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Performance of Different Winter Crops and Summer Mungbean as Intercrop at Paired Rows Planted Sugarcane

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ABSTRACT

An experiment was carried out at the farmers' field of Dhamurhuda Upazilla in Chuadanga district during the cropping season 2012-13 under irrigated condition to study the comparative performance of five winter crops Viz., onion, tomato, Potato, cauliflower and carrot with sugarcane (Var. Isd 39) as first intercrop followed by summer mungbean (BINA mung-5) as second intercrop in paired rows planted cane (PRC). Intercropping onion and potato increased cane yield while a slight decreases was observed in case of tomato, cauliflower and carrot intercropping. However, potato intercrop gave the highest additional economics return followed by onion compared to other intercrops. The maximum benefit cost ratio of intercropping was found 1: 3.79 and 1:3.28 from the treatment PRC + Potato – summer mungbean and PRC + onion – summer mungbean, respectively. Growing summer mungbean as second intercrop with PRC earn as additional income and helped to improved soil health by fixing atmospheric nitrogen and adding organic matter in soil. Therefore, intercropping winter crop like potato or onion as first intercrop and summer mungbean as second intercrop with paired rows planted cane recommended as the most profitable intercropping package for sustainable sugarcane farming in the Chuadanga area.

Key words: Sugarcane, Intercropping, tiller, millable cane, yield

INTRODUCTION

Sugarcane *(Saccharum officenarum* L.) is one of the most important cash crops in Bangladesh. It is cultivated in the tropical and sub-tropical regions of the world. It is grown in all the districts of Bangladesh, but its commercial cultivation for industrial supply in mostly concentrated in the northern districts. In Bangladesh, sugarcane is mainly used for sugar and jaggary production purpose. Taking the average of last 10 years production, out of 6.56 million tons of cane 1914.28 (19.16 %) thousand tons was used for sugar production , 3724.38 (56.73 %) thousand tons was used for jaggary production and 926.25 (14.11%) thousand tons was used for seed and chewing purpose, respectively (BBS, 2010). It is cultivated in an area of about 0.12 million hectares.

It is a long duration crop which requires 12-14 months to mature (Yadava, 1991). Most of the farmers of Bangladesh were marginal and they cannot have afforded such a long time to get return from a single crop and they interested to grow short duration and high value crops to get an interim benefit. The demand of vegetables, spices and pulses

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is increasing day by day with the rising population, but there is no scope for increasing production of those commodities by horizontal expansion of areas. To meet the national demand of sugar and jaggary production and to feed the mills at installed capacity sustainable sugarcane production are needed which can be obtained through profitable cultivation of sugarcane with intercropping.

Intercropping system is an important apporch of cropping system for increasing crop yield. Plant competition is an inevitable phenomenon in intercropping system that reduces intercrop productivity. Greater productivity in intercropping system that is commonly achieved by minimizing competition and maximizing complementary use of growth resources (Krishna and Raikhelker, 1997). Intercropping provides an opportunity to avoid crop competition advantage of increased production and greater profit or margin (Evans, 1960; Gribines, 1963) and gives higher resource use efficiency (Hashem and Maniruzzaman, 1986).

Intercropping increases crop yield per unit area by intensifying the use of land. It does not only contribute to increase the productivity, but also increase the farmer's income (Villarel, 1976). 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 and Khan *et al.*, 1995). Ali *et al.* (1989) observed that there was no significant adverse effect of row arrangement manipulating plant geometry suitable for intercropping on growth, yield and sucrose content of sugarecane. Successful intercropping of various crops with sugarcane has been reported by many researchers (Rathi *et al.*, 1974; Behhi and Narwal, 1977; Verma *et al.*, 1990).

The growth of sugarcane is slow in early stages and its takes about 3-5 months to establish the full canopy of the crop (Yadava, 1991). During this period of sugarcane growth some economically important short duration crops can be grown as intercrop in the vacant spaces between two rows. Farmers grow a large number of winter vegetables like potato, tomato, cauliflower, onion, carrot etc. as intercrop with sugarcane. On the other hand, about 20% of sugarcane land (160×10^3 ha) is intercropped with various short growing winter crops like potato, tomato, cauliflower, onion, carrot, pulses and oil seeds etc.

Paired rows system of sugarcane planting has been designed to keep two rows of cane at 60 cm apart leaving 140 cm between two such paired rows for growing two intercrops in sequence (Rahman, 2005). The wider space can accommodate higher number of plant. Growing double intercrop under paired row system increased the productivity by 31.20 per cent compared to the single intercrop under single row system (Alam, 1999). In view of this consideration, an experiment was designed to find out the performance of different high value vegetables with sugarcane as first and mungbean as second intercrop in paired rows sugarcane under farmers' condition in mill zones in High Ganges River Floodplain soil.

MATERIALS AND METHODS

The experiment was conducted during the cropping season of 2012-13 in mill zone area at Loknathpur of Chuadanga district where harvested cane was used for sugar making in sugar mill. Five different high value winter crops namely, onion

(Taherpuri), tomato (Sambol), carrot (Bejoy setera), potato (BARI Alu -7) and Califlower (BARI fulkoopi - 1) as first intercrops followed by mungbean variety BINA mung 5 as second intercrop were grown with sugarcane variety Isd 39. The experiment was laid out in randomized complete block design with three replications covering three areas as mentioned above. The unit plot size was 6m x 8m. The treatments included were:

T_1 = Paired rows cane (PRC) only
T_2 = T_1 + Onion (4 lines) – mungbean
T_3 = T_1 + Tomato (2 lines) – mungbean
T_4 = T_1 + Potato (2 lines) – mungbean
T_5 = T_1 + Cauliflower (2 lines) – mungbean
T_6 = T_1 + Carrot (4 lines) – mungbean

Two budded sugarcane setts were planted in each plot during 15 November 2012 at 60 cm apart keeping a wide distance of 140 cm in-between two paired rows of cane with intercrop namely, onion 4 lines (T_2), tomato 2 lines (T_3), potato 2 lines (T_4) cauliflower 2 lines (T_5) and carrot 4 lines were planted in between cane rows. Fertilizers were applied as per recommended dose (BARC, 2005). All TSP, Gypsum, one third of MoP and Urea were applied in trench and mixed with soil prior to planting of setts. The second dose of (1/3 rd) Urea and (1/3 rd) MoP were applied as first top dressing at 120 days after planting (DAP). Final top dressing of rest urea and MoP were applied in the month of April. Recommended dose of fertilizer was also applied for 1st and 2nd intercrops. Four times of irrigation and two times of weeding were practiced in the experimental field. Other intercultural practices were done when necessary. Recommended cultural practices and plant protection measures were taken. The intercrops were harvested at mature stages of each crop. Data in respect of yield of intercrops and yield contributing parameters of sugarcane i.e. germination, tiller, millable cane, tons cane per unit area, brix% were recorded. Besides expenses incurred and returns received from different crops were accounted so as to find out combined expenses and income from all crop combinations enlisted. Finally the adjusted yield of sugarcane was calculated by adding sugarcane equivalent yield of intercrops with the yield of sole cane crop. Economic analysis was done to assess the income earned from different crops. After harvest, data were collected, compiled, analyzed and interpreted following the standard statistical procedures (MSTAT C).

RESULTS AND DISCUSSION

Settling establishment

No significant effect of intercrpping was found on settling establishment (Figure 1). The highest settling establishment of 68.62% was obtained from treatment T_6 (PRC + Carrot – Mungbean) followed by treatment T_4(PRC + Potatoo – Mungbean), T_5(PRC + Cauliflower – Mungbean), T_3(PRC +Tomato – Mungbean,) and treatment T_1 (PRC only). The lowest settling establishment 62% was recorded from treatment T_2 (PRC + Onion – Mungbean). Simillar result was also reported by Islam *et al.* (2013) who explained intercropping of different winter crops with sugarcane under paired rows system did not show any adverse effect on settling establishment percentage as the intercrops were harvested before the start of grand growth period of cane.

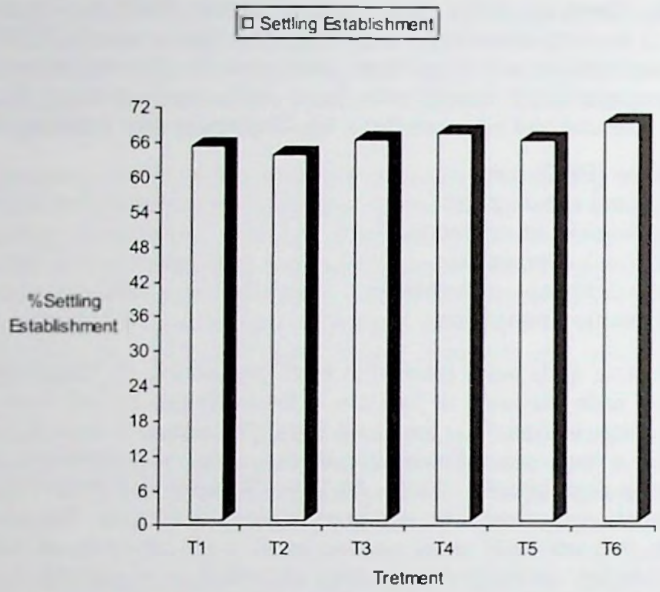

Figure 1. Settling Establishment % affected by different winter crops-mungbean intercropping combination

Tiller

Data on tillers production under different treatments were presented in the Table 1 and it was observed that no significant difference in tiller production among the treatment combinations. The highest tiller population of 242.70×10^3 ha^{-1} was found from T_4 (PRC+ Potato – mungbean) followed by the treatments T_2, T_1, T_3 and the lowest tiller population of 225.29×10^3 ha^{-1} was found from T_6 (PRC+ carrot– mungbean). Simillar result was also reported by Alam *et al.*, (2009) in case of tomato intercropped with paired row sugarcane.

Millable cane

Significant differences were observed in millable cane production (Table 1). The maximum millable cane 162.38 $\times 10^3$ ha^{-1} was recorded from the T_4 (PRC+Potato - Mungbean) treatment combination and the minimum 81.29 $\times 10^3$ ha^{-1} was from the T_6 (PRC+Carrot - Mungbean) combination (Table 1).This results aggred with Nakar (1990) who reported the beneficial effects of intercropping potato and lentil on millable cane stalk production.

Yield of cane

There were significant differences on cane yield among the treatment combination (Table 1), which indicated that intercropping of different winter crops with sugarcane had effect on cane yield. The highest cane yield 135.67 tha^{-1} was obtained in the treatment (T_4) where potato was grown as first intercrop and mungbean was grown as second intercrop. On the other hand, the lowest cane yield 71.29 tha^{-1} was recorded

from T_6 treatment where carrot was grown as first intercrop and mungbean was grown as second intercrop. This result agreed with Islam *et al.* (2013) who reported that intercropping of potato as winter crops with sugarcane had positive effect on cane yield.

Intercrop yield

From Table 1 significant effect was observed on yield of the first intercrops (Onion, Tomato, Potato and Carrot). Among all intercrops, potato gave the highest yield (18.50 tha^{-1}) and onion showed the lowest yield (5.56 tha^{-1}). The summer mungbean also performed better yield response as second intercrop for all of the combination.

Equivalent cane yield and adjusted cane yield

Sugarcane equivalent yield was calculated on sale proceeds received from intercrop equivalent sugarcane price. Equivalent yield of intercrop varied significantly. Table 1 revealed that T_4 (T_1+Potato- mungbean) gave the highest equivalent yield (74.88 tha^{-1}) and the lowest equivalent yield was observed from T_5 (45.09 tha^{-1}) which was statistically identical with T_5 (47.39 tha^{-1}).In considering adjusted cane yield, it was evident that T_4 (T_1+Potato- mungbean) produced the highest yield of 210.55 tha^{-1} and the lowest adjusted yield 118.69 tha^{-1} was found from T_6 (T_1+Carrot-mungbean) due to low intercrop yield and cane yield. The total adjusted cane yield indicated that all the intercrop plots with different high value vegetables-mungbean combinations were superior to the sole cane plot. Islam *et al.* (2013) reported that the highest adjusted cane yield was recorded from paired rows cane + potato- mungbean combination.

Table 1. Tiller, millable cane, cane yield, intercrop yield, equivalent cane yield and adjusted cane yield of different treatments during the cropping season of 2012-13

Treatments	Tiller ($x10^3$ ha^{-1})	Millable cane ($x10^3 ha^{-1}$)	Cane yield (tha^{-1})	Intercrop Yield (tha^{-1})		Equivalent cane yield (tha^{-1})	Adjusted cane yield (tha^{-1})
				1st	2nd		
T_1=PRC only	230.02	101.04	96.67	-	-	-	96.67 f
T_2= T_1+ Onion-MB	234.90	136.53	123.80	5.56	0.24	61.33	185.13
T_3= T_1+ Tomato-MB	228.63	100.42	92.23	14.85	0.23	58.28	150.51
T_4= T_1+ Potato-MB	242.70	162.38	135.67	18.50	0.22	74.88	210.55
T_5= T_1+ Cauliflower-MB	226.19	97.71	90.21	12.29	0.24	45.09	135.31
T_6= T_1+ Carrot-MB	225.29	83.21	71.29	10.467	0.23	47.39	118.69
LSD (0.05)	NS	17.45	15.92	1.34	NS	9.17	15.071

MB= Mungbean

Price of Crops:

Sugarcane	:	2500 Tk. ton^{-1}	Cauliflower	:	8 Tk. Kg^{-1}
Onion	:	25 Tk. Kg^{-1}	Carrot	:	10 Tk. Kg^{-1}
Tomato	:	10 Tk. Kg^{-1}	Mungbean	:	60 Tk. Kg^{-1}
Potato	:	12 Tk. Kg^{-1}			

Brix % cane

No significant effect on brix % of cane was recorded among the various different high value intercrops–mungbean combinations (Figure 1). The highest brix % of cane (22.14) was obtained from treatment T_6 (PRC + Carrot-Mungbean) followed by treatment T_1 (PRC only), treatment T_5 (PRC + Cauliflower–Mungbean), treatment T_2 (PRC + Onion–Mungbean), treatment T_4 (PRC + Potato–Mungbean). The lowest brix % (21.17) of cane was recorded from treatment T_3 (PRC + Tomato–Mungbean). Intercropping different high valued intercrops with sugarcane under paired rows system did not show any adverse effect on pol % cane as the intercrops were harvested before the start of grand growth period of cane.

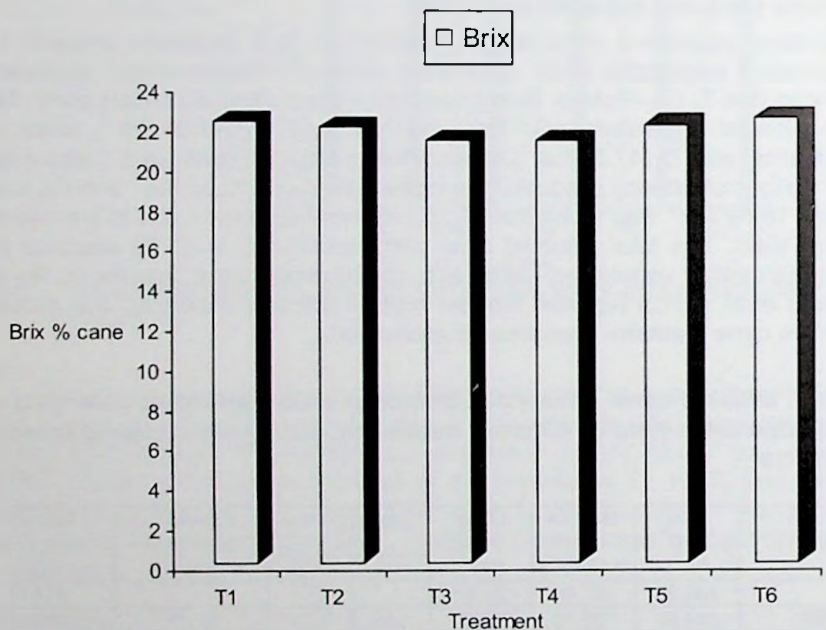

Figure 2. Brix % cane as affected by different winter crops-mungbean intercropping combinations

Economics

Eeconomic analysis of the experiment under different treatment combinations is shown in Table 2. Among the treatment combinations the highest total production cost 1,42,000 Tk. ha^{-1} was obtained from treatment T_4 followed by 1,41,000 Tk. ha^{-1} from treatment T_2 while the lowest cost Tk. 1,12,500 for treatment T_1 paired rows cane only. The total production costs varied due to variation of cost of production of first intercrop.

Table 2. Gross margin and benefit cost ratio (BCR) of different cane intercrop combinations at Loknathpur of Chuadanga during the cropping season of 2012-13

Treatments	Total Production cost (Tk.ha^{-1})	Gross return (Tk.ha^{-1})	Gross Margin (Tk.ha^{-1})	BCR
T_1=PRC only	1,12,500	241675	129175	2.14
T_2= T_1+ Onion-MB	1,41,000	462825	321825	3.28
T_3= T_1+ Tomato-MB	1,25,000	376275	251275	3.01
T_4= T_1+ Potato-MB	1,42,000	538875	396875	3.79
T_5= T_1+ Cauliflower-MB	1,38,000	338275	200275	2.45
T_6= T_1+ Carrot-MB	1,33,000	296725	163725	2.23

Price of Crops: Sugarcane : 2500 Tk. ton^{-1} Cauliflower : 8 Tk. Kg^{-1}
Onion : 25 Tk. Kg^{-1} Carrot : 10 Tk. Kg^{-1}
Tomato : 10 Tk. Kg^{-1} Mungbean : 60 Tk. Kg^{-1}
Potato : 12 Tk. Kg^{-1}

The highest gross return (5388755 Tk. ha^{-1}) was obtained from T_4 treatment followed by T_2 (462825 Tk. ha^{-1}) and the lowest (241675 Tk. ha^{-1}) was from the sole sugarcane crop (T_1). In case of gross margin the highest gross margin (396875 Tk. ha^{-1}) was obtained from T_4 followed by T_2 (321825 Tk. ha^{-1}) while the lowest (129175 Tk. ha^{-1}) was recorded from T_1. The highest benefit - cost ratio (BCR) of 3.79 was recorded from the T_4 and the lowest BCR (2.14) was from T_1. The results of the present experiment suggested that for higher economic return intercropping potato sequentially followed by mungbean with paired rows planted sugarcane recommended as the most profitable intercropping package for sustainable sugarcane farming in the Chuadanga area.

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