

Effects of Different Green Manuring Crops as Intercrop on Sugarcane Production

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ABSTRACT

An experiment was conducted in the farmer's field at Sreepur under Modhupur soil tract during 1997-98 cropping season with sunhemp, dhaincha and cowpea as intercrops with sugarcane. Pure stand sugarcane with recommended fertilizer application produced significantly higher tillers. Treatment with no fertilizer and no green manure (GM) produced significantly lower number of millable cane. Sugarcane intercropping with GMs produced significantly higher yield compared to farmers practice and no fertilizers + no GMs, while the highest cane yield (149.25 TCH) was obtained where full recommended fertilizer was applied with cowpea as intercrop. Cane yield increased over no fertilizer and no GMs ranged from 51.60 to 159.95 percent and 10.07 to 17.28 percent over recommended fertilizer doses. GMs intercrops increased organic matter, nitrogen, potassium and sulphur in the sugarcane soils. Besides, increasing cane yields and soil health, GM intercropping also showed economic benefit over pure stand sugarcane.

Key Words: Green manure, organic matter, biomass, cane yield, brix percent and intercrop.

INTRODUCTION

The organic matter (OM) content in our soil is far below than requirement and it is depleting day by day. Addition of OM to soil through farmyard manures has been reduced because the rural people use the major portion as fuel. Growing of green manuring (GM) crops is one of the ways to enrich OM as well as to fix nitrogen to the soils. Intensive crop cultivation due to poor per capita land holding does not spare the land to cultivate GM separately. Especially sugarcane lands get little scope to grow GM because of its long crop duration in the field. It requires about 12-16 months from growing to harvest. Within the growing period specially between planting to canopy formation it was observed that one GM crop could grow as intercrop with sugarcane to enrich the soils. It is well established that growing of GM, as intercrop with sugarcane did not impasse its yield and millable cane. In some instance, GM intercropping gave better sugarcane production than that obtained without GM intercropping (BSRI Annual Reports 1999a & 1999b). Gerardino *et. al.* 1993 found 28.96-32.53 and 27.55-33.64 percent cane higher and sugar yield respectively on the dry season planting of *C. juncea*. He also found 48.48-72.25 and 50.55-73.27 percent cane and sugar yield increase on the wet season planting of *C. juncea*. This significant increase in stalk diameter & stalk weight at harvest. The influence on yield of sugarcane by *C. juncea* as a green manure intercrop could be attributed to the timely and adequate release of nitrogen during mineralization. Addition of N during incorporation could hasten the release of available N from *C. juncea*. A

sugarcane farmer could save 3-4 bags of urea per hectare by using *C. juncea* as green manure intercrop. For higher yield of intercrops it is needed to accommodate higher number of plant population. Newly developed paired row system of transplanted sugarcane cultivation allows accommodating higher number of plant population and leaving a scope to grow intercrop.

To verify the previous results, to select suitable GM crops and to improve soil health condition of sugarcane soils, the experiment conducted under Soil Fertility and Fertilizer Project (SFFP) during 1997-98 cropping season.

MATERIALS AND METHODS

The experiment was conducted in the farmers' field at Sreepur, Gazipur under Modhupur soil tract during 1997-98 cropping season. The experiment was carried in RCB design with four replications. Individual plot size was 43.2 m². The experiment comprised of the following treatments.

T₁ = Control (No fertilizer and No GM)

T₂ = Farmers' practices of fertilizer for sugarcane cultivation in Modhupur under 28 AEZ (N=100, P₂O₅=185, K₂O= 62 and S=10.41 Kg/ha)

T₃ = Recommended dose of fertilizers for sugarcane under paired row arrangement (N=160, P₂O₅=120, K₂O= 165 and S=30 Kg/ha)

T₄ = $\frac{2}{3}$ N, and recommended dose of PKS fertilizers + sunhemp (*Crotalaria juncea*)

T₅ = $\frac{2}{3}$ N, and recommended dose of PKS fertilizers + cowpea (*Vigna sinensis*)

T₆ = $\frac{2}{3}$ N, and recommended dose of PKS fertilizers + dhaincha (*Sesbania aculeata*)

T₇ = T₃ + cowpea

T₈ = T₃ + dhaincha

T₉ = T₃ + sunhemp

Pre-germinated sugarcane settlings was transplanted in paired row arrangement in December 21, 1997. Eight rows of test variety Misrimala locally adapted was grown in the spacing of 0.45 m between one paired row and 1.35 m in between two paired rows. The fallow 1.35 m spacing in between two paired rows was used for GMs intercropping. On April 23, 1998 GMs were sown in the vacant space in four rows between two paired rows cane at 123 days after sugarcane transplanting. GMs were harvested and incorporated in the soil on June 30, 1998 at 67 days after sowing. Before incorporating total biomass production of GMs were recorded using a spring balance. Starting from the growing period to harvest data on sugarcane tiller production, millable cane, brix percent and cane yield were taken in time following recommended method. Initial and post harvest soils samples were collected and analyzed at Soil laboratory of BSRI using appropriate soil analysis methods.

RESULTS AND DISCUSSION

The yield and yield contributing characters of sugarcane and GM crops are presented in Table 1. The treatment effect on the tiller production was significant. The control plots gave only 1960.00 number of tiller ha⁻¹ which was increased to 2240.00 ha⁻¹ by the application farmers' fertilizer doses. The application of recommended doses of fertilizer produced the highest tiller (2870.00 h⁻¹). This indicated that the sugarcane growth during tillering phase could suffer in GM intercropped sugarcane. It might happen because sugarcane tillering phase attended its peak period when the GMs are in high growing condition. In case of millable cane production fertilizer and GM combination produced significantly similar number and did not differ with other treatments. This might happen and agreed with the findings of previous works done at BSRI. The same trend is observed in cane yield production. Among different GMs and recommended fertilizers doses, there is no significant difference in case of cane yield but it differed significantly with farmers' practices of fertilizer application and no fertilizer i.e. with T₁ and T₂. However, T₁ produced significantly lower cane yield than T₂ indicating that without fertilizer application sugarcane cultivation is not possible in the Modhupur soil tract. The GM crops that incorporated in the soils i.e. treatment T₄ to T₉ did not differ with recommended fertilizers applied treatment (T₃), but production of higher cane yield indicated that the effects of GMs has enhanced the production better than recommended fertilizers only. These might be due to addition of sufficient organic matter and nitrogen to the soils, which was immediately utilized by the growing cane plants. Gerardino, et. al. 1993 found 28.93-32.53 percent cane and 27.55-33.64 percent sugar yield by incorporating 45 days after seeding *Crotalaria juncea*. Apart from organic matter, some nitrogen supply through the nodules of these crops might add and supplied to the sugarcane crop. This was claimed to be benefited (SRTI Annual Report, 1995b; BSRI BSRI Annual Reports 1996; 1999a & 1999b; Imam, et al. 1984).

Table 1. Effect of different green manuring crops as intercrop in the productivity of sugarcane variety Misrimala at Sreepur under Modhupur soil tract during 1997-98 cropping season.

Treat-ments	Tiller no 10 ⁻³ x ha ⁻¹	Millable cane no. 10 ⁻³ x ha ⁻¹	Cane yield (TCH)	Brix (%)	Fresh biomass production (t/ha ⁻¹)
T ₁	196.00e [*]	68.59b	57.42c	20.58a	-
T ₂	225.00d	89.39a	89.93b	20.46ab	-
T ₃	287.00a	94.79a	127.25a	20.12 bc	-
T ₄	243.00c	97.10a	142.59a	20.25abc	3.64a
T ₅	250.00 bc	92.12a	125.12a	19.87c	3.59a
T ₆	253.00bc	102.32a	145.17a	20.12bc	3.98a
T ₇	245.00c	105.32a	149.25a	20.33ab	3.74a
T ₈	255.00bc	97.68a	142.25a	20.21abc	4.01a
T ₉	266.00b	98.32a	141.34a	20.40ab	3.73a

*In a column, means followed by same letter(s) are not significantly different at 5% level as per DMRT.

It was evident from Table 2 that the combined effects of GMs + fertilizers were higher than no fertilizers + no GMs. Cane yield increased over control (T_1) were found in all treatments ranging from 51.61 to 159.95 percent where the highest was found in sugarcane with full- recommended fertilizer + cowpea as intercrop.

Table 2. Sugarcane production as influenced by GM intercrops.

Treat-ments	Cane yield (TCH)	Cane yield increased/ decreased over control (TCH)	Cane yield increased/ decreased over control (%)	Cane yield increased/ decreased over recommended fertilizers (TCH)	Cane yield increased/ decreased over recommended fertilizer (%)
T_1	57.42	-	-	(-) 69.93	(-) 54.95
T_2	89.93	32.51	56.61	(-) 37.32	(-) 29.33
T_3	127.25	69.83	121.60	-	-
T_4	142.59	85.17	148.32	15.34	12.05
T_5	125.12	67.70	117.90	(-) 2.13	(-) 1.67
T_6	145.17	87.75	152.82	17.92	14.08
T_7	149.25	91.83	159.92	22.00	17.28
T_8	142.25	84.83	147.73	15.00	11.78
T_9	141.34	83.92	146.15	14.09	11.07

Percent cane yield increased over recommended fertilizers were found in all GMs intercropped sugarcane except T_5 where two-third nitrogen was applied. This might be due to the fact that the roots and shoots of cowpea incorporated to the soils might not return nitrogen for sugarcane. However, GMs like *Sesbania aculeata* & *Crotalaria juncea* with full and two-third recommended nitrogen produced higher cane yield over recommended fertilizer alone. This might be the fact that these GMs shoots and roots decomposed better and return quantities of organic matter and enrich nitrogen for sugarcane production. The findings agreed with the results obtained by Gerardino, *et. al.* (1993).

Initial and post harvest soil analysis shown in Table 3 indicates that OM, NKS increased after incorporation of GMs in the soils. This indicated that GMs intercrop could enrich both in physical and chemical properties of sugarcane soils.

Table 3. Physical and chemical properties of pre and post harvest soils.

Treat-ments	Texture	pH	OM (%)	N (%)	P (ppm)	K (meq/100g)	S (ppm)
Pre-harvest soil analysis							
	Loamy	5.5	1.78	0.070	10.00	0.14	14.00
Post-harvest soil analysis							
T_2	Loamy	5.6	1.78	0.06	8.00	0.14	13.00
T_3	Loamy	5.6	1.78	0.07	8.00	0.15	13.50
T_4	Loamy	5.5	1.90	0.075	8.50	0.15	16.00
T_5	Loamy	5.7	1.95	0.080	9.00	0.14	14.50
T_6	Loamy	5.6	1.90	0.080	9.00	0.15	14.00
T_7	Loamy	5.5	1.95	0.080	8.50	0.15	13.00
T_8	Loamy	5.65	1.80	0.07	8.00	0.14	15.00
T_9	Loamy	5.5	1.85	0.075	8.50	0.145	14.50

Economic analysis of green manuring crops intercropped with paired row sugarcane presented in Table 4 indicated that cane cultivation with GMs intercrop yielded better and produced higher net return over no fertilizer and no GM. Though the added cost of TK 17.31 thousand/ha spend for cowpea cultivation the highest profit over control was found in full recommended fertilizers + cowpea intercrop. A negative return of Tk. 0.58 thousand/ha was found when sugarcane cultivated with no fertilizer and no GMs. On the other hand, while compared with recommended fertilizer a huge amount of Tk. 64.36 thousand/ha was found as negative return. While almost all GMs intercropped combinations shows a positive return except sugarcane intercropped with cowpea applying two-third nitrogen. All other combinations earned profit in varying proportions. Benefit cost ratio was found higher in T6 and T7 that is more than double compare to control plot.

Table 4. Economic analysis of green manure crops as intercrop with sugarcane.

Cost of cultivation sugarcane + GM's ('000 Tk/ha)	Added cost due to treatment ('000 Tk/ha)	Yield of cane (TCH)	Total return ('000 Tk/ha)	Net return ('000 Tk/ha)	Profit/ loss over control ('000 Tk/ha)	Profit/ loss Over recomb. fertilizer ('000 Tk/ha)	Marginal cost of return (MBCR)	BCR
61.44	0.00	57.42	60.86	(-) 0.58	(-) 0.58	(-) 64.36	0.0	0.99: 1
65.20	3.76	89.93	95.32	30.12	30.54	(-) 33.82	0.47	1.46: 1
70.94	9.50	127.25	134.88	63.94	64.36	-	0.44	1.90: 1
76.31	14.87	142.59	151.14	73.83	74.25	9.89	0.08	1.98: 1
78.04	16.60	125.12	132.62	54.58	55.00	(-) 9.36	(-) 0.29	1.69: 1
75.61	14.17	145.17	153.88	78.27	78.69	14.33	0.34	2.03: 1
78.75	17.31	149.25	158.20	79.45	79.87	15.51	(-) 0.03	2.00: 1
76.32	14.88	142.25	150.78	74.46	74.88	10.52	(-) 0.03	1.97: 1

Considering the above facts, it appears that intercropping of green manuring crops were found highly profitable compared to growing sugarcane as pure stand crop except cowpea with two third dose of recommended nitrogen. The highest cane yield of 149.25 TCH and the highest profit of Tk.15.51 thousand could be obtained if cowpea intercropped with full-recommended nitrogen compared to pure stand crop with full recommended NPKS applied in paired row sugarcane.

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