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Yield and economics of sweet corn (*Zea mays*) - vegetable intercropping system

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Abstract

A field experiment was conducted at Jashipur in Orissa during *rabi* (winter) seasons of 2004-05 and 2005-06 to determine suitable vegetable intercrops for sweet corn (*Zea mays* L.). Intercropping of pea (*Pisum sativum*) with sweet corn in the ratio of 2:1 gave highest green cob equivalent yield (17.63 t/ha during 2004-05 and 17.49 t/ha during 2005-06), maximum net profit (Rs 32889 /ha during 2004-05 and Rs 33587 /ha during 2005-06) and highest benefit: cost ratio (2.6 during 2004-05 and 2.8 during 2005-06). This was followed by the intercropping of bean (*Phaseolus vulgaris*) with sweet corn in the ratio of 2:1. The weight of green cob and number of kernel per cob was negatively affected by presence of intercrops.

Key words: Intercropping, Pea, Sweet corn, Vegetable

Introduction

Intercropping increases productivity per unit area and time by efficient utilisation of available resources like land, water and solar radiation. Performance of intercrop extensively depends on natural and applied factors. Intercropping system with appropriate selection of crop and planting method can provide substantial yield advantage over the sole crop. Maize being a widely spaced crop offers an opportunity for intercropping (Kumar *et al*., 2003), which ultimately adds to the net income. Wider inter-spaces are left in between the rows of maize, which are not properly utilized at early growth stages. More specifically, during winter season, these lands can be profitably utilized with introduction of high value vegetable crops in the inter rows. The popularity of sweet corn (*Zea mays* L.) has increased considerably across the country, however, not much information is available about sweet corn - vegetable intercropping system during *rabi* season. Hence, this study was undertaken to find out suitable vegetable intercrop with sweet corn.

Materials and Methods

The present investigation was carried out at the Regional Research and Technology Transfer Sub-Station, Jashipur (located at 21º 57N latitude and 86º E longitude with an elevation of 400 m above the mean sea level) in the district of Mayurbhanj in the North Central Plateau Zone of Orissa during *rabi* seasons of 2004-05 and 2005-06 to determine the suitable vegetable intercrops like pea (*Pisum sativum*), bean (*Phaseolus vulgaris*), radish (*Raphanus sativus*) and spinach (*Spinacea oleracea*) with sweet corn (*Zea mays* L.). The soil of the experimental site was well-drained with sandy clay loam in texture. The soil pH was 5.6. The nutrient availability was low in nitrogen (181 kg/ha) and medium in phosphorus (21.6 kg/ha) and potassium (120 kg/ha). The experiment was laid out in a randomized block design with three replications. The treatments were : T_1 - sole sweet corn, T_2 - sweet corn + pea (1:1), T_3 - sweet corn + pea (2:1), T_4 - sweet corn + bean (1:1), T_5 - sweet corn + bean (2:1), T_6 - sweet corn + radish (1:1), T_7 - sweet corn + radish (2:1), T_8 - sweet corn + spinach (1:1) and T_9 - sweet corn + spinach (2:1).

Uniform spacing of 70 cm x 25 cm was given to the main crop. Seeds of sweet corn variety 'Madhuri' along with intercrops were sown on 19 November 2004 and 30 November 2005 in the respective years. Farm yard manure @ 5 tonnes/ha was applied at the time of final ploughing. The crop was uniformly applied with 120 kg N, 60 kg P_2O_5 and 60 kg K_2O per hectare. Whole amount of P and K along with 25 per cent N were applied as basal in furrows. Fifty per cent of N was applied at knee-high stage and the rest of N was applied at early tasselling stage of main crop. The net profit was calculated by taking the sale price of sweet corn at Rs 3.00, pea at Rs 9.00, bean at Rs 7.50, radish at Rs 1.50 and spinach at Rs 3.00 per kg.

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Table 1: Yield and economics of sweet corn - vegetable intercropping system

Treatment	Green cob yield (t/ha)		Intercrop yield (t/ha)		Green cob equivalent yield (t/ha)		Gross return (Rs/ha)		Expenditure (Rs/ha)		Net profit (Rs/ha)		Benefit: cost ratio	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
T_1	14.54	13.13	0	0	14.54	13.13	43611	39381	17593	18095	26019	21268	2.5	2.2
T_2	6.57	7.21	3.2	2.87	16.19	15.83	48556	47476	20370	19365	28185	28111	2.4	2.5
T_3	10.74	10.87	2.3	2.21	17.63	17.49	52889	52476	20000	18889	32889	33587	2.6	2.8
T_4	7.89	7.29	3.02	2.89	15.43	14.51	46306	43524	20926	19365	25380	24159	2.2	2.2
T_5	11.96	9.4	2.15	2.67	17.33	16.06	52000	48190	20926	18889	31074	29302	2.5	2.6
T_6	10.83	8.79	10.98	10.49	16.32	14.04	48972	42119	20000	18730	28972	23389	2.4	2.3
T_7	12.24	10.78	6.43	7.43	15.45	14.49	46361	43476	19815	18413	26546	25063	2.3	2.4
T_8	11.8	9.9	4.54	4.67	16.33	14.57	49000	43714	19444	18889	29556	24825	2.5	2.3
T_9	12.91	11.33	2.69	3	15.59	14.33	46778	43000	19630	18571	27148	24429	2.4	2.3
CD (P=0.05)	1.42	1.2	-	-	1.64	1.28	4933	3848	1170	NS	NS	4159	NS	0.3

Sale price (Rs/tonne) : Green cob – 3000, Pea- 9000, Bean- 7500, Radish- 1500, Spinach- 3000

Results and Discussion

Yield

Due to competition for solar radiation, soil moisture and plant nutrients, the main crop yield was reduced in presence of the intercrops. The yield reduction was 11.2 to 54.8 per cent during 2004-05 and 13.7 to 45.1 per cent during 2005-06 (Table 1). The sole crop of sweet corn yielded maximum green cob of 13.84 t/ha over the years. Earlier Khola *et al*. (1999) and Singh and Kumar (2002) observed maximum grain yield of maize as sole crop as compared to intercropping. The green cob yield was more with 2:1 row ratio than 1:1 ratio possibly because of more crowding effect with higher population of the intercrops. Increase in population of intercrop had inversely affected the green cob yield. Irrespective of the intercrops, main crop yield increased by 29.0 per cent during 2004-05 and 27.7 per cent during 2005-06 in the intercrop ratio of 2:1 as compared with row ratio of 1:1. Because of longer duration and taller plant height, the competition effect of pea and bean was more conspicuous than radish and spinach.

The intercrop yields were significantly affected by their population. Over the years, higher plant population in the ratio of 1:1 gave more intercrop yield than the lower plant population i.e., 2:1 ratio (Table 1). The increase in intercrop yield under 2:1 ratio over 1:1 ratio was to the tune of 34.6, 22.6, 54.9 and 61.9 per cent with pea, bean, radish and spinach, respectively. Doubling the population of intercrops, in the ratio of 1:1 as compared to 2:1 did not double the intercrop yield, possibly because of stress situation created due to competition among the plants.

Intercropping system recorded higher green cob equivalent yield than sole sweet corn (Table 1). This confirms the earlier finding by Sinha *et al*. (1999).The green cob equivalent yield was maximum (17.63 t/ha in 2004-05 and 17.49 t/ha in 2005-06) in intercropping of pea with sweet corn at the ratio of 2:1. This was significantly superior to other treatments during 2005-06. Over the years, T_5 (bean intercropped with sweet corn in the ratio of 2:1) resulted in next highest yield in the order. Although the intercrop (pea) yield in T_3 was less but the higher market value of pea significantly contributed towards the green cob equivalent yield. Whereas the effect of higher yield from radish was nullified due to its low market price.

Yield attributes

The yield attributing characters were at their higher values when sweet corn was grown as sole crop. Intercrops had negative effect on cob and kernel parameters of sweet corn in both the years. The sole crop yielded maximum green cob due to high number (63000/ha in 2004-05 and 61300/ha in 2005-06) of heavy cobs (198 g/cob in 2004-05 and 206 g/cob in 2005-06) with maximum number of kernels (368 in 2004-05 and 376 in 2005-06 per cob) as compared to other treatments (Table 2). The final plant stand, though not significant, was also negatively affected by the presence of intercrops. Sole crop had maximum plant stand (56.7 thousand/ha in 2004-05 and 56.2 thousand/ha in 2005-06) in both the years.

Economics

The gross return and net profit were affected by yield of main crop, intercrop and their market price. Maximum gross return (Rs 52889 /ha during 2004-05 and Rs 52476 /ha during 2005-06) was received from T_3, which was followed by T_5 in both the years (Table 1). Due to cost of seed and field operations the expenditure was more in case of intercropping system than in sole crops. Highest net profit of Rs 32889 and 33587/ha during 2004-05 and 2005-06, respectively, was obtained from pea intercropped with sweet corn at the ratio of 2:1 (Table 1), which was

Table 2 : Yield attributes of sweet corn in sweet corn - vegetable intercropping system

Treatment	Plant stand of sweet corn ('000/ha)		number of cobs ('000/ha)		Green cob weight (g)		number of kernel /cob	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
T_1	56.7	56.2	63.0	61.3	198	206	368	376
T_2	54.3	53.0	48.7	43.7	170	166	341	334
T_3	53.0	54.3	51.1	47.3	177	174	351	354
T_4	52.1	51.6	53.1	47.0	176	170	349	343
T_5	51.6	53.8	54.6	48.7	184	179	352	348
T_6	53.7	52.1	56.3	52.9	182	187	355	349
T_7	54.3	55.1	59.3	55.4	192	180	358	351
T_8	55.1	53.7	62.0	54.9	189	196	358	350
T_9	56.2	54.3	59.6	56.8	195	188	362	352
CD(P=0.05)	NS	NS	9.1	4.6	9	10	8	15

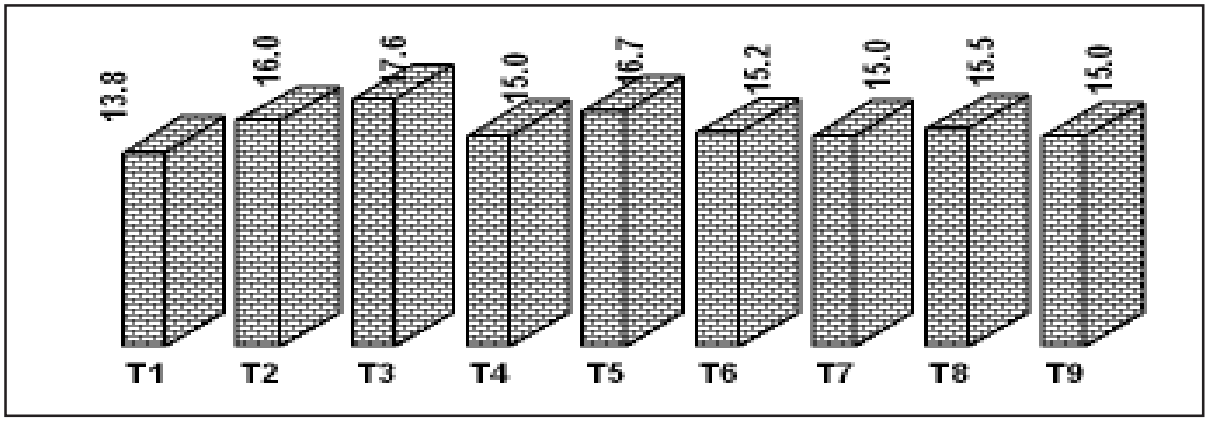

Fig. 1 : Green cob equivalent yield (t/ha) mean value of two years

followed by bean intercropped (Rs. 31074 & 29302) with sweet corn (2:1). On an average, additional income of Rs 9595/ha was obtained over the sole crop when pea was intercropped with sweet corn in the ratio of 2:1. Intercropping with pea resulted in highest net profit because of its higher market price as compared to bean, radish and spinach. Lowest net profit was obtained from the sole crop in both the years. The benefit: cost ratio was maximum (2.6 in 2004-05 and 2.8 in 2005-06) in pea intercropped with sweet corn in the ratio 2:1 (Table 1). It agrees with the earlier result obtained by Kumar *et al*. (2006).

Hence, it is recommended that pea should be intercropped with sweet corn in the ratio of 2:1 to obtain maximum green cob equivalent yield, net profit and benefit: cost ratio during *rabi* season. Alternatively, sweet corn-bean intercropping at the ratio of 2:1 may be followed to get more profit.

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