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Intercropping of sweet gourd with brinjal at different plant population

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ABSTRACT

An Experiment was conducted at the Regional Agricultural Research Station, Jamalpur during rabi 2014-2015 and rabi 2015-2016 to find out the optimum plant population of brinjal in brinjal sweet gourd intercropping systems(s). Intercrop combinations were viz., sole brinjal (80 cm × 60 cm), sole sweet gourd (2 m × 2 m), 100% brinjal + 100% sweet gourd, 100% brinjal + 75% sweet gourd, 100% brinjal + 50% sweet gourd and 100% brinjal + 25% sweet gourd. The result indicated that the highest gross return (Tk. 599300/ha) and cost of cultivation (Tk. 140000/ha) were obtained from (2014-15 and 2015-16) 100% brinjal + 100% sweet gourd followed by 100% brinjal + 75% sweet gourd. The highest gross margin (Tk 462200/ha) and BCR (4.37) were obtained from (2014-15 and 2015-16) 100% brinjal + 75% sweet gourd followed by 100% brinjal + 100% sweet gourd. Brinjal equivalent yield of all intercropping was higher than sole cropping indicating higher productivity of intercropping. The highest brinjal equivalent yield (2014-15 and 2015-16) (29.97 and 28.65 t/ha) was found in followed by 100% brinjal + 100% sweet gourd followed by 100% brinjal + 75% sweet gourd. 100% brinjal + 75% sweet gourd and 100% brinjal + 100% sweet gourd would be agronomically feasible and economically profitable.

Introduction

Intercropping can be explained as a system where two or more crop species are grown in the same field at the same time during a growing season (Ofori & Stern, 1987). It is a simple and inexpensive strategy and has been recognized as a potentially befitted technology to increase crop production due to its substantial yield advantage than sole cropping (Awal et al., 2006). The purpose of intercropping is to generate beneficial biological interactions between the crops that will increase yields, more efficiently use available resources, reduce weed, insect and disease pressures and provide greater biological and economic stability (Vandermeer, 1989). It has been an essential production method in tropical regions for hundreds of years (Vandermeer, 1989) and to a lesser extent in temperate regions (Li et al., 2001). Intercropping was once common in temperate regions, but has been largely replaced in the last 150 years by monocultures (Francis, 1986).

Intercropping is the most common practice to the farmers of Bangladesh, because it increases the total productivity per unit area through the maximum utilization of land, labour and growth resources (Ahmed et al., 2006). The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources that would otherwise not be utilized by a single crop. Better intercrop production could be achieved with the choice of appropriate crops (Santalla et al., 2001), population density and planting geometry of component species/crops (Myaka, 1995). Greater productivity in intercropping system is commonly achieved by minimizing inter-specific competition and maximizing complementary use of growth resources (Islam, 2002). Among the intercropping practices sweet gourd onion intercropping is a common practice to the farmers of char areas (Talukder et al., 2015a). Sweet gourd is creeper type species that covers the maximum areas of land and good source of vitamin and also used as vegetable. On the other hand, onion is an herb type species and it has a preservative and medicine uses (Vohra et al., 1994). It has been compared cropping systems over three successive seasons (monsoon, winter and summer) in India (Prabhakar & Shukla, 1990). In another study, intercropping of pearl millet with cowpea or groundnut showed their significant effects on soil and crop productivity after either sole or intercrop system (Reddy et al., 1992).

To optimize the planting density, the seedling rate of each crop on the mixture has been suggested to adjust below the full rate to reduce competition from overcrowding. Thus, intercrops yield was found to be increased in the mixture stand compared to sole stand (Hiebsch et al., 1980). Plant architecture allows one intercrop to capture sunlight that would not otherwise be available to others. This phonological character is particularly important to growth and yield of cereals and legume crops (Reddy et al., 1981; Gardiner et al., 1981). Depending on the crops to be intercropped, competition for water, light and nutrients may results in lower yields. In this case changes in the spatial arrangement of the intercrops will reduce resource competition (Reddy et al., 1981). Due to decreasing cultivable land, some farmers of char

areas (river flood plain) under greater Mymensingh district (together five district) in Bangladesh have been practicing sweet gourd brinjal intercropping system instead of sole cropping. But the farmers do not follow proper ratio of components crop especially for sweet gourd. The inventory of main river char lands estimated their total area at 8,444 km^2 or almost 6% of Bangladesh (FAP 16/19, 1993a). As a result they deprived of from obtaining good yield from intercropping systems. Moreover, little information is available for planting geometry of components crops. Hence, this experiment was undertaken to find out the optimum plant population of sweet gourd for intercropping with brinjal for higher productivity and economic return. Intercropping also reduces pests attack because the non host crop act as physical barriers to the movement of insect pests (Sheehan, 1986). Intercropping practices garden pea with onion (Rahman et al., 2015), coriander with onion (Talukder et al. 2015b) and vegetables, pulse and oilseed crops with wheat (Talukder et al., 2016) are common practice to the farmers of char areas. Among the intercropping practices sweet gourd brinjal intercropping is a common practice to the farmers of char areas. Sweet gourd is creeper type species and covers the maximum areas of land. On the other hand, brinjal is a perennial shrub type species. These two crops combination could be suitable for char area but farmer of the char area does not maintain the optimum population of component species/crops, as a result they deprived of from obtaining good yield from intercropping systems. Sometime after harvest of brinjal sweet gourd farmers use brinjal tree for trailing other vine type plant. The experiment, therefore, needs to be undertaken to find out the optimum plant population of sweet gourd for intercropping with brinjal for higher productivity and economic return of the growers in the char areas.

Methods and materials

Experimental site

The experimental site was of medium high land belonging to the agro-ecological zone Old Brahmaputra Floodplain under Agro-Ecological Zone 9 (UNDP & FAO, 1988).

Cultivation procedure and experimental design

The experiment was conducted at the Regional Agricultural Research Station, Jamalpur during *rabi* 2014-2015 and 2015-2016. Design of the experiment was RCB with three replications having the unit plot size of 4.8 m × 3.6 m. BARI Begun 10 and BARI Mistikumra 2 were used as planting material in this experiment. Intercrop combinations included in the experiment were as T_1 = sole brinjal (80 cm × 60 cm), T_2 = sole sweet gourd (2 m × 2 m), T_3 = 100% brinjal + 100% sweet gourd, T_4 = 100% brinjal + 75% sweet gourd, T_5 = 100% brinjal + 50% sweet gourd, T_6 = 100% brinjal + 25% sweet gourd. Fertilizers were applied for sweet gourd at the rate of 40-18-50-12-0.7-0.6 g of N-P-K-S-Zn-B pit^{-1}, respectively while for brinjal fertilizers were applied at the rate of 80-24-60-10-1.0-0.3 kg of N-P-K-S-Zn-B ha^{-1} in the form of urea, triple super phosphate, muriate of potash, zypsum, zinc sulphate and boric acid, respectively (FRG, 2012). In case of sweet gourd, all the phosphorus, potassium, sulphur, zinc, boron and organic manure was applied in pit at 5-7 days prior to planting while full amount of nitrogenous fertilizer was applied in to two equal installment around the plant by side dressing at 30 and 50 days after planting and mixed with soil followed by irrigation. In case of brinjal, half cowdung were applied during the final land preparation. Remaining cow dung and full full phosphorus, sulphur, zinc and boron were applied in pit before a week of transplanting. Nitrogen and potassium will be applied in three equal splits 21, 35 and 50 days after transplanting. Direct sweet gourd seed sown in the pit on 26 November, 2014 and November 07, 2015 while 20 days after transplanting brinjal seedlings. Intercultural operations like watering, weeding and spraying insecticides were followed as and when necessary. One pheromone trap was used for every one decimal land to control of fruit fly of cucumber and Solanaceae group. Irrigation was applied two times during the whole crop growing period. Fruit yield for sweet gourd and yield of brinjal was calculated in t ha^{-1} considering the whole plot harvest area. Five plants of brinjal in each plot were selected randomly to collect data on yield components.

Data collection and statistical analysis

Collected data were analyzed statistically with the help of STAR software and mean separation was done as per LSD test at 5% level of significance. Economic analysis was performed considering the price of sweet gourd and brinjal prevailed at the harvesting period in the local market. Brinjal equivalent yield was also calculated considering the local market price at the harvesting time following the formula as stated by Aujeneyulu et al. (1982).

Results and discussion

Effect of brinjal-sweet gourd intercropping on the performance of brinjal

Yield and yield components like single fruit weight, no. of fruit $plant^{-1}$, fruit weight $plant^{-1}$, no. of branch $plant^{-1}$ differed significantly influenced by different intercropping system (Table 1). The highest single fruit weight was found in sole brinjal (80 cm × 60 cm) due to no intercrop competition for growth resources and the lowest single fruit weight was obtained from 100% brinjal + 50% sweet gourd (2014-15 and 2015-16) might be due to heavy branching of sweet gourd. 100% brinjal + 75% sweet gourd (2014-15) and sole brinjal 80 cm × 60 cm (2015-16) produced the highest no. of fruit $plant^{-1}$ (21.8 and 22.1) followed by sole brinjal and 100% brinjal + 25% sweet gourd. Fruit weight $plant^{-1}$ was the highest in sole brinjal (2014-15 and 2015-16) and it was statistically similar with 100% brinjal + 50% sweet gourd and 100% brinjal + 25% sweet gourd. The highest and statistically same yield was observed in (2014-15 and 2015-16) sole brinjal (80

cm × 60 cm) and 100% brinjal + 25% sweet gourd. Among the intercropping systems yield of brinjal was gradually decreased with the increasing of sweet gourd population.

Effect of brinjal-sweet gourd intercropping on the performance of sweet gourd

Yield and no. of fruits plant^{-1} differed significantly influenced by different intercropping system (Table 2). The highest and same no. of fruits/plant was observed in 100% brinjal + 50% sweet gourd (2014-15) and in 100% brinjal + 25% sweet gourd (2015-2016). Sole sweet gourd produced the highest fruit yield (29.93 and 28.01 both years) followed by 100% brinjal + 100% sweet gourd (both years). Fruit yield of sweet gourd was mainly influenced by the variation of sweet gourd population.

Table 1. Growth, yield and yield components of brinjal in brinjal-sweet gourd intercropping system during *rabi* 2014-2015 (Y1) and 2015-2016 (Y2).

Intercrop combinations	Plant height (cm)		Single fruit wt. (gm)		Fruits plant^{-1} (no.)		Fruit wt. plant^{-1} (t ha^{-1})		Branch plant^{-1}		Yield (t ha^{-1})	
	Y1	Y2	Y1	Y2	Y1	Y2	Y1	Y2	Y1	Y2	Y1	Y2
Sole brinjal (80 cm × 60 cm)	89.8	88.5	100.33	94.5	21.67	22.1	1.27	1.3	5.47	6.10	23.40	22.20
Sole sweet gourd (2 m × 2 m)	-	-	-	-	-	-	-	-	-	-	-	-
100% brinjal + 100% sweet gourd	92.87	92.01	79.67	75.3	17.13	16.2	1.16	1.01	4.27	4.8	17.83	16.01
100% brinjal + 75% sweet gourd	93.53	94.50	80.00	77.2	21.80	20.1	1.22	1.02	4.20	5.01	22.37	20.30
100% brinjal + 50% sweet gourd	93.40	93.97	72.33	69.1	20.60	18.8	1.26	1.05	4.67	4.99	19.37	17.90
100% brinjal + 25% sweet gourd	90.73	91.50	85.00	80.1	19.20	19.0	1.20	1.1	4.73	5.10	23.40	21.8
$LSD_{0.05}$	NS	NS	5.25	8.96	5.03	7.5	1.23	6.4	0.80	3.4	2.76	5.7
CV (%)	1.26	1.57	3.34	4.6	8.30	6.30	8.31	3.5	9.11	8.1	6.89	8.9

Table 2. Yield and yield components of sweet gourd in brinjal - sweet gourd intercropping system during *rabi* 2014-2015 (Y1) and 2015-2016 (Y2).

Intercrop combinations	No. of fruit plant^{-1}		Breadth of fruit (cm)		Length of fruit (cm)		Fruit yield (t ha^{-1})	
	Y1	Y2	Y1	Y2	Y1	Y2	Y1	Y2
Sole brinjal (80 cm × 60 cm)	-	-	-	-	-	-	-	-
Sole sweet gourd (2 m × 2 m)	5.2	6.0	9.27	7.8	12.0	13.0	29.93	28.01
100% brinjal + 100% sweet gourd	4.1	3.9	9.42	8.0	12.2	12.5	24.27	23.06
100% brinjal + 75% sweet gourd	3.0	3.2	8.87	6.9	12.7	12.1	15.17	16.70
100% brinjal + 50% sweet gourd	6.0	5.3	9.18	9.5	13.2	12.0	18.50	19.80
100% brinjal + 25% sweet gourd	6.0	5.9	8.69	6.6	12.2	10.9	8.16	8.50
CV (%)	9.6	7.9	7.61	8.9	9.9	10.6	9.99	11.23
$LSD_{0.05}$	12.3	10.7	-	-	-	-	12.3	10.58

Table 3. Economic performances of sweet gourd brinjal intercropping system during *rabi* 2014- 2015 (Y1) and 2015-2016 (Y2).

Intercrop combination	BEY (t ha^{-1})		Gross return (Tk ha^{-1})		Total cost of cultivation (Tk ha^{-1})		Gross margin (Tk ha^{-1})		BCR	
	Y1	Y2	Y1	Y2	Y1	Y2	Y1	Y2	Y1	Y2
Sole brinjal (80 cm × 60 cm)	23.4	22.2	468000	444000	120000	120000	348000	324000	3.9	3.7
Sole sweet gourd (2 m × 2 m)	15.0	14.0	299300	280000	80000	80000	219400	200000	3.7	3.5
100% brinjal + 100% sweet gourd	30.0	27.5	599300	550000	140000	140000	459400	410000	4.3	3.9
100% brinjal + 75% sweet gourd	30.0	28.7	599100	573000	137000	137000	462200	436000	4.4	4.2
100% brinjal + 50% sweet gourd	28.6	27.8	572400	556000	135000	135000	437400	421000	4.2	4.1
100% brinjal + 25% sweet gourd	27.5	26.1	549600	522000	133000	133000	416800	389000	4.1	3.9

Selling price: Brinjal Tk. 20/- kg^{-1}; Sweet gourd Tk. 10/- kg^{-1}

Brinjal-sweet gourd intercropping efficiency

Brinjal equivalent yield (BEY) of all intercropping was higher than sole cropping indicating higher productivity of intercropping. The highest brinjal equivalent yield (2014-15 and 2015-16) (29.97 and 28.65 t/ha) was found in followed by 100% brinjal + 100% sweet gourd followed by 100% brinjal + 75 % sweet gourd.

Economic performance of brinjal-sweet gourd intercropping

The result indicated that the highest gross return (Tk. 599300 ha^{-1}) and cost of cultivation (Tk. 140000 ha^{-1}) were obtained from 100% brinjal + 100% sweet gourd followed by 100% brinjal + 75% sweet gourd in both the year. The highest gross margin (Tk. 462200 ha^{-1}) and BCR (4.37) were obtained from 100% brinjal + 75% sweet gourd followed by 100% brinjal + 100% sweet gourd in both the year.

Conclusion

Cultivation of brinjal with sweet gourd was found profitable than sole cropping of brinjal and sweet gourd. 100% brinjal + 75% sweet gourd and 100% brinjal + 100% sweet gourd would be agronomically feasible and economically profitable.

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