



## Assessing the suitability of different intercrops with sugarcane in Dinajpur region of Bangladesh

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### ABSTRACT

*Sugarcane is one of Bangladesh's most important cash cum industrial crops and is the primary source of sugar and goor (jaggery) production in Bangladesh. However, due to land crisis, long duration of crop production and less economic benefit, sugarcane acreage is reducing yearly. Therefore, it is high time to think about how the sugarcane farmers will be benefited. Intercropping with sugarcane generally gives the farmers higher profitability than sole sugarcane cropping. In this study, five different intercropping practices (sugarcane + potato, sugarcane + lentil, sugarcane + cabbage, sugarcane + cauliflower and sugarcane + onion) were compared with the sole sugarcane cropping system for two consecutive years, 2019-20 and 2020-21 in Dinajpur region of Bangladesh. The yield and yield contributing characters, production cost, gross return, net return and BCR were calculated to find the best options among these six treatments. Potato and onion intercropped with sugarcane cv. BSRI Akh 46 is found to be highly profitable and is recommended in the Dinajpur district of Bangladesh (AEZ 1) in comparison to other intercropping practices in both the cropping seasons.*

**Key Words:** Intercrop, Sugarcane, Potato, Onion and Profitable.

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### I. Introduction

Sugarcane (*Saccharum officinarum* L.) is a leading cash cum industrial crop of Bangladesh. More than 70% of the world's sugar is produced from sugarcane (Islam and Islam, 2018, Khatun and Islam, 2018). Sugarcane is an important raw material for the country's sugar and goor (jaggery) industries. It occupies about 2.05 percent of the arable land in Bangladesh and ranks fourth among the country's

major field crops. Over 0.60 million farm families rely on the sugar industry for their livelihood (Khatun and Islam, 2018). The sugarcane acreage has decreased in recent years and the farmers are shifting to other short-duration, high-value crops. Relative longer duration of crop cultivation, high cost of production, and less net income from sole sugarcane cultivation are some significant causes of acute depletion of sugarcane acreage. Therefore, options that ensure high economic returns are the crying need of the sugarcane farmers. Intercrops are generally considered a profitable option that ensures high economic returns (Rashid et al., 2020).

Intercropping is the technique of cultivating two or more crops in close proximity to one another, it frequently boosts yields, production efficiency, complementary use of resources, weed control, nutritional quality, economic returns, and lowers soil erosion and pollution. Yield benefits of intercropping increase with time relative to sole cropping or monocultures. Intercropping boosts soil fertility and increases soil organic matter, total nitrogen, and macro aggregates when comparing intercropped and monoculture soils. More widespread use of intercropping could boost crop yield and its long-term viability (Lian et al., 2018; Wang et al., 2021).

Initially, sugarcane grows slowly, and it takes approximately three to five months to establish a full canopy. Short-duration crops, such as mustard, lentil, potato, onion, tomato, garlic, chickpea, and coriander, can be cultivated as intercrops between two rows of sugarcane at an early growth stage (Islam and Islam, 2018). Intercropping with sugarcane may be a viable choice for increasing the yield of short-duration crops such as vegetables, oilseeds, pulses, corn, and spices. Wider spacing (90 to 100 cm) between rows, a long duration for germination from the buds (35–45 days), an initial moderate growth rate, and the capacity to compensate for losses by the intercrops provide numerous options for intercropping in sugarcane (Singh 2021). In this study, different intercrops have grown with a newly released variety BSRI Akh 46 to investigate the effects of different intercrops on the overall farm productivity at Kaharole Upazila of Dinajpur district (AEZ 1).

## II. Materials and Methods

The experiment was conducted at the farmer's field of Kaharole Upazila of Dinajpur district of Bangladesh (Old Himalayan Piedmont Plain, AEZ 1) during the 2019-20 and 2020-2021 cropping seasons. Sugarcane variety BSRI Akh 46 was planted as the sole crop along with five different intercrops following Randomized Complete Block Design with three replications.

Sugarcane Plantation was done with two budded setts in Mid-November of 2019 and 2020. The intercrops were sown or transplanted in the ridges and sugarcane in the furrows (trenches) at the time of cane plantation. Standard plot size of 8m × 8m was selected for the sugarcane plantation, where row-to-row distance was maintained at one meter. The following six treatments were included in this study: i) BSRI Akh 46 (SC), ii) SC + Potato (cv. Diamant), iii) SC + Lentil (cv. BARI Masur-7), iv) SC + Cabbage (cv. K-K Cross), v) SC + Cauliflower (cv. Snow White), vi) SC + Onion (cv. BARI Piyaz-3).

Fertilizers were applied following the recommended rate at AEZ 1 @  $N_{165}P_{55}K_{120}S_{30}Mg_{20}Zn_{2.5}$  Kg/ha for sugarcane (FRG, 2012). Additional fertilizers were applied for the intercrops. Potato, lentil, cabbage, cauliflower and onion received additional  $N_{70}P_{15}K_{45}S_5Mg_2$  kg/ha,  $N_7P_{10}K_9S_5$  kg/ha,  $N_{80}P_{28}K_{35}S_{22}$  kg/ha,  $N_{75}P_{25}K_{50}S_{10}$  kg/ha,  $N_{45}P_{22}K_{45}S_{16}$  kg/ha fertilizers; respectively. One-third of N and K and all the other fertilizers are applied to the experimental plots and mixed thoroughly with the soil before making the trenches for the sugarcane plantation. The remaining N and K of the intercrops' fertilizer are applied to the soil in equal two splits after 30 and 50 days after sowing (DAS) or transplanting the intercrops. Only in the case of lentil intercropping, the remaining N and K applied in one split at 30 DAS. The rest recommended doses of N and K of sugarcane recommended fertilizers are applied to the trenches in equal two splits. The first split was top-dressed at 120 days after planting (DAP) at tillering stage and 180 DAP after completion of the tillering. All the other necessary intercultural operations like irrigation and pest control were done properly and when required.

Data were collected at the crop's growth stages (germination, vegetative, and harvesting). Data were analyzed statistically using the statistics 10 software package, and the mean differences were compared by the least significant difference (LSD) at a 5% level of probability.

### III. Results and Discussion

#### Intercrops effect on sugarcane yield

**Germination:** The germination of sugarcane sett was influenced by different intercrop practices in both the cropping seasons. The highest sett germination 44.12 % and 42.52 % was found from the sole sugarcane (SC) cropping practice in 2020-21 and 2019-20 cropping seasons, respectively. Conversely, the lowest sett germination, 38.90% and 40.50% were recorded from treatment SC + Cauliflower in both cropping seasons ([Table 01](#)).

**Millable cane:** In both seasons, the highest number of millable cane was found from the sole sugarcane cropping practice 103,840 and 103,790. The lowest was observed from SC + Cauliflower 86,460 in 2019-20 and 90,920 from SC + Lentil practice in 2020-21 season ([Table 01](#)). Therefore, the intercrop and the cultural practice may have an impact on the number of millable cane.

**Table 01. Effect of different intercrops on germination, millable cane and yield of sugarcane variety BSRI Akh 46 in 2019-20 and 2020-21 cropping season**

Intercropping practice	Germination (%)		Millable Cane ('000/ha)		Yield (ton/ha)	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
SC	42.52 a	44.12 a	103.79 a	103.84 a	84.39 a	86.25 a
SC + Potato	42.06 ab	43.82 a	97.37 ab	93.75 bc	76.24 b	77.87 b
SC + Lentil	40.22 a-c	41.94 ab	91.38 b-d	90.92 c	74.64 b	76.21 b
SC + Cabbage	39.13 c	42.03 ab	87.54 cd	93.01 bc	72.59 b	75.24 b
SC + Cauliflower	38.90 c	40.50 b	86.46 d	91.69 c	71.29 b	73.96 b
SC + Onion	39.83 bc	41.47 b	94.37 bc	98.40 ab	77.57 ab	80.25 ab
LSD	2.63	2.34	7.78	6.21	7.20	6.60

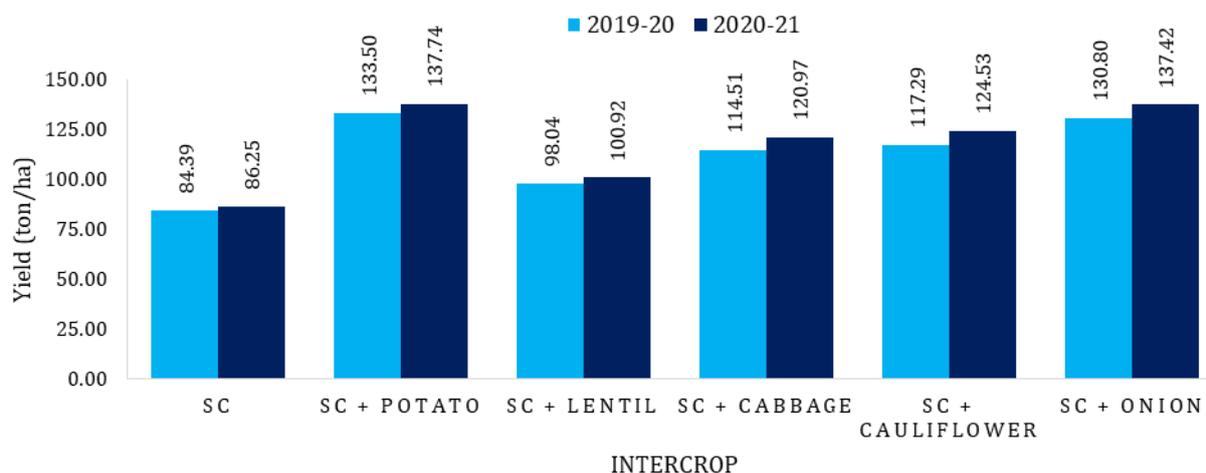
SC= Sugarcane, SC + Potato= Sugarcane-potato intercropping, SC + Lentil= Sugarcane-lentil intercropping, SC + Cabbage= Sugarcane-cabbage intercropping, SC + Cauliflower= Sugarcane-cauliflower intercropping, SC+ Onion= Sugarcane-onion intercropping. Means separated by lower case letter in each column are significantly different among intercropping at  $p \leq 0.05$ .

**Cane yield:** Cane yield was also influenced by different intercropping practices. The highest yield was recorded from sole sugarcane practice in both seasons 86.25 ton/ha and 84.39 ton/ha in 2020-21 and 2019-20, respectively. Whereas the lowest was recorded from SC + Cauliflower cropping practice 71.29 ton/ha and 73.96 ton/ha in 2019-20 and 2020-21; respectively ([Table 01](#)). [Rehman et al. \(2014\)](#) also observed highest cane yield in sole sugarcane cultivation practice. In an extensive review, [Geetha et al. \(2015\)](#) also stated sugarcane yield is reduced when intercrops are cultivated, whereas, [Alam et al. \(2020\)](#) and [Singh et al. \(2020\)](#) reported lowest cane yield in sole sugarcane cultivation practice. The planting material, planting practice and the time of plantation may have significant impact on the cane yield with intercropping practices. [Alam et al. \(2020\)](#) planted sugarcane in paired row system in September with the soil bed settlings. Therefore, the sugarcane crop got larger space and time than our experiment, which influences the cane yield and causes higher yield than ours. [Singh et al. \(2020\)](#) observed higher cane yield with intercrops which may be due to ratoon cane having an established root system and sugarcane having almost no competition during the early establishment of the cropping season in terms of nutrients and water.

**Adjusted cane yield:** Adjusted cane yield is an important parameter for determining the total yield potentials of cane and intercrop. [Figure 01](#) revealed that the adjusted cane yield in the 2020-21 cropping season was higher than in 2019-20. The highest total adjusted cane yield of 137.74  $\text{tha}^{-1}$  and 137.42 were found from Sugarcane + Potato and Sugarcane + Onion in the year 2020-21, while the lowest adjusted cane yield of 84.39  $\text{tha}^{-1}$  and 86.25  $\text{tha}^{-1}$  was found from sole sugarcane (SC) in both years. The overall adjusted cane yield with potato and onion as intercrops were found to be higher in comparison with other intercrops. [Alam et al. \(2020\)](#) also reported higher adjusted cane yield with intercropping practice than in sole sugarcane cultivation.

#### Intercrops effect on sugarcane economics

**Production cost:** Overall production cost increased in 2020-21 than in 2019-20 cropping season due to raise in labour and seed costs. The highest production cost was observed in SC + Potato cropping season (3,40,000 Tk) in 2019-20 cropping season and in 2020-21 Sc + Onion was found to be the most expensive (3,53,625 Tk) intercropping practice. In both cropping seasons, the sole sugarcane cropping system was the least expensive cropping practice ([Table 02](#)).



**Figure 01. Adjusted cane yield (ton/ha) of different intercrops**

**Gross return:** In 2020-21 cropping season, the overall gross return was higher than in 2019-20. The highest gross return (4,82,095 Tk and 4,67,240 Tk) was recorded from the SC + Potato intercropping practice in both seasons, followed by SC + Onion intercropping practice (4,80,975 Tk and 4,57,795 Tk). The least Gross return was recorded from the sole sugarcane practice (2,95,377 Tk and 3,01,875 Tk) (Table 02).

**Benefit cost ration (BCR):** All the intercropping practices were profitable, ranging from 1.29 to 1.38. The result of this experiment is in line with Singh et al. (2020). The sole sugarcane cultivation was the least profitable (1.29) compared to other intercropping practices in 2020-21. Geetha et al. (2019) also reported that sole sugarcane cultivation is least profitable. In 2019-20, SC + Cauliflower intercropping practice was the least profitable among the treatments. On the contrary, the highest benefit cost ratio (BCR) of 1.38 and 1.37 was recorded from SC + Potato intercropping practice in 2020-21 and 2019-20, respectively (Table 02).

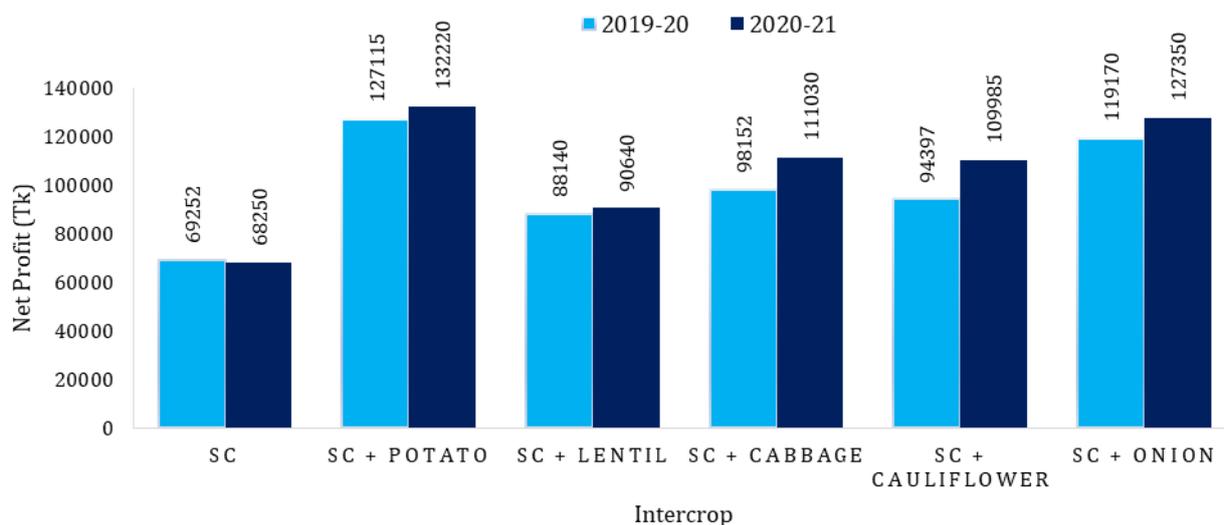
**Table 02. Economics of different intercrop practices with sugarcane variety BSRI Akh 46 in 2019-20 and 2020-21 cropping season**

Intercropping practice	Production Cost (Tk)		Gross return (Tk)		BCR	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
SC	226,125	233,625	295,377	301,875	1.31	1.29
SC + Potato	340,125	349,875	467,240	482,095	1.37	1.38
SC + Lentil	255,000	262,575	343,140	353,215	1.35	1.35
SC + Cabbage	302,625	312,375	400,777	423,405	1.32	1.36
SC + Cauliflower	316,125	325,875	410,522	435,860	1.30	1.34
SC + Onion	338,625	353,625	457,795	480,975	1.35	1.36

SC= Sugarcane, SC + Potato= Sugarcane-potato intercropping, SC + Lentil= Sugarcane-lentil intercropping, SC + Cabbage= Sugarcane-cabbage intercropping, SC + Cauliflower= Sugarcane-cauliflower intercropping, SC+ Onion= Sugarcane-onion intercropping.

### Net Return

The net profit was higher in the cropping season 2020-21 than in 2019-20, with exceptions in sole cropping practice. The highest net profit (1,27,150 Tk and 1,32,220 Tk) was found from the SC + Potato intercropping practice in both the seasons 2019-20 and 2020-21, respectively, followed by SC + Onion cropping practice (1,19,170 Tk and 1,27,350 Tk). The least net profit (68,250 Tk and 69,252 Tk) was recorded from the sugarcane sole cropping practice (SC) in 2020-21 and 2019-20 cropping seasons, respectively (Figure 02).



**Figure 02. Net profit (Tk) of different intercroppings**

#### IV. Conclusion

The present study revealed that intercropping with sugarcane is a good practice regarding total farm productivity, net return and benefit-cost ratio. Moreover, the potato and onion intercropping practice with sugarcane was more profitable than the other intercropping practices. Therefore, potato and onion are recommended as intercrop with sugarcane for Dinajpur district (AEZ 1).

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