

Profitability in Cultivation of Sugarcane Intercropped with Potato in Old Himalayan piedmont Plain Soils

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ABSTRACT

An investigation was conducted in farmers' field of Thakurgaon district for three consecutive years to determine profitability in cultivation of sugarcane with potato intercrop under Old Himalayan Piedmontplain soils. It was found that yield of sugarcane intercropped with potato increased over pure stand sugarcane in all years under experimentation. Sugarcane planted in furrow of potato crop-one month delayed than other treatments produced the lowest cane yield. The yield of potato as intercrop mulched with water hyacinth was increased over non mulched. the economic analysis showed that higher gross return and net profit were always obtained from the sugarcane + potato over pure stand cane.

INTRODUCTION

The Old Himalayan Piedmontplain comprises the northern part of Bangladesh and it is the second largest sugarcane belt in the country. There are three sugar mills in this zone. The major crops of the locality are T. Aman, jute, sugarcane, wheat, potato etc. are grown mainly in rainfed condition using residual soil moisture.

Sugarcane is a long duration crop. The farmers have to wait for a long period of 12-16 months to reap the produce and to get the return from the crop. Sometimes marginal farmers can not wait for such a long time and as such diverting from sugarcane cultivation to short duration crop, as a result, sugar mills are suffering from shortage of sugarcane. An interim return through growing short duration crops as intercrop would substantially encourage them for sugarcane cultivation.

Cultivation of short duration crops in interspace between sugarcane rows has been tried in many countries; intercropping or companion cropping with sugarcane has been adopted in commercial scale (Rahman *et al.* 1976). Potato, onion, garlic, mustard, pulses are generally grown as intercrop with sugarcane. Among intercrops, potato occupies 15% of total intercropped area with sugarcane in Bangladesh (Imam *et al.* 1987). Potato is the most compatible crop with sugarcane (Anon. 1992). It is generally grown commercially both under irrigated and rainfed conditions. Many investigators reported that sugarcane yield increased when potato was grown with

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sugarcane as intercrop (Anon. 1992; Rajeshwar *et al.* 1982; Singh *et al.* 1986; Imam *et al.* 1990). Moreover, the highest net profit is earned by potato intercropping over pure stand sugarcane (Anon. 1982; Imam *et al.* 1987). Irrigation is essential for successful cultivation of potato. But scope of irrigation is limited in this area. Besides, later part of Autumn upto spring season is a dry period. So, to retain the available soil moisture and for its efficient use by the crop in dry land agriculture is imperative. Mulching by water hyacinth or straw is one of the ways to prevent loss of soil moisture. Imam *et al.* (1990) reported that mulching of soil surface above the potato immediate after plantation significantly increased yield and economic return of both intercrop and maincrop sugarcane.

With the view to sustainable supply of sugarcane to sugar industries and Gur manufacturers as well as interim return of the growers the present trial was undertaken to find out effects of sugarcane intercropped with potato having water hyacinth mulching in Old Himalayan Piedmontplain soils.

MATERIALS AND METHODS

The experiment was conducted for three consecutive cropping seasons in the farmers field of Thakurgaon district in the old Himalayan piedmont plain soils. In all the years, the experiment was set up in RCB design.

First and Second seasons (1986-87 and 1987-88) :

Treatments (1986-87) :

T₀ = Pure stand sugarcane (Check).

T₁ = Sugarcane + One row of potato on ridge in between two rows of sugarcane.

T₂ = Sugarcane + One row of potato on flat surface in between two rows of sugarcane.

T₃ = Potato + sugarcane. Sugarcane was planted in the furrow 30 d after potato plantation.

T₄ = Sugarcane + two rows of potato planted on ridge in between two rows of cane.

Treatments (1987-88) :

T₀ = Pure stand sugarcane (Check).

T₁ = Sugarcane + One row potato planted on flat surface in between two rows of sugarcane.

T_2 = Sugarcane + two rows of potato on ridge in between two rows of sugarcane.

T_3 = Sugarcane + two rows of potato on ridge in between two rows of sugarcane and mulched with water hyacinth.

T_4 = Potato + sugarcane. Sugarcane was planted in the furrow 30 d after potato plantation.

Third season (1988-89) :

The planting method for both sugarcane and potato were modified to explore the potentiality of newly developed spaced transplanted technology and paired row method of sugarcane cultivation.

Treatments :

T_0 = Pure stand sugarcane (Check).

T_1 = Sugarcane + two rows of potato in between two paired rows of sugarcane.

T_2 = Sugarcane + two rows of potato in between two paired rows of sugarcane and mulched with water hyacinth.

T_3 = Potato + sugarcane. Sugarcane settlings were transplanted in the furrow 30 d after potato plantation.

In case of direct planting of three budded setts, row to row distance of sugarcane was maintained 1 metre. Sugarcane setts containing three buds were planted in the trenches.

In case of spaced transplanting method sugarcane settlings were raised in polybag and transplanted in main field in November in paired row system. The paired rows were made by alternating cane between row spacing of 120 cm with 60 cm, such that the potato intercrop occupied the wider space between paired cane row. The cutting of potato tubers 1-2 sprouted bud were planted immediate after transplanting of cane settlings.

In all three consecutive years same fertilizer dose were applied. Fertilizers for sugarcane, N-125 kg, P_2O_5 -125 kg, K_2O -163 kg and S-33 kg per hectare as urea, TSP, MP and Gypsum respectively were applied. For potato, N-100 kg, P_2O_5 -50 kg, K_2O -80 kg and S-10 kg per hectare from the fertilizers as mentioned above were applied.

Sugarcane variety Isd 2/54 and Potato variety kuprisinduri were used in this investigation. Necessary pest management and intercultural operation for both the crops were done, but irrigation was not practiced in the experiment. Potato was

harvested in February and sugarcane was harvested in December of the following year.

RESULTS AND DISCUSSION

Cropping season 1986-87 : The Table 1 shows that significantly higher yield of sugarcane was obtained in treatment having sugarcane + one row potato on flat surface compared to rest treatments except sugarcane + two rows potato on ridge. The lowest yield of sugarcane was obtained when sugarcane was planted one month later than potato plantation. The yield of sugarcane reduced probably due to late plantation of sugarcane compare to other treatments. Significantly higher yield of potato (17.6 t/ha) was found where two rows of potato were planted on ridge in between two rows of sugarcane. The reasons for higher yield for potato was perhaps due to higher plant population. Almost identical yield of potato was obtained in rest treatments (Table 1).

Table 1. Production and cost-benefit of sugarcane and potato as intercrop during 1986-87 cropping season.

Treatments	T ₁ (Cane + one row potato on ridge)	T ₂ (Cane + one row potato on flat surface)	T ₃ (Cane + one row potato, cane plantation 30 d after potato plantation)	T ₄ (Cane + Two rows potato on ridge)	T ₀ (Pure stand sugarcane)
Yield and economic data					
Yield of cane (TCH)	45.3 bc	57.0	40.3 c	50.7 ab	43.2 bc
Total variable cost of cane production (Tk/ha)	24,627	24,627	24,627	24,627	24,627
Gross return of cane (Tk/ha)	29,723	37,416	26,441	33,267	28,351
Net profit of cane (Tk/ha)	5,098	12,789	1,814	8,640	3,724
Yield of potato (t/ha)	9.5 b	10.8 b	10.4 b	17.6 a	—
Total variable cost of potato production (Tk/ha)	12,595	12,595	12,595	19,235	—
Gross return of potato (Tk/ha)	53,297	60,614	58,306	99,053	—
Net profit of potato (Tk/ha)	40,702	48,019	45,711	79,818	—
Total net profit of cane + Potato (Tk/ha)	45,798	60,808	47,525	88,458	—
Increased income over pure stand cane (Tk/ha)	42,074	57,084	43,801	84,734	—

Figures accompanied by similar letter (s) do not differ significantly at 5% level as per DNMR test.

In case of economic analysis, it was found that gross income and net profit of sugarcane was higher when potato was intercropped with sugarcane compared to pure stand sugarcane. The highest gross return of Tk. 37,416.0/ha and net profit of

Tk. 12, 789.0/ha was obtained when one row potato was grown on flat surface in between two rows of sugarcane. The lowest gross return and net profit were obtained when sugarcane was planted one month later potato plantation.

In case of intercrop potato, the highest gross return and net profit of Tk. 99,053./ha and Tk. 79,818.0/ha respectively were obtained when two rows of potato was grown on ridge in between two rows of sugarcane. The lowest gross return of Tk. 53,297.0/ha and the lowest net profit of Tk. 40,702.0/ha were found in treatment where one row potato was grown on ridge in between two rows of sugarcane.

In case of total net profit of cane + potato, the highest net profit of Tk. 88,458.00/ha and increased income of Tk. 84,734.0/ha over pure stand cane were obtained in sugarcane + two rows of potato on ridge combination.

Cropping season 1987-88 : In the cropping year 1987-88 identical yield of sugarcane in all treatments was found when sugarcane was planted one month later than potato plantation. In case of potato, significantly higher yield of potato (16.3 t/ha) was obtained where two rows of potato in between two rows of cane were planted and mulched with water hyacinth compared to rest treatments. Yield of potato was found statistically identical in the rest treatments (Table 2).

Table 2. Production and cost benefit of sugarcane and potato as intercrop during 1987-88 cropping season.

Treatments	T ₁ (Cane + one row potato on flat)	T ₂ (Cane + one row potato on ridge)	T ₃ (Cane + one row potato on ridge with mulch)	T ₄ (Cane + one row potato, cane plantation 30 days after potato plantation)	T ₀ (Pure stand sugarcane)
Yield and economic data					
Yield of cane (TCH)	67.6 a	70.8 a	63.1 ab	53.7 b	66.1 a
Total variable cost of cane production (Tk/ha)	24,654	24,654	24,654	24,654	24,654
Gross return of cane (Tk/ha)	48,909	51,210	45,647	38,847	47,795
Net profit of cane (Tk/ha)	24,255	26,556	20,993	14,193	23,141
Yield of potato (t/ha)	11.1 b	13.0 b	16.3 a	11.8 b	—
Total variable cost of potato production (Tk/ha)	12,255	17,560	18,620	14,320	—
Gross return of potato (Tk/ha)	59,641	69,822	87,130	63,070	—
Net profit of potato (Tk/ha)	47,386	52,262	68,510	48,750	—
Total net profit of cane + potato (Tk/ha)	71,641	78,818	89,503	62,943	—
Increased income over pure stand cane (Tk/ha)	48,500	55,677	66,362	39,802	—

Table 2a. Comparative economic analysis of potato production between mulch and non mulch conditions.

Treatments		Yield of potato (t/ha)	% increase of yield	Additional income (Tk/ha)	% additional income
T ₂	Two rows of potato without mulch.	13.0 b	—	—	—
T ₃	Two rows of potato with mulch	16.3 a	25.4	16,248	31.1

* Figures in columns accompanied by similar letter (s) do not differ significantly at 5% level as per DNMR test.

In case of sugarcane, the highest gross return and net profit of Tk. 51,210.0/ha and Tk. 26,556.0/ha respectively were obtained when two rows of potato was grown on ridge as intercrop. In case of potato, the highest gross return of Tk. 87,130.0/ha and net profit of Tk 68,510.0/ha were found when two rows of potato with water hyacinth mulching was grown in between two rows of sugarcane. In total, (sugarcane + potato), the highest net profit of Tk. 89,503.0/ha was found in this treatment. The lowest net profit was recorded when pure stand sugarcane was grown. Comparative economic analysis shows that due to mulching, yield of potato was increased by 25.4% over non-mulching (Table 2a). Additional income from potato due to mulching was Tk. 16,248.0/ha i.e. 31.1% increased income over non-mulching. Gross as well as net income mainly depend on yield.

Cropping season 1988-89 : In the cropping year 1988-89 significant cane yield reduction was recorded when sugarcane plantation was done one month later than potato plantation. Rest treatments including pure stand sugarcane gave identical sugarcane yield (Table 3). In case of potato, significantly higher yield of potato (16.0 t/ha) was found when potato was mulched with water hyacinth compared to without mulching. (Table 3).

The economic analysis shows that the highest gross return and net profit of sugarcane were Tk. 63,700.0/ha and Tk. 33,702.0/ha respectively when two rows of potato was grown in between two rows of sugarcane with water hyacinth mulching. In case of potato, the highest gross return of Tk. 96,240.0/ha and net profit of Tk. 77,220.0/ha were obtained in this treatment. The highest total net profit of Tk. 110,922.0/ha was also found in this treatment. The lowest gross return of Tk. 55,662.0/ha and net profit of Tk. 25,664.0/ha were found when sugarcane plantation was done 30 d after potato plantation (Table-3). It was found that yield of potato due to mulching was increased by 22.1% over non mulch and additional income Tk. 16,820/ha (Table 3a).

Table 3. Production and cost benefit of sugarcane and potato as intercrop under different treatments (1988-89).

Treatments	T ₁ (Cane + two rows potato)	T ₂ (Cane + two rows potato with mulch)	T ₃ (Cane + one row potato : Cane plantation 30 days after potato plantation)	T ₀ (Pure stand sugarcane)
Yield of cane (TCH)	62.3 a	63.4 a	55.4 b	58.8 ab
Total variable cost of cane production (Tk/ha)	29,998	29,998	29,998	29,998
Gross return of cane (Tk/ha)	62,575	63,700	55,662	59,118
Net profit of cane (Tk/ha)	32,577	33,702	25,664	29,120
Yield of potato (t/ha)	13.1 b	16.0 a	14.7 ab	—
Total variable cost of potato production (Tk/ha)	17,960	19,020	18,729	—
Gross return of potato (Tk/ha)	78,360	96,240	88,380	—
Net profit of potato (Tk/ha)	60,400	77,220	69,660	—
Total net profit of cane + Potato (Tk/ha)	92,977	110,922	95,324	—
Increased income over pure stand cane (Tk/ha)	63,857	81,802	66,204	—

Table 3a. Comparative economic analysis of potato production between mulch and non mulch conditions.

Treatments	Yield of potato t/ha	% increase of yield	Addition income (Tk/ha)	% additional income
T ₁ - Two rows of potato without mulch.	13.1 b*	—	—	—
T ₂ - Two rows of potato with mulch	16.0 a	22.1	16,820	27.8

* Figure in columns accompanied by similar letter (s) do not differ significantly at 5% level as per DNMR test.

From the experiment, it is found that the yield of sugarcane intercropped with potato was increased over pure stand sugarcane. Potato is compatible intercrop with sugarcane (Anon. 1992). The results on increase in yield of cane by potato intercrop are supported by reports published elsewhere (Anon. 1992; Tiwari *et al.* 1982; Imam *et al.* 1987; 1990; Rahman *et al.* 1976). Moreover, net return from sugarcane + potato was much higher than cane alone. Jayabal *et al.* (1990) reported 68% increase in profit over pure stand sugarcane when sugarcane was intercropped. Increase in yield of cane due to potato intercrop is possibly due to non exhaustive

and dwarf in nature of potato intercrop, residual effects of applied fertilizer of potato and cultural practices done to the intercrop. Similar opinion was given by Imam *et al.* (1987) and Rathi and Singh (1980). They reported that cane yield increases probably due to residual effect of fertilizer applied to potato and improvement in the physical, chemical and biological conditions of the soils. Yield of potato as intercrop mulched with water hyacinth increased over non mulched. Similar positive effect on yield of intercrop potato and also cane covering by mulch was found by Imam *et. al.* (1990). From the experiments, it is also found that early planted cane gave higher yield than later planted sugarcane. Rahman *et al.* (1976) reported that early planted cane gives 25-30% higher cane yield than late planted sugarcane.

It may be concluded that cultivation of sugarcane with potato intercrop is profitable. Delay planting of sugarcane reduces cane yield significantly. Potato tuber yield is closely related to its planting density. Residual effect of fertilizers applied to potato and cultural practices for potato improve physical and chemical conditions of the soils which ultimately increases yield of cane. Mulching on soil surface above the potato immediate after plantation increases potato and cane yield, and ultimately increases economic return.

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