Nutrient Requirement for Sugarcane and Garlic as Intercrop in Non-Mills Zone

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ABSTRACT

A field experiment was conducted at Sirajganj (AEZ 7) and Chapai Nawabganj (AEZ 11) during 2009-2010 cropping year to find out the optimum nutrient rates of sugarcane and intercrops in non-mills zone area and to update the fertilizer application rate under AEZ 7 and AEZ 11 based on the soil test value. The experiment was conducted in a randomized complete block design with three replications having six treatments viz.. T_1- Sole sugarcane (Fertilizer as per FRG'05);T_2- Sole sugarcane(Fertilizer as per STV for MYG);T_3- Sole sugarcane (Fertilizer as per STV for HYG;T_4- Sugarcane (Fertilizer as per FRG'05] + Intercrop,Garlic); T_5- Sugarcane (Fertilizer as per STV for MYG + Intercrop,Garlic) and T_6- Sugarcane (Fertilizer as per for HYG + Intercrop Garlic). The result showed that the highest cane yield of 115.2 tha^{-1} was obtained in treatment T_3 ($N_{189}P_{56}K_{160}S_{36}Zn_{4.74}$) but, the highest BCR of 2.78 for Sirajganj with the treatment T_5 where, garlic was cultivated as inter crop for medium yield goal. At Shibganj highest sugarcane yield of 92.08 tha^{-1} also was recorded in treatment T_3 ($N_{190}P_{22}K_{60}S_{30}Zn_{3.6}$) but BCR (3.32) was highest in treatment T_6 having fertilizer for high yield goal for sugarcane and garlic as intercrop by soil test value.

Key words: Sugarcane, garlic, fertilizer, soil test, yield

INTRODUCTION

Sugarcane is a nutrient exhaustive annual crop. It removes about about 140 kg N, 25 kg P, 325 kg K and 51 kg S ha^{-1} from the soils for the yield of 100 t ha^{-1} of sugarcane (FRG-2012). Isherwood (2006) estimated that in sugarcane cultivation less than 2% of the farmers apply potash whereas 92% apply nitrogen and 83 % apply phosphate as fertilizers. The cane height, number of tillers, millable cane stalks, yield of cane and sugar increased progressively with the application of NPK fertilizers (Gurmani *et al.*, 2003, Bokhtiar *et al.*, 2002, Iqbal *et al.*, 2002, Khan *et al.*, 2002, Chaudhery and Chattha 2000). Target yield can be achieved through application of fertilizers on soil test value (STV) followed by appropriate management practices. Substantial advantage in crop yield from intercropping system is achieved compared to sole cane due to synergistic effects of companion crops on each other by making better use of agronomic management and residual advantage of applied fertilizers for intercrops (Imam *et al.*, 1990; Bokhtiar *et al.*, 1995 and Willey *et al.*, 1979). Intercropping in sugarcane with potato, garlic, onion and vegetable is a common practice in cane growing countries. Intercropping with sugarcane cultivation in Bangladesh is localized depending on the soil, environment and market. However, information regarding proper fertilizer management for sugarcane intercropped with garlic is scanty. Sugarcane is a long duration and widely spaced crop and up to 120 days the canopy does not cover the vacant space in between the rows, as such there is ample scope to grow short- duration intercrops. Due to

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complementary effect of different crops when grown together, making better use of resources ultimately helps in productivity of sugarcane. In Bangladesh, sugarcane is mainly cultivated in South-western parts of the country and its cultivation is mostly concentrated in some Agro-Ecological Zones. The ability of an intercrop to make more efficient use of the nutrient than a sole crop depends on the soil water levels and on how completely the intercrop mixture explores the entire soil mass in the rooting zone (Yadav,1981 and Francis,1989). Intercropping also shows some beneficial effects on pest and disease control (Abdullah *et al.*, 2006). In most cases, intercropping gives higher total production (Gani and Paul, 2005), monetary returns, and greater resource use efficiently and land productivity. Intercropping potato, onion, garlic and cabbage with sugarcane are always profitable compared to sole sugarcane and help to get extra benefit for the farmers (Matin *et al.*, 2001; Alam *et al.*, 2007; Alam, 2013). The production of intercrop with sugarcane in Bangladesh is localized depending on the soil, environment and market in Bangladesh.

The present decline or stagnation of crop yield in Bangladesh is the cumulative effect of many soil related constraints. In Bangladesh the important constraint of lower crop productivity are nutrient mining, depletion of soil organic matter, unbalanced fertilization, scanty use of bio- and organic fertilizers, and poor management practices .It is important to identify proper nutrient requirement for sugarcane and garlic as intercrop for better economic return. A few experiments were conducted in Bangladesh on this aspect. Hence the present study was undertaken to find out the optimum nutrient rates for profitable cultivation of sugarcane and garlic as intercrop.

MATERIALS AND METHODS

The experiment was conducted at Sirajganj (AEZ 7) and Shibganj, Chapai Nawabganj (AEZ 11) in randomize complete block design with three replications. The experiment comprised of six treatments: T_1- Sole sugarcane ($N_{75}P_{25}K_{55}S_{12}Zn_2$ for Sirajgonj; $N_{150}P_{50}K_{90}S_{34}Zn_{3.5}$ for Shibganj), T_2- Sole sugarcane($N_{138}P_{38}K_{139}S_{24}Zn_{3.64}$for Sirajgonj; $N_{138}P_{15}K_{50}S_{20}Zn_{3.5}$ for Shibganj for MYG), T_3- Sole sugarcane ($N_{189}P_{56}K_{160}S_{36}Zn_{4.47}$ for Sirajgonj; $N_{190}P_{22}K_{60}S_{30}Zn_{3.6}$ for Shibganj for HYG), T_4- Sugarcane [$N_{75}P_{25}K_{55}S_{12}Zn_2$ for Sirajgonj; $N_{150}P_{50}K_{90}S_{34}Zn_{3.5}$ for Shibganj for HYG] + Intercrop (Garlic $N_{23}P_{20}K_{50}S_{15}$ for Sirajgonj; $N_{23}P_{20}K_{50}S_{15}$ for Shibganj), T_5- Sugarcane [$N_{138}P_{38}K_{139}S_{24}Zn_{3.64}$ for Sirajgonj; $N_{138}P_{15}K_{50}S_{20}Zn_{3.5}$ for Shibganj for MYG] + Intercrop (Garlic $N_{23}P_{20}K_{50}S_{15}$ for Sirajgonj; $N_{23}P_{20}K_{50}S_{15}$ for Shibganj)and T_6- Sugarcane [$N_{189}P_{56}K_{160}S_{36}Zn_{4.47}$ for Sirajgonj; $N_{190}P_{22}K_{60}S_{30}Zn_{3.6}$ for Shibganj for HYG]+ Intercrop (Garlic Garlic $N_{23}P_{20}K_{50}S_{15}$ for Sirajgonj; $N_{23}P_{20}K_{50}S_{15}$ for Shibganj).

Table 1. Treatments details

Code	Treatment detail
T_1	Sole sugarcane (Fertilizer as per FRG'05)
T_2	Sole sugarcane(Fertilizer as per STV for MYG)
T_3	Sole sugarcane (Fertilizer as per STV for HYG)
T_4	Sugarcane (Fertilizer as per FRG'05 + Intercrop Garlic)
T_5	Sugarcane (Fertilizer as per STV for MYG + Intercrop Garlic)
T_6	Sugarcane (Fertilizer as per STV for HYG + Intercrop Garlic)

The experimental plot size was 48 sq. meters. In conventional method, three budded setts were planted end to end system at Sirajganj on November 15, 2009 and at Sibgang (Chapai Nawabganj) November 10, 2009 .The cultivated sugarcane variety was Isd 38 and a local variety garlic was planted as intercrop. The initial and post harvest status of soil was presented in Table 4 and 5, full dose of triple supper phosphate (TSP), gypsum, zinc sulphate and 1/3rd of Muriate of Potash (MoP) and Urea were applied in trenches as basal and mixed with soil prior to planting of sugarcane setts. The rest amount of urea and muriate of potash were applied as top dressing in two equal splits at 120 and 150 day after planting (DAP). After each application, fertilizers were incorporated into the soil by spade. In the main field, flood irrigation was given. Pest and disease management were done following the cultural and chemical practices as per recommendation. Apart from chemical, cultural and mechanical control measures were done for insect-pests and disease management as and when required. No disease infestation was found in the experimental fields. Data on number of tillers at 150 DAP, cane diameter, millable canes, and stalk height, nutrient content of leaf, Brix % and cane yield were recorded for sugarcane. The bulb yield was recorded for garlic. The initial and post-harvest soils were analyzed for soil pH, organic carbon, total nitrogen, available phosphorus, exchangeable potassium and available sulphur. All the recorded data were analyzed statistically using computer based statistics 10 programs. Economic analysis was also done for the experiment.

RESULTS AND DISCUSSION

Results presented in Table 2 and 3 showed that treatment T_5 and T_6 recorded the highest number of tillers of sugarcane where, fertilizer was applied on the basis of soil test value for moderate and high yield goal at Sirajgonj and Shibgonj respectively. At Sirajgonj the maximum millable cane of 126.7×10^3 ha^{-1} by the treatment T_3 where only sugarcane was cultivated with the application of fertilizers on soil test value for high yield goal which was statistically similar with other treatments except T_5. This result indicated that intercrop had no adverse effect on sugarcane cultivation which corroborates with the findings of Imam *et al.*(1990).On the other hand at Shibgonj the height number of millablecane of 94.23×10^3 ha^{-1} was recorded in treatment T_4 which was statistically identical with treatments T_2 and T_6.

Table 2. Effect fertilizers application on growth parameters and yield of sugarcane and intercrop(garlic) in Sirajganj (AEZ-7)

Treatments	Tiller ($\times 10^3$ ha^{-1})	Millable cane ($\times 10^3$ ha^{-1})	Height (m)	Girth (mm)	Yield (t ha^{-1})	Garlic Yield (t ha^{-1})
T_1	158.55bc	112.0ab	3.44b	18.00	90.5c	-
T_2	151.62c	117.6ab	3.86ab	18.33	109.5ab	-
T_3	162.40b	126.7a	4.11a	20.33	115.2a	-
T_4	157.83bc	109.4ab	3.76ab	18.33	80.83d	1.86
T_5	180.31a	98.84b	4.21a	19.00	106.3bc	1.57
T_6	149.73c	110.0ab	4.31a	20.33	110.2ab	1.93
LSD (0.05)	10.19	20.16	0.58	NS	7.810	NS

Bokhtiar *et al.*(1995) confirmed that substantial advantage in crop yield from intercropping system is achieved compared to sole cane due to synergistic effects of companion crops on each other by making better use of agronomic management and residual advantage of applied fertilizer for intercrops.

The treatment T_3 produced significantly higher cane yield both the location where fertilizer was applied through soil test value for high yield goal. Bokhtiar *et el.* (2003) also reported that increasing rate of NPK over FRG'1997 recommendation gave the higher sugarcane and intercrop (potato and onion) yields at Rajshasi, Ishurdi and Jamalpur. It is further evident from Table 2 and 3 at Sirajganj that the treatment T_4 recorded the highest cane height with the recommended dose FRG 2005, it was statistically identical with all other treatments except T_4. On the other hand there was no significant effect was observed on cane girth and intercrop yield. At Shibganj cane hight, girth and intercrop yield also showed no significanr effect due to different treatment combination. The cane height, number of tillers, millable cane stalks, yield of cane and sugar yield was increased progressively with the application of NPK fertilizers (Gurmani *et al.*. 2003, Bokhtiar *et al.*, 2002, Iqbal *et al.*, 2002, Khan *et al.*, 2005,). Bokhtiar *et el.* (2002) observed that fertilizer had no significant effect on Brix % of sugarcane.

Table 3. Effect fertilizers application on growth parameters and yield of sugarcane and intercrop(garlic) in Shibganj(AEZ-11)

Treatments	Tiller ($\times 10^3$ ha^{-1})	Millable cane ($\times 10^3$ ha^{-1})	Height (m)	Girth (mm)	Yield (t ha^{-1})	Garlic Yield (t ha^{-1})
T_1	108.05b	70.86c	3.71	18.33	82.41ab	-
T_2	106.66b	92.65a	3.85	18.67	80.77ab	-
T_3	117.22ab	82.23b	4.04	19.33	92.08a	-
T_4	108.47b	94.23a	4.05	18.67	72.41b	3.89
T_5	112.50ab	81.18b	3.91	21.33	78.69ab	4.20
T_6	125.32a	91.25a	4.13	21.00	84.07ab	3.71
LSD (0.05)	15.25	3.435	NS	NS	13.50	NS

From the Table 4 and 5 it was showed that soil pH, total N content, available P and available S content of the post-harvest soils slightly increased compared with initial soil due to application of fertilizers to the crops. Thus it indicated a need of balanced fertilizer application in sugarcane with intercrop garlic for obtaining higher crop yield.

The economic aspect of any fertilizer management package is important both for crop production and acceptance by the farmers. The cost and return analysis help in deciding the suitability of a fertilizer management package. From the economic analysis it was found that treatment T_5 gave the highest benefit cost ratio (BCR) by the application of fertilizer on soil test value for sugarcane and inter crop (garlic) cultivation at Sirajganj

with the medium yield goal but, at Shibganj the highest BCR obtained in T_6 treatment at fertilizer doses as per soil test value for high yield goal (Table 6). Paul *et al.* (2007) noted that gross return and gross margin were greater in cane intercropped with onion over sole crop.

Table 4. Effect of fertilizer application on soil nutrient status at Sirajganj site (AEZ 7)

Treatments	Analytical value					
	pH	OC (%)	Total N (%)	Avail . P (ppm)	Exch. K (meq%)	Avail. S (ppm)
Initial soil	6.10	0.86	0.05	6.5	0.11	12.0
Post harvest						
T_1	6.62	0.64	0.060	7.0	0.12	7.0
T_2	6.60	0.64	0.060	7.0	0.12	8.0
T_3	6.64	0.75	0.055	9.0	0.13	12.5
T_4	6.63	0.65	0.050	10.0	0.12	12.0
T_5	6.63	0.67	0.060	10.0	0.12	10.5
T_6	6.54	0.67	0.050	7.0	0.12	14.0

Table 5. Effect of fertilizer application on soil nutrient status at Shibganj site (AEZ 11)

Treatments	Analytical value					
	pH	OC (%)	Total N (%)	Avail. P (ppm)	Exch. K (meq%)	Avail. S (ppm)
Initial soil	7.03	0.98	0.05	21.0	0.41	15.0
Post harvest						
T_1	7.03	0.99	0.050	19.0	0.38	15.0
T_2	7.00	0.96	0.060	25.0	0.33	10.5
T_3	7.06	0.99	0.060	19.0	0.38	13.0
T_4	7.05	1.13	0.060	25.0	0.36	10.0
T_5	6.98	0.99	0.055	25.0	0.38	10.5
T_6	7.02	0.96	0.050	21.0	0.35	10.0

Table 6. Economics of different nutrient management under sugarcane-garlic intercropping system at Sirajganj (AEZ 7) and Shibganj (AEZ 11)

Treatments	Totalproduction cost (Tk ha^{-1})		Gross income (Tk ha^{-1})		Net return (Tk ha^{-1})		BCR	
	Sirajgonj	Shibganj	Sirajgonj	Shibganj	Sirajgonj	Shibganj	Sirajgonj	Shibganj
T_1	69159	77738	235300	214266	166141	136528	2.40	1.76
T_2	77195	77133	284700	210002	207505	132869	2.69	1.72
T_3	85112	71421	299520	239408	214408	167987	2.52	2.35
T_4	79690	82738	275258	304966	195568	222228	2.45	2.68
T_5	87726	82133	331330	330594	243604	248461	2.78	3.03
T_6	95643	76421	354070	329882	258427	253461	2.70	3.32

Price of fertilizer: Urea = Tk. 20 kg^{-1} ; TSP = Tk. 22 kg^{-1} ; MoP = Tk. 15 kg^{-1} ; Gypsum = Tk. 10 kg^{-1} ; Zinc sulphate = Tk. 150 kg^{-1}
Price of crops: Sugarcane: Tk. 2600 t^{-1}, Garlic: Tk.35 kg^{-1} at Ishurdi & Tk.30 kg^{-1} at shibganj, Garlic seed: Tk.50 kg^{-1}

In conclusion, results revealed that due to highest BCR of 2.78,in treatment T_5 having the inorganic fertilizer by soil test value for high yield goal of $N_{189}P_{56}K_{160}S_{36}Zn_{4.74}$ kg ha^{-1}may be most profitable for sugarcane and garlic intercropping system at Sirajganj (AEZ 7). At Shibganj (AEZ 11) the highest BCR of 3.32 in the treatment indicated that for sugarcane and garlic intercropping system fertilizer dose of N_{190} P_{22} K_{60} S_{30} $Zn_{3.6}$ appeared to be most profitable fertilizer combination to achieve high yield goal.

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