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Intercropping of Sugarcane with Onion and Potato Followed by Sesame in Paired Row System

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Abstract: An experiment was made to evaluate the agronomic and economic performance of different intercrops viz. Onion (*Allium cepa*), Potato (*Solanum tuberosum*) and sesame (*Sesamum indicum*) with sugarcane in paired row system. Sugarcane with potato followed by second intercrop sesame produced the highest yield of cane, potato and sesame. Maximum number of tiller, millable cane, cane diameter and unit stalk weight were observed in the same crop combination. On the contrary, sugarcane with onion followed by sesame produced maximum economic return. Brix (%) of cane juice did not varied significantly. So Intercropping with sugarcane performed better in respect of agronomic and economic benefits over sole cane.

Key words: Intercropping, sugarcane, onion, potato, sesame, paired row system

Introduction

Sugarcane is an important cash-cum-industrial crop of Bangladesh and mainly cultivated in north-western part of the country as the principal crop (Anonymous, 1978). Sugarcane being a long duration and widely spaced crop does not cover the vacant space between the rows up to 3-4 months and as such there is an ample scope to grow one or two additional short duration intercrops. Due to complementary effect of different crops when grown together, making better use of resources ultimately helps in enhancing the productivity of sugarcane. Intercropping in sugarcane with pulses, oilseeds and vegetable is quite common practice and an economical approach to get high agricultural production from same piece of land. Intercropping is an excellent technique to increase total yield, higher monetary return, greater resource utilization and fulfill the diversified need of the farmers (Sing *et al.*, 1986). In Bangladesh, sugarcane growers generally grow winter crops viz., mustard, onion, tomato, cabbage, chickpea, lentil, potato, coriander etc., as inter crops. Singh *et al.* (1986) found that potato+cane was better than other systems (mustard+cane and wheat+cane) studied in terms of cane yield, monetary advantage and net return. Inter cropping with potato in autumn planted sugarcane was found most profitable in India (Kanwar, 1975). Verma *et al.* (1986) has performed an experiment on cane potato Intercropping at different row spacing and found that neither cane nor potato yields were affected negatively. Sugarcane+potato+vegetable amaranth was profitable followed by sugarcane+onion (Imam *et al.*, 1982). In respect of land use efficiency sugarcane+potato+onion

was found to be the best inter crop combination (Rahman *et al.*, 1994). Bangladesh Sugarcane Research Institute (BSRI) has recommended several inter crop combination with sugarcane after intensive studies at research station and at farmers field (SRTI Annual Report, 1979, 1983). But much less effort has been given to implement the recommendations of BSRI or even to select the most suitable intercrop combination(s) to be practiced by the farmers in particular agro-climatic and edaphic conditions. Hence, an attempt has been taken to study the suitability of different intercrops with sugarcane and their economic benefit in paired row system specially at Chuadanga and Jessore sites of Bangladesh.

Materials and Methods

The experiment was conducted in two locations of Ganges River Floodplain (AEZ11) soils of Bangladesh, at Chuadanga and Jessore district during 2000-2001 cropping season. The experiment comprised three treatments viz., T₁: sole paired row sugarcane (control), T₂: Sugarcane+onion followed by second intercrop sesame and T₃: sugarcane+potato followed by second intercrop sesame. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. The unit plot size was 8x6 m². Fortyfive days old two eyed soil bed settling of variety Isd 2/54 were used as test crop in the experiment. Row to row and plant to plant distance were 60 and 45 cm, respectively. The spaces between two rows of sugarcane were 120 cm. Inter crops viz. onion and potato were planted between the vacant spaces of paired row sugarcane. Onion bulbs were planted in 3 rows with 20 cm row to row and 10 cm plant to plant spacing. Potato tubers were planted in two rows following the spacing row to row 30 cm and plant to plant 15 cm. The second intercrop sesame were sown after the harvesting of 1st intercrops. Fertilizer were applied @ N-130, P-35, K-60, S-20, Zn-3, N-50, P-20, K-30 and S-10, N-48.6, P-17.4, K-21, S-12.6 and Zn-2.4 Kg ha⁻¹ for cane; potato; onion and sesame, respectively. Mustard oil cake @ 1 t ha⁻¹ and cowdung 7 t ha⁻¹ as organic manure (OM) were applied for potato and cowdung @ 3 t ha⁻¹ were applied for onion. In sugarcane, full dose of P, S and Zn were applied in the trenches and thoroughly mixed with the soil by spade just prior to planting. Half of N and K were applied at 30 days after transplanting (DAT), remaining N and K were applied at 150 DAT. In potato, full dose of P, K and OM, half of N were applied in the bottom of the furrow and was covered with 5 cm soil before planting. The rest amount of N was applied at the side of the row and covered with soil at 45 days after planting. In onion, full doses of P, K, S and OM, one-third of N were applied at the time of land preparation, half of remaining N were applied at 21 and rest amount of N at 42 days after plantation. In sesame, full dose of P, K, S and Zn, half of N were applied at the time of final land preparation and rest amount of N were applied after 30 days of sowing. All cultural and pest control measures were done when required. Data on yield and yield attributing parameters of cane and brix (%) of sugarcane and yield of intercrops were recorded and analyzed statistically at 5% level of probability using LSD test. Cost of production was calculated on the basis of the cost of land preparation, seed cost, fertilizer cost, pesticide cost, labour cost and interest on current capital.

Results and Discussion

Chuadanga site:

Results revealed that tiller, height of cane, diameter of cane stalk and brix (%) had increased progressively but no significant effect was found among the treatments (Table 1). The highest number of tiller was found from T₁ ($196.77 \times 10^3 \text{ ha}^{-1}$) followed by T₃ ($182.75 \times 10^3 \text{ ha}^{-1}$) and least number of tiller was found from T₂ ($180.67 \times 10^3 \text{ ha}^{-1}$) which was in accordance with the findings of Roodagi *et al.* (2000) and Muhammad *et al.* (2000). Sugarcane crop competes for nutrient and moisture with companion crops in T₂ and T₃ treatments that may causes low emergence of tiller. Mixture cane height was found from T₃ (3.31 m) followed by T₂ (3.25 m) and the maximum diameter of cane was found from T₃(6.01 cm), followed by T₂ (5.97 cm) at harvest. These might be possible due to non-exhaustive and dwarf nature of the intercrops and residual effect of the additional fertilizers as well as cultural practices and irrigation applied to companion crops on sugarcane. These results are in close conformity with Muhammad *et al.* (2000). Highest brix percent was obtained from T₃ (20.95%) followed by T₂ (19.99%). Millable cane stalks, units stalk weight and yield of cane were varied significantly. The highest millable cane was found in T₃ ($121.73 \times 10^3 \text{ ha}^{-1}$) that was closely followed by T₂ ($121.56 \times 10^3 \text{ ha}^{-1}$). Maximum unit stalk weight was obtained form T₃ (1.19 kg) followed by T₂ (1.16 kg). Maximum cane yield was obtained from T₃ (143.50 t ha^{-1}) followed by T₂ (135.3 t ha^{-1}) that was statistically identical with T₂. These results were similar to that of Imam *et al.* (1982). The reported similar findings with sugarcane+potato, sugarcane+onion and many other crop combination. These also might be possible due to beneficial effects of applied fertilizers and manures and crop management for intercrops i.e. onion and potato were 9.52 and 12.06 t ha⁻¹, respectively. Maximum yield of second intercrop sesame was found from T₃ treatments (0.86 t ha⁻¹). In sugarcane+onion-sesame intercropping system, T₂ treatment produced 26.69% higher cane yield and in sugarcane+potato-sesame intercropping system, T₃ treatment produced 34.36% more cane yield over T₁ (sole cane only).

Make Price of Cane @ Tk. 1125 M ton⁻¹, Potato @ Tk. 5,000 ton⁻¹, Onion @ Tk. 10,000 M ton⁻¹ and Sesame @ Tk. 16,074 M ton⁻¹. Seed costs (Tk kg⁻¹): Sugarcane-1.13, Onion-25.0, Potato-12.0, Sesame-30.0 Fertilizer cost (Tk kg⁻¹): Urea-6.0, TSP-13.0, Mp-10.0, Zypsum-4.0, Zinc sulphate-60.0, Mustard oil cake-8.50, Cowdung-1.0. cost of pesticides (Tk kg⁻¹): Bavistin-1250, Regent 3 GR-95, Furadan 5 G-85, Dithane M 45-500, Nogos 100 EC-TK. 1300 L⁻¹. Labour cost: Tk. 60 person⁻¹ Day⁻¹.

Jessore site

Number of tiller, millable cane stalk, height of cane, unit stalk weight and yield of cane were significantly influenced (Table 1). Highest number of tiller was found in T₁ ($201.1 \times 10^3 \text{ ha}^{-1}$) followed by T₃ ($198.1 \times 10^3 \text{ ha}^{-1}$). The highest millable cane were found in T₃ ($122.25 \times 10^3 \text{ ha}^{-1}$)¹ followed by T₂ ($120.83 \times 10^3 \text{ ha}^{-1}$). The maximum cane height was obtained from T₃ (3.33 m) followed by T₂ (3.27 m). The highest unit stalk weight was found in T₃ (1.20 kg) followed by T₂ (1.15 kg) and

Table 1: Effect of different intercrops on yield and growth parameters of sugarcane in paired row system at Chudanga and Jessore site

Parameters	Location							
	Chudanga				Jessore			
	T ₁	T ₂	T ₃	LSD	T ₁	T ₂	T ₃	LSD
Tiller ($\times 10^3$ ha ⁻¹)	196.77	180.67	182.75	NS	201.1a	195.2c	198.1b	0.51
Millable cane ($\times 10^3$ ha ⁻¹)	110.99b	121.56a	121.73a	34.50	111.15b	120.83a	122.25a	28.36
Height of cane stalk (m)	3.18	3.25	3.31	NS	3.17b	3.27ab	3.33a	0.109
Diameter of cane stalk (cm)	5.79	5.97	6.01	NS	5.84	5.97	6.02	NS
Unit stalk Weight (kg)	0.99b	1.16a	1.19a	0.122	1.02b	1.15a	1.20a	0.094
Yield of cane (t ha ⁻¹)	106.8b	135.3ab	143.5a	28.84	116.4b	121.2ab	124.8a	5.574
Brix (%)	19.79	19.99	20.95	NS	19.28	18.78	19.02	NS
Yield of 1st inter crops (t ha ⁻¹)								
Onion	-	9.52	-	-	-	9.98	-	-
Potato	-	-	12.06	-	-	-	13.01	-
Yield of 2nd intercrops sesame (t ha ⁻¹)	-	0.81	0.86	-	-	0.99	1.01	-

Figures in the column designated by same letter (s) do not differ significantly at 5% level of probability.

T₁ = Sole paired row sugarcane (control) T₂ = Sugarcane+onion followed by second intercrop sesame

T₃ = Sugarcane potato followed by second intercrop sesame

was statistically identical. Maximum cane yield (124.8 t ha⁻¹) was found in T₃ treatment and the second highest yield (121.2 t ha⁻¹) was obtained from T₂ treatment were as the lowest yield of 116.4 t ha⁻¹ was found from T₁ treatment (sole cane only). Diameter of cane stalk and brix (%) were not significantly responded. Highest cane diameter was obtained from T₃ treatment (6.02 cm) followed by T₂ (5.97 cm). Maximum brix (%) was observed in T₁ (19.28%) followed by T₃ (19.06%). The cane yield increased 4.12 and 7.22% by the treatment T₂ and T₃ respectively over T₁. At this location first intercrops yield of onion and potato were 9.98 and 13.01 t ha⁻¹, respectively. Maximum yield of sesame was found in T₃ (1.01 t ha⁻¹).

From the above discussion it was observed that potato as first inter crop do not showed any antagonistic effect on yield and yield attributing parameters of sugarcane. Potato intercropped plots produced second highest tiller, highest millable cane, maximum height, diameter, unit stalk weight and yield of sugarcane at both the locations. This findings were strongly corroborates with Miah *et al.* (1994) and Sinha *et al.* (1990). These might be possible due to beneficial effects of applied fertilizers and manures and crop management for potato that ultimately helped to produce better yield. It has given highest brix (%) at Chudanga but second highest brix (%) at Jessore.

Onion as first intercrop also does not showed any adverse effect on sugarcane yield and growth but it produced minimum number of tiller. It might be because of more competition of the crop for nutrient and water than that of potato. It has given second highest millable cane, second maximum height, diameter, unit stalk weight and yield of sugarcane at both the locations.

Table 2: Economics of different intercrops with sugarcane at Chuadanga and Jessore site

Parameters	Location					
	Chuadanga			Jessore		
	T ₁	T ₂	T ₃	T ₁	T ₂	T ₃
Income (TK ha ⁻¹)						
Cane	120150	152213	161438	1,30,950	1,36,350	1,40,400
Intercrop						
1st	-	95200	60300	-	99,800	65,050
2nd	-	13020	13824	-	15,913	16,235
Gross income Tk. (ha ⁻¹)	1,20,150	2,60,438	2,35,572	1,30,950	2,52,063	2,21,685
Cost of production (Tk ha ⁻¹)	49,549	1,02,590	1,18,520	9,594	1,02,590	1,18,520
Net income (Tk ha ⁻¹)	70,556	1,57,893	1,17,052	81,356	1,49,473	1,03,105
Percent income increased over sole cane	-	123.78	65.90	-	83.73	26.73

T₁ : Sole paired row sugarcane (control), T₂: Sugarcane+onion followed by second intercrop sesame and
T₃ : Sugarcane+potato followed by second intercrop sesame

Table 3: Sale proceed from intercrops and adjusted cane yield at Chuadanga and Jessore site

	Treatment		
	T ₁	T ₂	T ₃
Chuadanga			
Sale proceed from intercrops (Tk ha ⁻¹)			
1st	-	95,200	60,300
2nd	-	13,020	13,824
Adjusted cane yield from intercrops (Tk ha ⁻¹)	-	96.20	65.89
Jessore			
Sale proceed from intercrops (Tk ha ⁻¹)			
1st	-	99,800	65,050
2nd	-	15,913	16,235
Adjusted cane yield form intercrops (t ha ⁻¹)	-	102.86	72.25

T₁ : Sole paired row sugarcane (control), T₂: Sugarcane+onion followed by second intercrop sesame and
T₃ : Sugarcane+potato followed by second intercrop sesame

It also might be due to higher competition of the crop than potato for nutrient and water. Intercrop onion produced second highest and least brin (%) at Chuadanga and Jessore, respectively.

Sesame were shown as second intercrop after harvesting of first intercrop (potato and onion). Sesame intercropped plots increased sugarcane yield and its components significantly over control. It might be due to the carry over effects of fertilizers added to sesame.

In both the locations number of tiller were progressively decreased in intercropped plots. Maximum number of tillers was found in T₁ treatments where no intercrops were raised followed by T₃ (Sugarcane + potato - sesame). These values were non-significant at Chuadanga but significant at Jessore site. On the contrary, millable cane, height of cane stalk, diameter of cane stalk, unit stalk weight and yield of cane were increased in intercropped plots over control plots in both the location. Maximum increase of those values were found in T₃ (Sugarcane + potato sesame) treatment followed by T₂ (Sugarcane + onion - sesame). Among those values in the location, millable cane, unit stalk weight and yield of cane showed significant effect, diameter of cane stalk showed non-significant effect at Jessore site. Cane brix percent showed non-significant effect at Chuadanga but significant effect at Jessore. Maximum brix percent were obtained from T₃ treatment at Chuadanga and from T₁ treatment at Jessore. These results revealed that companion crops have no effect on brix percent.

Economic aspect:

The economics of different intercrops with sugarcane were worked out and are presented in the data revealed that cane + onion - sesame proved to be best combination, which gave maximum net profit of Tk. 1,57,893 ha⁻¹ at Chuadanga and 1,49,473 ha⁻¹ at Jessore Table 2. Rahman *et al.* (1994) found similar results with sugarcane + onion, sugarcane + potato and many other crop combination. Maximum income increased was 123.78 and 83.78% at Chuadanga and Jessore, respectively under sugarcane + onion-sesame intercropping system and the second highest income was 65.90 and 26.73% under sugarcane + potato - sesame intercropping revealed that the highest adjusted cane yield of 96.20 t ha⁻¹ at Chuadanga and 102.86 t ha⁻¹ at Jessore was obtained from the treatment T₂ (Table 3).

From the above discussion it is inferred that cultivation of short duration intercrops like onion and potato followed by sesame with sugarcane in paired row system were found profitable over sole planted sugarcane. Hence, both crop combination may be suggested for achieving higher cane yield as well as to get interim benefit from a same piece of land.

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