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Performance of Selected Winter Vegetables as First and Sunhemp as Second Intercrop with Paired Row Sugarcane

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ABSTRACT

The experiment was conducted at farmers' field in Jaipurhat sugar mills zone under Tista Meander Floodplain soils (AEZ-3), during the cropping year 2003-04 to study the performance of selected winter vegetable viz; potato, spinach, radish, coriander and carrot as first and sunhemp as second intercrop in paired row sugarcane. Intercropping combinations showed significant effect only on tiller population while non significant effect on all other parameters. Tiller production was decreased significantly over control while millable canes, yield of cane and brix percent were increased progressively over control though they showed non significant effect due to different intercropping combinations treatments. Highest yield of 111.25 t ha^{-1} was obtained from PRC+ potato–sunhemp combination (T_2) followed by PRC+ spinach– sun hemp combination (T_3), while, highest adjusted cane yield of 153.07 t ha^{-1} was obtained from PRC+ potato–sunhemp (T_2) followed by 131.43 t ha^{-1} PRC+ radish–sunhemp (T_4) and 131.13 t ha^{-1} from PRC+ carrot–sunhemp (T_6) combination. Highest economic benefit (Tk. 99452 ha^{-1}) and BCR (3.64) were also obtained from PRC+ potato–sunhemp followed by PRC+ radish–sunhemp (Tk. 45034 and BCR- 2.71 respectively) and PRC+ carrot–sunhemp combination (Tk. 44704 and BCR- 2.68 respectively).

Key words: Winter vegetables, Sun hemp, Intercrop, Paired row, Sugarcane

INTRODUCTION

Intercropping is an excellent technique to increase total yield, higher monetary return, and greater resource utilization and fulfill the diversified need of the farmers. As sugarcane is a long duration crop grown in considerable wide row spacing, so, intercropping with sugarcane is very economic (Kabir, 1988; Ali *et el.*1989). It is reported that 50 to 80 percent of the rain fed crops are planted as intercrops with sugarcane in many developing countries (Norman, 1974 and Jodha, 1977). Only 15 to 20 percent sugarcane area is intercroped in Bangladesh where as in Mauritius about 70-77 percent areas are intercroped mainly with potato and tomato (Imam *et al.*, 1990 and Anon., 1986). Successful intercropping of various crops with sugarcane has been reported by many researchers (Rathi *et al.*, 1974; Behli and Narwal; 1977; Verma *et al.* 1981; Imam *et al.* 1990). Usually one line of winter vegetables is intercropped in between two single rows of sugarcane and this system of conventional intercropping could not give satisfactory intercrop yield in most of the cases. To overcome this problem recently "paired row system" of sugarcane plantation has been developed at BSRI to facilitate higher intercrop population and raising two intercrops in sequence. The most significant yield increase (15-29%) over conventional spacing has been reported from planting two rows of cane at 40-50 cm apart leaving 150 cm between two such paired rows for growing intercrops (Roach, 1977). It has been reported that tiller, millable cane, cane stalk, cane yield and adjusted cane yield were significantly higher in paired row cane with potato-mungbean or onion-mungbean as sequential double intercrops with sugarcane than any other treatments with single row cane (Anon., 1991). Furthermore, Ali *et al.* (1989) reported that there was no significant adverse effect of row arrangement on germination of cane and recoverable sucrose percent. Growing double intercrop under paired row system increases the productivity by 31.20 per cent compared to the single intercrop under single row

system (Alam, 1999). Soils of Bangladesh deficient in organic matter (OM) content and it is depleting day by day. Growing of green manuring (GM) crops is one of the ways to enrich OM as well as to fix nitrogen to the soils. Intensive crop cultivation due to poor per capita land holding dose not spare the land to cultivate GM separately. Especially sugarcane lands get little scope to grow GM because of its long crop duration in the field. In some instance GM intercropping gave better sugarcane production than that of obtaining without GM intercropping (BSRI Annual Report 1999 a & 1999 b). Gerardino *et al.* (1993) found 28.96–32.53 and 27.55–33.64 percent higher cane and sugar yield, respectively on the dry season planting of *C. juncea*. He also found 48.48 - 72.25 and 50.55-73.27 percent cane and sugar yield increase on the wet season planting of *C. juncea*. Rashid *et al.* (2000) reported cane yield increased over no fertilizer and no GMs regard from 51.60- 159.95 percent and 10.67-17.28 over recommended fertilizer doses. Bangladesh Sugarcane Research Institute (BSRI) has recommended several intercrop combinations after intensive studies at research station and at farmers' field. But much less effort has been given to implement the recommendations of BSRI or even to select the most suitable intercrop combination (s) to be practiced by the farmers' in particular agro-climatic and edaphic conditions. Hence, an attempt has been taken to study the performance of selected winter vegetable as first intercrop and sunhemp as second intercrop with paired row sugarcane at Jaipurhat region (AEZ 3).

MATERIALS AND METHODS

The experiment was conducted at farmers' field in Jaipurhat sugarmills zone, during the cropping year 2003-04. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The plot size was 10 m x 8 m. After final land preparation 45 days old soil bed settlings of sugarcane variety Isd 32 was transplanted on December 9, 2003. Interplant spacing for sugarcane settlings was 45 cm for pair rows of 60 cm spacing while spacing between two paired rows was 140 cm. Five winter vegetable viz., potato, spinach, radish, coriander and carrot as first intercrop and sunhemp as second intercrop were grown with sugarcane. Seedlings/seeds of different first intercrops were transplanted/sown between vacant spaces of of paired rows of cane after 7 days of cane transplantation. Potato, radish, coriander and carrot were sown in 3 lines maintaining spacing line to line 30 cm and plant to plant 15 cm. Spinach was shown in 2 lines at 60 cm row to row. After harvest of first intercrops sunhemp was grown up to pre flowering stage and then buried under soil with earthling up at base of clump. Following treatments were included this experiment.

Table 1. Treatment details.

Treatments	Treatment detail
T_0	Paired Row Cane (PRC) only
T_1	PRC + Potato-Sunhemp
T_2	PRC + Spinach-Sunhemp
T_3	PRC + Radish-Sunhemp
T_4	PRC + Coriander-Sunhemp
T_5	PRC + Carrot-Sunhemp

Recommended dose of fertilizers were applied for sugarcane and two thirds of recommended dose of fertilizer of each intercrop were used. Intercultural operations were done as and when required for sugarcane as well as for intercrops. Data on different intercrops yield were recorded and converted into adjusted cane yield for economic analysis. For sugarcane, tiller population, millable canes, cane yield and brix were recorded. For economic analysis, all variable

costs related to intercropping were also included. Total returns were calculated on the basis of yield and local market price of products. Additional cost and additional income due to intercropping over the sole cane practices were also calculated.

RESULTS AND DISCUSSION

Growth parameters and yield of sugarcane

Data on different growth parameters of sugarcane (tiller, millable canes), yield and brix are presented in Table 2. Tiller production has been influenced significantly by different intercrop combinations under paired row system of planting. Highest tiller population of 171.81x 10^3 ha^{-1} was produced from the T_1 treatment (PRC), followed by 137.15x 10^3 ha^{-1} and 135.05x 10^3 ha^{-1} from treatment T_4 (PRC + Radish-Sun hemp) and T_2 (PRC + Potato-Sunhemp) respectively. Lowest number of tiller (127.01x 10^3 ha^{-1}) was obtained from T_5 (PRC + Coriander-Sunhemp). All the treatments of intercrop combinations showed statistically similar effect in tiller production. These results were at par with the findings of Hossain *et al.* (2003) where it was reported that the highest number of tiller was produced in the paired row sole cane planting than that of paired row cane with intercrop combinations. Hossain *et al.* (2004) also reported that the highest tiller production in paired row cane without intercrop combination and the lowest tiller from PRC + Coriander -Sunhemp combination. Sugarcane crop competes for nutrients and moisture with companion crops in early stage that may causes low emergence of tiller in treatments with different intercrop combinations than that in paired row cane without intercrop.

Millable canes were progressively increased over control though the millable canes production showed non-significant effect due to different treatments. Highest number of millable canes (107.71x 10^3 ha^{-1}) was obtained from T_2 treatment (PRC + Potato–Sun hemp) followed by 96.18x 10^3 ha^{-1} and 95.00x 10^3 ha^{-1} from T_3 (PRC + Spinach–Sunhemp) and T_4 (PRC + Radish-Sunhemp) respectively. This supports the finding of Hossain *et al.* (2003) and Alam *et al.* (2000) who reported increased millable canes in intercropped plots. Production of higher number of millable canes in intercropped plots might be possible due to beneficial effects of applied fertilizers, green manuring (sun hemp) and crop management practices for intercrops.

Brix of cane showed non significant effect due to different treatment combinations. Similar results have also been observed by Hossain *et al.* (2003), Hossain *et al.* (2004) and Khan *et al.* (1995). All the treatments increased cane yield progressively over control, but the yield of cane was non significant among different treatment combinations. Highest yield of cane 111.25 t ha^{-1} was obtained from T_2 (PRC + Potato-Sunhemp) followed by T_3 (97.78 t ha^{-1}) and T_4 (95.07 t ha^{-1}). Matin *et al.* (2001) reported statistically similar cane yield due to different treatments of intercrop combinations. Increased yield in intercrop plots might be possible due to beneficial effects of fertilizers applied to intercrops, green manures (sun hemp) which was incorporated to soil and crop management for intercrops.

Yield of intercrops

Yield of 1st and 2nd intercrops along with cane and adjusted yield of cane are presented in Table 3. It is evident from the Table 3 that the first intercrops potato, spinach, radish, coriander and carrot produced 8.5, 5.83, 17.00, 0.60 and 6.50 t ha^{-1} respectively. Highest yield of second intercrop as GM (Sunhemp) was obtained from T_2 treatment (24 t ha^{-1}) followed by T_3 (22 t ha^{-1}) treatment and the lowest yield of sun hemp were obtained from T_4 (12 tha^{-1}). Treatment T_5 and T_6 produced 16.50 t ha^{-1} and 17.50 t ha^{-1} yield of sun hemp respectively. The data showed that under intercropping condition, the type of first intercrop influence the yield of second intercrop (sun hemp). This was at par with the findings of Alam *et al.* (2000). Lower yield of sunhemp as second intercrop after radish, coriander and carrot might be due to micro environmental effect created by those first intercrops in soil.

Adjusted cane yield

Adjusted cane yield is an important parameter for determining the total yield potentials of the intercropped plot (Cane + intercrop) over the sole cane plot. From the Table 3 it was found that all the intercrop combinations produced higher adjusted cane yield over sole crop (cane in paired row). Highest adjusted cane yield of 153.07 t ha^{-1} was obtained from the T_2 (PRC + Potato-Sunhemp) while the lowest of 90.49 t ha^{-1} was obtained from the T_1 plot (sole paired row cane). Alam *et al.* (2000) and Khan *et al.* (1995) obtained the highest adjusted cane yield from paired row cane + potato-mungbean and paired row cane + potato–kang kong respectively. This result indicated that PRC + potato-sunhemp combination (T_2) was superior to other combination. The gradual decomposition of sunhemp may have excreted organic matter benefit to long duration sugarcane crop.

Economics of intercropping with sugarcane

It is revealed form the Table 4 that the highest additional cost of Tk. 9748 ha^{-1} was required for T_2 treatment (PRC + potato-sunhemp) and the lowest additional cost of Tk. 6708 ha^{-1} was needed for T_3 treatment (PRC + spinach -sunhemp). Due to intercropping with carrot, radish and coriander followed by sunhemp needed medium level additional cost of Tk. 8750, 8276 and 7595 ha^{-1} respectively. It is observed that treatment T_2 also gave the highest additional income of Tk. 99452 ha^{-1} while the lowest amount of Tk. 22693 ha^{-1} was form the T_5 (PRC + coriander-sun hemp), Radish, carrot, spinach followed by sun hemp (T_4, T_6 and T_3) gave medium level of additional income of Tk. 45034, 44704 and 30676 ha^{-1} respectively. All the treatments of intercrop combinations gave higher benefit cost ratio (BCR) over control (sole paired row cane). Highest BCR of intercropping was found 3.64 from T_2 treatment followed by T_4 and T_6 treatments (2.71 and 2.68 respectively). This result indicates that potato, radish and carrot followed by sun hemp are the most compatible intercrop combinations of paired row sugarcane. The overall results indicated that potato followed by sunhemp was the best intercropping combination with paired row sugarcane. Imam *et al.* 1982, Alam *et al.* 2000 and Hossain *et al.* 2004 found the highest BCR with potato in paired row sugarcane. Growing of sunhemp as GM after first intercrop can be recommended to enrich soil fertility by organic matter addition and atmospheric nitrogen benefits.

From the above discussion it may be concluded that for better economic benefit cultivation of potato followed by sunhemp as GM in paired row sugarcane was the most profitable intercrop combination in Jaipurhat region. Paired row sugarcane + Radish-sunhemp and Paired row cane+ carrot-sunhemp were 2nd and 3rd profitable combinations than sole paired row cane. Hence, PRC+ Potato-sunhemp, PRC+ Radish-sunhemp and PRC+ Carrot-sunhemp may be suggested as intercropping combinations for Jaipurhat region to get interim benefit from the sugarcane plot and to maintain soil fertility for sustainable sugarcane production.

Table 2. Performance of intercrop combinations on the growth and yield of sugarcane.

Treatment	Tiller ($x\ 10^3 ha^{-1}$)	Millable cane ($x\ 10^3 ha^{-1}$)	Yield of cane ($t\ ha^{-1}$)	Brix (%)
T_1-PRC (Control)	171.81 a	91.53	90.49	16.23
T_2-PRC+ Potato-Sunhemp	135.07 b	107.71	111.25	16.50
T_3-PRC+ Spinach-Sunhemp	131.81 b	96.18	97.78	16.47
T_4-PRC+ Radish-Sunhemp	137.15 b	95.00	95.07	17.17
T_5-PRC+ Coriander-Sunhemp	127.01 b	91.74	92.71	16.27
T_6-PRC+ Carrot-Sunhemp	133.33 b	92.99	93.63	17.13
LSD (P=0.05)	16.91	NS	NS	NS

Table 3. Performance of 1st and 2nd intercrops with paired row sugarcane.

Treatment	Yield of cane (t ha^{-1})	Yield of 1st intercrops (t ha^{-1})	Yield of Sunhemp (t ha^{-1})	Adjusted Cane Yield (t ha^{-1})
T_1-PRC (Control)	90.49	-	-	90.49
T_2-PRC+ Potato-Sunhemp	111.25	8.50	24.00	153.07
T_3-PRC+ Spinach-Sunhemp	97.78	5.83	22.00	118.38
T_4-PRC+ Radish-Sunhemp	95.07	17.00	12.00	131.43
T_5-PRC+ Coriander-Sunhemp	92.71	0.60	16.00	111.12
T_6-PRC+ Carrot-Sunhemp	93.63	6.50	17.50	131.13

Table 4. Economics of intercropping (1st and 2nd) with paired row sugarcane.

Treatment	Cost of Cultivation (Tk. ha^{-1})	Gross Income (Tk. ha^{-1})	Additional cost over control (Tk. ha^{-1})	Additional income over control (Tk. ha^{-1})	BCR
T_1-PRC (Control)	44918	99539	-	-	2.22
T_2-PRC+ Potato-Sunhemp	54666	198991	9748	99452	3.64
T_3-PRC+ Spinach-Sunhemp	51626	130218	6708	30679	2.52
T_4-PRC+ Radish-Sunhemp	53194	144573	8276	45034	2.71
T_5-PRC+ Coriander-Sunhemp	52513	122232	7595	22693	2.32
T_6-PRC+ Carrot-Sunhemp	53668	144243	8750	44704	2.68

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