Productivity and Profitability of Flowers-Mungbean Sequential Intercropping with Sugarcane

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ABSTRACT

A field experiment was conducted during 2014-2015 cropping season at Regional Sugarcrop Research Station, Thakurgaon to study the productivity and profitability of flowers-mungbean sequential intercropping with sugarcane. Flower is the symbol of love and it considered as the food of mind. Use of flowers has been increasing day by day. For profitable sugarcane cultivation, flower as first intercrop-summer mungbean as second intercrop in paired row planting system may be one of the best approaches. Three different flowers namely, African American marigold as Boro Gada/Genda, French marigold Gada/Genda and Gladiolus as first intercrops followed by mungbean as second intercrop were grown in paired rows sugarcane with sugarcane variety Isd 37. The highest number of tiller (236.78 × 10^3 ha^{-1}), millable cane (83.11 × 10^{-3} ha^{-1}), brix per cent (20.83) and cane yield were obtained in T1 (paired row cane only) treatment. The highest mungbean yield (0.57 t ha^{-1}) as second intercrop was found in T3 (PRC + French marigold-mungbean) treatment. The highest total production cost (Tk. 186566.44 ha^{-1}) was in T4 (PRC + Gladiolus-mungbean) treatment. The highest equivalent cane yield (80.85 t ha^{-1}) of intercrop and total adjusted cane yield (156.05 t ha^{-1}) were found in T4 (PRC + Gladiolus-mungbean). The highest gross return (Tk. 4,19,774.50 ha^{-1}), gross margin (Tk. 2,33,208.06 ha^{-1}) and benefit cost ratio (2.25) were found in T4 (PRC + Gladiolus-mungbean) treatment and the lowest values were in T1 where sole cane was produced. Therefore, growing of Gladiolus-mungbean, African American marigold-mungbean and French marigold–mungbean with sugarcane might be profitable and remunerative package technologies for the sugarcane farmers in Old Himalayan Piedmont Plain soils under AEZ 1 in Northern region of Bangladesh.

Keywords: Productivity, sugarcane, intercropping, flower, mungbean, yield

INTRODUCTION

Sugarcane is one of the most important food-cum-cash-cum-industrial crops in Bangladesh. It is a principle cash crop especially in north-western and south-western low rainfall belt of Bangladesh. Sugarcane is the raw materials of sugar industry and the main source of white sugar and jaggary (locally called goor). Sugarcane is a long duration crop takes about 12-14 months from transplanting to harvesting which decreases economic return to the farmers. To get higher economic return from sugarcane cultivation, appropriate intercropping practices with short duration crops will be the alternative way to increase total yield, interim and higher monetary return. It helps diversification of crop production as per need of farmers (Singh *et al.*,1986). Sugarcane crop is usually planted at wider row spacing, and takes about 3-5 months for canopy development. Because of wider row spacing and slow canopy development, it allows to grow short duration winter

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crops in the early stage as intercrops in the vacant spaces between two cane rows. Sugarcane growers can take this advantage with cultivation of various short duration crops like potato, onion bulb, onion seed, garlic, pulses, vegetables etc as first intercrop and some summer crops like red/stem amaranth, mungbean, sesame, green manuring crops etc as second intercrop to get interim return. Since small sugarcane growers can not wait for such a long time to get financial return from sole crop of sugarcane. As sugarcane crop is cultivated in high and medium high land and there is a higher demand for cereals and vegetables, it would better to cultivate various crops with sugarcane as intercrops. Such intercropping practices not only provide interim return to farmers but also help to meet the ever increasing demand of vegetables and pulses for rising population. Economic benefits of first and second intercrop production in sugarcane with paired row planting system have been reported elsewhere (Alam *et al.*, 2014 and Islam *et al.*, 2009). In Bangladesh, marigold flower (locally called Gada/Genda ful) has a vital role in the folk culture, like the marriage ceremony and Bosonto Utshob (spring celebration). In the part of marriage ceremony in 'Gaye Holud' or 'wedding – shower' ceremony people can't think without marigold flower. Marigold or Gada/Genda ful plants have many uses as medicinal purposes. Marigold or Gada/Genda ful plant is used to treat a number of skin diseases including eczema, juvenile acne and skin ulcerations. In Bangladesh marigold or Gada/Genda ful plant's leaves sap is used to stop bleeding. Most of the households in Bangladesh have marigold or Gada/Genda ful plants in their garden or in flower pot. Gladiolus is the second most popular flower in the world, especially from the commercial point of view. Gladiolus has great economic value and wide market in Bangladesh. However, the yield, quality of flower, and year round supply has not been achieved up to the mark. Therefore, the present study was undertaken to examine the productivity and profitability of sugarcane with three flowers as first followed by mungbean as second intercrop.

MATERIALS AND METHODS

An experiment was conducted at experimental field of Regional Sugarcrop Research Station, Thakurgaon, Bangladesh during 2014-2015 cropping season under irrigated condition. The site represents the Old Himalayan Piedmont Plain Soils (Agro Ecological Zone 1) with medium high land of typical sandy loam soil having pH 5.5. Three selected flowers namely, African American marigold as Boro Gada/Genda, French marigold as Gada/Genda and Gladiolus as first intercrops followed by summer mungbean as second intercrop were grown with paired row sugarcane where sugarcane variety was Isd 37. The experiment was laid out in a randomized complete block design with five replications where the unit plot size was 8m × 6m. The treatments were as T_1 : Paired row cane (PRC) only, T_2 : PRC + African American marigold – mungbean (plate 1), T3: PRC + French marigold – mungbean (Plate 2), T_4: PRC + Gladiolus – mungbean (Plate 3). Previously raised two budded soil bed sugarcane settlings were transplanted in each plot during on 15th November, 2014 with 30 cm interplant spacing in 60 cm apart paired rows and spacing between two paired rows was 140 cm. For sugarcane Urea, TSP, MoP, Gypsum and $ZnSo_4$ were applied @ 358, 275, 240, 188 and 7 kg ha^{-1}, respectively. Full quantity of TSP, Gypsum, $ZnSo_4$ and one-third of MoP were applied in trench and mixed with soil prior to transplanting of settlings. One-third of urea was applied 21 days after transplanting (DAT). The second dose of Urea (1/3rd) and MoP (1/3rd) were applied as first top dressing at 90 DAT and final top dressing with the rest amount of Urea and MoP were applied at 150 DAT. Recommended doses of fertilizers were applied for the intercrops separately.

For African American marigold Urea, TSP and MoP @ 120, 117 and 108 kg ha^{-1} , for French marigold Urea, TSP and MoP @ 176, 180 and 144 kg ha^{-1} for Gladiolus Urea, TSP and MoP @ 195, 170 and 136 kg ha^{-1}, and for summer mungbean Urea, TSP, MoP and gypsum @ 20, 40, 25 and 30 kg ha^{-1}, respectively were applied. Before first intercrop planting decomposed cowdung @ 5.0 t ha^{-1}, was applied in bed in between two paired rows. For sugarcane to control insect pests, chlorpyrifos (trade name: regent 3 GR) was applied @ 33 kg ha^{-1}, during planting and carbofuran (trade name: furadan 5G) was applied @ 40 kg ha^{-1}, in two times in the month of March and May 2015. Intercultural operations like irrigation, gap filling, weeding, mulching, earthing-up, tying and cross tying were done in time. Cultural operations for intercrops were also done as and when required. Data on yield and various yield contributing parameters of cane and intercrops were collected. The yields of first and second intercrops were recorded at harvest. Tiller population of sugarcane was recorded at 150 DAT. Stalk height, stalk diameter, millable cane and cane yield were recorded at harvest. The data were analyzed following standard statistical procedures (Gomez and Gomez, 1984) by the Microsoft excel where applicable. The analyses of variance for different parameters were performed and mean differences were compared by Duncan's Multiple Range Test (DMRT) using a computer operated program named MSTAT-C (Russel, 1986).

Equivalent cane yield of intercrops (ECY)

Yield of intercrop was converted into equivalent cane yield on the basis of prevailing market price and calculated by the following formula (Lal and Ray, 1976, Verma and Modgal, 1983 and Bandyopadhyay, 1984).

$$\text{Equivalent cane yield of intercrops (ECY)} = \frac{(Yif \times Pf) + (Yim \times Pm)}{PS}$$

where,
Yif = Number of flowers as intercrop
Yim = Yield of mungbean as intercrop (t ha^{-1})
Pf = Selling price of flower
Pm = Selling price of mungbean
PS = Selling price of sugarcane

Adjusted cane yield (ACY):
Adjusted cane yield was calculated by adding equivalent cane yield of intercrops with the yield of sugarcane.

Adjusted cane yield (ACY) = ECY + SY
where,
ECY = Equivalent cane yield of intercrops
SY = Sugarcane yield

Benefit cost ratio (BCR):
Benefit cost ratio was calculated by the following formula (CIMMYT 1988)

$$BCR = \frac{\text{Gross return (Tk.)}}{\text{Total production cost (Tk.)}}$$

RESULTS AND DISCUSSION

Tiller production

Tiller is an important factor of sugarcane production. Flowers - mungbean sequential intercropping with paired row sugarcane affected significantly on tiller production. The highest number of tillers of 236.78 × 10^{-3} ha^{-1} was obtained in T_1 (paired row cane only) treatment followed by 214.38 × 10^{-3} ha^{-1} in T_4 (PRC + Gladiolus - mungbean) treatment and the lowest of 19945.45 × 10^{-3} ha^{-1} in T_2 (PRC + African American marigold - mungbean) treatment (Table 1). The intercropped plots were produced varied numbers of tiller but they were statistically similar. It might be due to intra and inter specific competition (Islam and Islam, 2016). The results are in agreement with the findings of Ahmed *et al.* (2007) when sugarcane was intercropped with potato followed by mungbean.

Millable cane production

Millable cane production was affected significantly by Flowers - mungbean intercropping in sequence with sugarcane The highest number of millable cane (83.11 × 10^{-3} ha^{-1}) was produced in T_1 (Paired row cane only) treatment followed by T_2 treatment which was statistically similar with T_1 and the lowest (73.88 × 10^{-3} ha^{-1}) was in T_3 (PRC + French marigold - mungbean) treatment (Table 1). Present findings are in agreement with the findings of Alam *et al.* (2009) when sugarcane was intercropped with tomato followed by mungbean.

Stalk height and diameter

No significant effect of intercropping on stalk height was observed among the treatments and stalk height was ranged from 3.08 to 3.23 m. As like as stalk height same effect was obtained in stalk diameter which it was ranged from 2.15 to 2.37cm (Fig. 1).

Brix (%)

Brix readings have been shown in Table 1. Significantly the highest brix (%) (20.83) was obtained in T_1 (PRC only) treatment followed by T_4 (PRC + Gladiolus – mungbean) (20.16%) and the lowest (19.83%) in T_3 (PRC + French marigold – mungbean) treatment. The present results agreed to the earlier report Rashid et al. (2000) and Kashem *et al.*(2009).

Yield of cane

Intercropping Flowers-mungbean with sugarcane had no significant effect on cane yield. It indicated that some flowers as first and mungbean as second intercrop production with sugarcane had no adverse effect on cane yield. The highest cane yield of 79.22 t ha^{-1} was harvested in T_1 (Paired row cane only) treatment followed by 75.20 t ha^{-1} in T_4 (PRC + Gladiolus – mungbean) while the lowest cane yield of 72.43 t ha^{-1} was obtained

in T_2 (PRC + African American marigold - mungbean) treatment (Table 2). The results are in agreements with Alam *et al.* (2009), Islam *et al.* (2009) and Hossain *et al.* (2007).

Intercrop yield

Significant effects on yields of Flowers-mungbean combinations were observed where yields of different intercrops were found satisfactorily. The highest monetary return was achieved in T_4 (PRC + Gladiolus -mungbean) treatment and the lowest in T_3 (PRC + French marigold - mungbean) treatment (Tabel 2). The highest mungbean yield (0.57 t ha^{-1}) was obtained in T_3 (PRC + French marigold - mungbean) treatment and the lowest (0.35 t ha^{-1}) in T_4 (PRC + Gladiolus -mungbean) treatment (Tabel 2).

Equivalent cane yield of intercrops

The highest equivalent cane yield of intercrop (80.85 t ha^{-1}) was found in T_4 (PRC + Gladiolus -mungbean) treatment and the lowest equivalent cane yield (40.92 t ha^{-1}) in T_3 (PRC + French marigold - mungbean) treatments (Table 2). The results are in agreement with Alam *et al.* (2009) and Alam *et al.* (2014).

Total adjusted cane yield

Total adjusted cane yields have been shown in table 2. The highest total adjusted cane yield (156.05 t ha^{-1}) was obtained in T_4 (PRC + Gladiolus - mungbean) treatment followed by T_2 (PRC + African American marigold - mungbean) and the lowest of 97.22 t ha^{-1} in T_1 (Paired row cane only) treatment.

Table 1. Effect of flowers-mungbean intercropping on tiller and millable cane production and brix (%) of sugarcane

Treatments	Tillers ($\times 10^3 ha^{-1}$)	Millable cane ($\times 10^3 ha^{-1}$)	Brix (%)
T_1 : Paired row cane (PRC) only	236.78a	83.11a	20.83a
T_2 : PRC + African American marigold - Mungbean	199.45b	76.86ab	19.87b
T_3 : PRC + French marigold - Mungbean	204.11b	73.88b	19.83b
T_4 : PRC + Gladiolus -Mungbean	214.38b	79.11b	20.16ab
CV (%)	7.36	5.39	2.64

Table 2. Cane yield, intercrops yield, equivalent cane yields of intercrops and total adjusted cane yield as affected by some flowers-mungbean intercropping in paired row sugarcane

Treatments	Cane yield (tha^{-1})	Number of flowers as 1st intercrops	Mungbn yield as 2nd intercrop ($t\ ha^{-1}$)	Equivalent cane yield of intercrops ($t\ ha^{-1}$)	Total adjusted cane yield ($t\ ha^{-1}$)
T_1 : PRC only	79.22	-	-	-	79.22
T_2 : PRC + African American marigold - Mungbean	72.43	1,00,000	0.40	44.60	117.03
T_3 : PRC + French marigold - Mungbean	72.94	1,36,000	0.57	40.92	113.86
T_4 : PRC + Gladiolus -Mungbean	75.20	40,000	0.35	80.85	156.05
CV (%)	9.47	-	-	-	-
LSD (0.05)	10.81	-	-	-	-

Price of crops: Sugarcane: 2690 TK t^{-1}, African American marigold: 1.0 Tk $pice^{-1}$, French marigold: 0.60 Tk $pice^{-1}$, Gladiolus: 5.0 Tk $pice^{-1}$ and Mungbean: 50,000 Tk t^{-1}

Economics of intercropping

The economic analysis of the experiment under different treatments is shown in Table 3. Among the different treatments the highest total production cost of 1,86,566.44 Tk. ha^{-1} was in T_4 (PRC + Gladiolus – mungbean) treatment followed by 1,46,423.58 Tk. ha^{-1} in T_2 (PRC + African American marigold – mungbean) and the lowest of 1,26,846.30 Tk.ha^{-1} in T_1 (Paired row cane only). The highest gross return of 419774.50 Tk. ha^{-1} was achieved in T_4 (PRC + Gladiolus –mungbean) treatment and the lowest of 2,13,101.80 Tk. ha^{-1} in T_1 (Paired row cane only) treatment. The highest gross margin of 2,33,208.06 Tk. ha^{-1} was obtained in T_4 (PRC + Gladiolus –mungbean) treatment and the lowest gross margin of 86,255.50 Tk. ha^{-1} in T_1 (Paired row cane only) treatment. The highest benefit cost ratio (BCR) of 2.25 was found in T_4 (PRC + Gladiolus –mungbean) treatment and the lowest of 1.68 was found in T_1 (Paired row cane only) treatment. The results are in agreement with the findings of Hossain *et al.* (2015) when sugarcane was intercropped by some winter crops followed by mungbean.

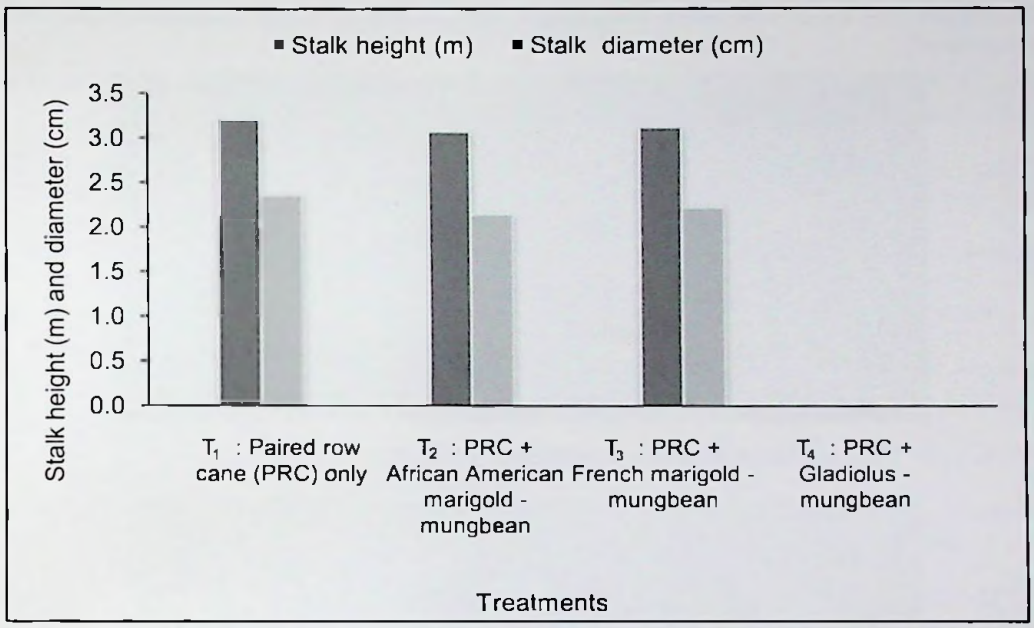

Figure 1. Effects of flowers-mungbean sequential intercropping with sugarcane on stalk height (m) and diameter (cm)

Table 3. Total production cost, gross return, gross margin and benefit cost ratio of some flowers-mungbean sequential intercropping in paired row planting system of sugarcane

Treatments	Total production cost (Tk. ha^{-1})	Gross return (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	Benefit cost ratio (BCR)
T_1 : PRC only	1,26,846.30	2,13,101.80	86,255.50	1.68
T_2 : PRC + African American marigold - Mungbean	1,46,423.58	3,14,810.70	1,68,387.12	2.15
T_3 : PRC + French marigold - Mungbean	1,43,123.08	3,06,283.40	1,63,160.32	2.14
T_4 : PRC + Gladiolus - Mungbean	1,86,566.44	4,19,774.50	2,33,208.06	2.25

The overall results showed that growing of Gladiolus-mungbean followed by African American marigold-mungbean and French marigold–mungbean would be profitable and it could be remunerative package technology for the sugarcane farmers in

Old Himalayan Piedmont Plain soils under AEZ 1 especially in Northern region of Bangladesh.

PRC + African American marigold - mungbean

PRC + French marigold- mungbean

PRC + Gladiolus – mungbean

Figure 2. Field view of flower – mungbean intercrop

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