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Residual effects of Fertilizers applied to Intercrop Potato on Sugarcane Production

M. A. Majid, F. Alam, M. A. Ghafur and S. N. A. Chowdhury
Bangladesh Sugarcane Research Institute,
Ishurdi, Pabna, Bangladesh.

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ABSTRACT

Two experiments were conducted in the farmers field in two different locations at Ishurdi under High Ganges River Floodplain and Jaipurhat under Tista meander floodplain during 1992-93 crop season. This study was aimed to find the agronomic and economic benefits related to the intercropping of potato with sugarcane and also to evaluate the residual effects of fertilizers applied to intercrop on sugarcane. Cane yield was enhanced when the intercrop potato grown with the different rates of fertilizers. Application of fertilizers at the rate of N 90 P_2O_5 60K_2O 90 S 6 kg ha^{-1} to intercrop potato increased the sugarcane yield of 11% and 23% at Ishurdi and Jaipurhat respectively. Tuber yield as intercrop increased from 12 to 82% due to fertilizer application. Intercropping of potato with sugarcane also significantly increased the available K content in post harvest soil.

Key words : Residual effects, fertilizer rates, intercrop potato, sugarcane.

INTRODUCTION

Intercropping in sugarcane with legumes, pulses, oilseeds and vegetables is an age old practice in Bangladesh. With its potentiality, culture, cost benefit ratio and other advantages, potato has been proved and the most suitable and profitable intercrop grown with sugarcane both under irrigated and rainfed condition. At present in Bangladesh about. 1.12 thousand hectares of sugarcane field is intercropped by potato with the average production of 10.24 t/ha^{-1} (Anon., 1993). Among the intercrops, potato occupies 15% of the total sugarcane intercropped area (Imam *et al.* 1987). There are strong evidences of increasing sugarcane productivity through systematic intercropping of potato in sugarcane. Imam *et al.* (1987) reported that residual fertilizers applied for intercrop potato help to increase cane yield. In sugarcane+potato intercropping sequence, cane yield increases probably due to the residual effect of fertilizer applied to potato and improvement in the pysical, chemical and biological condition of the soil (Rathi and Singh, 1980). In India, Singh and Singh (1973) found maximum increase in cane yield by 64.26% from intercropping of potato with sugarcane. Mathur (1976) reported that maximum increase in the net profit by intercropping potato with sugarcane over sugarcane planted after harvesting of potato.

The present acreage of potato intercrop in sugarcane is increasing day by day though the yield level of both the crops remaining stagnant. In Bangladesh, no research findlings on the actual requirement of chemical fertilizers of intercrop potato vis-a-vis its residual effects on sugarcane are available, So, attempts were made here to findout the appropriate fertilizer requirement of intercrop potato and its effects on sugarcane productivity.

MATERIALS AND METHODS

The experiments were conducted in the farmers field at Ishurdi (High Ganges River floodplain) and Jaipurhat (Tista Meaner Floodplain) during 1992-93 cropping season forty five days old sugarcane settlings of variety Isd 16 were transplanted at 1.0 m row to row and 0.5 m plant to plant spacing in November. Simultaneously potato (Variety cardinal) was planted in rows between those of sugarcane. Major preplanting soil properties of experimental plots were pH 7.63, OM 1.2%, total N 0.069%,P 30.0 ppm, K 0.17 me/100 g soil and S 58 ppm at Ishurdi and pH 6.7, OM 0.74%, total N 0.034% ,P 27.5 ppm, K 0.08 me/100 g soil and S 43 ppm at Jaipurhat. The experiment comprised of the following treatments with intercrop potato and laid out in a randomized complete block design with four replications.

T_1 - Control

T_2 - 60 P_2O_5 60 K_2O 60 S 4 kg ha^{-1}

T_3 - 90 P_2O_5 60K_2O90 S 6 kg ha^{-1}

T_4- N 120 P_2O_5 80 K_2O 120 S 8 kg ha^{-1}

Recommended rates of fertilizers for sugarcane were applied in time (N 60 P_2O_5 110 K_2O 100 S 40 Zn 10 and N 160 P_2O_5 100 K_2O 120 S 30 Zn 4 kg ha^{-1} respectively at Ishurdi and Jaipurhat location). During potato plantation, half of N from Urea, full amount of P from TSP (Triple super phosphate), half of K from MP (Muriate of potash) and full amount of S from Gypsum were applied in rows and mixed properly with the soil. The rest half of N and K were applied as side dressing after 35 d of planting. Fungicides were applied regularly to protect the potato crop from blights. Two irrigations were provided in sugarcane trenches which was sufficient enough to moisten the potato ridges. Intercultural opera for both the crops were done as and when necessary. Harvest of the intercrop was effected over the period 110 d with potato as the earliest crop and sugarcane was harvested 400 d after transplanting. After harvest of potato, soil samples were collected from each treatment and analysed for some soil properties (Table 2). Soil texture was determined by hydrometer method, organic carbon was determined by wet oxidation method (Walkley and Black), pH by a glass electrode pH meter and total N by macro kjeldahl method. Available P was determined by using 0.5 M $NaHCO_3$ extraction procedure following colorimetric measurement by a spectrophotometer (Modified Olsen's method), exchangeable K was determined on IM NH_4OAc extraction using flame photmeter. Available S was also determined by turbidimetric method (Black, 1965).

RESULTS AND DISCUSSION

Sugarcane : Data on sugarcane yield and yield contributing parameters are presented in Table 1. It is seen from the Table that intercropping of potato in sugarcane with varied fertilizer tates significantly influenced tiller production and the highest tiller numbers being 134.7 x 10^3 ha^{-1} in T_4 treatment at Ishurdi. However , this effect was absent at Jaipurhat location. The effect on millable cane was not significant in both locations. Application of N 90 P_2O_5 60 K_2O 90 S 6 kg ha^{-1} to intercrop potato produced significantly higher cane yield of 86.6 t ha^{-1} and 177.1 t ha^{-1} at Ishurdi and Jaipurhat locations respectively. The lowest cane yield was recorded in T_1 at both the locations. Similar result was reported by Imam *et al.* (1990) where they applied full rates to intercropped potato and sugarcane resulted in cane yields significantly greater than for any other treatments. It is evident from the results presented in Table 2 that due to intercropping of potato in sugarcane; the available K content

of post harvest soild increased significantly specially at Ishurdii from its inital values but decreased the amount of S and P. The organic mater and total nitrogen content in post harvest soils due to intercropping in sugarcane. This results suggested that to increase P and S balance in these soils under potato+sugarcane cropping sequence, more P and S are to be added for sustaining crop production.

Table 1. Influence of fertilizers applied to intercrop potato on yield and yield contributing parameters of sugarcane and potato.

Location	Treatment	Tiller ($x10^3 ha^{-1}$)	Millable cane ($x10^3 ha^{-1}$)	Yield of cane ($t\ ha^{-1}$)	Recoverable sucrose content (%)	Yield of potato ($t\ ha^{-1}$)
Ishurdi	T_1	124.4b*	76.3 a	77.9 b	9.07 a	6.8 c
	T_2	131.0 a	81.9 ab	80.5 ab	9.08 a	11.3 ab
	T_3	129.0 ab	77.1 a	86.6 a	8.30 a	12.4 a
	T_4	134.7 a	82.7 a	84.9 ab	8.73 a	10.5 b
Jaipurhat	T_1	156.0 a	127.0 a	123.9 b	9.35 a	4.9 b
	T_2	158.4 a	129.4 a	153.8 b	9.05 a	5.9 a
	T_3	166.7 a	138.5 a	177.1 a	8.98 a	5.5 ab
	T_4	160.0 a	132.1 a	161.5 ab	8.90 a	6.1 a

* Figures accompanied by the same letters in column are not different at 5% level of probability as per DNMR test.

Table 2. Nutritional status of soils after harvesting of intercrop potato.

Location	Treatment	pH	OM (%)	Total N (%)	Available P (ppm)	Available K (me/100) g soil)	Available S (ppm)
Ishurdi	T_1	7.9 a*	1.31 a	0.063 a	25.0 b	0.29 a	36.0 a
	T_2	7.8 b	1.35 a	0.059 a	23.0 b	0.27 b	35.0 a
	T_3	7.9 a	1.36 a	0.061 a	30.0 b	0.27 b	24.5 b
	T_4	7.8 b	1.34 a	0.061 a	16.0 c	0.24 c	22.0 b
Jaipurhat	T_1	6.9 a	0.74 b	0.040 a	12.0 a	0.07 b	21.0 a
	T_2	6.4 b	0.71 b	0.031 a	18.0 a	0.12 a	17.5 a
	T_3	7.0 a	0.81 a	0.040 a	14.0 a	0.07 b	20.0 a
	T_4	6.8 a	0.81 a	0.040 a	15.0 a	0.12 a	19.0 a

* Figures accompanied by the same letters in column are not significant at 5% level of probability as per DNMR test.

Application of fertilizers to intercrop potato resulted insignificant effects on recoveralbe sucrose content of sugarcane. From Figure 1 it is seen that sugarcane yield increases from 3.33 to 23.07% due to application of applied fertilizer to potato.

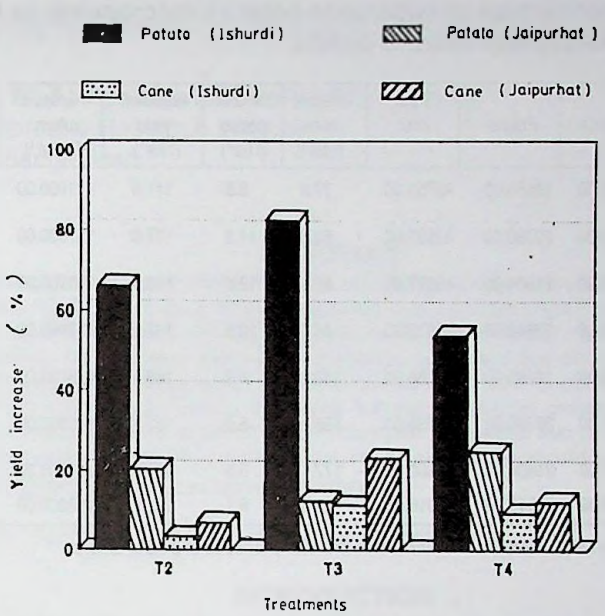

Figure 1. Cane and potato yield increase (%) over control.

Potato : Potato yield significantly increased with the application of fertilizer. From table 1 it is seen that the highest tuber yield of 12.4 and 6.1 t ha^{-1} were recorded in T_3 & T_4 treatments at Ishurdi & Jaipurhat respectively. Fertilizer application increased potato yield from 12.24% to 82.35% over control (Figure 1). Results showed that fertilizer application to itercrop potato increased maximum of 82.35% tuber yield over control at Ishurdi the lowest yield of potato tuber was recorded in T_1 (control) treatment at both the locations. At higher fertilizer rates, yield of potato tubers was decreased. This partially agreed with the findings of Verma and Yadav (1988) who reported that different levels of nitrogen application to sugarcane did not significantly increase potato tuber yield but increase the foliage yield.

Economics of fertilizer use : The combined yield of cane and potato interms of cane yield showed that highest production per unit area and time were obtained in T_3 treatment at both the location (148.0 and 204.6 t ha^{-1}). Maximum return with highest cost benefit ratio was also obtained from the same treatment (Table 3). Similar results were also found by Imam et al. (1987). Similarly when net return and profit loss was considered, intercropping of potato with the application of N 90 P_2O_5 60 K_2O 90 S 6 kg ha^{-1}) (T_3 treatment) along with sugarcane gave highest net return and profit. Kabir (1988) reported that the highest yield of sugarcane and net return was obtained from sugarcane+potato cropping sequence than sugarcane as sole crop.

From the results, it may be suggested that application of N 90 P_2O_5 60 K_2O 90 S 6 kg ha^{-1} to intercrop potato along with the recommended rates of fertilizers to sugarcane is most suitable and economical for sugarcane+potato intercropping sequence at High Ganges river floodplain and Tista Meander Floodplain soils of Bangladesh.

Table 3. Yield and economics of sugarcane potato intercropping as influenced by different fertilizer rates to potato.

Location	Treat ment	Sugarcane	Potato	Total cost	Yield of cane (t ha^{-1})	Yield of potato (t ha^{-1})	Adjusted yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Gross profit (Tk. ha^{-1})	CBR
Ishurdi	T_1	27073.00	18680.00	45753.00	77.9	6.8	111.9	111900.00	66147.00	1:1.44
	T_2	27073.00	20760.00	47833.00	80.5	11.3	137.0	137000.00	89167.00	1:1.86
	T_3	27073.00	21804.00	48877.00	86.6	12.4	148.0	148600.00	99723.00	1:2.04
	T_4	27073.00	22840.00	49913.00	84.9	10.5	137.4	137400.00	87487.00	1:1.75
Jaipurhat	T_1	26276.00	18680.00	44856.00	143.9	4.9	168.4	168400.00	123544.00	1:2.75
	T_2	26176.00	20760.00	46936.00	153.8	5.9	183.3	183300.00	136364.00	1:2.90
	T_3	26176.00	21804.00	47980.00	177.1	5.5	204.6	204600.00	156620.00	1:3.26
	T_4	26176.00	22840.00	49016.00	161.5	6.1	192.0	192000.00	142984.00	1:2.91

* Adjusted yield = Yield of cane+equivalent yield of cane from the sale proceeds of potato tubers.

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