ha^{-1} was from the T_1 (Paired row cane only). The total adjusted cane yield indicated that all the intercropped plots with different wheat varieties-mungbean combinations were superior to the sole cane plot.

Pol % cane

No significant effect on pol % cane was recorded among the different wheat varieties-mungbean combinations (Fig. 1). Highest pol % cane of 13.51 was obtained from treatment T_5 (T_1 + Sourav-mungbean) followed by treatment T_3 (T_1 + Akbar-mungbean) and the lowest pol

% cane was recorded from treatment T_6 (T_1 + Gourab-mungbean). Intercropping different wheat varieties with sugarcane under paired row system does not have any adverse effect on pol % cane as the intercrops were harvested before start of grand growth period of cane.

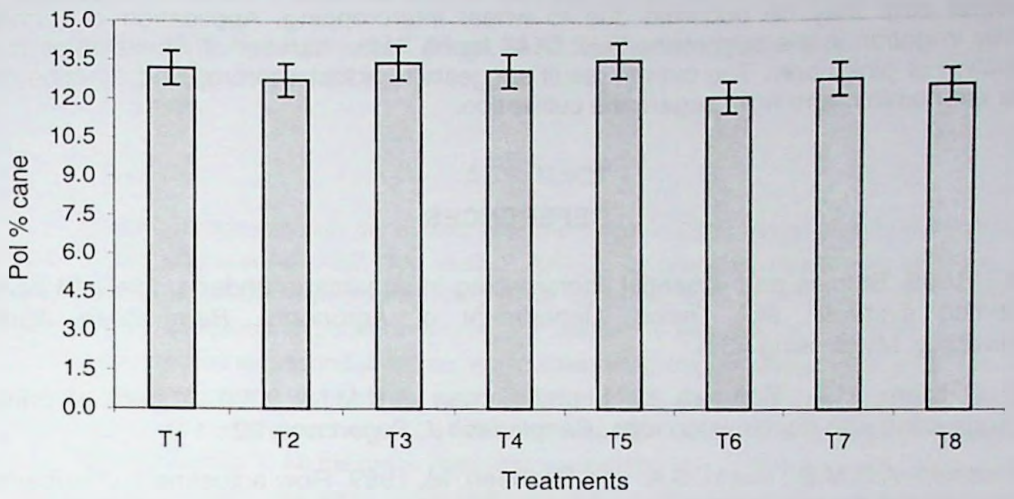

Figure 3. Pol % cane as affected by different wheat-mungbean combinations.

Economics

The economic analysis of the experiment under different treatment combinations was shown in Table 2. Among the intercrop combinations, the highest total production cost (Tk. 75,500) was for treatment T_3 (T_1 + Akbar-mungbean) followed by (Tk. 75,400) treatment T_5 (T_1 + Sourav-mungbean) while the lowest (Tk. 52,000) for treatment T_1 (Paired row cane only). The total production costs were different due to variation of cost of production of sugarcane and intercrops.

Table 2. Economics and benefit cost ratio (BCR) of different cane intercrop combinations at BSRI during cropping year 2005-2006.

Treatments	Total production cost (Tk. ha^{-1})	Gross return (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
T_1 = Paired row cane only	52,000	1,09,363.50	57,363.50	2.10
T_2 = T_1 + Kanchan-mungbean	74,500	1,63,633.50	89,133.50	2.20
T_3 = T_1 + Akbar-mungbean	75,500	1,63,404.00	87,904.00	2.16
T_4 = T_1 + Protiva-mungbean	74,200	1,58,787.00	84,587.00	2.13
T_5 = T_1 + Sourav-mungbean	75,400	1,67,818.50	92,418.50	2.22
T_6 = T_1 + Gourab-mungbean	74,800	1,75,567.50	100,767.50	2.34
T_7 = T_1 + Shatabdi-mungbean	72,700	1,66,536.00	93,836.00	2.29
T_8 = T_1 + 0-mungbean	61,500	1,32,516.00	61,016.00	2.15

Price of crops : Sugarcane: 1,350.00 Tk t^{-1}, Wheat: 18,500.00 Tk t^{-1} and Mungbean : 45,000.00 Tk t^{-1}

Highest gross return (Tk. 1,75,567.50) was recorded from T_6 followed by T_5 and the lowest was from the sole sugarcane crop (T_1). In case of gross margin, the highest gross margin (Tk. 1,00,767.50) was obtained from T_6 followed by T_7 (Tk. 93,836.00) while the lowest (Tk. 57,363.50) was recorded from T_1. Highest benefit cost ratio (BCR) of 2.34 was recorded from the T_6 and the lowest BCR was from T_1. Highest gross return, gross margin and BCR were

recorded from T_6 due to the total adjusted cane yield was higher from this combination. Alam *et al.*, 2000 obtained higher BCR (2.68) in PRC + potato-mungbean. Imam *et al.*, (1982) also reported that potato and onion gave the highest BCR when grown as intercrop with sugarcane. The BCR for the rest treatment combinations was almost identical. Pink borer infestation initially in sugarcane crop may be occurred due to wheat intercropping. Application of Furadan 5G followed by irrigation in the sugarcane field @ 40 kg ha^{-1} after harvest of wheat helps to control the infestation of pink borer. The overall result suggests to adopt intercropping practice of wheat for higher economic return from sugarcane cultivation.

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