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Performance of Different Vegetables-Mungbean Sequential Intercropping with Paired Row Sugarcane in Different Hill Districts

A K M R Islam, M A T Sohel, M J Alam, M K Rahman, D Tanchangya, Kyachan, M and D Chakma
Bangladesh Sugarcane Research Institute
Ishurdi, Pabna, Bangladesh

ABSTRACT

The experiment was conducted at farmer's field in Bandarban, Rangamati and Khagrachori sadar areas during 2008-09 and 2009-10 cropping season to find out the feasibility and profitability of growing short duration vegetables i.e., Potato, onion, cabbage, and French bean with sugarcane (var. Rangbilash) as first intercrops followed by mungbean (BINAmung-5) as second intercrop in paired row cane (PRC). No significant effect of intercropping on germination, cane yield and brix % cane was found in the experiment. But there is a significant effect on tiller and millable cane production. It was found that total adjusted cane yield of sugarcane and intercrops were higher compared to sole sugarcane. Maximum benefit-cost ratio of 1:4.00 was found from PRC + onion - mungbean combination. Growing mungbean as second intercrop with PRC earned an additional income and helped to improve soil health by fixing atmospheric nitrogen and adding organic matter in soil. The results revealed that all the intercropping packages tested in the experiment were found suitable in paired row planting system of sugarcane in hilly areas.

Key words: Sugarcane, Intercropping, Hilly area

INTRODUCTION

Sugarcane (*Saccharum officinarum* L) is one of the most important agro-industrial crop in Bangladesh. It is cultivated in an area of about 0.17 million hectares. It is a long duration crop which requires 12-14 months to mature (Yadava, 1991). Most of the farmers of Bangladesh are marginal and they can not offord such a long time to get return from a single crop and they interested to grow short duration and high value crops to get an interim benifit. The demand for vegetables, oilseed and pulses is increasing day by day with the rising population, but there is a little scope for increasing production of those commodities by horizontal expansion of areas. To meet the national demand of sugar and goor production and to feed the mills at installed capacity sustainable sugarcane production is needed which can be obtained through profitable cultivation of sugarcane with intercropping.

Intercropping system is an important approach of cropping system for increasing crop yield. Plant competition is an inevitable phenomenon in intercropping system that reduces intercrop productivity. Greater productivity in intercropping system is commonly achieved by minimizing competition and maximizing complementary use of growth

resources (Krishna and Raikhelker, 1997). Intercropping provides an opportunity to avoid crop competition and advantage of increased production and greater profit or margin (Evans, 1960; Gribines, 1963) and gives higher resource use efficiency (Hashem and Maniruzzaman, 1986). Intercropping increases crop yield per unit area by intensifying the use of land. It does not only contribute to increase the productivity, but also increases the farmer's income (Villarel, 1976). To make intercropping more profitable per unit area and time with sugarcane, it is necessary to produce more than one intercrop (Hossain *et al.*, 1995 and Khan *et al.*, 1995). Ali *et al.* (1989) observed that there was no significant adverse effect of row arrangement manipulating plant geometry suitable for intercropping on the growth, yield and sucrose content of sugarcane. Successful intercropping of various crops with sugarcane has been reported by many researchers (Rathi *et al.*, 1974; Behhi and Narwal, 1977; Verma *et al.*, 1981 and Imam *et al.*, 1990).

The growth of sugarcane is slow in early stages and it takes about 3 to 5 months to establish the full canopy of the crop (Yadava, 1991). During this period of sugarcane growth, some economically important short duration crops can be grown as intercrop in the vacant spaces between two rows. Farmers grow a large number of winter vegetables like potato, cabbage, cauliflower, carrot, radish, broccoli etc. as sole crop. On the other hand, about 20% of sugarcane land (160 x 10^3 ha) is intercropped with various short growing winter crops like potato, onion, radish, pulses and mustard etc. Paired row system of sugarcane planting has been designed to keep two rows of cane at 60 cm apart leaving 140 cm between two such paired rows for growing two intercrops in sequence (Rahman, 2005). The wider space can accommodate higher number of plant population which in turn produce higher yield.

MATERIALS AND METHODS

The experiment was conducted on high land at hill valleys of Bandarban, Rangamati and Khagrachori sadar areas in farmers fields during cropping season 2008-09 and 2009-10 under irrigated condition. The major hill soils are yellow-brown to strong brown, permeable, friable, loamy very strongly acidic and low in moisture holding capacity. However, soil patterns generally are complex due to local differences in sand, silt and clay contents of the underlying sedimentary rocks and in the amount of erosion that has occurred. The soil of the experimental field was sandy loam having p^H 5.5 and nitrogen (N), zinc (Zn) and boron (B) was very low, but P, K and S status was medium and organic matter content and general fertility level are low. The site represents the area of AEZ 29. Four different intercrops i.e., Potato (var. local), onion (var. Taherpuri), cabbage (var. Atlas 70), and French bean (var. BARI Jharseem-2) as first intercrops followed by mungbean (Binamoog-5) as second intercrop were grown with sugarcane variety (Rangbilash). The unit plot size was 8 m × 8 m. The experiment was laid out in RCB design with three replications.

The treatments were as follows:

T_1	:	Paired row cane (PRC) only
T_2	:	T_1 + Potato - Mungbean
T_3	:	T_1 + Cabbage - Mungbean
T_4	:	T_1 + Bush bean – Mungbean
T_5	:	T_1 + Onion – Mungbean

Previously raised single budded soil bed sugarcane settlings were transplanted in each plot during mid November, 2007 and 2008 with 30 cm interplant spacing in 60 cm apart paired rows. Spacing between two paired rows was 140 cm. For sugarcane Urea, TSP, MOP Gypsum and $ZnSO_4$ were applied @ 206, 127, 160, 90 and 4 kg ha^{-1}, respectively (BARC, 2005). All TSP, Gypsum, $ZnSO_4$ and one-third MOP were applied in trench and mixed with soil prior to planting of settling. One-third urea was applied at 21 days after transplanting (DAT) of setts. The second dose of Urea ($1/3^{rd}$) and MOP($1/3^{rd}$) were applied as first top dressing at 90 DAT. Final top dressing of rest Urea and MOP were applied at 150 DAT. Recommended fertilizers were also applied for the intercrops. To control insect pests, Furadan 5G was applied @ of 40 kg ha^{-1} in three splits in December, 2008 and 2009, March and May, 2009 and same ways in 2009- 2010 cropping season.

Pic: PRC+ Onion – Mungbean

Pic. PRC + Cabbage - Mungbean

Pic.: PRC + Potato – Mungbean

Pic: PRC+ Bushbean – Mungbean

Pic: PRC+ 1st intercrop– Mungbean

Other recommended intercultural operations like gap filling, weeding, mulching, earthing-up and tying were done in-time. Collection of data on yield and various yield contributing parameters of cane and intercrops were done. The yields of first and second intercrops were recorded at harvest. Tiller population of sugarcane was recorded at 90, 120, 150 and 180 DAT. Millable cane and yield data were recorded at harvest. The cane equivalent yield for the intercropped plot were calculated by adding the cane yield with the equivalent cane yield obtained from the intercrops on the basis of sale value. Economic and statistical analysis on different parameters for sugarcane and intercrops were done following standard procedures.

RESULTS AND DISCUSSION

Settling establishment %, tiller and millable cane production

Settling establishment %, tiller and millable cane production under different treatments are presented in Table 1. No significant effect of intercropping was found on establishment, in case of tiller and millable cane production there is a significant effect among the different treatment-combinations. The highest establishment % was found 93.39 % in treatments T_3 followed by T_5 and the lowest was in treatment T_2 (88.41 %) where potato as 1st intercrop. The highest tiller population of 149.810 x 10^3 ha^{-1} and 140.837 x 10^3 ha^{-1} were found from treatments T_5 (T_1 + Onion – Mungbean) and T_4 (T_1 + bushbean-mungbean) and the lowest was in treatment T_2 (T_1 + potato -mungbean). In case of millable cane, treatments T_4 (T_1 + bushbean -mungbean) produced the highest millable cane 131.8 x 10^3 ha^{-1} but it was identical to T_1 (PRC only). The lowest millable cane was found in treatments T_2 and T_3 where potato and cabbage were grown as first intercrops. Lower production of millable cane under intercropping conditions was reported by Matin *et al.*, 2001 in case of cauliflower, potato, carrot and knolkhol intercropped with paired row sugarcane.

Table 1. Establishment (%), tiller, millable cane, cane yield, intercrops yield and total adjusted cane yield at different hill districts, 2008-09 and 2009-10

Treatments	Establish-ment (%)	Tiller ($\times 10^3$ ha^{-1})	Millable cane ($\times 10^3$ ha^{-1})	Cane Yield (t ha^{-1})	Intercrop yield (t ha^{-1})		Equivalent cane yield (t ha^{-1})	Total adjusted cane yield (t ha^{-1})
					1st	2nd		
T_1 = PRC only	90.92	135.20	126.3	169.0	-	-	-	169.0
T_2:T_1 + Potato - Mungbean	88.41	134.15	115.2	166.2	8.89	0.226	37.17	193.37
T_3:T_1+ Cabbage - Mungbean	93.39	134.41	122.4	169.8	39.00	0.194	88.29	249.09
T_4:T_1 + Bush bean – Mungbean	89.30	149.81	131.8	167.3	9.71	0.201	56.41	213.71
T_5:T_1 + Onion – Mungbean	91.12	140.83	124.2	165.7	8.45	0.226	118.32	267.42
LSD (0.05)	NS	13.60	9.93	NS	2.06	0.214	-	-

Price of crops :

Sugarcane	:	2160 Tk/ton	Potato	:	12 Tk/kg
Onion	:	15 Tk/kg	Cabbage	:	3 Tk/kg
Bushbean	:	10 Tk/kg	Mungbean	:	45 Tk/kg

Yield of cane

Yields of sugarcane in different hill districts with different intercrops combination were found satisfactory and there was no significant difference on cane yield among the different treatments including control plot (Table 1), which indicates intercropping of vegetables with sugarcane has no adverse effect on cane yield. Among different combinations, the highest cane yield of 169.8 t ha^{-1} was obtained in the treatment (T_3) where cabbage was as first intercrop and mungbean was grown as second intercrop. On the other hand, the lowest cane yield 165.7 t ha^{-1} was recorded from T_5 where sugarcane was intercropped with onion.

Intercrop yield and adjusted cane yield

Significant effect on yield was obtained in different vegetables-mungbean combinations in hill districts. But yield of different intercrops and mungbean were found satisfactory in all intercropped plots (Table 1). The highest intercrop yield of 39.00 t ha^{-1} was obtained from the cabbage followed by bush bean 9.71 t ha^{-1} and the lowest (8.45 t ha^{-1})was recorded from onion. Yield of second intercrop mungbean varied in small amount with different treatment combinations. The highest mungbean yield of 0.226 t ha^{-1}

was obtained from T_2 and T_5 treatment where first intercrop potato and onion were grown but in treatment T_3 second intercrop was not suitable to grow where cabbage was as first intercrop. Adjusted cane yield is an important parameter for determining the total yield potential of the intercropped plots (cane + intercrop) over the sole cane plot (Table 1). The highest total adjusted cane yield of 267.42 t ha^{-1} was recorded from T_5 treatment (T_1 + onion-mungbean) followed by T_3 (249.09 t ha^{-1}) {T_1 + cabbage-mungbean} and the lowest total adjusted cane yield of 169.00 t ha^{-1} was obtained from T_1 (Paired row cane only). The total adjusted cane yield indicated that all the intercropped plots with different intercrops-mungbean combinations was superior to the sole cane plot.

Brix % cane

No significant effect on brix % cane was recorded among the different treatment combinations (Fig. 1). The highest brix % cane of 20.00 was obtained from treatment T_1 (Paired row cane only) followed by treatment T_4 and the lowest brix % cane was recorded from treatment T_3 where cabbage was as first intercrops. Intercropping different vegetables with sugarcane under paired row system in different hill districts does not have any adverse effect on brix % cane as the intercrops were harvested before start of grand growth period of cane.

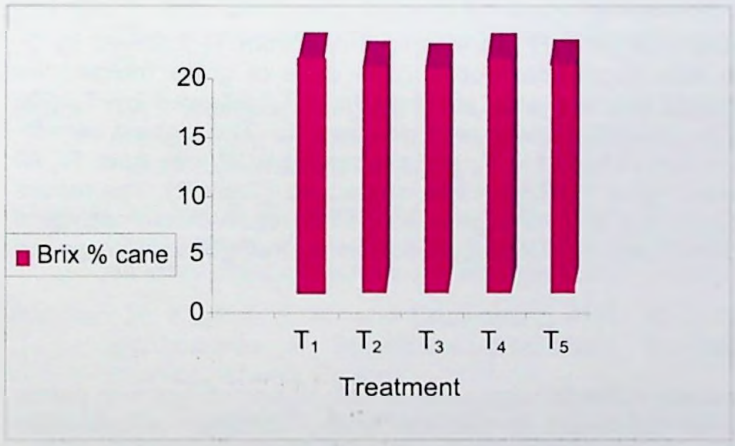

Figure 1. Brixl % cane as affected by different winter crops-mungbean intercropping combinations

Economics

The economic analysis of the experiment under different treatment combinations was shown in Table 2. Among the intercrop combinations, the highest total production cost Tk. 151220.00 was for treatment T_3 followed by Tk. 144345.00 for treatment T_5 while the lowest Tk 112500.00 for T_1 (Paired row cane only). The total production costs were different due to variation of cost of production of sugarcane and intercrops.

Table 2. Economics and benefit-cost ratio (BCR) of different cane intercrops combinations during cropping year 2008-09 and 2009-10

Treatments	Total production of cost (Tk. ha^{-1})	Gross return (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
T_1 = PRC only	112500.00	365040.00	252540.00	3.24
T_2:T_1 + Potato - Mungbean	142100.00	475804.00	275579.00	3.34
T_3:T_1+ Cabbage - Mungbean	151220.00	538034.00	386814.00	3.55
T_4:T_1 + Bush bean – Mungbean	129160.00	461613.00	332453.00	3.57
T_5:T_1 + Onion – Mungbean	144345.00	577627.00	433282.00	4.00

Price of crops

Sugarcane	:	2160 Tk/ton	Potato	:	12 Tk/kg
Onion	:	15 Tk/kg	Cabbage	:	3 Tk/kg
Bushbean	:	10 Tk/kg	Mungbean	:	45 Tk/kg

The highest gross return (Tk. 577627.00) was recorded from T_5 followed by T_3 and the lowest was from the sole sugarcane crop (T_1). In case of gross margin, the highest gross margin (Tk. 433282.00) was also obtained from T_5 followed by T_3 (Tk. 386814.00) while the lowest (Tk. 252540.00) was recorded from T_1. The highest benefit-cost ratio (BCR) of 4.00 was recorded from the T_5 and the lowest BCR was from T_1. All the intercropping system showed higher BCR than sole sugarcane (Table 2). The results of the present experiment suggested that for higher economic return intercropping of onion, cabbage, potato and bush bean sequentially followed by mungbean with paired row sugarcane in hill districts.

Farmer's feedback:

Farmers' opined that they generally cultivate sugarcane as sole or sometimes with potato as intercrop. But they are now convinced to cultivate onion, cabbage or bushbean followed by mungbean as intercrop with sugarcane in their fields for quick and higher economic return. Farmers did not face any pest or diseases attack, so farmer's have shown their keen interest to cultivate this intercropping package with sugarcane in large scale but seed of onion and cabbage are not available locally.

Conclusion

All the intercropping system like onion, cabbage, potato and bush bean as first and mungbean as second intercrop was found profitable and might be recommended for large scale adoption under said locations compared to sole sugarcane.

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