

Performance of Onion Seed Crop and Mungbean Sequential Intercropping at Paired Rows Planted Sugarcane

M.I. Hossain^{1*}, H.M. Al- Amin², M. S. Islam³, M.J. Uddin⁴ and M.E. Reza³

¹ Pathology Division, ³ Entomology Division, ² BSRI Sub-Station Rajshahi and ⁴ BSRI Sub-Station Chuadanga, Bangladesh Sugarcrop Research Institute (BSRI), Ishurdi, Pabna, Bangladesh

ABSTRACT

An experiment was conducted at farmers field in Rajshahi during 2014-2015 cropping season under irrigated condition to study the performance of sugarcane with onion seed as first and mungbean as second intercrop in paired rows planting system of sugarcane. Significant differences were observed on millable cane, cane yield and first intercrop of onion seed. No significant effect of intercropping on brix percentage was found in the experimental plots. It was found that total adjusted cane yield of sugarcane and intercropping practices were found better compared to sole sugarcane cultivation. The highest cane yield (107.02 t ha^{-1}) was found from the treatment T_5 (PRC+ onion 6 lines – Mungbean). The highest yield of onion seed (0.33 t ha^{-1}) obtained from six lines of onion with paired rows cane followed by 5 lines onion (0.28 t ha^{-1}). Mungbean as second intercrop after harvest of paired rows cane only showed better performance. The highest adjusted cane yield (350.29 t ha^{-1}) and the highest gross margin of Tk 7,75,379.75 ha^{-1} were recorded from the treatment T_5 compared to the control. The highest land equivalent ratio 3.27 was recorded from T_5 (PRC+ onion 6 lines – Mungbean) combination. Maximum benefit cost ratio of 5.12 was found from T_5 (PRC+ onion 6 lines – Mungbean) combination. Growing mungbean as second intercrops with PRC helped in earning an additional income thus improving soil health by fixing atmospheric nitrogen and adding organic matter in soil. The overall result revealed that onion seed crop as first and mungbean as second intercrop with paired rows sugarcane was found suitable and (PRC+ onion 6 lines – Mungbean) combination was found the best among the tested combination and may be recommended as the profitable intercropping package for sustainable sugarcane farming at Rajshahi area in Bangladesh.

Key words: Sugarcane, onion, seed, intercropping, millable cane, yield

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is one of the most important food-cum-industrial cash crops in Bangladesh and cultivated in more than 90 countries of the

* Corresponding author: M. I. Hossain, Scientific Officer
e-mail: imam4all@gmail.com

tropical and Sub-tropical regions of the world (FAO, 2011). Sugarcane occupies an area of 23.82 million hectares with a total production 1685.44 million metric tons in the world (FAO, 2012). In Bangladesh, on an average 6.50 million metric tons of sugarcane is produced annually from 0.12 million hectares of land (FAOSTAT, 2012). It is grown in all the district of Bangladesh, but its commercial cultivation for industrial supply is mostly concentrated in the northern districts. In Bangladesh Sugarcane is mainly used for sugar and jaggery production purpose. Taking the average of last 10 years production, out of 6.50 million tons of cane 1914.28 (19.16%) thousand tons was used for Sugar production, 3724.38 (56.73%) thousand tons was used for jaggery production and 926.25 (14.11%) thousand tons was used for seed and chewing purpose, respectively (BBS, 2012).

The growth of sugarcane is slow in early stages and it takes about 3-5 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, tomato, cauliflower, onion, carrot etc. as intercrop with sugarcane. Onion (*Allium cepa*) is an important spice crop in Bangladesh. The total requirement onion seed does not meet-up from the indigenous production. The total production of onion seed in Bangladesh is about 150 tons per year, as against the requirement of more than 300 tons. Moreover, the seed available in the market is often poor quality in respect of germination, vigor and varieties purity. Hence, a huge quantity of seed is required to import with the expense of hard-earned foreign currency. There is a scope to produce onion seed as intercrop with sugarcane under paired rows planting systems. Through utilization of the vacant space between the two paired rows cane the production of onion seed may be increased and thus the dependency on import will be reduced.

Paired rows 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. Growing double intercrops under paired rows system increased the productivity by 31.20% compared to the single intercrop under single row system (Alam, 1999). In view of this consideration an experiment was designed to find out the performance of seed onion crop with sugarcane as first and mungbean as second intercrop in paired rows sugarcane under farmers' condition in mill zones in high Ganges river flood plain soil.

MATERIALS AND METHODS

The experiment was conducted at farmers field at Horian in Rajshahi during the year of 2014-2015 cropping season under irrigated condition. The site represents High Ganges River flood plain under Agro-ecological Zone 11 with medium high land of typical sandy loam soil having pH 7.6. Popular onion variety Taherpuri used as first intercrop followed by mungbean (*Vigna radiata*) variety BINA mung-5 as second intercrop were grown with Sugarcane variety Isd 39. Taherpuri onion variety was selected for its high storability and pungency characters which helps to grow second intercrop. The experiment was laid out in a randomized complete block design with four replications. The unit plot size was 8 m × 8 m with the following treatment combination.

- T_1 = Paired rows cane (PRC) only
 T_2 = T_1 + Onion (3 lines) – mungbean
 T_3 = T_1 + Onion (4 lines) – mungbean
 T_4 = T_1 + Onion (5 lines) – mungbean
 T_5 = T_1 + Onion (6 lines) – mungbean

Two budded sugarcane setts were planted in each plot on 25 October 2014 at 60 cm apart keeping a wide distance of 140 cm in between two paired rows of cane with intercrop namely, onion 3 lines (T_2), onion 4 lines (T_3), onion 5 lines (T_4) and onion 6 lines (T_5) were planted in between cane rows. Fertilizers were applied as per recommended dose (BARC, 2012). All TSP, Gypsum, one third of MoP and Urea were applied in trench and mixed with soil prior to planting of setts. The second dose of 1/3 rd Urea and 1/3 rd MoP were applied as first top dressing at 120 days after planting (DAP). Final top dressing of rest urea and MoP were applied in the month of April. Recommended dose of fertilizer was also applied for first and 2nd intercrops. Four times of irrigation and two times of weeding were practiced in the experimental field. Recommended cultural practices and plant protection measures were taken as required. The intercrops were harvested at mature stages of each crop. Data in respect of seed yield of intercrops and yield contributing parameters of sugarcane i.e. germination, tiller, millable cane, tons cane per unit area, brix% were recorded. Besides expenses incurred and returns received from different crops 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. Land equivalent ratio was calculated by the ratio of land required by the pure (sole) crop to produced the same yield as that of intercrop. Economic analysis was done to assess the income earned from different crops. After harvest, data were collected, compiled, analyzed and interpreted following the standard statistical procedures (MSTATC).

RESULTS AND DISCUSSION

Millable Cane

There was significant differences were observed in millable cane production among the treatments (Table 1). The maximum millable cane $91.00 \times 10^3 \text{ ha}^{-1}$ was recorded from the T_4 (PRC+ Onion 5 lines - Mungbean) treatment combination and the minimum $78.50 \times 10^3 \text{ ha}^{-1}$ was from the T_2 (PRC+Onion 3 lines - Mungbean) combination (Table 1). The variation of millable cane production among the treatments due to the soil and agronomic management factors. Nakar *et al.* (1990) reported that the beneficial effects of intercropping potato, lentil and onion on millable cane stalk production.

Yield of Cane

There was significant differences on cane yield among the treatments combination (Table 1), which indicated that intercropping of onion as seed crop with sugarcane had effect on cane yield. The highest cane yield 107.02 t ha^{-1} was obtained in the treatment (T_5) where 6 lines onion were grown as first intercrop and mungbean was grown as second intercrop. On the other hand, the lowest cane yield 90.30 t ha^{-1} was recorded from T_1 treatment where only sugarcane was produced. This result agreed with Islam *et al.* (2013) who reported that intercropping of winter crops with sugarcane had positive effect on cane yield.

Table1. Millable cane, cane yield, brix%, intercrop yield, equivalent cane yield, adjusted cane yield and land equivalent ratio of different treatments during the cropping season of 2014-15

Treatments	Millable cane (10^3 ha^{-1})	Cane yield (t ha^{-1})	Intercrop Yield (t ha^{-1})		Equivalent cane yield (t ha^{-1})	Adjusted cane yield (t ha^{-1})	Land Equivalent Ratio (LER)
			1 st	2 nd			
T ₁ =PRC only	90.69	90.30	-	-	-	90.30	1.00
T ₂ = T ₁ + Onion 3 line-MB*	78.50	98.97	0.20	0.20	149.09	248.06	2.50
T ₃ = T ₁ + Onion 4 line-MB	87.11	103.80	0.24	0.19	178.00	281.80	2.72
T ₄ = T ₁ + Onion 5 line-MB	91.00	104.16	0.28	0.18	206.90	311.06	2.99
T ₅ = T ₁ + Onion 6 line-MB	90.02	107.02	0.33	0.19	243.27	350.29	3.27
LSD (0.05)	11.40	13.29	0.06	NS	-	-	-

Price: Sugarcane 2.75 Tk/kg, Onion seed 2000 00 Tk/kg, MB*- Mungbean 50.00 Tk/kg

Intercrop yield

Significant difference was observed on yield of the first intercrops onion in different treatments combination. Among the different treatments combination, the highest yield of onion seed 0.33 t ha^{-1} obtained from the treatment T₅ (PRC + Onion 6 lines – Mungbean) and the lowest yield of onion seed 0.20 t ha^{-1} obtained from the treatment T₂ (PRC + Onion 3 lines – Mungbean). Yield of second intercrop mungbean was not significant in different treatment combinations. Apparently the height mungbean yield of 0.20 t ha^{-1} was obtained from T₂ treatment combinations where onion was in three lines and the lowest yield was obtained in T₄ where onion was in five lines. Similar result was also reported by Alam *et al.* (2009) and Islam *et al.* (2013) in case of tomato potato intercropped with paired rows sugarcane.

Equivalent cane yield, Adjusted Cane Yield and Land Equivalent Ratio

Sugarcane equivalent yield was calculated on sale proceeds received from intercrop equivalent sugarcane price. Equivalent cane yield varied due to the varied yield of intercrop. Table 1 revealed that T₅ (PRC + Onion 6 lines – Mungbean) gave the highest equivalent yield 243.27 t ha^{-1} and the lowest equivalent yield was 149.09 t ha^{-1} observed in T₂ (PRC + Onion 3 lines – Mungbean). 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 350.29 t ha^{-1} was recorded from T₅ treatment (PRC + Onion 6 lines – Mungbean) and the lowest total adjusted cane yield of 90.30 t ha^{-1} was obtained from the T₁ (paired rows cane only). The highest land equivalent ratio was recorded from T₅ treatment (PRC + Onion 6 lines – Mungbean) and the lowest land equivalent ratio 1.00 was recorded from the T₁ (paired rows cane only). The total adjusted cane yield and land equivalent ratio indicated that all

the intercropped plots with different onion line – mungbean combinations were superior to the sole cane plot. Islam *et al.* (2013) reported that the highest adjusted cane yield was recorded from paired rows sugarcane with potato-mungbean combination.

Brix % Cane

No significant effect on brix % of cane was recorded among the various different lines of onion – mungbean combinations (Fig.1.). The highest brix % of cane (20.10) was obtained from treatment T₄ (PRC + onion 5 lines-Mungbean) followed by treatment T₃ (PRC + onion 4 lines-Mungbean), treatment T₅ (PRC + onion 6 lines-Mungbean) and treatment T₁ (PRC only). The lowest brix % (19.56) of cane was recorded from treatment T₂ (PRC + onion 3 lines – Mungbean). Intercropping different lines of onion with sugarcane under paired rows system did not show any adverse effect on brix % cane as the intercrops were harvested before the start of grand growth period of cane. . Similar result was also reported by Alam *et al.* (2009) and Islam *et al.* (2013) in case of tomato potato intercropped with paired rows sugarcane.

Table 2. Gross margin and benefit cost ratio (BCR) of different cane intercrop combinations at Horian of Rajshahi during the cropping season of 2014-15

Treatments	Total Production cost (Tk. ha ⁻¹)	Gross return (Tk. ha ⁻¹)	Gross Margin (Tk. ha ⁻¹)	BCR
T ₁ =PRC only	1,50,000	2,48,325.80	98,325.8	1.66
T ₂ = T ₁ + Onion 3 lines-MB	1,81,500	6,82,165.00	5,00,665	3.76
T ₃ = T ₁ + Onion 4 lines-MB	1,83,750	7,74,950.00	5,91,200	4.22
T ₄ = T ₁ + Onion 5 lines-MB	1,86,000	8,55,415.00	6,69,415	4.60
T ₅ = T ₁ + Onion 6 lines-MB	1,88,250	9,63,629.75	7,75,379.75	5.12

Price: Sugarcane 2.75 Tk/kg, Onion seed 2000.00 Tk/kg, Mungbean 50.00 Tk/kg

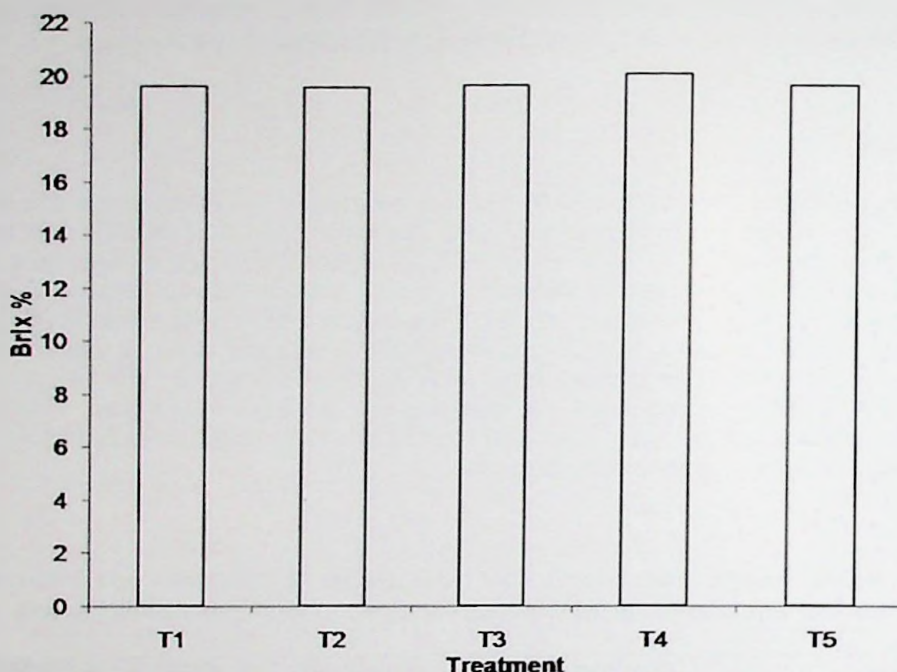


Figure 1. Brix % Cane as affected by different combination of onion seed crop followed by mungbean

Economics

Economic analysis of the experiment under different treatment combinations is shown in Table 2. Among the treatment combinations the highest total production cost 1,88,25 Tk. ha⁻¹ was obtained from treatment T₅ followed by 1,86,000 Tk. ha⁻¹ from treatment T₄ while the lowest cost Tk. 1,50,000 for treatment T₁ paired rows cane only. The total production costs varied due to variation of cost of production of first intercrop.

The highest gross return (9,63,629.75 Tk. ha⁻¹) was obtained from T₅ treatment followed by T₄ (9,63,629.75 Tk. ha⁻¹) and the lowest (2,48,325.80 Tk. ha⁻¹) was from the sole sugarcane crop (T₁). In case of gross margin the highest gross margin (7,75,379.75 Tk. ha⁻¹) was obtained from T₅ followed by T₄ (6,69,415 Tk. ha⁻¹) while the lowest (98,325.8 Tk. ha⁻¹) was recorded from T₁. The highest benefit cost ratio (BCR) of 5.12 was recorded from the T₅ and the lowest BCR (1.66) was from T₁. The results of the present experiment suggested that for higher economic return intercropping onion seed crop 6 lines sequentially followed by mungbean with paired rows planted sugarcane recommended as the most profitable intercropping package for sustainable sugarcane farming in the Rajshahi area.

REFERENCES

- Alam, M.J. 1999. Studies on sequential intercropping in sugarcane under single and paired row planting systems. MS Thesis, Department of Agronomy. Bangladesh Agricultural University, Mymensingh. p.43.
- Alam, M.J.; Hossain, M.S.; Islam, A.K.M.R.; Rahman, M.K. and Kabir, M.L. 2009. Performance of Tomato-Mungbean sequential intercropping in Paired Row. Transplanting. *Bangladesh J. Sugarcane*, **31**: 31-37.
- BARC (Bangladesh Agricultural Research Council). 2012. Fertilizer Recommendation Guide. Pub. by BARC, New Airport Road, Farmgate, Dhaka, 1207.pp. 97-136.
- BBS (Bangladesh Bureau of Statistics). 2012. Year Book of Agricultural Statistics of Bangladesh, Ministry of Planning, Government of the People's Republic of Bangladesh. Dhaka, Bangladesh.
- Evan, A.C. 1960. Studies on intercropping maize or sorghum with groundnuts. *East Africa Agricultural Journal*, **27**: 1-10.
- FAO (Food and Agriculture Organization). 2011. Economic and Social Department, The Statistical Division. p.567.
- FAO (Food and Agriculture Organization). 2012. Production year book, The United Nations, Rome, **36**. 178-179
- FAOSTAT (Food and Agriculture Organization Statistics). 2012. Economic and Social Department, The Statistical Division. p.567
- Grihines, B.C. 1963. Intercropping and alternate row cropping cotton and maize. *East Africa Agricultural Journal*, **28**(3): 161-163.
- Hashem, A. and Moniruzzam, A.F.M. 1986. Effect of intercropping maize with cowpea at varying plant population levels. *Bangladesh Agro. J.* **2**(1): 15-25.
- Islam, N. ; Shohel. A.T.M. ; Alam, M.N. ; Ahmed, M.M. ; Rahman. M.H. and Akhter.S. 2013. Performance of Paired Row Sugarcane with some High valued crops as First and Mungbean as Second Intercrop under Madhupur Tracts soils. *Bangladesh J. Sugarcane*, **33-34**: 61-66.
- Krishna, A. and Raikhelkar, S.V. 1997. Crop complementary and competition in maize (*Zea mays*) when intercropping with different legumes. *Indian J. Agric. Sci.* **67**: 291-294.
- Nakar, J.T. 1990. Scope and prospects for intercropping of potato with sugarcane in Maharashtra state, India. *Field Crop Res.* **25**: 123-132.
- Rahman, M.K.; Pal, S.K. and Choudhary, A.T.M. 2005. Improved techniques and technologies of sugarcane production. Bangladesh Sugarcane Research Institute, Ishurdi, Pabna.
- Yadava, R.L. 1991. Sugarcane production technology-constraints and potentialities. Oxford and IBH Publishing Co. Pvt. Ltd. 66 Janpath, New Delhi, 110001.