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Performance of Winter Vegetables and Summer Mung as Intercrops with Paired Row Transplanted Sugarcane

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ABSRTRACT

An experiment was carried out at the Bangladesh Sugarcane Research Institute (BSRI) farm during 1995-96 cropping season under irrigated condition to study the comparative performance of six winter vegetables viz. cabbage, cauliflower, potato, carrot, knolkhol and broccoli as first intercrops followed by summer mung as second intercrop with paired row transplanted cane. Intercropping cauliflower, potato and carrot increased cane yield while a slight decrease was observed in case of cabbage, knolkhol and broccoli intercropping. However, cabbage intercrop gave the highest additional economic return followed by potato compared to other intercrops. The maximum cost benefit ratio of intercropping was found 1:3.28 and 1:2.57 from the treatment Paired row cane (PRC) + cabbage (3 lines) - summer mung (3 lines) and PRC + carrot (3 lines) - summer mung (3 lines) respectively. Growing summer mung as second intercrop with cane generated an extra income from the same field. Therefore, intercropping winter vegetable like cabbage or carrot as first intercrop and summer mung as second intercrop grown with paired row transplanted cane might be recommended as the most profitable intercropping package for sustainable sugarcane farming in Bangladesh.

Key words: Intercrop, paired row, sugarcane, summer mung, transplanted cane

INTRODUCTION

The average farm size in Bangladesh is less than 1.0 hectare per house hold (Anon., 1986). Farmers grow large number of winter vegetables e.g. potato, cabbage, cauliflower, carrot, radish, broccoli etc. as sole crop occupying an area of about 220 X 103 ha. On the other hand, about 20 % of sugarcane land (160 X 103 ha) is intercropped with various short growing winter crops viz. potato, onion, radish, pulses and mustard as major ones. In Bangladesh, potato occupies about 15% of total area intercropped with sugarcane (Imam et al. 1990). Yield stability of sugarcane due to intercropping of potato has been reported else where (Rao and Shetty, 1976). Successful intercropping of various crops with sugarcane has been reported by many researchers (Rathi *et al.* 1974; Behli and Narwal, 1977; Verma *et al.* 1981 and Imam *et al.*, 1990).

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Sugarcane being a long duration crop usually requiring 12-16 months to mature and planted in wide space (one meter apart) allows for growing intercrops during the early slow growth stage. Without intercropping, the poor cane growers can not wait for such a long time to get economic return from sole crop of sugarcane. Therefore, sustainable sugarcane cultivation and to meet national requirement for sugar and gur, it is utmost necessary to find the possible ways of increasing economic benefit from sugarcane cultivation. Intercropping of various economic important crops e.g. winter vegetables with sugarcane through utilisation of our present limited resources as well as improved modern technologies might solve this problem to a greater extent. Furthermore, the demand for vegetables consumption is increasing day by day with rising population. But there is a very little scope for increasing vegetables production by horizontal expansion of land. Therefore, immediate administrative and technological initiatives are necessary for increasing the present area of vegetables intercropping with sugarcane by at least 25% to solve this problem. Usually, one line of winter vegetables is intercropped in between two single rows of sugarcane and this system of conventional intercropping could not give satisfactory intercrop yield in most of the cases. To overcome this problem, recently "paired row system" of sugarcane plantation has been developed at BSRI to facilitate higher intercrop population and raising two intercrops in sequence. The most significant yield increase (15-29%) over conventional spacing has been reported from planting two rows of cane at 40-50 cm apart leaving 150 cm between two such paired rows for growing intercrops (Roach, 1977). It has been reported that tiller, millable cane, cane stalk, cane yield and adjusted cane yield were significantly higher in paired row cane with potato-mung bean or onion-mung bean as sequential double intercrops with sugarcane than any other treatments with single row cane (Anon., 1991). Furthermore, Ali *et al.* (1989) reported that there was no significant adverse effect of row arrangement on germination of cane and recoverable sucrose per cent. In view of the above circumstances, an experiment was designed to study the agronomic performances of some selected winter vegetables as first intercrop and summer mung as second intercrop grown with paired row transplanted sugarcane.

MATERIALS AND METHODS

A field experiment was conducted at the BSRI farm, Ishurdi, Pabna during 1995-1996 cropping season under irrigated condition. After final land preparation, polybag settlings of variety Isd 20 were transplanted on 15 November 1995. Inter-plant spacing for sugarcane settlings was 45 cm for pair rows of 60 cm spacing while spacing between two paired rows was 140 cm. The wider spaces (140 cm) between two paired rows were used for growing intercrops. The unit plot size was 12 x 8 m. The experiment was fitted in a randomised complete block design (RCBD) with three replications. Six winter vegetables as first intercrops and summer mung as second intercrop was grown with sugarcane. Fertilizers for sugarcane were @ 325, 250,180,190 kg ha^{-1} as Urea, TSP, MP and Gypsum, respectively. Fertilizers for cabbage, cauliflower, knolkhol and broccoli were @ 110,100 and 50 kg ha^{-1} as Urea, TSP, MP respectively. Gypsum was applied only for cauliflower @ 50 kg ha^{-1}. Fertilizers for potato were @ 110, 50 and 80 kg ha^{-1} as Urea, TSP and MP respectively. Fertilizers for carrot were @ 130, 125, 120 and 80 kg ha^{-1} as Urea. TSP MP and Gypsum respectively. Necessary cultural practices were done as and

when required. The treatments for the experiment were as follows:

T_0 = Paired row cane (PRC) only.
T_1 = PRC + cabbage 3 lines - summer mung (3 lines)
T_2 = PRC + cauliflower 3 lines - summer mung (3 lines)
T_3 = PRC + potato 2 lines - summer mung (3 lines)
T_4 = PRC + potato 3 lines - summer mung (3 lines)
T_5 = PRC + carrot 3 lines - summer mung (3 lines)
T_6 = PRC + knolkhol 3 lines - summer mung (3 lines)
T_7 = PRC + broccoli 3 lines - summer mung (3 lines)

Seedlings/seeds of different first intercrops were transplanted sown between vacant spaces of paired rows of cane after 7 d of cane transplantation. The varieties of different first intercrops were green dewk, atlas-70, snow ball-x, takii, white vianae and cardinal for broccoli, cabbage, cauliflower, carrot, knolkhol and potato, respectively. After harvesting of first intercrops on 15th February 1996, summer mung (var. kranti) was sown as second intercrop in the following day. The second intercrop was harvested on 30th May 1996.

Data on different intercrops yield were recorded and converted into adjusted cane yield for economic analysis. For sugarcane, tiller population (x 1000 ha^{-1}), millable canes (x 1000 ha^{-1}), cane yield (t ha^{-1}), recoverable sucrose per cent and sugar yield (t ha^{-1}) were recorded. Partial budget analysis (Horton, 1982) was used to compare performance of different intercrops over sole cane in respect of net income. For analysis, all variable costs related to intercropping were also included. Total returns were calculated on the basis of yield and local market price of products. Additional cost and additional income due to intercropping over the sole cane practices were also calculated.

RESULTS AND DISCUSSION

Tiller and millable cane production:

Data on tillers and millable canes production under different treatments are presented in the Table 1. Significantly the highest tiller population $175x10^3$ and$176x10^3$ ha^{-1} was obtained from the T_4 and T_2 treatments where first intercrops were potato and cauliflower, respectively. Significantly the lowest tiller population of $85.67x10^3$ and $95.4x10^3$ and ha^{-1} was from the T_1 and T_7 treatment where the first intercrop were cabbage and broccoli respectively. This result indicated that intercropping cabbage and broccoli exerted a significant adverse effect on cane growth leading to a reduced tiller population compared to pure stand cane and other intercrop combinations. However, cauliflower, potato, carrot and knolkhol were found statistically identical to show their effect on tiller production of cane. Although, Ali *et al.*(1989) has also observed increased tiller production of cane under potato intercropping. A decrease in tiller production also reported when cabbage and broccoli were grown as first intercrop with paired row cane (Anon., 1995).

Table 1. Tiller population, millable cane, cane yield, intercrop and adjusted cane yield under paired row system of plantings.

Treatments	Tiller ($\times 10^3$ ha^{-1})	Millable cane ($\times 10^3$ ha^{-1})	Cane yield (t.ha^{-1})	Intercrop yield (t ha^{-1})		Adjusted cane yield (t ha^{-1})
				1st	2nd	
T_0 = Paired row cane (PRC)	160.2 a	86.3 ab	59.8 a	-	-	59.8 f
T_1 = PRC + cabbage – mung	85.7 b	71.3 c	52.8 a	70.4	0.25	197.8 a
T_2 = PRC + cauliflower – mung	175.1 a	84.9 ab	61.0 a	9.8	0.19	94.2 c
T_3 = PRC + potato 2 lines – mung	150.1 a	78.7 bc	56.6 a	6.4	0.26	87.0 d
T_4 = PRC + potato 3 lines – mung	175.7 a	88.8 a	63.9 a	10.0	0.23	108.3 b
T_5 = PRC + carrot – mung	160.5 a	85.1 ab	63.3 a	21.0	0.21	109.3 b
T_6 = PRC + knolkhol – mung	158.7 a	78.3 bc	54.8 a	9.3	0.22	77.6 e
T_7 = PRC + broccoli – mung	95.4 b	77.7 bc	56.7 a	5.5	0.20	76.9 e

Figures in a column accompanied by similar letters do not differ significantly as per DNMR test at 5% level of significance

Significantly the highest number of millable cane (88.8 x 10^3ha^{-1}) was obtained from the treatment T_4 while the lowest (71.3 x 103ha^{-1}) was from the treatment T_1 but the performance of T_4 treatment was statistically identical to T0, T_2 and T_5 treatments. The treatments T_3, T_6, and T_7 were also statistically similar in respect of millable cane production. A decrease of 1.4 to 17.5 % in millable cane production was observed in all cane intercrops combinations except for T4 (potato 3 lines) compared to the sole cane (T_0). Potato intercropping increased millable cane production by about 3% in the T_4 treatment compared to the sole cane (T_0). These results confirmed the findings of Khan *et al.* (1995) and Anon. (1995). They observed a considerable reduction in millable cane when winter vegetables like cabbage, cauliflower, radish, carrot and knolkhol were intercropped with paired row cane. Ali *et al.* (1989) reported an increase of 2,000 to 7,000 millable cane per hectare when potato was intercropped with cane than sole cane. The increase in millable cane production under potato intercropping might be related to the contribution of residual effects of N, P, K fertilizers applied to potato compared to sole cane and other intercrops.

Yield of cane:

Cane yield was found to be affected by type of first intercrops (cabbage, cauliflower, potato, carrot, knolkhol and broccoli) grown with paired row cane (Table 1).

Intercropping of cabbage, knolkhol and broccoli decreased cane yield (5-12%) while intercropping of potato (3 lines), carrot and cauliflower increased cane yield. Among different intercrop combinations, the highest cane yield of 63.9 t ha^{-1} was recorded from T_4 treatment followed by T_5 treatment (63.3 t ha^{-1}) while the lowest cane yield of 52.8 t ha^{-1} was obtained from the T_1 treatment. The decrease of cane yield due to intercropping of cabbage (T_1), knolkhol (T_6) and broccoli (T_7) might be related to the reduced millable cane production and lower unit weight compared to T_0, T_2, T_4 and T_5 treatments. Singh *et al.* (1999) reported that intercropping cabbage with sugarcane decreased cane yield by 4% while potato intercropping increased cane yield (Anon., 1995; Govinden, 1990 and Ali *et al.* 1989).

Intercrop yield:

The yield of intercrops were found satisfactory in all intercropped treatments with paired row sugarcane (Table 1). The yields of cabbage, cauliflower, carrots, knolkhol and broccoli were 70.4, 9.8, 21.0, 9.3 and 5.5 t ha^{-1} respectively. The yield of intercrop potato was 10.0 t ha^{-1} for 3 lines and 6.4 t h^{-1} for 2 lines. Yield of second intercrop (mung) varied with different treatment combinations for first intercrops. The higher mung yield (0.26 to 0.25 t ha^{-1}) was obtained from the T_3 and T_1 treatments where it was grown after harvesting first intercrop potato (2 lines) and cabbage. The lower yield of mung (0.19 t ha^{-1}) was obtained from T_2 where mung was grown after harvesting of cauliflower. This result indicated that type of preceeding first intercrop to some extent influenced yield of second intercrop. However, in all cases the yield of second intercrop was not satisfactory.

Recoverable sucrose and sugar yield:

Recoverable sucrose (%) and sugar yield (t ha^{-1}) were influenced greatly by type of intercrops (Fig. 1). The highest recoverable sucrose (9.06%) was obtained from T_5 treatment (PRC + carrot - mung) followed by T_4 treatment (PRC + potato 3 lines - summer mung while the lowest recoverable sucrose (7.99%) was obtained from T_1 treatment (PRC + cabbage - summer mung). The hifghest yield of sugar was found in T_5 treatment (5.73 t ha^{-1}) followed by T_4 treatment and the lowest sugar yield (4.22 t ha^{-1}) was found from T_1 treatment. Thus, it is seen from the results that cabbage intercropping showed negative effects both on sucrose content in juice and sugar yield while carrot intercropping increased both sucrose content and sugar yield.

Economics of intercropping with sugarcane:

It is revealed that the highest additional cost of Tk. 34, 000 ha^{-1} was needed for T_4 treatment (cane + potato 3 lines - mung) and the lowest additional cost of Tk. 10, 000 ha^{-1} was needed for T_5 treatment (cane + carrot - mung) (Table 2).

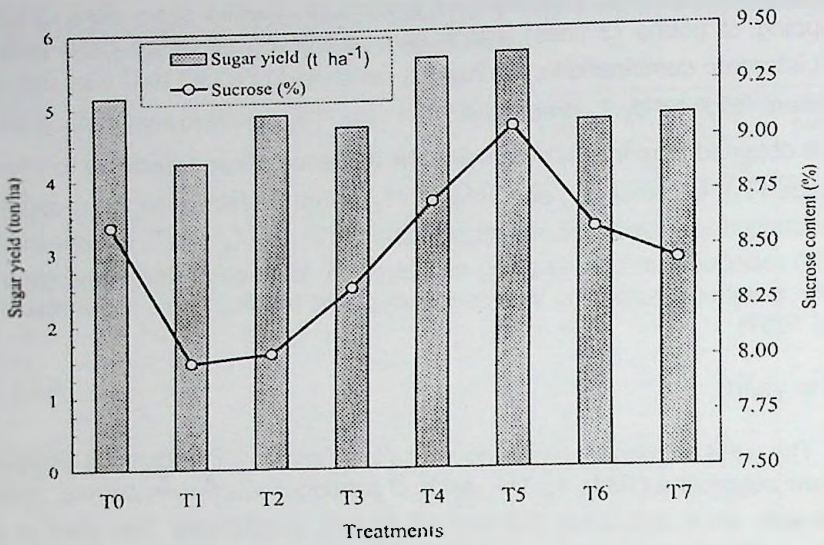

Figure 1. Effects of intercropping winter vegetable on the sucrose content (%) and sugar yield (t ha^{-1}) of sugarcane.

Table 2. Economic of intercropping winter vegetable with pairewd row sugarcane

Treatments	Cost of cultivation (Tk.ha^{-1})	Gross income (Tk.ha^{-1})	Additional cost over control (Tk.ha^{-1})	Additional income over control (Tk.ha^{-1})	Benefit Cost Ratio
T_0 = Paired row cane (PRC)	30,758	60,100	-	-	1.95
T_1 = PRC + cabbage – mung	60,625	198,865	25,000	138,000	3.28
T_2 = PRC + cauliflower – mung	60,625	94,710	25,000	34,000	1.56
T_3 = PRC + potato 2 lines – mung	62,310	81,210	24,000	37,000	1.30
T_4 = PRC + potato 3 lines – mung	65,120	98,820	34,000	48,000	1.52
T_5 = PRC + carrot – mung	42,650	109,820	10,000	49,600	2.57
T_6 = PRC + knolkhol – mung	46,620	78,075	15,000	18,100	1.68
T_7 = PRC + broccoli – mung	48,120	77,190	20,000	17,200	1.60

The additional cost due to cabbage and cauliflower - mung intercropping was Tk.25,000 ha^{-1}. It is revealed from data that T_1 treatment (cane + cabbage-summer mung) gave the highest additional income of Tk. 1,38,000 ha^{-1} while the lowest amount of Tk.17, 200 ha^{-1} was from the T_7 (cane + broccoli - mung). Potato 3 lines or carrot

followed by summer mung (T_4 and T_5) gave medium level of additional income. The highest cost/benefit (in Tk.) ratio of intercropping was found 1:3.28 from T_1 treatment followed by T_5 treatment (1:2.57). Intercropping of broccoli and potato (2 lines) was not found profitable (T_3 and T_7). This result suggests that cabbage and potato (3 lines) are the most compatible intercrops of paired row sugarcane. However, level of economic return due to intercropping may depends upon local market price of intercrops. The over all results indicated that cabbage was the best winter vegetables for intercropping with paired row cane as first intercrop. Growing summer mung as second intercrop can be recommended to get extra crop or income, which will also enrich soil fertility by biological nitrogen fixation into the soil.

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