*Bangladesh J. Sugarcane, 28 : 81-85* *July, 2006*

# Effect of different Green manuring crops as Second intercrop on Nutrient requirement and Sugarcane-Potato Intercrop production

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Received on : 20.12.06

## ABSTRACT

An experiment was conducted in the farmer's field at Sreepur under Modhupur soil tract in three successive cropping seasons with different green manuring crops as double intercrop while potato was first intercrop. The recommended chemical fertilizers produced 207.59 ha-1 thousand numbers of tillers which was significantly lower than half N with recommended PKS + black gram and half N with recommended PKS + potato + sun hemp treatments. Those treatments produced 239.90 ha-1 and 229.59 ha-1 thousand numbers of tillers. The same trend was observed in millable cane production. Half N with recommended PKS + potato + black gram) treatment produced significantly higher number and differed significantly with recommended doses of chemical fertilizers applied plots. No significant differences were found in case of cane yield production. However, there have been some differences within same GM crop and among different GM crops. GM intercrops increased OM nitrogen, potassium and sulphur in the sugarcane soil. Besides, additional yield of sugarcane with GM intercropped indicated both enrichment of soil nutrition and economic benefit compared to only recommended fertilizers applied for sugarcane.

**Key words**: Green manure, double intercrop, potato, dhancha, sunhemp, mungbean, cowpea.

## INTRODUCTION

The organic matter (OM) content in Bangladeshi soil is far below than requirement and it is depleting day by day. Addition of OM to soil through farmyard manure has been reduced because of diversified used. Growing of green manuring (GM) crops is one of the ways to enrich OM as well as to nitrogen contact in the soils. Intensive crop cultivation due to poor per capita land holding does not spare the land to cultivate GM separately. Specially sugarcane lands get little opportunity 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 at the early stage of crop growth till for canopy formation one GM crop could be grown as intercrop with sugarcane which may help enrich the soils. It is well established that cultivating GMs with sugarcane as intercrop increase millable cane and cane yield some times promoting better production compared to chemical fertilizers alone (BSRI,1996 and BSRI, 1997). Rashid *et al.* (2000) reported that cane yield increased over no fertilizer and no GM ranged from 51.60 to 159.95 percent and 10.07 to 17.28 percent over recommended fertilizer doses. GM intercrops increased organic matter (OM), 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.

To meet the growing need of different crops intercropping with sugarcane has been found effective. 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.

Among all intercrops growing with sugarcane potato has been found profitable by majority of the investigators at various places They reported increase in net profit varied from 29-68 percent ( Imam *et al.* 1982), so that potato has been selected as first intercrop.

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To verify the results, to select suitable GM corps and to improve soil health condition of sugarcane soils the experiment was conducted to find out the potentiality of green manuring (GM) crops as double intercrop with sugarcane in the view of enrichment of physical soil properties and increase the productivity of sugarcane in the red soil environment of Sreepur. Six different GM crops were selected with different nitrogen fertilizer combinations. 50 % and 100 % nitrogen fertilizers were applied with all GM crops.

## MATERIALS AND METHODS

The experiment was conducted in farmer's field at Sreepur, Gazipur under Modhupur soil tract in three successive cropping seasons starting from 1996-97. The experiment was carried out in RCB design replicated three times in 43.2 $m^2$ plots in paired row cane of locally adapted variety Misrimala.

The experiment comprised of the following treatments.

$T_0$ = $N_{160}$ $P_2O_5$ $_{120}$ $K_2O_{160}$ $S_{40}$ (Recommended dose for AEZ-28 according to Fertilizer Recommended Guide 1995)
$T_1$ = $T_0$ +Potato
$T_2$ = $T_0$ + Potato+ Dhancha (*Sesbania aculeata* )
$T_3$ = $N_{80}$ $P_2O_5$ $_{120}$ $K_2O_{160}$ $S_{40}$+ Dhancha *(Sesbania aculeata* )
$T_4$ = $T_0$+Potato+ Dhancha (*Sesbania rostrata*)
$T_5$ = $N_{80}$ $P_2O_5$ $_{120}$ $K_2O_{160}$ $S_{40}$ + Potato+ Dhancha *(Sesbania rostrata)*
$T_6$ = $T_0$+ Potato + Sunhemp *(Crotalaria juncea*)
$T_7$ = $N_{80}$ $P_2O_5$ $_{120}$ $K_2O_{160}$ $S_{40}$+ Potato+ Sunhemp *(Crotalaria juncea*)
$T_8$ = $T_0$ +Potato + Cowpea (*Vigna sinensis* )
$T_9$ = $N_{80}$ $P_2O_5$ $_{120}$ $K_2O_{160}$ $S_{40}$ + Potato + Cowpea (*Vigna. sinensis*)
$T_{10}$ = $T_0$ +Potato+ Mungbean (*Phaseolus aureus*)
$T_{11}$ = $N_{80}$ $P_2O_5$ $_{120}$ $K_2O_{160}$ $S_{40}$ + Potato + Mungbean (*Phaseolus aureus*)
$T_{12}$ = $T_0$ + Potato +Black gram ( *Phaseolus mungo* )
$T_{13}$ = $T_{80}$ + Potato +Black gram ( *Phaseolus mungo* )

Pre germinated sugarcane settlings of variety Misrimala was transplanted in paired row arrangement in November in three successive seasons. Four paired rows sugarcane in the spacing of 0.45 m between one-pair row and 1.35 m in between two paired rows were transplanted. The vaccant 1.35 m spacing in between two paired rows sugarcane was used for potato and GMs intercropping. Three rows of Diamond variety of potato was as first intercrop and was planted on first week of December in between two paired rows of sugarcane with a plant spacing of 25cm. The intercrop potato was fertilized @ of 69, 36, 72 kg ha-1 of N, P2O5 and K2O respectively as Urea, TSP and MP were applied. After harvesting of potato four lines GMs were sown in the vacant space between two paired rows cane on the second week of April at 123 to 130 days after sugarcane transplanting. GMs were harvested and incorporated in the soil in June at 60 to 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 and recommended methods. Initial and post harvest soils samples were collected and analyzed at BSRI, Ishurdi Soil Science laboratory using appropriate soil analysis methods.

## RESULTS AND DISCUSSION

The yield and yield contributing characters of sugarcane, first intercrop potato and second intercrop different green manuring crops are presented in Table 1. Results revealed that significant differences were found among yield contribution characters in sugarcane production. The treatment effect on the tiller production was significant. The control plots (applied only recommended chemical fertilizers) produced 207.59 ha-1 thousand numbers of tillers which was significantly lower than half N with recommended PKS + potato + black gram and half N with recommended PKS + potato + sun hemp treatments. These treatments produced 239.90 $ha^{-1}$ and 229.59 $ha^{-1}$ thousand numbers of tillers. The results indicated that during tillering phase sugarcane somehow received nitrogen from GMs like sun hemp and black gram immediately after incorporation GMs in the soils. However, some GM tested produced significantly higher number of tillers compared to recommended doses of chemical fertilizers applied in the sugarcane plots. It might happen because sugarcane tillering phase attended its peak period when the GMs were incorporated a month before.

The same trend was observed in millable cane production. Half N with recommended PKS + potato + black gram treatment produced significantly higher number and differed significantly with recommended doses of chemical fertilizers applied plots.

No significant differences were found in case of production of cane yield. However, there are some differences within same GM crop and between GMs crops. 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. The GM crops that incorporated in the soils did not differ with recommended fertilizers applied treatment, but production of higher cane yield indicated that the effects of GMs has enhanced the production compare to recommended fertilizers only. This finding is agreed with former workers at BSRI, Ishurdi ( BSRI, 1994, 1995, 1996, 1997b; Imam *et al.* 1984)

Sugarcane cultivation as sole crop a farmer can get net returned TK. 87.96 thousand/ ha only. While sugarcane production with potato as first and different GM crops as second intercrops might gave net return TK. 107. 94 thousand/ ha. Maximum profit over control could be earn TK 71.42 thousand/ ha by cultivating sugarcane with double intercrops. (first intercrop potato and second intercrop sunhemp with half dose nitrogen applied plots). This type of findings agreed with Islam et al. ( 1995) where they found higher cane yield in GM incorporated intercrop compared to sole crop.

**Table 1: Effect of different green manuring crops as Second intercrop in the productivity of sugarcane variety Misrimala at Sreepur under Modhupur soil tract (AEZ 28), Sreepur, 1998-99.**

| Treatments | Sugarcane growth and yield contributing characters | | | Potato yield (t/ha) | GM yield (t/ha) |
|---|---|---|---|---|---|
| | Tiller no. $10^3$x ha$^{-1}$) | Millable cane no. ($10^3$x ha$^{-1}$) | Cane yield (TCH) | | |
| $T_0$ = $N_{160}$ $P_{120}K_{160}$ $S_{40}$ (Control) | 207.59 b | 82.01 bc | 139.20 a | - | - |
| $T_1$ = $T_0$ + Potato | 232.08 ab | 85.76 abc | 139.49 a | 7.73 | - |
| $T_2$ = $T_0$ + Potato + S. aculeata | 226.96 ab | 82.01 bc | 137.49 a | 7.72 | 6.85 |
| $T_3$ = $N_{80}$ PKS as $T_0$+Potato+ S. aculeata | 232.36 ab | 83.47 abc | 143.38 a | 6.80 | 6.72 |
| $T_4$ = $T_0$ + Potato + S. rostrata | 229.49 ab | 83.99 abc | 138.22 a | 7.45 | 7.02 |
| $T_5$ = $N_{80}$ PKS as $T_0$+Potato+S. rostrata | 219.72 bc | 85.90 ab | 149.88 a | 7.55 | 6.95 |
| $T_6$ = $T_0$ + Potato + Sun hemp. | 222.44 abc | 80.53 cd | 134.41 a | 6.80 | 7.80 |
| $T_7$ = $N_{80}$ PKS as To+Potato+Sun hemp | 239.90 a | 81.86 bc | 129.13 a | 6.95 | 7.52 |
| $T_8$ = $T_0$ + Potato + Cowpea | 226.70 ab | 83.40 abc | 134.04 a | 7.35 | 5.20 |
| $T_9$ = $N_{80}$ PKS as $T_0$+Potato+Cowpea | 229.86 ab | 82.00 ab | 140.34 a | 7.62 | 5.18 |
| $T_{10}$ = $T_1$ + Potato+ Mungbean | 234.04 ab | 81.56 bcd | 134.96 a | 7.76 | 4.19 |
| $T_{11}$ = $N_{80}$ PKS as $T_0$+Potato+Mungbean | 230.08 ab | 83.76 abc | 134.49 a | 7.50 | 4.21 |
| $T_{121}$ = $T_1$ + Potato + Black gram | 226.62 ab | 84.44 abc | 148.43 a | 6.90 | 4.20 |
| $T_{13}$ = $N_{80}$ PKS as $T_0$+Potato+Black gram | 229.59 ab | 87.37 a | 142.71 a | 7.85 | 4.15 |
| CV (%) | 3.80 | 2.70 | 10.00 | - | - |

Initial and post harvest soil analysis as shown in Table 2 indicated that OM, nitrogen and potassium increased after incorporation of GMs in the soils. This again indicated that GMs intercropped in sugarcane was profitable and could enrich the soils both in physical and chemical properties. It revealed that due to incorporation of GMs in soil pH of post harvest soils also increased from 5.20 to 5.30-5.92 that were nearer to neutral soils. These further indicated that GM crops not only enriched physical and chemical properties but also neutralized pH of soils (Giller et. al., 1991). This may be occurred after cultivation of GM consecutively several years.

Economic analysis of green manuring crops double intercropped with paired row sugarcane is presented in Table 3 indicated that cane cultivation with GMs as double intercrop yielded almost equal and produced same yield compared with recommended dose of fertilizers applied plot. The highest profit over control was found in half N with PKS + potato + sun hemp applied plots compared to control plots. This further confirms sugarcane cultivation with GM crops as second intercrop might reduce 50 percent N fertilizer application.

**Table 2: Physical and chemical properties of pre and post harvest soil as influenced by different GMs, Sreepur, 1998-99.**

| Treatments | $p^H$ | OM (%) | N (%) | P (Mg/ml) | K(Meq/100 ml) | S(Mg/ ml) |
|---|---|---|---|---|---|---|
| Initial soil Status | 5.20 | 1.45 | 0.065 | 11 | 0.29 | 17 |
| Post Harvest Soil Status | | | | | | |
| $T_0 = N_{160}\ P_{120}K_{160}\ S_{40}$ (Control) | 5.92 | 1.58 | 0.065 | 14 | 0.30 | 17 |
| $T_1 = T_0$ + Potato | 5.92 | 1.59 | 0.065 | 14 | 0.30 | 17 |
| $T_2 = T_0$ + Potato + S. aculeata | 5.92 | 1.60 | 0.080 | 14 | 0.31 | 17 |
| $T_3 = N_{80}$ PKS as $T_0$ + Potato + S. aculeata | 5.93 | 1.63 | 0.080 | 14 | 0.30 | 17 |
| $T_4 = T_0$ + Potato + S. rostrata | 5.93 | 1.60 | 0.080 | 14 | 0.31 | 17 |
| $T_5 = N_{80}$ PKS as $T_0$ + Potato + S. rostrata | 5.88 | 1.64 | 0.076 | 14 | 0.30 | 17 |
| $T_6 = T_0$ + Potato + Sun hemp. | 5.89 | 1.60 | 0.076 | 14 | 0.30 | 17 |
| $T_7 = N_{80}$ PKS as To + Potato + Sun hemp. | 5.31 | 1.54 | 0.078 | 14 | 0.30 | 17 |
| $T_8 = T_0$ + Potato + Cowpea | 5.30 | 1.52 | 0.078 | 14 | 0.30 | 17 |
| $T_9 = N_{80}$ PKS as $T_0$ + Potato + Cowpea | 5.29 | 1.48 | 0.068 | 14 | 0.31 | 17 |
| $T_{10} = T_1$ + Potato+ Mungbean | 5.30 | 1.51 | 0.072 | 14 | 0.30 | 17 |
| $T_{11} = N_{80}$ PKS as $T_0$ + Potato + Mungbean | 5.35 | 1.53 | 0.086 | 14 | 0.30 | 17 |
| $T_{121} = T_1$ + Potato + Black gram | 5.35 | 1.53 | 0.086 | 14 | 0.30 | 17 |
| $T_{13} = N_{80}$ PKS as $T_0$ + Potato + Black gram | 5.35 | 1.53 | 0.086 | 14 | 0.30 | 17 |

Therefore, in conclusion it may be stated that, GM crops like *S. rostrata*, S. aculeata, C. juncea, *V. sinensis, P. mungo,* and *P. aureus* are suitable GMs as double intercrop and fifty percent recommended nitrogen fertilizer would be applied when sugarcane would be cultivated with GM crops

**Table 3: Economics of green manuring crops as double intercrop in sugarcane. Sreepur, 1998-99.**
*** Sugarcane Price = @ Tk 1,100.00 per ton**

| Treatments | Cost of cultivation sugarcane+GM ('000' Tk/ha) | Gross return ('000 tk./ha) | | | Net return ('000' Tk/ha) | Profit/ loss over ontrol ('000'Tk/ha) |
|---|---|---|---|---|---|---|
| | | Sugarcane | Intercrops | Total | | |
| $T_0 = N_{160}\ P_{120}K_{160}\ S_{40}$ (Control) | 65.16 | 153.12 | | 153.12 | 87.96 | 65.16 |
| $T_1 = T_0$ + Potato | 94.27 | 155.45 | 38.65 | 194.10 | 99.83 | 53.29 |
| $T_2 = T_0$ + Potato + S. aculeata | 87.52 | 151.23 | 38.60 | 189.83 | 102.31 | 50.81 |
| $T_3 = N_{80}$ PKS as $T_0$+Potato+S.aculeata | 93.47 | 157.71 | 34.60 | 192.31 | 98.94 | 54.18 |
| $T_4 = T_0$ + Potato + S. rostrata | 93.47 | 152.04 | 37.25 | 189.29 | 95.82 | 57.30 |
| $T_5 = N_{80}$ PKS as $T_0$+Potato+S.rostrata | 94.67 | 164.86 | 37.75 | 202.61 | 107.94 | 45.18 |
| $T_6 = T_0$ + Potato + Sun hemp. | 94.67 | 147.85 | 34.00 | 181.85 | 87.18 | 65.94 |
| $T_7 = N_{80}$ PKS as To+Potato+Sun hemp | 95.27 | 142.04 | 34.75 | 176.97 | 81.70 | 71.42 |
| $T_8 = T_0$ + Potato + Cowpea | 95.27 | 147.44 | 36.75 | 184.19 | 88.92 | 64.20 |
| $T_9 = N_{80}$ PKS as $T_0$+Potato+Cowpea | 95.72 | 154.37 | 38.10 | 192.47 | 96.75 | 56.37 |
| $T_{10} = T_1$ + Potato+ Mungbean | 95.72 | 148.45 | 38.80 | 187.25 | 91.53 | 61.59 |
| $T_{11} = N_{80}$ PKS as $T_0$+Potato+Mungbean | 95.72 | 147.93 | 37.50 | 185.43 | 89.71 | 63.41 |
| $T_{12} = T_1$ + Potato + Black gram | 95.72 | 163.27 | 34.50 | 197.77 | 102.05 | 39.26 |
| $T_{13} = N_{80}$ PKS as $T_0$+Potato+Black gram | 95.72 | 156.98 | 39.25 | 196.23 | 100.51 | 52.61 |

* Sugarcane Price = @ Tk 1,100.00 per ton
* Potato Price = @ Tk 5000.00 per ton

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