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Sustainability of Sugarcane Cultivation through Paired Row Planting System with Wide Spacing and double Intercropping

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ABSTRACT

An experiment was conducted at four non mill zone areas of Rajshahi, Serajganj, Tangail and Manikganj districts to find out the potential yield of sugarcane in paired row system with wide spacing and double intercropping. The highest germination (48.41%) and tillering (187.53 x $10^3 ha^{-1}$) was obtained from single row cane + garlic but highest millable cane (114.53 x $10^3 ha^{-1}$) and cane yield (143.04 t ha^{-1}) were recorded in the combination paired row can + onion + red amaranthus followed by paried row cane + potato + mung bean. The highest yield (13.79 to ha^{-1}) among the 1st intercrop was recorded in potato, among 2nd intercrops kang kong, gave the highest yield (3.08 t ha^{-1}) when cultivated in wide space of paired row planting system. The highest sugarcane equivalent yield (77.67 t ha^{-1}) and total adjusted cane yield (207.44 t ha^{-1}) was obtained from the combination paired row cane + potato 3 lines + mung bean 3 lines followed by paired row cane + onion 4 lines + red amaranthus 3 lines and the lowest equivalent yield (26.57 t ha^{-1}) and adjusted cane yield (131.42 t ha^{-1}) was recorded from paired row cane + mustard 3 lines + kang kong 3 lines. Maximum gross return of Tk. 238575.50, profit Tk. 160127.50 and benefit cost ration of 1:2.04 were obtained from paired row cane + potato + mung bean followed by paired row cane + onion + red amaranthus. Sugarcane cultivation could profitably be sustained through wide spacing and growing multiple intercropping thus earning higher net profit and keep abreast besides crop competition.

Key words : Double intercropping, paired row sugarcane, equivalent and adjusted yield, BCR.

INTRODUCTION

Bangladesh is an over populated South Asian country with low land man ration and high population growth rate. Rice being the staple food crop, occupies two-third of the cultivated land and sugarcane occupies 2% of the cultivated land and is one of the important cash-cum-industrial crop particularly for north western part of the country. Due to many factors including growing of short duration high value vegetables and other crops the sustainability of long duration sugarcane crop is at treat. This is more acute in high land where most of short duration crops grow well including sugarcane. To meet the situation, strategies are to be evolved to increase sugarcane yield, income and benefit in totality per unit area. Intercropping one or more crops with sugarcane is an appropriate approach of getting additional farm income beside the principal sugarcane crop. Yadav

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and Verma (1984) have reported that intercropping of sugarcane with other crops was found profitable, particularly in the sub-tropical region of India. Raju *et al.* (1988) found that intercropping with groundnut and black gram did not affect the yield of sugarcane during two years of field trials. The monetary returns from intercrops + cane was greater than cane grown alone. Intercropping with potato in Autumn planted sugarcane was most profitable in India (Kanwar, 1975). Imam et al. (1982) reported that sugarcane + potato + amaranth was more profitable followed by sugarcane + onion than the sole sugarcane crop. They also suggested cane + mustard can be grown as alternative intercrop in case, the investment is low.

Planting distance is another important aspect of agronomical management practices especially for a long duration tall crop like sugarcane. Generally, farmers cultivate sugarcane in single row at one-meter row to row distance or less, which does not allow more than one intercrop to grow before canopy is formed. If paired row with wide space of 135 cm is allowed in between two paired rows of sugarcane at 45 cm apart, it facilitates growing more than one intercrop by providing adequate space, light, air, water and nutrients for their proper growth. It does not also adversely affect the cane yield because of availability of equal number of cane clumps as in the case of single row. Hossain et al. (1995) concluded that soybean and some other pulses and oil seed crops as intercropped with paired row transplanted sugarcane gave additional economic return and added about 3.5 to 4.5 t ha-1 biomas to soil which is useful for soil organic matter and ultimately sustainable productivity of soil.

Consequently accounting the expenses incurred and income earned from all the harvests and thus help farmer to learn know-how and gain self-confidence on this new technique of cane growing profitably. the study was designed to observe the location specific difference and constraints encountered by participating farmer and involved scientists in conducting this study and subsequent adoption of the technology. The expected results are likely to establish the evident fact of on station study, that higher economic return may be obtained through inclusion of more than one intercrop.

MATERIALS AND METHODS

The experiment was conducted during crop season 2000-2001 at four place of non-mill zone area of Rajshahi, Serajganj, Tangail and Manikganj districts where harvested cane is used for gur making. Design followed was Randomized Complete Blocks (replication) covering four areas as mentioned above. The treatments included are :

T_1 = Single row cane + garlic (Farmers practices as control)
T_2 = Paired row cane + potato + mung bean
T_3 = Paired row cane + onion + red amaranthus and
T_4 = Paired row cane + mustard + kang kong

The main block measuring 1300 sq. m was divided into four plots. The treatments were randomly distributed in four plots together constituted a complete block representing one replication. Cane was planted at 1 meter row distance with one line of garlic in between tow cane rows as intercrops in one plot (T_1). In rest three subplots, paired row cane was planted at 45 cm apart keeping a wide distance of 135 cm in between two paired rows of cane with intercrops namely, potato 3 lines (T_2), onion 4 lines (T_3) and mustard 3

lines (T_4) were planted in between cane rows. The total area was covered with the variety Isd 16 using conventional three budded setts in trenches within 1-15 November 2000 in four different locations. Fertilizer was applied as per recommended dose. Three fourth of the recommended dose of fertilizer was applied to intercrops in paired row plots i,e 150 kg urea, 75 kg TSP, 12 kg MP for potato, 165 kg urea, 150 kg TSP, 150 kg MP and 150 Gypsum for onion, 100 kg urea, 75 kg TSP, 45 kg MP and 80 kg Gypsum for mustard and half of the dose amounting 110 kg urea, 100 kg TSP, 100 kg MP and 80 kg Gypsum for garlic in 1 meter apart single row cane planted and the second intercrops 3 lines each of mung bean, red amaranthus and kang kong just after the first ones were harvested. For second intercrops 16 kg urea, 25 kg TSP and 50 kg MP for red amaranthus, 60 kg urea, 25 kg TSP, 60 kg MP for kang kong. Recommended cultural practises and plant protection measures were applied. The intercrops were harvested at mature stages of each crop and the cane around 15 December 2001. Data in respect of yield of intercrops and yield contributing parameters of sugarcane i.e. germination, tillering, millable cane, tons cane per unit were recorded. Besides expenses incurred and returns received from different crops in question were accounted so as to find out combined expenses and income from all crop combinations enlisted. Finally the adjusted yield of sugarcane was calculated by adding sugarcane equivalent yield of intercrops with the yield of sole cane crop. Economic analysis was done to asses the income earned from different crops single and in combinations. After harvest data were collected, compiled, analysed and interpreted. Farmers attitude on "paired row" system which is new to them and the constraints encountered in conducting the studies was noticed and discussed so as to motivate farmers from oscillating to positive state through involvement in his own piece of land through participation.

RESULTS AND DISCUSSION

The results on germination, tillering, number of millable cane and yield of cane was presented in the Table 1. It is revealed from the table that the highest germination (48.41%) was obtained from T_1 (single row sugarcane + garlic) followed by T_3 (paired row cane + onion + red amaranthus), T_2 (paired row cane + potato + mung bean) and T_4 (paired row cane + mustard + kang kong). In single row higher germination might be induced by well tilth land for garlic planting. Germination although varied in different treatments was not statistically significant. Ali *et al.* (1989) observed that there was no significant adverse effect on germination because of varied row arrangement. Tiller production among the treatments varied greatly but was not statistically significant. The highest number of tillers were ($191.53 \times 10^3 ha^{-1}$) produced in T_1 (single row cane + garlic), which was closely followed by T_3 (paired row cane + onion + red amaranthus, $187.53 \times 10^3 ha^{-1}$), T_2 (paired row cane + potato + mung bean, $182.17 \times 10^3 ha^{-1}$). The lowest number of tillers ($141.45 \times 10^3 ha^{-1}$) was recorded T_4 (paired row cane + mustard + kang kong). Sugarcane grown with garlic as intercrop tended to produce maximum tillers per hectare and is likely due to good tilth for garlic and consequent improved soil-water condition, which led towards increased tillering. This finding is in line with as observed by Ahmed *et al.* (1997). Muhammad *et al.* (2000) reported that different intercropping treatments did not affect tillering of sugarcane significantly although sole crop produced slightly large number of tillering.

Table 1. Effects of different intercrops on some yield contributing parameters and yield of wide spaced-paired row sugarcane, 2000-2001.

Treatments	% germination	Tillers ($x10^3 ha^{-1}$)	Millable canes ($x10^3 ha^{-1}$)	Yield ($t\ ha^{-1}$)
T_1	48.41	191.53	93.67	92.73 a
T_2	44.96	182.17	103.94	129.77 a
T_3	45.41	187.53	114.53	143.04 a
T_4	44.33	141.45	91.25	104.85 b

Millable canes varied greatly due to the effects of various treatments (Table 1). The highest millable cane ($114.53 \times 10^3 ha^{-1}$) was obtained in T_3 (paired row cane + onion + red amaranthus), which was followed by T_2 (paired row cane + potato + mung bean, $103.94 \times 10^3 ha^{-1}$), T_1 (single row cane + garlic, $93.67 \times 10^3 ha^{-1}$), but the lowest one ($91.25 \times 10^3 ha^{-1}$) was recorded in T_4 (paired row cane + mustard + kang kong). The exhaustive effects of mustard might reduce tillering and millable canes and competition for light and nutrients enhanced tiller mortality in single row plantation resulted in lower number of millable canes.

Data presented in the Table 1 indicates that variation among the average yield of cane of various treatments are statistically significant. Treatment T_2 and T_3 are statistically identical, T_1 and T_4 are also identical but differed significantly from T_2 and T_3. The highest cane yield 143.04 t ha^{-1} was harvested from treatment combination T_3 (paired row cane + onion + red amaranthus) followed by treatment T_2 (paired row cane + potato + mung bean) and T_4 (paired row cane + mustard + kang kong). The lowest cane yield (92.73 t ha^{-1}) was recorded in T_1 (single row + garlic). Treatment T_3 (paired row cane + onion + red amaranthus) produced highest yield which might be due to good tilth and intercultural operations for onion and intensive management for red amaranthus, besides in paired row due to spacious planting sugarcane received maximum sunlight for photo-synthesis and produced more number of millable cane and reduce tiller mortality contributed towards increased cane yield. In single row plants compete seriously for light, nutrients, water and spacing, thus affected tiller mortality and individual cane weight which was probable reason for lower yield. Roodag et al. (2000) found paired row cane recorded yield of 102.57 t ha^{-1} while normal method of planting yielded 101.25 t ha^{-1}. Verma *et al.* (1986) also performed experiments on cane-potato intercropping at different row spacing and that neither cane nor potato yields, were affected.

Among the four intercrops planted, highest yield was harvested from potato followed by onion and garlic. Among the three second intercrops, kang kong produced highest average yield followed by red amaranthus and mung bean (seed).

Sugarcane equivalent yield calculated on sale proceeds received from intercrop equivalent sugarcane price. Equivalent yield of intercrop varied significantly. Garlic and onion produced similar equivalent yield but potato and mustard differed significantly in terms of equivalent yield. It is revealed from Table 2 that T_2 (paired row cane + potato + mung bean) gave the highest equivalent yield (77.67 t ha^{-1}) followed by T_3 (paired row cane + onion + red amaranthus, 46.42 t ha^{-1}). In considering adjusted cane yield, it is evident that T_2 (paired row cane + potato + mung bean) gave adjusted yield 207.44 t ha^{-1} which led to higher income followed by T_3 (paired row cane + onion + red

amaranthus, yielding 189.46 t ha^{-1}) and T_1 (single row + garlic yielding 143.33 t ha^{-1}. The lowest adjusted yield (131.42 t ha^{-1}) was found from T_4 (paired row cane + mustard + kang kong) due to low yield and price of mustard as intercrop. Khan *et al.* (1995) reported that the highest cane yield was obtained from STP cane in conventional row with intercrop potato in single row. But the highest sale proceed and adjusted cane yield (104.8 TCH) was observed from the treatment of paired row (60 cm) STP cane and two rows potato-kang kong (120 cm).

Table 2. Yield of first and second intercrops, their sugarcane equivalent yield and adjusted yield (t ha^{-1}), 2000-2001.

Treatments	Yield of 1st intercrops	Sugarcane equivalent yield of 1st intercrops	Yield of 2nd intercrops	Sugarcane equivalent yield of 2nd intercrops	Total equivalent yield of intercrops	Yield of sugarcane	Total adjusted cane yield
T_1	1.94	50.60 ab	-	-	-	92.73 b	143.33
T_2	13.79	71.94 a	0.33	5.73 b	77.67	129.77 a	207.44
T_3	3.16	41.21 ab	1.20	5.21 b	46.47	143.04 a	189.46
T_4	0.73	15.86 b	3.08	10.71 a	26.57	104.85 b	131.42
LSD (5%)							

The economics of different planting systems along with intercrop combination were calculated to find out the most profitable and best combination. It is seen from the Tables 3 and 4 that cultivation cost of intercrop onion + red amaranthus ranked maximum (Tk. 32650.00) followed by potato + mung bean (Tk. 32570.00), mustard + kang kong (Tk. 13215.00) when planted with paired row cane. But when garlic as only intercrop was planted with single row cane incurred cost Tk. 19700.00 which was highest than mustard + kang kong due to high price of garlic as seed in planting season. Considering net profit, T_2 (paired row cane + potato + mung bean) appeared to be the best treatment which returned maximum net profit of Tk. 160127.50 ha^{-1} and cost benefit ratio (BCR) 1:2.04 followed by T_3 (paired row cane + red amaranthus, amounting Tk. 139368.00 with BCR of 1:1.77 and T_1 (single row cane + garlic) amounting Tk. 99261.00 with BCR 1:1.51. The lowest profit Tk. 92051.50 was earned from T_4 (paired row cane + mustard + kang kong) Where BCR was 1:1.56. Rathi and Singh (1981) intercropped cane with wheat, potato and onion, and have reported that intercropping of sugarcane with a number of crops reduced cane yield but it was increased with all combinations involving potato as an intercrop and the most profitable alternatives were intercropping with potato and onion.

Table 3. Cost of cultivation of intercrops and sugarcane, 2000-2001.

Treatments	Cost of intercrops cultivation (Tk.)			Cost of cane cultivation (Tk.)	Total cost of cultivation (Tk.)
	1st intercrop	2nd intercrop	Total		
T_1	19700.00	-	19700.00	45878.00	65578.00
T_2	27690.00	4880.00	32570.00	45878.00	78448.00
T_3	29550.00	3100.00	32650.00	45878.00	78528.00
T_4	10065.00	3150.00	13215.00	45878.00	59093.00

Table 4. Benefits derived from intercrops and sugarcane, 2000-2001.

Treatments	Return from (Tk.)			Gross return (Tk.)	Total cost of cultivation (Tk.)	Loss/Profit (Tk.)	BCR
	1st intercrop	2nd intercrop	Sugarcane				
T_1	58200.00	-	106639.50	164839.50	65578.00	99261.50	1:51
T_2	82740.00	6600.00	149235.50	238575.50	78448.00	160127.50	1:2.04
T_3	47400.00	6000.00	164496.00	217896.00	78528.00	139368.00	1:1.177
T_4	18250.00	12317.00	120577.50	151144.00	59093.00	92051.50	1:1.56

From the above discussions it can be concluded that sugarcane cultivation paired row system with wide spacing is a promising technology along with double intercrops in sequence with sugarcane. Potato and mung bean were found best as 1st and 2nd intercrops respectively followed by onion and red amaranthus. Growing two or more intercrops is likely to give more economic return than other cropping patterns and thus facilitate sustain sugarcane cultivation even at present situation of hard crop competition.

REFERENCES

Ali, H.; Hossain, A.H.M.D.; Imam S.A. and Shaheen, M. 1989. Row adjustment of sugarcane on the yield of intercropping cane and potato. Bangladesh J. Sugarcane, **11** : 78-82.

Ahmed, M.S.; Cheema, M.S. and Muhammad, G. 1991. Feasibility of intercropping Rabi crops in Autumn crop of sugarcane. *Pak. Sugar J.*, **5** : 10-14.

Hossain, A.H.M.D.; Rahman, M.K.; Kabir, M.L.; Matin, M.A. and Alam, M.J. 1995. Performance of Soybean and some other crops as intercrop with paired row transplanted sugarcane. *Bangladesh J. Sugarcane*, **17** : 119-122.

Imam, S.A.; Ali, A. and Razzaque, M.A. 1982. Performance of intercropping with sugarcane under several crop combination. Bangladesh J. Sugarcane, **4** : 32-47.

Muhammad, I.; Ayaz, S.; Mahmood, I. and Ahmed, I. 2000. A glance at the agro economic study of sugar intercropping with three other crop. *Pak. Sugar J.*, **15** : 18-22.

Kanwar, R.S. 1975. Scope of intercropping in North India. *Indian Sugar*, **25** : 187-189.

Khan, N.U.; Pal, S.K.; Amanullah, A.S.M.; Islam, M.J. and Hossain, A.H.M.D. 1995. Performance of double intercropping in paired row planting of sugarcane with different planing techniques. Bangladesh J. Sugarcane. **17** : 77-80.

Raju, D.V.N.; Rao, K.L. and Raju, J.S.N. 1986. Studies on intercropping with sugarcane in Andra Pradesh. *Bharatiya Sugar*, **11** : 65-67.

Roodag, L.I.; Itnal, C.J. and Khandagave, R.B. 2000. Influence of planting system and intercrops on sugarcane tillering and yield. *Indian Sugar*, **1** : 605-609.

Rathi, K.S. and Sing, R.A. 1981. Summary of effect of intercropping of different rabi crops on cane yield and net profit in comparison to pure autumn cane. *Indian Sugar Crops J.*, **8** : 21-26.

Verma, R.S.; Yadav, R.L. and Singh, K. 1986. A new planting technique of potato for intercropping in autumn sugarcane. *Indian Sugar*, **36** : 19-20.

Yadav, R.L. and Verma, R.P. 1984. Transfer of the intercropping techniques to sugarcane growers. *Indian Sugar Crops J.*, **10** : 1-2.