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Growth and yield of sweet corn as affected by fertility level and date of harvest

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Abstract
A field experiment was conducted at the Odisha University of Agriculture and Technology, Bhubaneswar during rabi season of 2019-20 to study the effect of fertility level on growth and yield of sweet corn (*Zea mays* var. *saccharata*).The experiment was laid out in a split-plot design with three levels of fertility (120:60:60, 80:40:40 and 40:20:20 kg N, P_2O_5 and K_2O ha^{-1}) and five dates of harvest (16, 20, 24, 28, and 32 days after silking) with three replications. The results revealed that application of 120:60:60 kg N, P_2O_5 and K_2O ha^{-1} resulted in the tallest plants (183.7 cm at harvest) with maximum dry matter accumulation (853.0 g m^{-2}).The fertility level of 120:60:60 kg N, P_2O_5 and K_2O ha^{-1} produced maximum yield of green cob (15.63 t ha^{-1}), fresh kernel (7.86 t ha^{-1}) and green fodder (36.42 t ha^{-1}). The yield of green cob (15.22 t ha^{-1}) and fresh kernel (7.82 t ha^{-1}) increased significantly up to 24 days after silking. Hence, application of 120:60:60 kg N:P_2O_5:K_2O ha^{-1} with harvesting at 24 days after silking was found suitable to obtain optimum yield of green cob and fodder.

Keywords: Sweet corn, fertility level, date of harvest, yield, split-plot

Introduction
Sweet corn (*Zea mays* L.) occupies an important position among different types of specialty corn due to its diversified consumption. Sweet corn is usually eaten at stage of green cob in boiled, steamed or roasted form and consumed with wide variety of vegetable mixtures, soups and canning products (Abhishek and Basavanneppa, 2020) [1]. Sweet corn is gaining popularity both in rural and urban areas of our country because of high sugar content (Game *et al*., 2017) [4]. Sweet corn is a heavy feeder, which requires adequate quantity of nitrogen, phosphorus and potassium (Ortas and Sari, 2003) [8] for growth and development. Nutrient requirement of sweet corn varies depending on inherent soil fertility status, cropping season, variety used and management practices. Besides other factors, the productivity of sweet corn is very much influenced by soil fertility status and quantity of applied nutrient. Similarly, the date of harvest has a deciding effect on quality and quantity of sweet corn production. Therefore, it is necessary to find out suitable fertility level and appropriate date of harvest to maximize production of good quality sweet corn.

Materials and Method
The experiment was conducted during *rabi* season of 2019-20 at the College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar under the East and South Eastern Coastal Plain Zone of Odisha. The soil of the experimental field was sandy loam in texture with pH value of 5.72.It was medium in available nitrogen, phosphorus and potassium. The experiment was conducted in split plot design with three levels of fertility (40:20:20; 80:40:40 and 120:60:60 kg N:P_2O_5:K_2O ha^{-1}) and five dates of harvest (16, 20, 24, 28 & 32 days after silking). Seeds of the sweet corn hybrid Sugar 75 was planted at a spacing of 60 cm x 25 cm on 23rd November 2019.The field was irrigated just after sowing and subsequent irrigations were provided as per the requirement of the crop.

Results and Discussion
Plant Growth
Accelerated growth of various plant parts due to higher level of fertility resulted in enhanced crop growth rate in sweet corn. The rate of crop growth was significantly influenced by variation in fertility level up to 45 days after sowing because of availability of plant nutrients in adequate quantity, which was received from basal application. It is in confirmation with the opinion expressed by Akpan and Udoh (2017) [2], who endorsed that increase in quantity of

applied fertilizer resulted better growth of sweet corn. The effect of fertility level was conspicuously observed on the growth of the plant. There was rapid increase in plant height up to 60 days after sowing after which the growth was at a slower rate till harvest. The rate of growth of plant height attained its maximum during 45-60 days after sowing that coincides with tassel emergence. The increase in height was arrested after emergence of tassel. Increase in fertility level up to 120:60:60 kg $N:P_2O_5:K_2O$ ha^{-1}produced tallest plants (183.7 cm) due to accelerated process of cell division and other physiological activities (Table 1). Similar findings were also reported by Rao *et al*. (2020) [9] and Jat *et al*. (2009) [5].

Leaf area index increased with application of higher dose of fertilizer (120:60:60 kg $N:P_2O_5:K_2O$ ha^{-1}) due to enhanced photosynthetic activity thereby enhancing the dry matter accumulation at different stages of plant growth. This has resulted in maximum quantity of dry matter production (853.0 g m^{-2}) at harvest with application of 120:60:60 kg $N:P_2O_5:K_2O$ ha^{-1} due to maximum plant height (183.7 cm) and highest leaf area index (4.24). Similar findings have also been reported by Singh *et al*. (2019) [16] who obtained maximum dry matter production with application of 120:60:40 kg $N:P_2O_5:K_2O$ ha^{-1}. Adequate supply of plant nutrients might have accelerated the cell division, which had resulted in higher quantity of dry matter accumulation.

Tasseling and silking were significantly affected by levels of fertilizer application. Days taken to fifty per cent tasseling was the minimum (50.7) with application of 120:60:60 kg $N:P_2O_5:K_2O$ ha^{-1}. Availability of adequate quantity of plant nutrients in case of highest fertility level accelerated the process of plant growth, which resulted in earliness of tasseling and silking (Table 1). Similar findings were also reported by Sahoo and Panda (1997) [5] in baby corn, who recorded delay in emergence of tassel and silk in absence of fertilizer application.

Table 1: Effect of fertility level and time of harvest on plant growth of sweet corn

Treatment	Plant height (cm)	Dry matter accumulation (g m^{-2})	Leaf area index	Days to 50% tasseling	Days to 50% silking
Fertility level (kg ha^{-1})					
40:20:20	160.0	764.4	4.02	52.3	57.2
80:40:40	179.6	817.3	4.03	51.7	54.9
120:60:60	183.7	853.0	4.24	50.7	54.1
SE(m) +	12.13	30.30	0.056	0.28	0.27
CD (0.05)	NS	NS	NS	1.09	1.04
Time of harvest (days after silking)					
16	165.20	744.4	4.18	51.6	55.3
20	180.18	790.0	4.05	50.6	54.6
24	177.61	815.0	4.07	51.6	55.3
28	173.40	842.2	3.91	51.4	55.7
32	175.89	866.2	4.28	52.6	56.2
SE(m) +	7.06	25.06	0.111	0.56	0.73
CD (0.05)	NS	73.16	NS	NS	NS

Yield attributes

Several authors have reported that nitrogen application influenced the yield attributing characters of sweet corn. Mahmood *et al.* (2001) [6] opined that nitrogen had a significant effect on number of grains per cob, grain weight and harvest index. Increase in application of fertilizer considerably improved various yield attributing characters of sweet corn such as cobs per plant, kernel per cob and kernel weight due to promotion of physiological activities (Sahoo and Mohanty, 2020) [4]. Application of 120:60:60 kg $N:P_2O_5:K_2O$ ha^{-1} resulted in the maximum number (76.91 thousand ha^{-1})of heaviest (349.9 g cob^{-1}) cobs (Table 2).The stress condition created by deficient supply of plant nutrients in case of minimum level of fertilizer application (40:20:20 kg $N:P_2O_5:K_2O$ ha^{-1}) caused reduction in cob number (71.47 thousand ha^{-1}), cob weight with husk (314.8 g) and hundred kernel weight (30.3 g).Sahoo and Mahapatra (2007) [13] also realized more barren plants (28.2%) and lighter cobs (84 g) with less number of kernels (144 cob^{-1}) in absence of fertilizer application in sweet corn. Similarly, nutrient deficiency at later stage might have resulted in leaf senescence due to diminution of photosynthesis, which was reflected in production of green cob and fodder. Similar findings were also reported by Shanti *et al.* (2012) [17] from Hyderabad, who harvested thickest and longest cobs with application of 150:75:45 kg $N:P_2O_5:K_2O$ ha^{-1}.

The weight of cob with husk increased steadily up to 28 days after silking, but decreased when harvested at 32 days after silking. The heaviest husked cob (371.2 g cob^{-1}) was observed at 28 days of silking, which was statistically similar with the treatments harvested at 24 or 32 days after silking. Progress in date of harvest enhanced the weight of dehusked cob with its maximum value of 233 g $cob^{-1}$when harvested at 32 days after silking. This was statistically similar with the results obtained from the plots harvested at 24 or 28 days after silking (Table 2).

Yield

Adequate supply of plant nutrients at all the crop growth stages through 120:60:60 kg $N:P_2O_5:K_2O$ ha^{-1} yielded maximum green cob (15.63 t ha^{-1}) and fresh kernel (7.86 t ha^{-1}). Dangariya *et al*. (2017) [3] also obtained maximum yield of green cob (8.10 t ha^{-1}) with application of 120 kg N and 60 kg P_2O_5 ha^{-1}. Supply of plant nutrients in higher quantity during crop growth stages created a favorable environment for better growth and yield of crop. This has produced 23.5 per cent more green cob, 28.9 per cent more fodder and 14.9 per cent more kernel yield with fertility level of 120:60:60 kg $N:P_2O_5:K_2O$ ha^{-1}as compared with application of 40:20:20 kg $N:P_2O_5:K_2O$ ha^{-1}. Several authors (Singh *et al*., 2012; Sahoo & Mahapatra, 2004) [17, 12] also realized the highest yield of sweet corn with application of 120 kg nitrogen ha^{-1}.

Time of harvest plays a vital role in deciding the quality sweet corn (Ruan *et al*., 1999) [11]. In case of delayed harvest, the crop gets more time for photosynthesis and thereby more accumulation of assimilate. The number and weight of kernel attained the optimum value when the crop was harvested at 24 days after silking. All these factors contributed to obtain optimum yield of green cob (15.22 t ha^{-1}) and fresh kernel (7.82 t ha^{-1}) from the crop harvested at 24 days after silking. Although there was marginal enhancement of yield by harvesting at 28 or 32 days after silking, the increase was not significant. Similar findings were also reported by Sumitra *et al.* (1992) [18] under Thailand situation, who opined that 16-22 days after 50% silking is the appropriate time for harvest of sweet corn.

Increase in plant height and dry matter accumulation might have contributed for maximum green fodder yield of 36.42 t ha^{-1} with application of 120:60:60 kg $N:P_2O_5:K_2O$ ha^{-1}. The photosynthetic activity was continuously maintained throughout the cropping season due to availability of plant nutrients at higher level in balanced quantity. This has resulted in the highest fodder yield (36.42 t ha^{-1}) with application of 120:60:60 kg $N:P_2O_5:K_2O$ ha^{-1}. This result is in agreement with the findings by Mathukia *et al.* (2014) [7] and Rathod *et al.* (2018) [10]. The progress in harvesting date continuously enhanced the yield of green fodder. Harvesting the crop at a later date (32 days after silking) produced maximum of 34.88 tonne green fodder per hectare, which was statistically similar with the yield obtained when the crop was harvested at 20 or 24 or 28 days after silking (Table 2). Although fodder yield was increased up to 32 days after silking, the rate of growth was decelerated after 24 days of silking due to reduction in photosynthetically active leaves at the later stage of reproductive phase. However, there is no significant difference among quantity of green fodder harvested any date after 20 days of silking.

Table 2: Effect of fertility level and time of harvest on yield and yield attributes of sweet corn

Treatment	No. of cobs ('000 ha^{-1})	Cob wt. with husk (g)	Wt. of dehusked cob (g)	Fresh kernel weight (g per 100)	Kernels per cob	Green cob yield (t ha^{-1})	Green fodder yield (t ha^{-1})	Fresh Kernel yield (t ha^{-1})
Fertility level (kg ha^{-1})								
40:20:20	71.47	314.8	176.1	30.3	336.9	12.66	28.26	6.84
80:40:40	76.27	346.6	212.6	32.0	345.9	14.62	35.15	7.45
120:60:60	76.91	349.9	213.0	32.7	352.4	15.63	36.42	7.86
SE(m) +	0.761	5.57	4.75	0.29	10.40	0.242	0.433	0.079
CD (0.05)	2.987	21.87	18.65	1.13	NS	0.951	1.700	0.311
Time of harvest (days after silking)								
16	73.61	254.1	134.7	28.4	292.3	11.88	30.80	6.11
20	74.63	334.1	189.9	30.2	323.9	12.94	32.53	6.97
24	74.22	360.8	212.5	32.6	365.1	15.22	33.49	7.82
28	75.96	371.2	232.7	33.4	372.4	15.59	34.69	7.95
32	76.01	365.2	233.0	33.8	371.5	15.89	34.88	8.07
SE(m) +	1.171	9.68	7.32	0.75	12.06	0.368	0.914	0.146
CD (0.05)	NS	28.26	21.37	2.20	35.21	1.075	2.669	0.425

Conclusion

Application of plant nutrients @ 120:60:60 kg $N:P_2O_5:K_2O$ ha^{-1} with harvesting at 24 days after silking was found suitable to obtain optimum yield of green cob and fodder. Harvesting the crop at 24 days after silking can enable the farmer to take the subsequent crop in the same field without sacrificing the yield.

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