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INTERCROPPING OF CAULIFLOWER WITH SWEET GOURD AT DIFFERENT PLANT POPULATION

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Abstract

Intercropping is a popular way to boost crop yield and profitability by maximizing the use of natural and agricultural resources. A study was carried out to establish crop arrangement for sweet gourd and cauliflower intercropping systems. The experiment was carried out during two consecutive years of 2019-20 and 2020-21 to identify the appropriate cauliflower population for intercropping with sweet gourd for increased production and profitability. Seven treatments viz. T_1= Sole Sweet gourd (2 m × 2 m), T_2=100% Sweet gourd + 3 rows cauliflower 37.5% (60 cm × 50 cm), T_3=100% Sweet gourd + 3 rows cauliflower 23% (60 cm × 80 cm), T_4=100% Sweet gourd + 4 rows cauliflower 50% (50 cm × 50 cm), T_5=100% Sweet gourd + 4 rows cauliflower 31% (50 cm × 80 cm), T_6=100% Sweet gourd + 5 rows cauliflower 31% (40 cm × 100 cm) and T_7=Sole Cauliflower (50 cm × 50 cm). The maximum sweet gourd equivalent yield (SGEY) 34.83 t ha^{-1} was obtained from T_4. The maximum gross return (Tk. 278640 ha^{-1}), gross margin (Tk. 180384 ha^{-1}), BCR (2.85) and LER (1.40) were also observed from T_4 and the lowest in sole cauliflower (T_7). The overall results revealed that among the intercrop combinations 100% Sweet gourd+4 rows cauliflower 50% (50 cm × 50 cm) (T_4) followed by 100% Sweet gourd + 3 rows cauliflower 37.5% (60 cm × 50 cm) (T_2) combinations could be profitable combinations for cauliflower with sweet gourd intercropping system.

Introduction

Intercropping is a popular strategy used in modern agricultural systems to increase productivity and yield stability while minimizing resource use and impact on environmental (Alizadeh *et al*., 2010). Intercropping advantages include increased output or production, more effective use of water, land, nutrients and labor and a significant decline in insect, disease, and weed problems (Awal *et al.*, 2006). Vegetables are grown on 2.63 percent of cultivable land in Bangladesh (BBS, 2015). Malnutrition is unlikely to arise if people consume an adequate amount of vegetables. In Bangladesh, the average daily vegetable consumption per capita is 56 grams, but the recommended daily intake is 250 grams (FAO, 2015).

In Bangladesh, the output of vegetables, such as sweet gourd (*Cucurbita maxima*), is steadily growing. It occupied 42636 acres of land in Bangladesh, with a total production of 186112 metric tons (BBS, 2016). Sweet gourd is often cultivated with greater row spacing and inter row space may be efficiently and effectively utilized for maximum production. As a result, farmers may easily intercrop short duration crop with sweet gourd at an early stage of growth. As a result, farmers may easily plant a short-term crop as an intercrop with sweet gourd at an early stage of growth. Cauliflower (*Brassica oleracea* L. var. *botrytis*) is the most widely produced vegetable in the country in terms of crop cultivated area of 47749 acres of land with a total production of 268484 metric tons (BBS, 2016). Cauliflower is a high-value, short-duration (60-70 days) rabi crop which gives early return by suitable appropriate crops, population density, and planting geometry for component crops might result in improved intercrop productivity (Santalla *et al.,* 2001). However, there is little literature on population density and planting geometry of intercropping cauliflower with a wide spacing sweet gourd crop. As such, the experiment was carried out to determine the cauliflower population for intercropping with sweet gourd for increased production and economic return.

Materials and Methods

Experimental site description

The experiment was carried out at the Agricultural Research Station, Bangladesh Agricultural Research Institute (BARI), Rajbari, Dinajpur, during two consecutive *rabi* season of 2019-20 and 2020-21. The experimental site was located at Latitude: 25°38'7.3" N and Longitude: 88°39'5.65" E at an elevation of 39 m above mean sea level and it belongs to the Agro-ecological Zone-1 (Old Himalayan piedmont plain) in Bangladesh (FRG, 2018). The initial soil sample (0-15 cm) was tested at the Soil Resources Development Institute (SRDI), Dinajpur, Bangladesh (Table 1). The soil at the experimental area was medium-high and clay loam texture having 2.19% organic matter, pH 6.05, 0.10% total nitrogen (N), 0.13meq 100 g^{-1} soil potassium (K), 47.20μg/g phosphorus (P), 8.12μg/g sulfur (S),0.91μg/g zinc (Zn) and 0.33 μg/g boron (B). During crop growth period, monthly weather data on temperature (maximum and minimum) and rainfall (mm) were recorded in both the years (Figure 1). The average maximum and minimum temperature in the crop season (November to April) were 27.1°C and 15.04°C, 28.53°C and 15.33°C during in 2019-20 and in 2020-21, respectively. During the crop season, the experimental site's weather is hot sub-humid with total rainfall of 129 mm in 2019-20 and 25 mm in 2020-21.

Experimental design and treatments

The experiment was conducted in a randomized complete block design with three replications to test the effectiveness of sweet gourd and cauliflower intercropping. The unit plot size was 16 m^2 (4 m × 4 m). Sweet gourd was the major crop while cauliflower as an intercrop. The experiment consisted of seven treatments viz., T_1=Sole Sweet gourd (2 m × 2 m), T_2=100% Sweet gourd+3 rows cauliflower 37.5% (60 cm × 50 cm), T_3=100% Sweet gourd+3 rows cauliflower 23% (60 cm × 80 cm), T_4=100% Sweet gourd+4 rows cauliflower 50% (50 cm × 50 cm), T_5=100% Sweet gourd+4 rows cauliflower 31% (50 cm × 80 cm), T_6=100% Sweet gourd +5 rows cauliflower 31% (40 cm × 100 cm) and T_7=Sole Cauliflower (50 cm × 50 cm).

Crop husbandry

Sweet gourd var. BARI Misti kumra-2, and cauliflower var. BARI fulcopy-1 was used in this experiment. Twenty-five days old seedlings of cauliflower were transplanted on 12 November, 2019 and 10 November, 2020. Fifteen days old seedlings of sweet gourd were transplanted on 27 November, 2019 and 25 November, 2020. The recommended doses of fertilizers such as, 75-36-60-21-2-1.4 kg N, P, K, S, Zn and B ha^{-1} and 90-45-75-18-2.4-1.4 kg N, P, K, S, Zn and B ha^{-1} for sole crop of sweet gourd and cauliflower, respectively were applied separately in sole crop. In intercropping sweet gourd was fertilized with 90-55-85-22-2.4-2 kg N, P, K, S, Zn and B ha^{-1} in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid, respectively (FRG, 2018). Cowdung @ 5 t ha^{-1} were applied as a blanket dose during final land preparation. All of organic manure and chemical fertilizers were applied at final land preparation, while urea and MoP were top dressed in three equal splits at 15, 30 and 50 DAT of cauliflower. The full amount of P, K, S, Zn and B and cowdung were applied in pit 7 days before transplanting of sweet gourd seedlings. N was be applied around the plant as side dressing at 15, 30, 50 and 70 DAT under moist soil condition and mixed thoroughly with the soil. Four irrigations were provided after applying of urea. Fungicide Indofil M @ 0.2% was sprayed at every 15 days interval to control powdery mildew on sweet gourd. Cucurbit fruit fly was controlled in the sweet gourd field using pheromone traps (Cue lure) @100 traps per hectare from 30 days after planting through sweet gourd harvesting. Harvesting of sweet gourds began at 105 DAT and was repeated four times in both years. Cauliflower was harvested three times (74, 80 and 84 DAT) in two consecutive years.

Assessment of economic indices

The economic analysis took total variable costs (TVC), gross returns (GR), gross margin (GM) and BCR into account. The variable costs included human labour, machinery rent and production inputs (seed, fertilizer, pesticides). Gross returns were determined by multiplying crop economic yield by price at harvesting time. The difference between GR and TVC was used to determine the gross margin (GM) (GM= GR-TVC). Various competition functions such as sweet gourd equivalent yield (SGEY), land equivalent ratio (LER), replacement value of intercropping (RVI), monetary advantage index (MAI), Aggressivity Index (A), Relative crowding coefficient (RCC), System productivity index (SPI), competitive ratio (CR) and benefit-cost ratio was calculated to determine the benefit and effect of competition among the treatments. The competition functions were calculated by using the following formula:

Sweet gourd equivalent yield

The Sweet gourd equivalent yield (SGEY) was calculated using the following formula:

$$\text{Sweet gourd equivalent yield (SGEY)} = Yisg + \frac{Yic \times Pc}{Psg}$$

Where, Yisg= Yield of intercrop sweet gourd, Yic= Yield of intercrop cauliflower, Psg = Price of sweet gourd, Pc= Price of cauliflower

Land equivalent ratio

The following formula was used to compute the land equivalent ratio (LER)

$$LER = (Yisg/Yssg) + (Yic/Ysc)$$

Here, Yisg = intercrop yield of sweet gourd; Yssg = sole crop yield of sweet gourd; Yic = intercrop yield of cauliflower; Ysc= sole crop yield of cauliflower (Ofori and Stern, 1987 and Willy, 1979).

Replacement value of intercropping

Replacement value of intercropping (RVI) and monetary advantage index (MAI) was calculated according to Moseley (1994) and Ali and Mishra (1993), respectively.

$$RVI = \frac{Yisg \times Psg + Yic \times Pc}{Yssg \times Psg - Cssg}$$

Where, Yisg & Yic are the yield of intercrops, Psg & Pc are the respective market price of these crops, Yssg & Cssg are the yield and input cost of the main crop in sole stand.

Monetary advantage index

The Monetary Advantage Index was computed in the method stated by (Ghosh, 2004).

MAI = Value of combined intercrop yield×(LER-1)/LER.

Aggressivity Index

The following formula was used to determine the Aggressivity Index (A)

$$A_{\text{sweet gourd}} = \frac{Yisg}{Yssg \times Zssg} - \frac{Yic}{Ysc \times Zcp} \quad \text{and} \quad A_{\text{cauliflower}} = \frac{Yic}{Ysc \times Zcp} - \frac{Yisg}{Yssg \times Zsgp}$$

where, Yisg & Yic are the yield of intercrops, Yssg&Ysc are yield of sole crops and Zsgp and Zcp are the proportion of sweet gourd and cauliflower, respectively (Banik *et al.,* 2006 and Khan *et al.,* 2018).

Relative crowding coefficient: The following formula was used to compute the relative crowding coefficient (RCC): $RCC_{\text{sweet gourd}} \times RCC_{\text{cauliflower}}$, Where,

$$RCC_{\text{sweet gourd}} = \frac{Yisg \times Zcp}{(Yssg - Yisg) \times Zsgp} \quad \text{and} \quad RCC_{\text{cauliflower}} = \frac{Yic \times Zsgp}{(Ysc - Yic) \times Zcp}$$

where Zsgp and Zcp are the proportion of sweet gourd and cauliflower in the mixture, respectively.

System productivity index

The following formula was used to estimate the System productivity index (SPI)

$$\text{System productivity index (SPI)}= \frac{Yssg}{Ysc} \times (Yic+Yisg)$$

where, Yssg & Ysc are yield of sole crops and Yisg&Yic are the yield of intercrops (Willey, 1979).

Competitive ratio

The competitive ratio (CR) among various treatment combinations was estimated usingthe formula below (Willey and Rao, 1980):

$$CR_{\text{sweet gourd}} = \frac{LER_{\text{sweet gourd}}}{LER_{\text{ cauliflower}}} \times \frac{Zcp}{Zsgp} \quad \text{and} \quad CR_{\text{cauliflower}} = \frac{LER_{\text{cauliflower}}}{LER_{\text{ sweet gourd}}} \times \frac{Zsgp}{Zcp}$$

Where, Zsgp and Zcp are the proportion of sweet gourd and cauliflower in the mixture, respectively.

Benefit-cost ratio

The benefit-cost ratio (BCR) was carried out using the current price of sweet gourd and cauliflower in the local market at the time of harvesting. Benefit-cost ratio (BCR)was calculated using the following formula (Hossain *et al.*, 2015):

$$BCR = \frac{\text{Gross return}}{\text{Total variable cost}}$$

Data recorded and Statistical analysis

Data on fruit plant^{-1}, fruit length, fruit diameter, Single fruit weight, and fruit yield of sweet gourd were collected from selected 4 plants from each plot. Data on plant height, curd diameter, individual curd weight and yield were recorded from ten randomly selected plants from each plot. Yields of both the crops were taken from whole plot. Collected data of all crops were analyzed (combined analysis) statistically by using R software packages (R Core Team, 2016) and mean differences for each character were compared by Least Significant Difference (LSD) at 5% level of significance (Gomez and Gomez, 1984).

Table 1. Initial status of soils of the experimental plots at ARS, BARI, Rajbari, Dinajpur

Soil characteristic	pH	Organic Matter (%)	Total N (%)	Available P (µg/g)	K (meq/100g)	S (µg/g)	Zn (µg/g)	B (µg/g)
Initial	6.05	2.19	0.10	47.20	0.13	8.12	0.91	0.33
Status	SA	M	L	VH	L	L	M	M

SA=Slightly Acidic, M=Medium, L=Low, VH=Very High

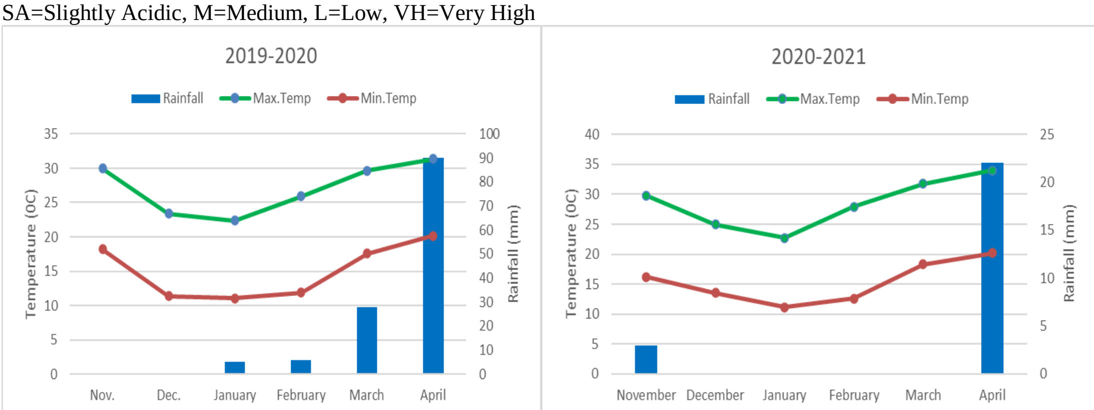

Fig. 1. Monthly average maximum temperature, minimum temperature and rainfall during the cropping period in both years of experimentation.

Results and Discussion

Yield and yield contributing characters of sweet gourd: The number of fruit plant^{-1}, fruit length, fruit diameter, single fruit weight and fruit yield of sweet gourd were affected significantly by intercrop combination and sole cropping (Table 2). The highest number of fruit plant^{-1} (4.01) was obtained from sole sweet gourd (T_1) and the lowest 3.02 from T_4 treatment. Sole sweet gourd (T_1) gave the highest fruit length (26.25 cm) and diameter (20.88 cm) which was followed by T_3 treatment (25.82 cm length and 20.08 cm diameter) and the lowest fruit length (24.77 cm) and diameter (19.62 cm) were measured in T_4. The maximum single fruit weight (2.81 kg) was obtained from sole sweet gourd (T_1) which was followed by T_3 (2.60 kg) and the lowest (2.18 kg) in T_4. The highest fruit yield 25.20 t ha^{-1} was obtained from sole sweet gourd (T_1) and the lowest (20.01 t ha^{-1}) in T_4. The yield of sweet gourd in different treatments varied from 19.98 to 25.20 t ha^{-1} where 12.34 to 21 % yield reduction was recorded in intercropping systems than sole sweet gourd (T_1). Intercropping systems resulted in a 15.51% lower yield than sole cropping systems (Islam *et al.*, 2013). In the present study, highest fruit plant^{-1}, fruit length, fruit diameter, single fruit weight and finally fruit yield of sweet gourd were obtained from sole cropping and among the intercropping where a less number of cauliflower population (Table 2).

Table 2. Yield contributing characters and fruit yield of sweet gourd in sweet gourd- cauliflower intercropping system (Pooled of 2 years)

Treatments	Fruits plant^{-1} (no.)	Fruit length (cm)	Fruit diameter (cm)	Single fruit weight (kg)	Fruit yield (t ha^{-1})
T_1	4.01	26.25	20.88	2.81	25.20
T_2	3.42	24.37	19.37	2.21	20.01
T_3	3.50	25.82	20.08	2.60	22.09
T_4	3.02	24.77	19.62	2.18	19.98
T_5	3.48	25.04	19.90	2.30	20.34
T_6	3.32	24.79	19.65	2.20	20.15
LSD $_{(0.05)}$	0.34	1.91	1.46	0.55	2.23
CV (%)	6.53	1.55	3.40	8.70	6.42

T_1=Sole Sweet gourd (2m × 2m), T_2=100% Sweet gourd+3 rows cauliflower 37.5% (60 cm × 50 cm), T_3=100% Sweet gourd+3 rows cauliflower 23% (60 cm × 80 cm), T_4=100% Sweet gourd+4 rows cauliflower 50% (50 cm × 50 cm), T_5=100% Sweet gourd+4 rows cauliflower 31% (50 cm × 80 cm) and T_6=100% Sweet gourd+5 rows cauliflower 31% (40 cm × 100 cm)

These results were consistent with the findings of Hossain *et al.* (2015) who reported that the yield of sweet gourd in different treatments varied from 12.16 to 17.12 t ha^{-1} where 1.34 to 28.93% yield reduction was recorded in intercropping system than sole sweet gourd. This was due to competition of cauliflower population with sweet gourd and shading effect of cauliflower, which seriously affected the vegetative growth of the seedlings resulting drastically reduced the fruit yield of sweet gourd. The results were in agreement with the findings of Alom *et al.* (2014).

Yield contributing characters and curd yield of Cauliflower: Yield contributing characters and curd yield of cauliflower were significantly influenced by the intercropped of different cauliflower population in sweet gourd (Table 3). The maximum plant height (52.66 cm), curd diameter (17.45 cm), individual curd weight (1073.33 g) were recorded in (T_3) which was followed by T_5 treatments. while the lowest (889.89 g) in sole cauliflower (T_7). However, the highest cauliflower yield 32.50 t ha^{-1} was recorded in sole cauliflower (T_7). On the other land, the highest cauliflower yield under intercrop situation was recorded in T_4 (19.80 t ha^{-1}) which was followed by T_2 (15.82 t ha^{-1}). The lowest cauliflower yield 11.12 t ha^{-1} was recorded from T_3 in two consecutive years. In the present study, the planting arrangement significantly influenced cauliflower yield in different intercropping combinations were due to the different plant population of cauliflower in per unit area (Table 3). Increase of cauliflower population with sweet gourd, increased the curd yield of cauliflower. The cauliflower yield varied in different treatment might be due to the variation of number of cauliflowers of that treatment.

Table 3. Yield contributing characters and curd yield of cauliflower in sweet gourd- cauliflower intercropping system (Pooled of 2 years)

Treatments	Plant height (cm)	Curd diameter (cm)	Individual curd weight (g)	Curd yield (t ha^{-1})
T_2	48.33	16.50	900.20	15.82
T_3	52.66	17.45	1073.33	11.12
T_4	45.00	16.02	920.33	19.80
T_5	50.00	17.11	990.16	14.17
T_6	49.00	16.76	950.09	15.01
T_7	43.67	15.86	889.89	32.50
LSD $_{(0.05)}$	4.76	1.58	92.26	1.91
CV (%)	5.44	4.85	6.04	4.32

T_2=100% Sweet gourd+3 rows cauliflower 37.5% (60 cm × 50 cm), T_3=100% Sweet gourd+3 rows cauliflower 23% (60 cm × 80 cm), T_4=100% Sweet gourd+4 rows cauliflower 50% (50 cm×50 cm), T_5=100% Sweet gourd+4 rows cauliflower 31% (50 cm × 80 cm) and T_6=100% Sweet gourd+5 rows cauliflower 31% (40 cm × 100 cm) and T_7=Sole Cauliflower (50 cm × 50 cm)

Sweet gourd equivalent yield (SGEY): Sweet gourd equivalent yield gave higher (30.43-34.83 t ha^{-1}) in all the intercropping system over sole crop of sweet gourd (25.20 t ha^{-1}) (Table 4). The highest sweet gourd equivalent yield (34.83 t ha^{-1}) was recorded from sweet gourd (100 %) + 4 rows of cauliflower (50 %) (T_4) which covered the yield advantages of 21 and 40 % over their respective sole crops. This yield advantage might be attributed to the combined yield of both crops. Intercropping has been shown to produce greater biomass and as a result, make better use of land and available resources than sole cropping. Similar results were observed by Rahman *et al.* (2015), Hossain *et al.* (2015) and Khanum *et al.* (2019).

Economic performance: Intercropping cauliflower with sweet gourd resulted in a higher gross return and gross margin than growing cauliflower as a single crop. 100% Sweet gourd + 4 rows cauliflower 50% (50 cm × 50 cm) was obtained the maximum gross return Tk. 278640 ha^{-1} which gave additional benefit of Tk. 201600 ha^{-1} over sole sweet gourd and Tk. 195000 ha^{-1} over sole cauliflower (Table 4). Total cultivation cost was reduced in sole crop and higher in intercropping treatments due to the addition of component crop. Among the intercropping systems, 100% Sweet gourd+4 rows cauliflower 50% (50 cm × 50 cm) (T_4) obtained the highest benefit cost ratio of 2.85 which further indicated the superiority to T_4 over other treatments. These findings were consistent with those of Bharati *et al.* (2007) who found that sweet gourd intercropping had a greater net return than a single sweet gourd crop. These findings were consistent with those of Rahman *et al.* (2015), Hossain *et al.* (2015) and Khanum *et al.* (2019) who found that intercropping systems had a higher gross margin or net return than sole crops.

Table 4. Sweet gourd equivalent yield (SGEY) and economics of intercropping sweet gourd with cauliflower (Mean data of 2 years)

Treatments	SGEY (t ha^{-1})	Gross return (Tk. ha^{-1})	Total variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
T_1	25.20	201600	81805	119795	2.46
T_2	31.87	255000	96015	158985	2.66
T_3	30.43	243440	95500	147940	2.55
T_4	34.83	278640	98256	180384	2.85
T_5	30.96	247740	95640	152100	2.59
T_6	31.40	251260	95640	155620	2.63
T_7	24.37	195000	92500	102500	2.10

SG = Sweet gourd, SGEY= Sweet gourd equivalent yield, TVC = Total variable cost
Market price (Tk kg^{-1}): Sweet gourd 8/-, Cauliflower 6/-
T_1=Sole Sweet gourd (2m×2m), T_2=100% Sweet gourd+3 rows cauliflower 37.5% (60 cm × 50 cm), T_3=100% Sweet gourd+3 rows cauliflower 23% (60 cm × 80 cm), T_4=100% Sweet gourd+4 rows cauliflower 50% (50 cm × 50 cm),

T_5=100% Sweet gourd+4 rows cauliflower 31% (50 cm × 80 cm) and T_6=100% Sweet gourd+5 rows cauliflower 31% (40 cm × 100 cm) and T_7=Sole Cauliflower (50 cm × 50 cm)

Land equivalent ratio (LER): Based on a two-year average and regardless of planting combinations, the maximum LER value (1.40) was found in T_4 (100% Sweet gourd + 4 rows cauliflower 50% (60 cm × 50 cm) intercropping system against the minimum for T_3 (100% Sweet gourd + 3 rows cauliflower (60 cm × 80 cm) (1.21) indicating that the yield advantages ranged between 21-40%. In this study, the LER of sweet gourd and cauliflower intercropping was 1.32-1.42 (2019-2020) and 1.29-1.40 (2020-2021) respectively, demonstrating the clear advantage of intercropping. In this analysis, the LER values in all intercropping systems were greater than 1.0 (Table 5) indicating the yield benefit of intercropping over sweet gourd single cropping. The results were consistent with the observations of Seran and Brintha (2009).

System productivity index (SPI): The findings revealed that 100% sweet gourd + 4 rows cauliflower (60 cm × 50 cm) T_4 intercropping system showed the maximum SPI value (31.02) than other intercropping systems (Table 5). The system productivity index (SPI) assists in standardizing the yield of the secondary crop (cauliflower) in terms of the primary crop (sweet gourd), as well as identifying the crop combinations that most effectively used growth resources while maintaining consistent yields. (Tajudeen, 2010).

Replacement value of intercropping (RVI): The RVI values were in the range of 2.03 to 2.32. The RVI value for sole sweet gourd (T_1) was the lowest (1.68). The greatest RVI value (2.32) was found in T_4 (100% Sweet gourd + 4 rows cauliflower (60 cm × 50 cm) (Table 5), suggesting that this combination was more lucrative than sweet gourd alone and other intercropping treatments. It was found that about 50% more lucrative than sole sweet gourd crop was intercropping cauliflower with sweet gourd.

Monetary advantage index (MAI): The monetary advantage index (MAI) values were positive in all intercropping treatments (Table 5). The highest MAI (Tk. 79907 ha^{-1}) was received in T_4 (100% Sweet Gourd + 4 rows Cauliflower (60 cm × 50 cm) which implies that this combination was productive and financially beneficial due to higher LER value.

Table 5. Land equivalent ratio (LER), System Productivity Index (SPI), Replacement Value of Intercropping (RVI) and Monetary Advantage Index (MAI) of sweet gourd with cauliflower intercropping system (average of 2 years)

Treatments	LER values			SPI	RVI	MAI
	Sweet gourd	Cauliflower	Total			(Tk. ha^{-1})
T_1	1.00	-	1.00	-	1.68	-
T_2	0.79	0.48	1.28	27.94	2.12	55908
T_3	0.87	0.34	1.21	25.90	2.03	43692
T_4	0.79	0.60	1.40	31.02	2.32	79907
T_5	0.80	0.43	1.24	26.91	2.06	48454
T_6	0.79	0.46	1.26	27.42	2.09	52076
T_7	-	1.00	1.00	-	-	-

T_1=Sole Sweet gourd (2m × 2m), T_2=100% Sweet gourd+3 rows cauliflower 37.5% (60 cm × 50 cm), T_3=100% Sweet gourd+3 rows cauliflower 23% (60 cm × 80 cm), T_4=100% Sweet gourd+4 rows cauliflower 50% (50 cm × 50 cm), T_5=100% Sweet gourd+4 rows cauliflower 31% (50 cm × 80 cm) and T_6=100% Sweet gourd+5 rows cauliflower 31% (40 cm × 100 cm) and T_7=Sole Cauliflower (50 cm × 50 cm)

Competitive ratio (CR): The competitive ratio values showed difference between the intercropping treatments suggesting the differential competitive potential of the component crop to be affected by the intercrops of cauliflower (Table 6). Cauliflower had a higher CR value (range: 1.30-2.56) than sweet gourd (range: 0.39-0.76), suggesting that cauliflower was the excellent competitor relative to sweet gourd. As a result, 100% Sweet Gourd + 3 rows Cauliflower (60 cm × 80 cm) (T_2) intercropping system with higher CR discrepancy (2.17) showed differentials in the competitiveness of the component crops. However, 100% Sweet Gourd + 4 rows of cauliflower (50 cm × 50 cm) (T_4)

intercropping system with a lower CR discrepancy (0.54) showed quite meaningful competition between component crops. The findings revealed that equal competition across component crops with a minimal CR allowed for more efficient use of growth resources, resulting in increased intercropping efficiency and production. These results are consistent with the observations of Islam *et al*. (2016).

Relative crowding coefficient (RCC): The relative crowding coefficient (RCC) of sweet gourd and cauliflower was substantially higher than unity, indicating higher non-competitive interference than competitive interference. i.e., yield benefits were received in intercropping treatments where T_4 treatment was the maximum (5.94). In all treatments, the intercropped sweet gourd had greater relative crowding coefficient values, that seems to be, more aggressive than the intercropped cauliflower (Table 5).

Table 6. Competitive ratio (CR) of sweet gourd and cauliflower in sweet gourd-cauliflower intercropping system (average 2 years)

Treatments	Competitive ratio (CR)			Relative Crowding Coefficient (RCC)		
	Sweet gourd	Cauliflower	Differences	Sweet gourd	Cauliflower	Product
T_1	-	-	-	-	-	-
T_2	0.61	1.63	1.02	1.45	2.53	3.67
T_3	0.39	2.56	2.17	1.63	2.25	3.66
T_4	0.76	1.30	0.54	1.91	3.11	5.94
T_5	0.54	1.85	1.31	1.29	2.49	3.21
T_6	0.57	1.73	1.16	1.23	2.76	3.39
T_7	-		-	-	-	-

T_1=Sole Sweet gourd (2m × 2m), T_2=100% Sweet gourd+3 rows cauliflower 37.5% (60 cm × 50 cm), T_3=100% Sweet gourd+3 rows cauliflower 23% (60 cm × 80 cm), T_4=100% Sweet gourd+4 rows cauliflower 50% (50 cm × 50 cm), T_5=100% Sweet gourd+4 rows cauliflower 31% (50 cm × 80 cm) and T_6=100% Sweet gourd+5 rows cauliflower 31% (40 cm × 100 cm) and T_7=Sole Cauliflower (50 cm × 50 cm)

Conclusion

Intercropping not only enhances productivity and system sustainability but also enhances farmer's income, employment and reduces risks against climatic aberrations and changes. Sweet gourd 100% (2m × 2m) + 4 rows cauliflower 50% (50 cm × 50 cm) combinations could be productive and profitable for cauliflower intercropping with sweet gourd.

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