Bangladesh J. Sugarcane, 30 : 91-97 *July, 2008*

Performance of Some Selected Intercrops as First and Green Manuring Crop as Second Intercrop with Paired Row Sugarcane

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ABSTRACT

An experiment was conducted at Thakurgaon, Dinajpur and Panchagarh under irrigated condition during 2001-2002 cropping season to study the performance of potato, onion, garlic, mustard and carrot as first and sunhemp as second (GM crop) intercrop with sugarcane in paired row planting system Intercropping practices significantly affected on tillers and millable canes formation but in minimum quantity. Treatment T_1 (Paired row sugarcane + potato-sunhemp), T_2 (Paired row sugarcane + onion-sunhemp) and T_3 (Paired row sugarcane + garlic-sunhemp) produced comparatively higher number of tillers and millable canes than other treatments. The highest cane yield (82.12 t ha^{-1}) was obtained from the treatment T_1 followed by T_2 and T_3 and the lowest (67.54 t ha^{-1}) from T_4.Again, this attribute was found significantly variable in different treatments as well as locations. The highest total adjusted yield of 128.09 t ha^{-1} was found in the treatment T_3 followed by T_1 and the lowest 77.97 t ha^{-1} in T_4. Brix (%) was affected significantly by different treatments as well as locations. The maximum gross return (Tk. 1,42,436.07), net profit (Tk. 85,454.73) and BCR (2.50) was recorded in the treatment T_3 followed by T_1, T_2 and T_5 and the minimum was in T_4. From the findings, it might be concluded that intercropping influenced cane yield and other yield contributing factors but found profitable compared to sole sugarcane grown suroundling the experimental plots.Growing potato, onion, garlic and carrot as first and sunhemp as second intercrop (green manure) will be profitable and these packages might be recommended for adoption in those locations.

Key words: Intercropping, paired row, sugarcane, green manure

INTRODUCTION

Sugarcane (*Saccharum officinarum* L) is one of the most important agro-industrial crops in Bangladesh. It is cultivated on an area about 0.17 million hectares annualy with average cane yield of only 41 ton per hectare (BBS, 1998). It is a long duration crop which requires 12-14 months to mature. Most of the farmers of Bangladesh are marginal and they can not wait such a long time to get return from a single crop and they interested to grow short duration and high value crops. The demand for vegetables, oilseed and pulses is increasing day by day with the rising population, but there is a little scope for increasing production of those commodities by horizontal expansion. To meet the national demand of sugar and gur production sustainable sugarcane production is needed which can be obtained through profitable cultivation of sugarcane following intercroppings. The growth of sugarcane is slow in early stages and it takes about 3 to 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 cane rows. Farmers grow a large number of winter vegetables like potato, cabbage, cauliflower, carrot, radish, broccoli etc. as sole crop. On the other hand, about 20% of sugarcane land (160×10^3 ha) is intercropped with various short growing winter crops like potato, onion, radish, pulses and mustard etc. Successful intercropping of various rabi crops with sugarcane has been reported by many researchers (Behl and narwal, 1977; Imam *et al.*, 1990; Rathi *et al.*, 1974 and Verma *et al.*, 1982). Usually, one line intercrop is grown in between two single sugarcane rows (90 cm apart) and this system of conventional intercropping could not give satisfactory intercrop yield and economic benefit in most of the cases. Paired row 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, 2001). It has been reported that tiller, millable cane stalks, cane yield and adjusted yield were significantly higher in paired row cane with potato-mungbean or onion-mungbean as sequential double intercrops with sugarcane than any other systems with single row cane (Rahman *et al.*, 2001). Furthermore, Ali *et al.* (1989) reported that there was no significant adverse effect of row arrangement on germination of cane and recoverable sucrose (%) of sugarcane. In view of the above circumstances, an experiment was conducted at different locations to find out the performance of some selected intercrops as first followed by sunhemp (green manuring) crop as second intercrop in paired row planting system of sugarcane.

MATERIALS AND METHODS

An experiment was conducted in the farmers' field at Thakurgaon, Dinajpur and Panchagarh under irrigated condition during 2001-2002 cropping season. The site represents Old Himalayan Piedmont Plain under Agro-Ecological Zone-1, with high land of sandy loam soil having pH 4.5 to 5.5. After final land preparation, sugarcane setts of variety Isd 28 were planted on 15 November, 2001. Three budded setts were placed in trench end to end in paired row of 60 cm apart while the distance between two paired rows of cane (PRC) was 140 cm. The distance (140 cm) between two paired rows were used for growing intercrops. Individual plot size was 10m x 10m and the treatments included in the experiment were as follows:

T_1 : Paired row sugarcane (PRC) + potato-sunhemp
T_2 : Paired row sugarcane (PRC) + onion-sunhemp
T_3 : Paired row sugarcane (PRC) + garlic-sunhemp
T_4 : Paired row sugarcane (PRC) + mustard-sunhemp
T_5 : Paired row sugarcane (PRC) + carrot-sunhemp

The experiment was laid out in randomized complete block design (RCBD) with three replications. Five winter crops viz. potato (*Solanum tuberosum*), onion (*Allium cepa*), garlic (*Allium sativum*), mustard (*Brassica campestris*) and carrot (*Daucus carota*) as first and sunhemp (*Crotalaria juncea*) as second intercrop were grown with sugarcane. Seeds of different first intercrops were planted/sown in the vacant spaces of paired rows of cane after completion of sugarcane setts plantation. The varieties of different first intercrops were Cardinal, Taherpuri, Local, Tori-7 and Takii for potato, onion, garlic, mustard and carrot

respectively. Fertilizer for sugarcane were @ 270, 175, 200, 140 and 6 kg ha^{-1} for urea, TSP, MP, gypsum and zinc sulphate, respectively (BARC, 1997). Full amount of TSP, gypsum, zinc sulphate, one third ($1/3^{rd}$) urea and MP were applied as basal in the trenches and mixed thoroughly with the soil. Rest amount of urea and MP were top dressed in two equal splits at 120 days after plantation (DAP) and at 180 DAP i.e. at tillering completion state. Fertilizer for potato were @ 150, 75, 120, 55 and 6, for onion and garlic @ 110, 90, 130, 60 and 8, for mustard @ 90, 75, 50, 75 and 4, for carrot @ 120, 90, 72, 60 and 6 kg ha^{-1} as urea, TSP, MP, gypsum and zinc sulphate respectively. For intercrops half of urea and MP, full amounts of TSP, gypsum and zinc sulphate were applied as basal doses. Remaining half of urea and MP were top dressed after 45 DAP. After harvesting of first intercrops sunhemp as green manure crop was grown and incorporated green manure in the soil after 45 days of seed sowing. Insect pests were control by applying, furadan 5G @ of 40 kg ha^{-1} in three splits in December, 2001, March and May, 2002. Other recommended cultural management practices were followed for sugarcane and intercrops when required. Tiller population of sugarcane was recorded at 90, 120, 150 and 180 DAT. Millable cane, cane yield and brix (%) were recorded at harvest. Data on yield and yield contributing parameters of cane and intercrops were recorded. The yields of first and second intercrops were recorded at harvest and converted into cane yield on the basis of sale price for economic analysis. Economic and statistical analysis on different parameters for sugarcane and intercrops were done following the standard procedures.

RESULTS AND DISCUSSIONS

Sugarcane is a vegetatively propagated crop. Its sprouting of buds depends on temperature and soil moisture status. Optimum temperature required for good germination ranges from 25°C to 35 °C and soil moisture 70-80 % of field capacity. In our experiment average germination was ranged from 54 to 60 % which is considered enough to obtain a good cane yield. No significant effect on germination was found among the treatments at different locations (Table 1) but it was found comparatively higher at Thakurgaon (60.0 %) than Dinajpur and Panchagarh (54.0 %)differ in locations.

Table 1. Germination (%) of buds at different locations, 2001-2002.

Treatments	Germination (%)			
	Locations			Mean
	Thakurgaon	Dinajpur	Panchagarh	
T_1 : PRC + potato-sunhemp	61.03	55.25	55.64	57.30
T_2 : PRC + onion-sunhemp	62.31	54.08	54.14	56.84
T_3 : PRC + garlic-sunhemp	61.16	55.05	55.88	57.36
T_4 : PRC + mustard-sunhemp	58.24	54.28	54.33	55.61
T_5 : PRC + carrot-sunhemp	57.21	51.09	50.09	52.79
Mean	59.99	53.59	54.01	-
LSD (5%)	ns	ns	ns	ns

Number of millable cane (stalk) per unit area of land at harvest is the most significant related factor to obtained higher yield in sugarcane (Yadava, 1993). Millable cane can be maximised by introducing high tillers formation in the early stage. Number of millable cane may reduced for high mortality of produced tillers due to different factors like higher interplant competition for solar energy, nutrient as well as adverse effect of micro environment raised for intercropping. In our experiment, enough tillers were produced in all treatments under different locations and tiller mortality was found remarkable and it was almost similar in all the treatment combinations (Table 2). Considering tillers produced at different locations under variable treatments it may be noted that significant difference was found in Thakurgaon where the highest tillers (176.2 x 10^3 ha^{-1}) were produced in T_1 (PRC + potato-sunhemp) and it was the lowest (150.4 x 10^3 ha^{-1}) in T_4 (PRC + mustard-sunhemp). No significant difference in tillering was found among others three treatments (T_1, T_2 and T_3). In millable cane production, statistically identical quantity were found in Dinajpur and Panchagarh in all treatments but significantly higher millable canes (93.2 x 10^3 ha^{-1}) were produced in T_1 than other treatment combinations. The lowest number of millable canes were found in T_4 (75.9 x 10^3 ha^{-1}). Other treatments obtained almost identical data on the said parameters.

It may be noted from Table 3 where cane yield, equivalent cane yield of intercrops and total adjusted yield were presented that cane yields in different treatments were significantly affected by different intercropping packages at Thakurgaon and Panchagarh locations but it was found statistically identical at Dinajpur. At Thakurgaon, the highest cane yield (85.2 t ha^{-1}) was produced in T_1 which was found statistically identical to T_2 and T_5 and the lowest cane yield (71.7 t ha^{-1}) was reported in T_4. Similar trend was also seen at Panchagarh. Mean data on yield production revealed that intercropping mustard and sunhemp with paired row cane adversely affected sugarcane production. Again, other treatment combinations of different intercrops with paired row sugarcane produced almost identical cane yield except T_1 where it was significantly higher. Equivalent cane yield (ECY) of different intercrops not only depends on the yield of intercrops but it might be influenced by market value of said crops. So, T_3 (PRC + garlic-sunhemp) gave the highest ECY (54.1 t ha^{-1}) and it was found the lowest (9.9 t ha^{-1}) in T_4 (PRC + mustard-sunhemp). Considering the total adjusted yield, significant difference was found at different locations under variable treatment combinations. The maximum average total adjusted yield of 128.09 t ha^{-1} was found in the treatment T_3 followed by T_1 (128.09 t ha^{-1}) and the minimum 77.97 t ha^{-1} was from T_4. Brix (%) was affected significantly by different treatment combinations as well as locations (Fig. 1).

Table 2. Tiller, millable cane stalk production and tiller mortality (%) of different treatment combinations at different locations, 2001-2002.

Treatments	Tiller (x 10^3 ha^{-1})				Millable cane (x 10^3 ha^{-1})				Tiller mortality (%)			
	Locations			Mean	Locations			Mean	Locations			Mean
	Thakurgaon	Dinajpur	Panchagarh		Thakurgaon	Dinajpur	Panchagarh		Thakurgaon	Dinajpur	Panchagarh	
T_1	176.20	175.78	173.77	175.25	93.19	80.79	89.43	87.80	47	54	49	50
T_2	168.93	171.62	171.50	170.68	84.68	78.78	83.19	82.22	50	54	51	52
T_3	172.21	160.37	167.96	166.85	82.58	79.16	82.30	81.35	52	51	51	51
T_4	150.35	152.37	153.84	152.19	75.90	71.24	75.90	74.35	50	53	51	51
T_5	154.57	156.87	167.12	159.52	84.09	75.95	78.66	79.57	46	52	53	50
Mean	164.45	163.40	166.84	-	84.09	77.18	81.89	-	49	53	51	51
LSD (5%)	16.67	ns	ns	11.23	7.15	ns	ns	5.15	ns	ns	ns	ns

Table 3. Cane yield, equivalent cane yield of intercrops and total adjusted cane yield of different treatment combinations at different locations, 2001-2002.

Treatments	Cane yield (t ha^{-1})				Equivalent cane yield of intercrops (t ha^{-1})				Total adjusted yield (t ha^{-1})			
	Locations			Mean	Locations			Mean	Locations			Mean
	Thakurgaon	Dinajpur	Panchagarh		Thakurgaon	Dinajpur	Panchagarh		Thakurgaon	Dinajpur	Panchagarh	
T_1	85.19	79.08	82.10	82.12	44.0	44.0	41.9	43.3	129.15	123.19	124.11	125.48
T_2	80.23	78.00	77.97	78.73	32.4	35.5	35.4	34.43	112.71	113.59	112.98	113.09
T_3	77.11	77.24	77.72	77.36	48.6	52.1	51.9	51.04	124.97	129.54	129.76	128.09
T_4	71.71	64.45	66.47	67.54	11.0	9.9	10.2	10.37	82.77	74.40	76.73	77.97
T_5	80.00	71.37	76.53	75.97	32.0	27.9	29.9	30.01	112.08	99.35	106.52	105.98
Mean	78.85	74.03	76.16	-	33.60	33.88	33.86	-	112.34	108.01	110.02	-
LSD (5%)	7.50	ns	9.10	4.97	-	-	-	-	9.04	13.10	8.97	5.45

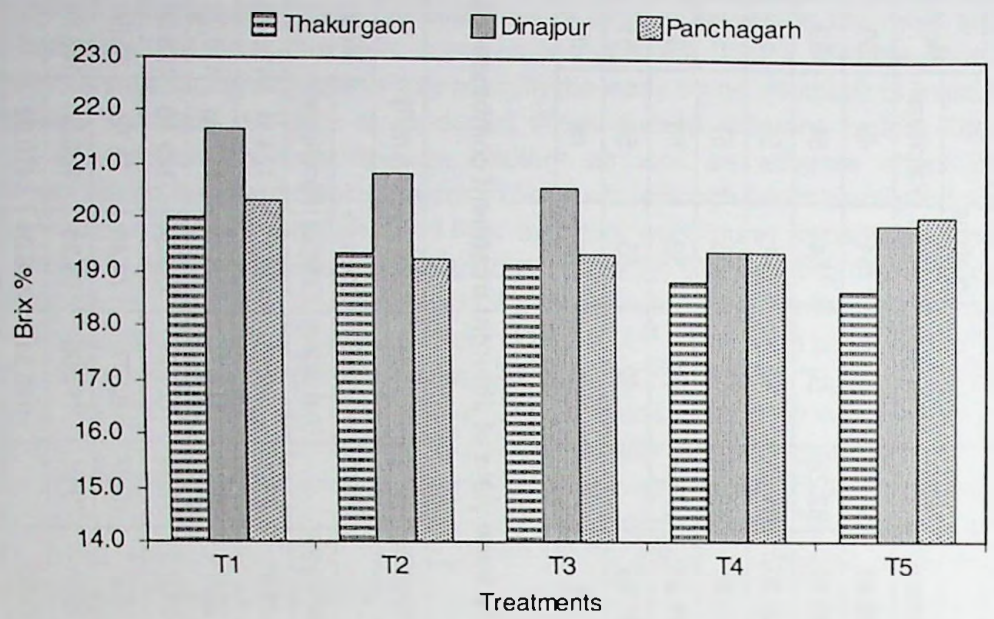

Fig.1. Brix % as affected by treatment combinations at different locations.

Table 4 shows the economic analysis of the experiment for different treatment combinations at different locations. The highest variable cost of Tk. 61226.67 was needed for T_1 followed by T_2, T_3, T_5 and the lowest cost of Tk. 44056.67 was for T_4. The maximum gross return (Tk. 1,42,436.07), net profit (Tk. 85,454.73) and BCR (2.50) was recorded from the treatment T_3 followed by T_1, T_2 and T_5 and the minimum was from T_4. From the findings it might be concluded that raising intercrops influenced cane yield and other yield contributing factors but found profitable compared to sole sugarcane grown in farmer'S field surounding the experimental plots. Growing potato, onion, garlic and carrot as first and sunhemp as second intercrop (green manure) was found profitable and might be recommended for large scale adoption under said locations.

Table 4. Economic analysis and BCR for intercropping of some selected intercrops as first and sunhemp as second intercrop with sugarcane at different locations, 2001-2002.

Treatments	Cost of production (t ha^{-1})		Total variable cost (Tk ha^{-1})	Gross return (Tk ha^{-1}) (Cane + Intercrop)	Net profit (Tk ha^{-1})	BCR
	Cane	Intercrops				
T_1	34640.00	26586.67	61226.67	139537.47	78310.80	2.28
T_2	34226.67	23334.00	57560.67	125759.80	68199.13	2.18
T_3	34033.33	22948.00	56981.33	142436.07	85454.73	2.50
T_4	32883.33	11173.33	44056.67	86698.93	42642.27	1.97
T_5	33900.00	18503.33	52403.33	117853.47	65450.13	2.25

Price of crops:

Sugarcane	:	1112 Tk t^{-1}	Mustard	:	15 Tk kg^{-1}
Potato	:	5 Tk kg^{-1}	Carrot	:	5 Tk kg^{-1}
Onion	:	8 Tk kg^{-1}	Sunhemp	:	200 Tk t^{-1} (fresh wt.)
Garlic	:	18 Tk kg^{-1}			

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