Effect of different rate and time of nitrogen application to sweet corn (*Zea mays* L. *saccharata*) under south Gujarat condition

ABSTRACT

A field experiment was conducted at college farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat India, during *rabi* season in 2017-18 to study the response of sweet corn (*Zea mays* L. *saccharata*) to different rate and time of nitrogen application under south Gujarat condition. The experiment was laid out in Factorial randomized block design (FRBD) with three replications. The factors consisted of four nitrogen levels *i.e.*, 90 kg ha^{-1} (N_1), 120 kg ha^{-1} (N_2), 150 kg ha^{-1} (N_3) and 180 kg ha^{-1} (N_4) and four treatments of split application *i.e.*, ½ basal + ½ at knee height (T_1), ½ basal + ¼ knee height + ¼ tasseling (T_2), $^1/_3$ basal + $^1/_3$ knee height + $^1/_3$tasseling (T_3), ¼ basal + ½ at knee height + ¼ tasseling (T_4). The results revealed that increasing the nitrogen level from 90 (N_1) to 180 (N_4) kg ha^{-1} significantly increased the growth characters *viz,* plant height, stem diameter, number of leaves, yield attributes *viz,* number of grains per cob, weight of grains per cob, weight of cob per plant, green cob and fodder yield. Significantly higher green cob (132.94 q ha^{-1}) and fodder yield (307.29 q ha^{-1}) with net return (Rs.258239 ha^{-1}) and benefit: cost ratio of 4.74 was obtained with 180 kg ha^{-1} nitrogen application. Application of nitrogen in three splits *i.e.*, at ¼ basal + ½ at knee height + ¼ tasseling (T_4) recorded significantly higher growth characters *viz,* plant height, stem diameter, number of leaves, yield attributes *viz,* number of grains per cob, weight of grains per cob, weight of cob per plant, green cob (126.99 q ha^{-1}) and fodder yield (293.14 q ha^{-1}) with net return (Rs.242739 ha^{-1}) and benefit: cost ratio of 4.47.

Key words: nitrogen, maize, time of application, sweet corn, south Gujarat

INTRODUCTION

Maize (*Zea mays* L.) is also known as Indian corn while in the United States of America, it is simply known as corn. It is one of the most important cereal crops in the world's agriculture economy and used both as food for human and feed for animals. Globally, maize is known as "Queen of Cereals" because it has the highest genetic yield potential among the cereals. Being a C_4 plant, it is capable to utilize solar radiation more efficiently even at higher radiation intensity. It is one of the most versatile crops having wider adaptability under varied agro-climatic conditions.

It is cultivated on an area of 150 million ha with a production of 782 million tonnes of grain and productivity of 4.92 t ha^{-1}. In India, it is cultivated on an area of 6.4 million ha with a production of 20.3 million tonnes of grain and productivity of 2.43 t ha^{-1}. Haryana, Maharashtra, Meghalaya, Karnataka, and Andhra Pradesh are the major sweet corn producing state of India. While Gujarat occupies an area of 4.7 lakh ha producing 12.2 lakh tonnes of grain with the productivity of 2.59 t ha^{-1}. Maize contributes 36 % (782 mt) in the global grain production. The United States of America (USA) is the largest producer of maize contributing nearly 35 % of the total production in the world and maize is the driver of the US economy. The USA has the highest productivity (> 9.6 t ha^{-1}) which is double than the global average (4.92 t ha^{-1}). Whereas, the average productivity in India and Gujarat is 2.43 t ha-1and 2.59 t ha^{-1}, respectively (Anonymous, 2016).

For diversification and getting more valuable crops, presently greater emphasis is being given on cultivation of sweet corn to augment the income of farming community dwelling in the outskirts of big cities and metropolis. It has been developed into a multi-dollar business because of its potential as a value-added product for export and a good food substitute. It has potentiality not only in domestic market but also in an international market. Sweet corn is becoming popular and is being cultivated in maize growing areas of India. Being a high value crop, there is growing demand for sweet corn in star hotels for soup making. In addition, the seed of this crop is used for canning purpose and for preparation of different sweet items. Added advantage of sweet corn is that after the harvest of green ears, the crop remains at green stage and it is fit for feeding cattle as green fodder. Due to its short duration, it is finding place in different cropping systems. It has been tried in different low canopy crops like groundnut, green gram, black gram and high canopy crops like red gram of varying durations as intercrop and found most suitable. As far as Gujarat is concerned, there is an adequate possibility that production of sweet corn in South Gujarat can be taken as a substitute to paddy because of the availability of irrigation water and sweet corn being a short duration crop; it is best suited in existing cropping systems after *kharif* rice.

The lack of knowledge about the use and economic importance of sweet corn and unavailability of appropriate production technologies are the major constraints for its popularization among Indian maize growers. It is an established fact that plant growth and higher grain yield depends on adequate fertilizer application at right time in particular, nitrogen. The inadequate management of nitrogen (N) is considered a major limiting factor for maize grain yield. Results obtained by Lemaire and Gastal (1997) demonstrated that, under appropriate levels of other nutrients in the soil, nitrogen provides the greatest increment to maize yield. Nitrogen is subjected to several transformations in the soil; thus, it is considered as dynamic and complex element, generating debates and controversies regarding its best source and time of application in crops especially in maize.

Therefore, it is essential to know the optimum level of nitrogen and timing of application for getting a higher crop yield so that maximum benefits could be realized. Inadequate nitrogen availability during the first six weeks after planting can be resulted in decreased source, sink, size and reduced yield potentials. Nitrogen use and demand is continuously increasing day by day. Since nitrogen is highly mobile, it is subjected to greater loss from the soil plant system. Therefore, matching optimum level of nitrogen and timing of nitrogenous fertilizer application is essential to achieve the targeted yields.

However, no systematic research has been conducted to develop site and situation specific production technology for sweet corn. Hence, there is a need to establish a relationship between nitrogen levels and timing of nitrogen application.

MATERIALS AND METHODS

In order to achieve the pre-set objectives of the present study was conducted on plot number E-18 of the College Farm, N. M. College of Agriculture, NAU, Navsari during *rabi* season of 2017-18. The place is located 12 km away in the east from great historical place "Dandi" on the Arabian seashore. The climate of this region is characterized by fairly hot summer, moderately cold winter and warm humid monsoon with heavy rainfall. During the course of investigation, the weekly mean maximum and minimum temperature varies from 26.60 ^{0}C to 37.30 ^{0}C and 100 ^{0}C to 19.90 ^{0}C, respectively and the bright sunshine hours were available in the range of 2.5 to 9.8 hrs day^{-1} during the crop period. The soil of the experimental site is dark greyish brown type with flat topography. The soil is characterized by medium to poor drainage and good water holding capacity. The predominant clay mineral is montmorillonite. Data of initial soil analysis indicated that the experimental site was clay in texture and showed low, high and high rating for available nitrogen (209.6 kg ha^{-1}), phosphorus (40.62 kg ha^{-1}) and potassium (384.32 kg ha^{-1}), respectively. The soil was found slightly alkaline (pH 7.9) with normal electric conductivity (0.37 ds m^{-1}).

The present experiment was laid out in Factorial Randomized Block Design with 16treatments combinations of four nitrogen levels *i.e.*, 90 kg ha^{-1} (N_1), 120 kg ha^{-1} (N_2), 150 kg ha^{-1} (N_3) and 180 kg ha^{-1} (N_4) and four treatments of split application *i.e.*, ½ basal + ½ at knee height (T_1), ½ basal + ¼ knee height + ¼ tasseling (T_2), $^1/_3$ basal + $^1/_3$ knee height + $^1/_3$tasseling (T_3), ¼ basal + ½ at knee height + ¼ tasseling (T_4) with three replications. The entire quantity of phosphorus and potash applied as basal through SSP and MOP fertilizer respectively, whereas nitrogen applied in form of urea as per treatments. All the observation, growth and yield parameter were taken as per standard method. The statistical analysis of data recorded for different characters during the course of investigation was carried out through the procedure appropriate to the design of the experiment as described by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Plant population

Data on emergence count and final plant stand revealed that the plant stands were optimum and fairly uniform. The effect of different treatment and their interaction on per cent emergence count was not significant. This indicated that the variation in growth, yield contributing characters and yield were due to treatments effects. The plant stand did not differ significantly due to different level of nitrogen and time of nitrogen application at initial growth stage (30 DAS) and at harvest of sweet corn. Similar results were also observed by Bhatt (2012).

Periodical plant height (cm)

The data pertaining to plant height recorded at periodical interval 30 DAS, 60 DAS and at harvest of sweet corn as influenced by nitrogen levels and time of nitrogen application in table 1. A perusal of data indicated that different nitrogen levels had significant effect on plant height recorded at 60 DAS and at harvest of sweet corn except at 30 DAS. Significantly the tallest plants (115.78 and 207.99 cm, respectively 60 DAS and at harvest) were observed under the nitrogen rate 180 kg N ha^{-1} (N_4) and it was at par with 150 kg N ha^{-1} (N_3). Whereas shortest plant (100.18 and 183.17 cm, respectively) was recorded in nitrogen rate 90 kg N ha^{-1} (N_1) at 60 DAS and at harvest. Time of nitrogen application had a profound influence on plant height at the growth stages *i.e.,* at 60 DAS and at harvest of sweet corn except at 30 DAS. Application of nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4) recorded the significantly highest plant height (112.08 and 208.52 cm respectively) at 60 DAS and at harvest and it was at par with $^1/_3$ Basal + $^1/_3$ knee height + $^1/_3$ tasseling (T_3) and ½ basal + ¼ knee height + ¼ tasseling (T_2). Significantly the lowest plant height (98.95 and 180.19 cm, respectively) was observed with application of nitrogen at ½ basal + ½ at knee height (T_1) treatment during growth stages *i.e.,* at 60 DAS and at harvest of sweet corn. The maximum plant height recorded at higher levels of nitrogen might be due to more cell division and cell elongation as promoted by nitrogen. Adequate nitrogen supply increased the amount of cell plasma and chlorophyll, which is a factor for growth of the crops. Milthrope and Moorby (1979) observed that under adequate nitrogen supply, cells elongate extensively along the main axis leading to more growth of internodes and increases the length of stem. The increase in plant height in response to higher levels of nitrogen was in conformity with the findings of Kumar (2009), Bhatt (2012) and Singh *et al.* (2012).

Number of leaves per plant (cm)

It was observed from data presented in table 1, that 180 kg N ha^{-1} (N_4) was recorded significantly the maximum number of leaves per plant (10.96 and 15.60, respectively) and it was at par with 150 kg N ha^{-1} (N_3). Whereas, minimum number of leaves per plant (9.82 and 13.82) was recorded with 90 kg N ha^{-1} (N_1) at 60 DAS and at harvest, respectively. In case of time of nitrogen application, significantly the maximum number of leaves per plant (10.98 and 15.42, respectively) was recorded with ¼ basal + ½ at knee height + ¼ tasseling (T_4) and it was at par with $^1/_3$ basal + $^1/_3$ knee height + $^1/_3$ tasseling (T_3) and ½ basal + ¼ knee height + ¼ tasseling (T_1). Whereas, minimum number of leaves per plant (9.46 and 13.84, respectively) was recorded with ½ Basal + ½ at knee height (T_1) at 60 DAS and at harvest. These findings are in contrast with the results of Bhatt (2012) and Singh *et al.* (2012).

Plant stem diameter

Perusal of data showed in table 1 reflected that significant differences were noticed due to different nitrogen levels and time of nitrogen application at 60 DAS and at harvest except at 30 DAS. Significantly the maximum stem diameter (1.40 cm and 1.94 cm, respectively) was recorded with 180 kg N ha^{-1} (N_4) and it was at par with 150 kg N ha^{-1} (N_3). While, significantly lowest stem diameter (1.29 cm and 1.76 cm) was recorded with 90 kg ha^{-1} (N_1) at 60 DAS and at harvest respectively. Application of nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4) was recorded significantly the maximum stem diameter (1.38 and 1.93 cm, respectively) and it was at par with $^1/_3$ basal + $^1/_3$ knee height + $^1/_3$ tasseling (T_3) and ½ basal + ¼ knee height + ¼ tasseling (T_2). Whereas, significantly minimum stem diameter (1.29 cm and 1.75 cm) was recorded with application of nitrogen at ½ basal + ½ at knee height (T_1) at 60 DAS and at harvest, respectively. Similar results were confirmed by Kumar (2009) and Singh *et al.* (2012).

Days to 50% tasseling

The experiment result presented in table 1, indicated that the response of days to 50 % tasseling due to different nitrogen levels and time of nitrogen application was found to be significant. Among different rates of nitrogen, day to 50 % tasseling was observed late (55.24 days) in nitrogen rate 180 kg N ha^{-1} (N_4) and A minimum day of 50 % tasseling (51.99 days) was recorded with application of nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4). These results are in full agreement with the findings of Thakur *et al*. (2015).

Yield and yield attributes

The number of cobs per plant, cob length per plant with and without husk, cob diameter per plant with and without husk, cob weight per plant, number of grains per row of cob, number of grain row per cob, number of grains per cob, fresh weight of grain per cob, green cob yield, green fodder yield and harvest index of sweet corn were influenced by nitrogen rates which presented in table 2.

Number of cobs per plant

Data on number of cobs per plant was recorded at harvest of sweet corn as influenced by various nitrogen levels and time of nitrogen application in table 2. Analysis of data indicated that the number of cobs per plant at harvest was found to be not significant under different nitrogen level and different time of nitrogen application.

Cob length

Data with respect to cob length as influenced by various nitrogen levels and time of nitrogen application in table 2. The highest cob length with and without husk (23.78 cm and 17.38 cm, respectively) were obtained in 180 kg N ha^{-1} (N_4). Whereas, significantly lowest cob length with and without husk (20.67 cm and 15.27 cm, respectively) was found in 90 kg N ha^{-1} (N_1). Such an effect of greater cob length due to 180 kg N ha^{-1} could be attributed to its favourable effect on cell enlargement in production of larger leaves and improving photosynthetic efficiency of plants. These results are in tune with the findings reported by Bhatt (2012), Singh *et al.* (2012), Arvadiya *et al.* (2012) and Sunitha and Reddy (2012). A perusal of data showed that cob length was significantly affected by time of nitrogen application. Application nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4) were recorded significantly the maximum cob length with and without husk (23.27 cm and 16.95 cm, respectively) and it was at par with $^1/_3$ basal + $^1/_3$ knee height + $^1/_3$ tasseling (T_3) and ½ basal + ¼ knee height + ¼ tasseling (T_2).

Cob diameter

It was observed from data presented in table 2, that Influence of nitrogen levels and time nitrogen application was found significant on cob diameter with and without husk.

Significantly highest cob diameter with and without husk (5.98 cm and 5.06 cm, respectively) was recorded with nitrogen level 180 kg N ha^{-1} (N_4) and it was at par with 150 kg N ha^{-1} (N_4). Whereas, the lowest cob diameter with and without husk (5.41 cm and 4.69 cm, respectively) was found in 90 kg N ha^{-1} (N_1). The data revealed that the higher cob diameter with and without husk (5.85 cm and 4.98 cm, respectively) were found with application of nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4) and it was at par with treatments $^{1}/_{3}$ basal + $^{1}/_{3}$ knee height + $^{1}/_{3}$ tasseling (T_3) and ½ basal + ¼ knee height + ¼ tasseling (T_2). Whereas, the lowest cob diameter with and without husk (5.54 cm and 4.66 cm, respectively) were found with application of nitrogen at ½ Basal + ½ at knee height (T_1). These results are in partial conformity with those reported by Sunitha and Reddy (2012).

Cob weight per plant

Data presented in table 2, showed that cob weight per plant was influenced significantly by various nitrogen levels. Significantly highest cob weight per plant with and without husk (252.17 g and 210.17 g, respectively) was recorded with 180 kg N ha^{-1} (N_4) and it was at par with 150 kg N ha^{-1} (N_3). Whereas, the lowest cob weight per plant with and without husk (172.42 g and 137.42 g, respectively) was found in 90 kg N ha^{-1}. Among the time of nitrogen application treatments, application of nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4) was found significantly highest cob weight with and without husk per plant (227.11 and 196.08 g, respectively) and it was at par with treatments $^{1}/_{3}$ basal + $^{1}/_{3}$ knee height + $^{1}/_{3}$ tasseling (T_3) and ½ basal + ¼ knee height + ¼ tasseling (T_2). Whereas, the lowest cob weight with and without husk per plant (196.92 g and 150.75 g, respectively) were found with application of nitrogen at ½ basal + ½ at knee height (T_1). These findings are in contrast with the result of Bhatt (2012) and Singh *et al.* (2012).

Number of grains per row of cob

The result of data presented in table 2, grains per row of cob revealed that Among the nitrogen levels tested, 180 kg N ha^{-1} (N_4) was found significantly highest number of grains per row of cob (34.02) and it was at par with nitrogen level 150 kg N ha^{-1} (N_3). Whereas, the lowest number of grains per row of cob (27.19) found in nitrogen level 90 kg N ha^{-1} (N_1). Among the different time of nitrogen application, significantly higher numbers of grains per row of cob (32.46) were found in application of nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4) and it was at par with treatments $^{1}/_{3}$ basal + $^{1}/_{3}$ knee height + $^{1}/_{3}$ tasseling (T_3) and ½ basal + ¼ knee height + ¼ tasseling (T_2). Whereas, the lowest numbers of grains per row of cob (28.78) were found with application of nitrogen at ½ basal + ½ at knee height

(T1). These results are in partial conformity with those reported by Kumar (2009) and Bhatt (2012).

Number of grains row per cob

It was evident from data presented in table 2, that significantly highest number of grains per row of cob (34.02) was recorded with 180 kg N ha^{-1} (N_4) and it was at par with nitrogen level 150 kg N ha^{-1}. Whereas, the lowest number of grain row per cob (13.26) found in nitrogen level 90 kg N ha^{-1} (N_1). Among the treatments time of nitrogen application, significantly higher numbers of grain row per cob (14.38) were found with application of nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4) and it was at par with treatments 1/3 basal + $^{1}/_{3}$ knee height + $^{1}/_{3}$ tasseling and ½ basal + ¼ knee height + ¼ tasseling (T_2). Whereas, the lowest number of grain row per cob (12.32) were found with application of nitrogen at ½ basal + ½ at knee height (T_1). Similar results were confirmed by Kumar (2009) and Bhatt (2012).

Number of grains per cob

Data furnished in table 2, indicated that number of grains per cob was influenced significantly by nitrogen levels and time of nitrogen application. In case of nitrogen levels, 180 kg N ha^{-1} (N_4) was found significantly highest number of grains per cob (454.03) and was at par with nitrogen level 150 kg N ha^{-1} (N_3). Whereas, the lowest number of grains per cob (335.57) found in nitrogen level 90 kg N ha^{-1} (N_1). Among the time of nitrogen application, significantly higher numbers of grains per cob (409.77) were found in application of nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4) and it was at par with treatments $^{1}/_{3}$ basal + $^{1}/_{3}$ knee height + $^{1}/_{3}$ tasseling (T_3) and ½ basal + ¼ knee height + ¼ tasseling (T_2). Whereas, the lowest numbers of grains per cob (340.22) were found with application of nitrogen at ½ basal + ½ at knee height (T_1). These results are collaborated to Sahoo and Mahapatra (2007) and Bhatt (2012).

Fresh weight of grains per cob

Data presented in table 2, show that fresh weight of grain per cob was influenced significantly by various nitrogen levels and time of nitrogen application. In case of nitrogen levels, significantly highest fresh weight of grain per cob (189.95 g) was recorded with nitrogen level 180 kg N ha^{-1} (N_4). Whereas, the lowest fresh weight of grain per cob (154.28 g) found in 90 kg N ha^{-1} (N_1). In treatments time of nitrogen application, significantly highest fresh weight of grain per cob (183.56 g) was found with application of nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4) and it was at par with treatments $^{1}/_{3}$ basal + $^{1}/_{3}$ knee height + $^{1}/_{3}$ tasseling (T_3) and ½ basal + ¼ knee height + ¼ tasseling (T_2). Whereas, the lowest fresh weight of grain per cob (155.69 g) was found with application of nitrogen at ½ basal + ½ at knee height (T1). Statistically significant values recorded for fresh kernel weight with application of 180 kg N ha^{-1} were probably due to availability of adequate and balanced nutrients in the higher nitrogen level, which resulted in heavier and bolder kernels compared to those at lower nitrogen levels. Similar results were also reported by Sahoo and Mahapatra (2007), Kumar (2009), Narayanaswamy and Siddaraju (2011) and Bhatt (2012).

Green cob yield

The mean data on green cob yield of sweet corn as influenced by various nitrogen levels and time of nitrogen application have been presented in table 2. The data revealed that significantly higher green cob yield (132.94 q ha^{-1}) was recorded in nitrogen level 180 kg N ha^{-1} (N_4) and it was at par with nitrogen level 150 kg N ha^{-1} (N_3). Whereas, Significantly higher green cob yield (126.99 q ha^{-1}) was recorded with application of nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4) and it was at par with $^1/_3$ basal + $^1/_3$ knee height + $^1/_3$ tasseling (T_3) and ½ basal + ¼ knee height + ¼ tasseling (T_2). The positive response to higher level of nitrogen on green cob yield could be ascribed to overall improvement in crop growth that enabled the plant to absorb more nutrients, moisture, higher light interception and increased leaf area which might have enabled the plant to accumulate more quantities of photosynthates in the sink. Similar findings of response of sweet corn to higher nitrogen levels were reported by Kumar (2009), Akintoye and Kintomo (2011), Narayanaswamy and Siddaraju (2011), Bhatt (2012) and Singh *et al.* (2012).

Green fodder yield

It was observed from data presented in table 2, that green fodder yield (307.29 q ha^{-1}) of sweet corn was significantly highest with nitrogen level 180 kg N ha^{-1} (N_4) and it was at par with nitrogen levels 150 kg N ha^{-1} (N_3). Among the different time of application, significantly higher green fodder yield (293.14 q ha^{-1}) was recorded with application of nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4) and it was at par with treatments $^1/_3$ basal + $^1/_3$ knee height + $^1/_3$ tasseling (T_3) and ½ basal + ¼ knee height + ¼ tasseling (T_2). Positive response of high nitrogen application at right time on growth parameters like plant height, stem diameter and number of plant leaves directly affect on green fodder yield. These results are in full agreement with the findings of Akbar *et al.* (2002), Kar *et al.* (2006), Kumar (2009), Bhatt (2012) and Singh *et al*. (2012).

Harvest index

The statistical analysis of the data presented in table 2 revealed that the difference in harvest index at harvest was found non-significant due to various nitrogen levels and time of nitrogen levels.

Effect on economics

Perusal of data showed in table 2 reflected that maximum B:C ratio of 4.59 was accrued with nitrogen level 180 kg N ha^{-1} (N_4), and in case of time of nitrogen application, at ¼ basal + ½ at knee height + ¼ tasseling (T_4) was recorded maximum B:C ratio of 4.34, which was followed by application of nitrogen at $^1/_3$ basal + $^1/_3$ knee height + $^1/_3$ tasseling (T_3) with B:C ratio 4.12. This was attributed to higher cob and fodder yield and also chemical fertilizers are cheaper and required less quantity to supply recommended dose of nutrient hence cost of cultivation was lower with application of nitrogen at ¼ basal + ½ at knee height + ¼ tasseling (T_4), ultimately reflected into higher net return and BCR. These results are in partial conformity with those reported by Kumar (2009**).**

Interaction effect on growth, yield attributes and yield of sweet corn

An examination of data presented in table 1 and table 2 interaction effect of different rate of nitrogen and time of nitrogen application treatments revealed that interaction effect of various nitrogen rate and different time of nitrogen application treatments on growth parameters, yield attributes and yield of sweet corn was found not significant.

CONCLUSION

In view of the results obtained from the one-year investigation, it is concluded that the higher green cob and fodder yield with higher net returns can be obtained with application of 180 kg ha^{-1} (N_4) nitrogen and in three splits at time of ¼ basal + ½ at knee height + ¼ tasseling (T_4).

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Table 1: Effect of different nitrogen level and time of nitrogen application on growth parameters of sweet corn

Treatments	Plant population (no. ha^{-1})		Plant height			Leaves $plant^{-1}$ (no.)			Stem diameter (cm)			Days to 50% tasseling
	At 30 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	
(N) Nitrogen levels												
N_1 : 90	70229	67347	37.73	100.18	183.17	5.52	9.82	13.82	0.99	1.29	1.76	51.41
N_1: 120	71790	68226	37.88	102.17	193.43	5.48	10.02	14.48	1.01	1.32	1.83	52.74
N_1: 150	72722	68342	38.60	108.65	204.41	5.80	10.52	15.14	1.03	1.37	1.92	53.91
N_1: 180	73123	69392	39.42	115.78	207.99	5.84	10.96	15.60	1.05	1.40	1.94	55.24
S.Em.±	2346.47	2125.10	0.68	2.50	3.57	0.16	0.29	0.35	0.02	0.02	0.02	0.75
C.D. at 5%	NS	NS	NS	7.23	10.31	NS	0.83	1.00	NS	0.07	0.07	2.16
(T) Time of nitrogen application												
T_1 : ½ Basal + ½ at knee height	70500	66901	37.55	98.95	180.19	5.48	9.46	13.84	1.00	1.29	1.75	55.49
T_2 : ½ Basal + ¼ knee height + ¼ tasseling	71513	68744	37.72	105.72	199.23	5.50	10.34	14.70	1.00	1.34	1.88	53.07
T_3 : $^1/_3$ Basal + $^1/_3$ knee height + $^1/_3$ tasseling	72864	68797	39.08	110.03	201.06	5.76	10.56	15.08	1.02	1.36	1.89	52.74
T_4 : ¼ Basal + ½ at knee height + ¼ tasseling	72986	68865	39.28	112.08	208.52	5.90	10.98	15.40	1.06	1.38	1.93	51.99
S.Em.±	2346.47	2125.10	0.68	2.50	3.57	0.16	0.29	0.35	0.02	0.02	0.02	0.75
C.D. at 5%	NS	NS	NS	7.23	10.31	NS	0.83	1.00	NS	0.07	0.07	2.16
INTERACTION												
N X T	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	11.29	10.77	6.12	8.12	6.27	9.95	9.68	8.13	6.62	5.98	4.25	4.86

Table 2: Effect of different nitrogen level and time of nitrogen application on yield attributes and yield of sweet corn

Treatments	Cobs plant^{-1} (no.)	Cob length (cm)		Cob diameter (cm)		Cob weight plant^{-1} (g)		Grain row cob^{-1} (no.)	No. of grain row^{-1}	Grains cob^{-1} (no.)	Fresh weight of grain cob^{-1} (g)	Green cob yield (q ha^{-1})	Green Fodder yield (q ha^{-1})	Harvest index (%)	B:C
		With husk	Without husk	With husk	Without husk	With husk	Without husk								
(N) Nitrogen levels															
N_1 : 90	1.38	20.67	15.27	5.41	4.69	172.42	137.42	13.26	27.19	335.57	154.28	94.68	241.55	28.08	3.39
N_1: 120	1.25	21.86	15.42	5.66	4.71	194.08	173.08	13.50	28.16	355.97	163.60	105.36	256.98	28.93	3.72
N_1: 150	1.28	23.00	16.53	5.79	4.93	238.27	199.00	13.78	32.77	423.25	182.36	123.00	289.82	29.74	4.29
N_1: 180	1.37	23.78	17.38	5.98	5.06	252.17	210.17	14.14	34.02	454.03	189.95	132.94	307.29	30.02	4.59
S.Em.±	0.05	0.60	0.42	0.07	0.08	7.22	5.62	0.21	0.80	12.12	3.76	4.48	6.85	0.99	-
C.D. at 5%	NS	1.72	1.23	0.21	0.23	20.86	16.23	0.62	2.30	35.00	10.87	12.94	19.79	NS	-
(T) Time of nitrogen application															
T_1 : ½ Basal + ½ at knee height	1.28	20.66	15.28	5.54	4.66	196.92	150.75	12.32	28.78	340.22	155.69	91.07	249.09	26.80	3.27
T_2 : ½ Basal + ¼ knee height + ¼ tasseling	1.32	22.51	15.88	5.70	4.86	212.92	183.58	13.92	30.34	399.98	173.19	117.17	274.37	29.78	4.01
T_3 : $^1/_3$ Basal + $^1/_3$ knee height + $^1/_3$ tasseling	1.38	22.87	16.50	5.75	4.89	220.00	189.25	14.05	30.56	418.84	177.74	120.75	279.05	30.06	4.12
T_4 : ¼ Basal + ½ at knee height + ¼ tasseling	1.30	23.27	16.95	5.85	4.98	227.11	196.08	14.38	32.46	409.77	183.56	126.99	293.14	30.14	4.34
S.Em.±	0.05	0.60	0.42	0.07	0.08	7.22	5.62	0.21	0.80	12.12	3.76	4.48	6.85	0.99	-
C.D. at 5%	NS	1.72	1.23	0.21	0.23	20.86	16.23	0.62	2.30	35.00	10.87	12.94	19.79	NS	-
INTERACTION															
N X T	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-
C.V. %	13.17	9.25	9.10	4.49	5.59	11.68	10.82	5.41	9.04	10.70	7.55	13.62	8.66	11.78	-