

Performance of Intercropping with Sugarcane under Several Crop Combinations

S. A. Imam, A. Ali¹ and M. A. Razzaque²
Sugarcane Research & Training Institute,
Ishurdi, Pabna, Bangladesh.

ABSTRACT

An experiment on ten sugarcane based crop combinations was conducted in the Sugarcane Research & Training Institute, Ishurdi in 1976-77. The purpose was to assess the performance of sugarcane and winter crops under various crop combinations. Of all the systems, the sugarcane+potato+vegetable amaranth proved most desirable in respect of TCH, TSH and net return per ha, even though the combination involved the greatest investment. Sugarcane+onion (seedlings) may be the second choice. Hence, if investment could be made these combinations would be a suitable one. Sugarcane+Mustard could be an alternative choice if investment is limited. To grow winter crops as intercrop with sugarcane profitably, sugarcane should be planted early in the season.

INTRODUCTION

Sugarcane, *Saccharum Officinarum* Linn; is a long duration crop requiring nearly 15 months to mature under Bangladesh Agro-Climatic condition. During this long period, the growers mostly the tenant farmers and small holding owners have to invest profusely in terms of capital, labour and inputs and can expect a return only at the end of the cropping season.

In sugarcane growing regions, the farmers are confronted with the problem of choosing the profitable intercrop, wintercrop and sugarcane that demand similar type of land and planting season. To circumvent the problem, wintercrops are raised first, followed by sugarcane plantation, resulting in a lower yield of crop and sugar per unit area (Razzaque *et. al.*, 1978). Therefore, the growing of wintercrops with sugarcane is to avoid competition between crops (Sun, 1961; Tang, 1964; Villarico and Ledesma, 1969; Anonymous, 1973; Kanwar, 1975; Wankhede and Parashar, 1975; Agarwal and Mathuria, 1976; Rahman *et. al.* 1978) but the farmers can not expect as much yield of and return from a wintercrop when grown as intercrop as it would produce when grown as a pure stand.

-
1. Additional Chief (Cane Development), BSFC, Southern Zone, Kushtia.
 2. Senior Scientific Officer (Farming system), BARC, BARC Complex, Farmgate, Dhaka—15.

Kanwar (1975) reported the maximum net income per unit area from potato followed by onion. It was demonstrated in India that intercropping pea or potato in Autumn-planted sugarcane was the most profitable proposition and the farmers who would not be interested in Autumn-planting of sugarcane could supplement their income by intercropping onion with spring planted sugarcane. Early mustard being a profitable crop could be advantageously grown before spring-planted sugarcane (Kar and Nath, 1965).

The present study with different crop combinations were undertaken to find out most compatible and economic wintercrop to grow as intercrop with sugarcane in Bangladesh condition.

MATERIALS AND METHODS

The experiment was set up in November, 1976 and was fitted in a Completely Randomized Block Design (RCB). Ten crop combinations listed in Table 1 were tested with four replications.

Co.1158 variety of sugarcane was planted in trenches spaced 105 cm in the end-to-end method with recommended doses of fertilizers (123kg N, 123kg P_2O_5 and 109.8kg K_2O per ha). Normal recommended doses of fertilizers were applied to wintercrops when grown as pure stand and 50% of the recommended dose were applied when grown as intercrop with sugarcane. The method of cultivation of the intercrops or wintercrops and their dates of harvesting are given in Table 1.

All cultural practices appropriate to the sugarcane and wintercrops were followed. The sugarcane was harvested on 15th January, 1978. The size of individual plot was 9.60m x 8.53m.

Data on yield and sugarcane equivalent yield of wintercrops, yield components recoverable sucrose content, yield and adjusted yield of sugarcane and pest infestation as influenced by the wintercrops were recorded. The cost and return from each treatment were calculated and presented. The sugarcane equivalent yield of the intercrops was calculated by adopting the procedure suggested by Lal and Ray (1976). The adjusted yield of sugarcane was found out by adding the sugarcane equivalent yield of the wintercrop concerned with the yield of sugarcane of the plot. Appropriate statistical and economic analyses were used to isolate the desirable treatments. Observations were made on the compatibility aspects of the component crops of the individual crop combinations.

RESULTS AND DISCUSSION

Sugarcane after potato induced the highest germination percentage significantly different from all other combinations. This might be due to better soil management in the potato cultivation compared to other wintercrops. Sugarcane after wheat, however, produced least germination percentage (Table 2a). Temperature at the time of planting may have influenced germination.

Table 1. Planting dates of sugarcane and wintercrops, cultivation method and harvesting dates of wintercrops.

Treatments	Sugarcane planting date.	Wintercrop							
		Planting date	Row intensity.	Spacing					Harvesting dates.
				Between row. (cm)	Between Plant (cm)	N	P ₂ O ₅	K ₂ O	
Wheat followed by sugarcane	22 March, '77	13 Nov. '76	Pure stand	30.48	Solid line	83.13	62.36	41.57	22 March, '77
Mustard followed by sugarcane	16 Feb. '77	11 Nov. '76	Pure stand	30.48	Solid line	41.57	62.36	27.72	14 Feb. '77
Sugarcane+Mustard	14 Nov. '76	16 Nov. '76	1	—	Solid line	11.81	17.81	7.92	14 Feb. '77
Sugarcane+Potato Vegetable amaranth	14 Nov. '76	Potato	1	—	22.50	47.51	23.75	47.51	15 March '77
		16 Nov. '76 Veg. amaranth 17 March '77	2	30.48	10.00	20.78	10.39	13.86	25 April '77
Potato followed by sugarcane	6 March '77	13 Nov. '76	Pure stand	60.96	22.50	83.14	41.57	83.14	5 March '77
Sugarcane+Wheat	14 Nov. '76	15 Nov. '76	2	30.48	Solid line	47.51	35.62	23.75	22 March '77
Sugarcane+Potato	14 Nov. '76	16 Nov. '76	1	—	22.50	47.51	23.75	47.51	5 March '77
Onion (bulb) followed by sugarcane+Onion (seedling)	16 Feb. '77	Onion (bulb)	3	20.00	10.00	20.78	20.78	55.52	16 Feb. '77
		14 Nov. '76 Onion (seedling) 16 Feb. '77	3	20.00	10.00	12.48	12.48	33.25	25 April '77
Sugarcane+Onion (seedling)	14 Nov. '76	16 Feb. '77	3	20.00	10.00	12.48	12.48	33.25	25 April '77
Sugarcane (pure stand)	14 Nov. '76								15 January '78 (Sugarcane)

Table 2a. Effect of intercrop combination on yield, yield components, sucrose content and sugar yield of sugarcane.

Treatments	Germination %	Tiller No. /ha ('000')	Millable cane/ ha ('000')	Yield/ha (tons)	Sucrose content(%)	Sugar yield/ ha(tons)
Wheat followed by sugarcane	40.25e	98.35cd	78.48c	60.61d	9.40b	5.70d
Mustard followed by sugarcane	61.97b	106.89cd	84.91c	74.85cd	10.32a	7.72c
Sugarcane+Mustard	56.48bcd	122.10c	91.18c	86.16c	10.34a	8.89c
Sugar cane+Potato+Vegetable amaranth	61.42bc	218.40ab	122.04a	128.42a	10.84a	13.92a
Potato followed by sugarcane	71.17a	113.22c	89.53c	73.29cd	10.89a	7.98c
Sugarcane+onton (seedling)	58.68bcd	226.32a	112.88ab	121.03ab	10.17a	12.31ab
Sugarcane+Wheat	52.84d	76.66d	83.72c	83.62c	10.29a	8.60c
Sugarcane+Potato	58.58bcd	200.12b	108.95ab	115.35ab	10.15ab	11.71b
Onion (bulb) followed by sugarcane+ Onion (seedling)	52.89cd	113.10c	89.58c	81.89c	10.34a	8.47c
Sugarcane (pure stand)	55.74bcd	211.97ab	107.89ab	107.36b	10.56a	11.34b
S. E.	2.38	33.13	31.23	3.45	0.22	0.92

Figures in the column followed by same letters do not differ significantly at 5% level of probability.

Sugarcane+onion (seedlings), sugarcane+potato+vegetable amaranth and sugarcane (pure stand) produced significantly higher number of tillers than the rest of the treatments but were indentical to each other (Table 2a).

Sugarcane+potato+vegetable amaranth produced highest number of millable canes/ha (122.04x130) and had been statistically equal to sugarcane+onion (seedling) and sugarcane+potato but the latter two systems did not differ significantly from only sugarcane (Table 2a).

Sugarcane+potato+vegetable amaranth, sugarcane+onion(s) and sugarcane+potato induced the sugarcane yields of 128.42, 121.03 and 115.35 TCH (Tons Cane/ha) respectively and did not differ significantly from each other. The latter two combinations produced yields identical to the one produced by cane grown as pure stand. The higher yield of sugarcane produced by the above crop combination over others might be due to the non exhaustive and dwars nature of the intercrop and residual effect of the additional fertilizers, cultural practices and irrigation applied to companion crop on sugarcane. The highest yield of sugarcane in sugarcane+potato+vegerable amaranth was contributed by production of increased number of tillers and millablecanes (Table 2a). The yield of sugarcane was greatly reduced when a wintercrop like wheat, mustard, onion or potato was grown first as pure stand and planting of sugarcane was delayed. Poorest yield of 69.61 TCH was produced when a preceding crop of wheat was grown. Wheat might have exhausted the soil and delayed plantation of sugarcane.

Plantation of sugarcane after wheat produced the lowest recoverable sucrose content and sugar yield. The poor sucrose content and sugar yield in the above combination were due to late planting of sugarcane and subsequently poor germination, tiller, millable cane production, lower yield of cane and significantly higher pink borer infestation on the cane shoots due to growing of wheat in this combination. The pink borer, *Sesamia inferene* Walk, Infestation on sugarcane was the highest (22.03%) when wheat was grown as intercrop in sugarcane+wheat combination differing significantly from all other combinations. The other systems proved identical in respect of infestation of this insect pest. All other crop combinations were found to contain identical quantity of sucrose. Sugarcane+potato+vegetable amaranth produced highest sugar yield of 13.92 tons/ha and significantly differed from all but sugarcane+onion(s), the latter one being identical to sugarcane+potato and sugarcane (pure stand). This was due to highest yield of sugarcane supported by higher number of tiller, millable cane production and higher sucrose content. In all cases sugarcane and sugar yield decreased when the crop followed a preceding wintercrop causing delay in sugarcane planting and subsequent poor performance of the crop. This result agrees with that obtained by Parashar *et. al.*, (1979).

Onion(b) followed by sugarcane+onion(s) induced the greatest intercrop yield (8.97 tons/ha) and mustard followed by sugarcane, sugarcane+mustard and sugarcane+onion (seedlings) produced the lowest yields of intercrop (Table 2b). Sugarcane+mustard did not differ significantly from mustard followed by sugarcane. Sugarcane+onion(s), sugarcane+potato+vegetable amaranth and sugarcane+potato induced the least sugarcane equivalent yields owing to either lower yield or lesser market price or both attributing to wintercrops.

Adjusted sugarcane yields from sugarcane+potato+vegetable amaranth, sugarcane+onion(s), sugarcane+potato, sugarcane+mustard, onion(b) followed by sugarcane+onion(s) did not differ significantly from each other (Table 2b). Potato followed by sugarcane produced the least adjusted yield (86.48 tons/ha) differing significantly from all other systems except wheat followed by sugarcane. Evidently, higher adjusted sugarcane yield, in any cases, was attributed mainly to the higher sugarcane yield owing to its early plantation (Table 2b).

Table 2b. Effect of crop combinations on yield and sugarcane equivalent yield of wintercrops and adjusted yield of sugarcane.

Treatments	Wintercrop		Adjusted yield of sugarcane (tons/ha)
	Yield (tons/ha)	Equivalent yield (tons/ha)	
Wheat followed by sugarcane	4.03	36.25a	96.85cd
Mustard followed by sugarcane	1.11	31.13b	105.92bc
Sugarcane+Mustard	1.16	32.53ab	118.85ab
Sugarcane+Potato+Vegetable amaranth.	1.66**	6.64e	135.05a
Potato followed by sugarcane	3.31	12.24d	86.48d
Sugarcane+Onion (seedling)	1.19	4.76e	125.72a
Sugarcane+Wheat	2.72	24.46c	108.04bc
Sugarcane+Potato	2.20	8.80e	124.00ab
Onion (bulb) followed by sugarcane+onion (seedling)	8.97	35.88a	117.75ab
Sugarcane (pure stand)	—	—	107.36bc
S. E.		2.02	8.98

Figures in the column followed by similar letters do not differ significantly at 5% level of probability.

**Potato+potato equivalent yield of amaranth.

The infestation level of all sugarcane borers like pink borer, *Sesamia inferens* walk, internode borer, *Chilo tumidicostalis* Hams., and early shoot borer *Chilo infuscatellus* Sn., pooled together was also the highest for sugarcane+wheat followed by sugarcane after wheat, Sugarcane after wheat however, didnot differ significantly from all except sugarcane+wheat and sugarcane (pure stand). Cultivation of only sugarcane resulted in the lowest total borer infestation (2.21%). It was evident that pink borer and other borer infestation was in alarming proportion when wheat was included in the crop combinations either as intercrop with or preceding crop to sugarcane resulting in decreased sugarcane and sugar productivity and demanding effective pest control (Table 3). This finding corroborates the results of kalva *et. al.*, 1975.

Sugarcane+mustard produced the benefit/cost ratio of Tk. 2.44 : 1.00 and ranked first among the combinations studied followed by Tk. 2.36 and Tk. 2.35 to a Taka invested for sugarcane+onion(s) and sugarcane+potato+vegetable amaranth (Table 4). However, sugarcane+potato+vegetable amaranth produced the greatest net return/ha (Tk. 20.817.15) followed by sugarcane+onion(s) (Tk. 19.442.70) and least net return (Tk. 6,826.20) was earned by potato followed by sugarcane. This finding is simiiar to that of Kar *et. al.*, (1975) The cost/benefit ratio and net return could not maintain any correlation due to requirement of dissimilar quantities of seed used for growing different winter-crops and different market prices of the products.

Evidently, the crop combinations having wintercrops as intercrop with sugarcane produced, in general, greater benefit/cost ratio and net return/ha than these having them as preceding crop to sugarcane causing its delayed planting and subsequent decreased yield (Table 3).

Table 3. Borer infestation of cane as influenced by different intercrops.

Treatments	Pink borer infestation (%)	Total borer infestation (%)
Wheat followed by sugarcane	0.56b	8.78b
Mustard followed by sugarcane	1.27b	7.66bc
Sugarcane+Mustard	0.63b	4.76bc
Sugarcane+Potato+Vegetable amaranth	0.18b	4.02bc
Potato followed by sugarcane	0.31b	4.03bc
Sugarcane+Onion (seedling)	1.48b	3.65bc
Sugarcane+Wheat	22.03a	27.12a
Sugarcane+Potato	2.02b	3.69bc
Onion (bulb) followed by sugarcane+Onion (seedling)	1.06b	5.21bc
Sugarcane (pure stand)	0.56b	2.21c
S. E.	0.99	1.65

Figures in the column followed by similar letters do not differ significantly at 5% level of probability.

Table 4. Cost and return figures accruing to various crop combinations.

Treatments	Income/ha (Tk.)			Cost/ha (Tk.)			Net return (Tk.)	Benefit/ cost ratio
	Sugarcane	Wintercrop	Total	Sugarcane	Wintercrop	Total		
Wheat followed by sugarcane	16244.40	9714.90	25959.30	12423.90	2088.00	14511.90	11447.40(9)*	1.79 : 1.00(9)*
Mustard followed by sugarcane	20058.90	8344.05	28402.95	12423.90	1144.05	13567.95	14712.00(8)	2.09 : 1.00(7)
Sugarcane+Mustard Sugarcane+Potato+	23091.90	8714.85	31806.75	12423.90	633.75	13057.65	18749.10(3)	2.44 : 1.00(1)
Vegetable amaranth	34416.00	1774.80	36190.80	12423.90	2949.75	15373.65	20817.15(1)	2.35 : 1.00(3)
Potato followed by sugarcane	19641.75	3549.60	23191.35	12423.90	3941.25	16365.15	6826.20(10)	1.42 : 1.00(10)
Sugarcane+Onion (seedling)	32436.00	1271.55	33707.55	12423.90	1840.95	14264.85	19442.70(2)	2.36 : 1.00(2)
Sugarcane+Wheat	22409.58	6556.05	28965.63	12423.90	981.00	13404.90	15561.00(6)	2.16 : 1.00(6)
Sugarcane+Potato Onion (bulb) followed by	30912.75	2357.55	33270.30	12423.90	2663.70	15087.60	18182.70(4)	2.21 : 1.00(5)
sugarcane+Onion (seedling)	21946.20	9615.84	31562.04	12423.90	3632.40	16056.30	15505.74(7)	1.96 : 1.00(8)
Sugercane (pure stand)	28773.75	—	28773.75	12423.90	—	12423.90	16349.85(5)	2.32 : 1.00(4)

- * Figures in parentheses indicate the relative rank of the cropping systems.

Cane price @ Tk. 10.00/md. (Tk. 268.00/M. ton).

Market rate of Wheat @ (Tk. 90.00/md.) (Tk. 2410.64/M. ton)

Market rate of Mustard @ Tk. 280.00/md. (Tk. 7517.16 M. ton)

Market rate of Potato @ Tk. 40.00/md. (Tk. 1072.00 M. ton)

Market rate of Onion @ Tk. 40.00/md. (Tk. 1072.00 M. ton)

Briefly, among the crop combinations, sugarcane+potato+vegetable amaranth proved the most desirable one in terms of sugarcane and sugar yield and net return, although it involved the second greatest investment. Hence, if investment is not scarce, this system could be a suitable one. However, if investment is a constraint, sugarcane+mustard or any other combinations ranked in succession according to benefit/cost ratio gradient could be proved suitable. In any case, the yield of sugarcane was the predominant factor for selecting a profitable cropping combinations. For higher yield of the crop plantation of sugarcane early in the season is highly desirable.

In all combinations studied, cultivation of sugarcane with intercrop or as pure stand preceded by a wintercrop was found to reduce the sugarcane and sugar yield seriously. Hence, plantation of sugarcane in November (early) and growing of potato or onion as intercrop with sugarcane is suggested to get higher economic benefit.

ACKNOWLEDGEMENT

The Authors are indebted to Dr. M. M. Rahman, Dr. M. Shahjahan, Mr. M. A. Karim and Mr. M. A. A. Sarkar for their advice and assistance. The author expresses his gratitude to Dr. M. A. Hamid Miah, Principal entomologist, SRTI for his kind suggestions and advice for improvement of the paper. Mr. A. M. Kashem and Mr. Giashuddin are also thankful for their help.

REFERENCES

- Agarwal, M. L. and Mathuria, R. S., 1976. Intensive cropping with autumn-planted sugarcane. *Cane Growers' Bull.* 3(4) : 5-8.
- Anonymous, 1973. Annual Report. Mauritius Sugar Industry Research Institute Reudit, Mauritius. pp : 55-59.
- Kalra, A. W.; Varma, A. and Srivastava, T. N., 1975. Companion cropping of sugarcane and wheat. The pest problem and how to tackle it. *Sug. News* : 7(7) : 11-12.
- Kanwar, R. S., 1975. Scope of intercropping in sugarcane in North India. *Indian Sug.* 25(3) : 187-189.
- Kar, K. and Nath, A., 1965. Intercropping sugarcane under Uttar Pradesh condition. Cold. Jub. Souv., Sugarcane Research Station, Anakapalle, India. pp. 65-70.
- Kar, K.; Dixit, R. S. and Saroj, J. S., 1975. Intercropping with autumn planted sugarcane in Terai tract of U. P. *Indian Sug.* 15(1) : 1-4.
- Lal, R. S. and Ray, S., 1976. Economics of crop production of different cropping intensities. *Indian J. Agric. Sci.* 46(2) : 93.

- Parashar, K. S.; Arora, P. N. and Sharma, R. P. 1979. Effect of short duration winter vegetables in intercrops grown in Autumn planted cane on the yield of millable canes, juice quality and Economics. *Indian Sug.* 29(4) : 217-223.
- Rahman, M. M.; Razzaque, M. A.; Imam, S. A. and Ali, A. 1978. Highlights of sugarcane based cropping system research at the sugarcane Research Institute. A paper presented at the National Workshop on Cropping System Research, Bangladesh Rice Research Institute, Joydebpur (mimeo)
- Razzaque, M. A.; Mannan, M. A.; Imam, S. A. and Ali, A. 1978. Potential of some wintercrops for intercropping with sugarcane. *Indian J. Agric. Sci.* 48(6) : 324-327.
- Sun, V. G. 1961. Intercropping system in Taiwan, *Taiwan Sug.* 8(3) : 13-23.
- Tang, C. K. 1964. Interplanting sweet potato with sugarcane. *Int. Sug. J.* 67(796) : 104.
- Villarico, B. S. and Ledesma, F. I. 1969. ntercropping sugarcane with legumes Proc. Philipp. Sug. 17 : 255-258.
- Wankhede, N. P. and Parashar, K. 1975. Studies on intercropping cotton, *Gossypium hirsutum* L., in spring planted sugarcane, *Saccharum officinarum* L, *Indian Sug.* 24(11) ; 951-954.