



# **Response of Sweet Corn to Intercropping and Fertility Level**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

A field experiment was conducted to study the effect of intercropping and fertility level on yield and economics of sweet corn at the Department of Agronomy, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha during rabi season of 2022-23. The experiment was conducted with split plot design having three main plots and five sub plots with three replications. The main plots were sole sweet corn, sweet corn + radish and sweet corn + beans; whereas the sub plots include the fertility levels of 0:0:0, 40:20:20, 80:40:40, 120:60:60 and 160:80:80 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ha<sup>-1</sup>. Observations were taken on plant growth, yield attributing factors, yield and economics. There was reduction in growth and yield of sweet corn due to competition from intercrops. The highest green cob yield of 10.07 t ha<sup>-1</sup> was obtained from sole sweet corn, which was statistically superior over yield obtained from sweet corn taken with any of the intercrops. However, maximum green cob equivalent yield of 12.66 t ha<sup>-1</sup> was obtained in sweet corn + radish intercropping system. In case of fertility levels, optimum yield of green cob (10.61 t ha<sup>-1</sup>) was recorded with application of 120 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> and 60 kg K<sub>2</sub>O ha<sup>-1</sup>. The green cob equivalent yield attained the optimum value (14.32 t ha<sup>-1</sup>) with application of 120 kg N, 60 kg P<sub>2</sub>O<sub>5</sub>

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and 60 kg K<sub>2</sub>O per hectare. Maximum net profit of ₹ 111.3 thousand per hectare was obtained when radish was intercropped with sweet corn. From the findings of this experiment, it can be inferred that application of 120 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> and 60 kg K<sub>2</sub>O per hectare to sweet corn and sweet corn + radish intercropping system is suitable to obtain optimal yield of sweet corn, green cob equivalent yield and net profit.

**Keywords:** Sweet corn; intercropping; fertility level; yield; economics.

## 1. INTRODUCTION

Sweet corn (*Zea mays var. saccharata*) is a type of maize with higher sugar content, which is cultivated for human consumption. It has gained wide popularity, both in urban and rural areas due to its sweetness and pleasant taste. As per Sumarni *et al.* (2025) sweet corn has vast potentiality for utilization due to increasing demand for household consumption and supply of raw material to food industries. Sweet corn as a wider-spaced crop, provides opportunities to grow component crops without incurring a financial loss, while sacrificing a lower sweet corn yield in exchange for increased production in terms of land and time (Anushree *et al.*, 2024). With suitable crop planning, various crops can be grown in the inter-row spaces of sweet corn without affecting the plant population of main crop. Appropriate intercrops not only enhance profit of the farmers, but also improve the soil fertility. Both field crops and vegetables can be rightfully taken as intercrop along with sweet corn. Among several vegetable crops, radish and beans can be appropriately intercropped with sweet corn as these are short duration crops with higher economic yields and result in higher economic return. Radish can be comfortably grown in the inter space of sweet corn, as it has less canopy and no shading effect. Being a leguminous crop, bean offers double benefit of profit enhancement and soil health improvement when intercropped with sweet corn. Latati *et al.* (2013) reported that bean had a positive effect on inter-specific competition through nitrogen partitioning with the intercropped maize due to increase in nitrogen fixation.

Proper nutrient management is crucial to ensure healthy plant, high yield and obtain good quality sweet corn. Intercropping provides avenue for better nutrient utilization as the surplus nutrients from main crop can be effectively absorbed by the associated crops grown between rows (Nandini *et al.*, 2024). Adequate supply of plant nutrients accelerates physiological activity of the plant resulting in higher dry matter accumulation and more yield. Sahoo and Mohanty (2020)

opined that fertilizer management can be optimally decided to obtain profitable yield of sweet corn. With this backdrop, it was felt necessary to determine appropriate intercrops for sweet corn and suitable levels of fertility to obtain maximum yield and net profit.

## 2. MATERIALS AND METHODS

A field experiment was conducted at Agronomy Main Research Farm, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar under East and South Eastern Coastal Plain Agro-climatic Zone of Odisha. The experiment was carried out during rabi season of 2022-23 under irrigated situation to study the response of sweet corn based intercropping to levels of fertility. The climate of experimental site is hot, moist & sub-humid with hot & humid summer and mild winter. There was no rainfall during the entire cropping season. The soil of the experimental field was well drained, sandy loam with pH value of 5.71. The status of available nitrogen, phosphorus and potassium was medium. The experiment was conducted in the statistical design of split plot having three main plots (sole sweet corn, sweet corn + radish and sweet corn + beans) and sub plots consisting of five fertility levels such as 0:0:0, 40:20:20, 80:40:40, 120:60:60 and 160:80:80 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ha<sup>-1</sup>. There were three replications in the experiment. The seeds of sweet corn hybrid Sugar 75, radish variety Palak Patta-71 and beans variety Poorva were sown on 27<sup>th</sup> October 2022. The spacing of sweet corn was 60 cm x 25 cm, whereas radish and beans were sown at a plant to plant spacing of 15 cm in the inter-rows of sweet corn without affecting the population of main crop. All phosphorus & potassium and 25 per cent of nitrogen were applied as basal fertilizer. As per treatment, 50 per cent of nitrogen was applied as first top dressing and rest 25 per cent of nitrogen was applied as second top dressing coinciding with early tasseling stage. Two weedings have been done at 25 and 42 days after sowing. Each time, weeding was followed by earthing up operation. Harvesting of radish and beans were started 56

and 66 days after sowing, respectively. However, sweet corn harvesting was done starting from 79 days after sowing. Observations on growth parameters, yield attributes, yield and economics of sweet corn were recorded. Observations on yield and economics data of both the intercrops have been taken.

### 3. RESULTS AND DISCUSSION

Growth of sweet corn was adversely affected due to presence of intercrops because of competition for solar radiation, water and nutrients. Sole crop of sweet corn resulted in better plant growth in absence of competition for sunlight, plant nutrients and water, which has reflected in higher yield and yield attributing characters. The highest weight of green cob with husk (235.1 g) was obtained in sole crop of sweet corn, which was 5.5 % and 14.9 % more than sweet corn intercropped with radish and beans, respectively. Earlier, Vidhyashree *et al.* (2019) obtained 50.5 per cent higher yield of fresh cob from sole sweet corn than sweet corn + fenugreek intercropping system. The maximum of 314.4 kernels per cob was recorded in sole sweet corn, which was 6.4 per cent more than the kernels obtained from sweet corn intercropped with beans (Table 1) due to less competition in the sole maize crop in absence of intercrop. Hossain *et al.* (2015) also observed that number of kernels per cob was higher in sole maize crop than intercropping treatments. Similar findings were reported by Anushree *et al.* (2024), who recorded significantly higher yield attributing parameters, cob yield and stover yield of sole sweet corn as compared with its performance in intercropping with vegetable crops due to competition free environment for growth resources such as sunlight, water and plant nutrients. However, Richo *et al.* (2024) reported that yield components of maize were higher under maize + radish intercropping system due to the fact that radish was less aggressive and exerted less competition for plant nutrient, solar radiation, soil moisture and field space when compared with other intercropping systems.

The highest green cob yield of 10.07 t ha<sup>-1</sup> was obtained from the sole sweet corn, which was statistically superior over the yield obtained from sweet corn in intercropping treatments. There was reduction of green cob yield by 24.0 and 30.3 per cent when sweet corn was intercropped with radish and beans, respectively. Vidhyashree *et al.* (2019) also reported 50.5 per cent higher yield of fresh cob from sole sweet corn than

sweet corn + fenugreek intercropping system. Similarly, Samsuri *et al.* (2022) obtained higher yield from sole sweet corn crop than its intercropping. Additional production of intercrops contributed to higher value of green cob equivalent yield from the intercropping system. Maximum green cob equivalent yield of 12.66 tonne per hectare was recorded in sweet corn + radish intercropping system, which was 25.7 per cent higher than sole sweet corn (Table 2). Maximum green fodder yield of 31.19 t ha<sup>-1</sup> was recorded in sole sweet corn crop. Slow down of vegetative growth of sweet corn due to presence of intercrops like radish and beans reduced the green fodder yield of sweet con by 12.9 and 21.2 per cent, respectively when compared with sole crop. Cost of cultivation is a crucial factor for selection of intercrops as mentioned by Banik and Sharma (2009). In the present experiment, economics of cultivation goes in favor of sweet corn and radish intercropping system, which resulted in maximum net return of ₹ 111.3 thousand per hectare due to maximum green cob equivalent yield. In absence of intercrop, sole sweet corn provided minimum net return of ₹ 79.2 thousand ha<sup>-1</sup>, which underscores the importance of intercrop with sweet corn. The maximum benefit-cost ratio of 2.3 was obtained when sweet corn was intercropped with radish. This is due to additional yield obtained from radish with minimum additional expenditure. Similar findings were obtained by Richo *et al.* (2024), who reported the highest gross return (₹ 56721 ha<sup>-1</sup>), net return (₹ 27133 ha<sup>-1</sup>) and B:C ratio (1.92) from maize + radish intercropping system.

Adequate supply of plant nutrients due to additional application of fertilizer accelerated the plant growth rate, which was reflected in enhancement of yield and yield attributing factors. Additional production of photosynthates due to addition of plant nutrients in the soil resulted in considerably higher values of yield attributing characters. Maximum number of cobs (75.1 thousand ha<sup>-1</sup>) with higher cob weight (295.5 g cob<sup>-1</sup> with husk) were produced in the treatment, where 160:80:80 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O per hectare was applied. The optimum value of cob weight (278.0 g) with and without husk (169.8 g) was attained at fertility level of 120:60:60 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ha<sup>-1</sup>. Massey and Gaur (2006) also obtained heaviest cobs with application of 120 kg N and 60 kg K<sub>2</sub>O ha<sup>-1</sup>. The number of kernels per cob and weight of kernel have linearly increased with additional application of plant nutrients from external sources, which confirms the earlier

Table 1. Effect of intercropping and fertility level on yield parameters of sweet corn

Treatment	Plant stand at harvest ('000 ha <sup>-1</sup> )	No. of cobs ('000 ha <sup>-1</sup> )	Weight of cob with husk (g)	Weight of dehusked cob (g)	Weight of fresh kernel (g per 100)	Kernels per cob
<b>Intercropping</b>						
Sole sweet corn	62.4	66.1	235.1	136.3	29.2	314.4
Sweet corn + radish	61.0	63.0	222.8	127.7	28.7	308.8
Sweet corn + beans	59.2	61.7	204.6	125.3	28.6	295.4
SE(m) +	1.03	1.81	7.11	2.39	0.63	5.92
CD (0.05)	NS	NS	NS	NS	NS	NS
<b>N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O (kg ha<sup>-1</sup>)</b>						
0:0:0	59.5	47.6	143.7	72.3	25.6	256.4
40:20:20	61.1	52.7	171.6	98.5	27.8	282.9
80:40:40	61.7	69.4	215.4	131.9	29.2	304.4
120:60:60	61.4	73.2	278.0	169.8	30.5	336.0
160:80:80	60.5	75.1	295.5	176.3	31.2	351.3
SE(m) +	1.77	2.92	6.26	4.05	0.77	6.39
CD (0.05)	NS	8.53	18.28	11.82	2.23	18.66

Table 2. Effect of intercropping and fertility level on yield and economics

Treatments	Yield of green cob (t ha <sup>-1</sup> )	Yield of green fodder (t ha <sup>-1</sup> )	Yield of intercrop (t ha <sup>-1</sup> )	Green cob equivalent yield (t ha <sup>-1</sup> )	Net profit (₹ ha <sup>-1</sup> )	Benefit-cost ratio
<b>Intercropping</b>						
Sole sweet corn	10.07	31.19	0.00	10.07	79.2	2.0
Sweet corn + radish	7.65	27.17	5.01	12.66	111.3	2.3
Sweet corn + beans	7.02	24.59	1.83	10.95	83.4	1.9
SE(m) +	0.357	0.495	0.046	0.373	5.63	0.06
CD (0.05)	1.400	1.944	0.180	1.466	22.09	0.24
<b>N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O (kg ha<sup>-1</sup>)</b>						
0:0:0	3.26	19.68	1.26	5.06	1.4	1.0
40:20:20	6.43	24.18	1.83	8.86	57.9	1.7
80:40:40	9.17	28.96	2.46	12.37	109.5	2.3
120:60:60	10.61	31.86	2.86	14.32	136.7	2.6
160:80:80	11.74	33.58	2.99	15.51	151.0	2.6
SE(m) +	0.439	1.481	0.146	0.442	6.31	0.07
CD (0.05)	1.280	4.322	0.427	1.291	18.43	0.21

findings of Jaliya et al. (2008). Absence or inadequate supply of plant nutrients at the time of reproductive phase might be the cause of lighter cob production under deficient or no supply of fertilizers.

Supplementary addition of every dose of plant nutrients increased the yield of green cob attaining the maximum value of 11.74 t ha<sup>-1</sup> at the fertility level of 160:80:80 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ha<sup>-1</sup>. It was of course statistically comparable with application of 120:60:60 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ha<sup>-1</sup>. The optimum yield (10.61 t ha<sup>-1</sup>) of green cob was recorded at the fertility level of 120:60:60 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ha<sup>-1</sup>, which is 225 per cent higher than the control plot because of 93.5, 31.0 and 19.1 per cent more cob weight (with husk), kernel per cob and kernel weight, respectively. Similar finding was also reported by Dangariya et al. (2017), who obtained the optimum yield of green cob with application of 120 kg N and 60 kg P<sub>2</sub>O<sub>5</sub> per hectare.

Major nutrients like nitrogen, phosphorus and potash play a pivotal role in root development, formation of protein & chlorophyll and enhanced vegetative growth thereby influencing fodder yield of sweet corn. Abundant supply of plant nutrients through application of 160:80:80 kg N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ha<sup>-1</sup> resulted in the maximum yield (33.58 t ha<sup>-1</sup>) of green fodder, of course statistically similar to the fertility level of 120 kg nitrogen, 60 kg phosphorus and 60 kg of potash per hectare. Similar findings have also been reported by Massey and Gaur (2006), who obtained maximum fodder yield with application of 120 kg N and 60 kg P<sub>2</sub>O<sub>5</sub> per hectare. Increase in fertility level linearly increased the yield of intercrop, which was reflected in green cob equivalent yield. Optimum value of green cob equivalent yield (14.32 t ha<sup>-1</sup>) was obtained with the fertility level of 120 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> and 60 kg K<sub>2</sub>O per hectare, which was 183.0 per cent higher than the control plot (Table 2).

Supplementary provision of plant nutrients increased the net profit (₹ 136.7 thousand ha<sup>-1</sup>) up to application of 120 kg nitrogen and 60 kg each of phosphorus & potash per hectare, beyond which the effect was not significant. Yield enhancement with additional application of plant nutrients was the sole reason of augmentation of net profit. Similar observations were also reported by Kumar and Chawla (2018), who obtained maximum net return and benefit-cost ratio with application of 150 kg N, 50 kg P<sub>2</sub>O<sub>5</sub> and 60 kg K<sub>2</sub>O ha<sup>-1</sup>. The benefit-cost ratio of 2.6 did

not increased with additional application of plant nutrients beyond 120 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> and 60 kg K<sub>2</sub>O ha<sup>-1</sup>. Hence, application of 120 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> and 60 kg K<sub>2</sub>O ha<sup>-1</sup> was found suitable to obtain optimum value for yield of green cob & green fodder, net profit and benefit-cost ratio.

#### 4. CONCLUSION

Based on the results of this experiment, it is inferred that application of 120 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> and 60 kg K<sub>2</sub>O per hectare to sweet corn intercropped with radish is appropriate to obtain optimum yield of sweet corn, green cob equivalent yield and net profit. Further research may be done to assess the effect of nutrient management and intercropping on quality of sweet corn.

#### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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