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Response of Sweet Corn Hybrid to Transplanting Dates and Nitrogen Levels under Temperate Conditions

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A B S T R A C T

A field experiment on "Response of Sweet corn hybrid to transplanting dates and nitrogen levels under temperate conditions" was conducted at research farm of Faculty of Agriculture (SKUAST-K) during 2016. The soil of the experimental field was silty clay loam in texture, low in soil available N and P and medium in available K and neutral in reaction. The treatments comprised of two transplanting dates *viz.*, 1st of May and 1st of June and five levels of N *viz.*, 0, 30, 60, 90 and 120 kg/ha. Although latter date of sowing resulted in better quality of seedlings but 1st May transplanting was superior in all growth and yield attributes. 1st May transplanting resulted 35.4% and 19.8% higher cob yield and green fodder yield over 1st June transplanting, respectively. Nitrogen application resulted in a significant increase in growth and yield parameters. The green cob yield increased by 34%, 44%, 52%, and 54% respectively at 30, 60, 90 and 120 kg/ha N over control. The corresponding figures for the green fodder yield were 39%, 70%, 91% and 108%, respectively. Highest net profit and benefit cost ratio was realised in 1st May transplanting applied with 120 kg N/ha.

Introduction

The popularity of sweet corn is fast growing across India due to its sweet taste and high nutritional quality. Its consumption at immature stage as roasted and boiled ears is a popular practice as the kernels are sweet, creamy, tender, crispy and almost shell-less. The awareness about sweet corn in Kashmir valley is also growing gradually and may increase further with the growth in tourism industry. Abundant sunshine, moderate temperature and nearly pest free environment of Kashmir valley is suited for high quality and yield of sweet corn. Optimum sowing/transplanting dates is important to maximize the yield and also to sustain the supplies for a longer time keeping in view the perishable nature of the crop. Planting date is a major factor affecting the sweet corn production in addition to other factors such as soil fertility, temperature regimes and irrigation (Ramankutty *et al.*, 2002; Anapalli *et al.*, 2005). Early sowing of sweet corn in first week of April exposes the crop to cold and cut worm damage. The crop can be grown by raising the seedlings under protected conditions and then established using transplanting method. Therefore it was imperative to study the effect of sowing dates on growth and quality seedlings. Earlier planting of corn is preferable because of utilization of the entire growing season, achieving physiological maturity before frost, thereby increasing profit (Lauer *et al.*, 1997) while delays in sowing date reduced individual kernel weight (Cirilo and Andrade, 1996). Among the inputs nitrogen is most critical due to is profound impact on vegetative and reproductive growth of the sweet corn. Nitrogen plays an important role in synthesis of chlorophyll, amino acids and other organic compounds of physiological significance in plant system (Havlin *et al.*, 2005). Therefore a field investigation on the transplanting dates and nitrogen levels was conducted to evaluate the seedling quality and optimize the transplanting dates and N levels for higher growth and yield and profitability of sweet corn.

Materials and Methods

A field experiment was conducted at Faculty of Agriculture, Wadura, Sopore to investigate the response of sweet corn to dates of transplanting and nitrogen levels on the yield and quality of sweet corn. It is located at latitude of 34° 34´ N, longitude 74°40´ E and altitude of 1590 m amsl. The soil of the experimental field was silty clay loam in texture, neutral in reaction, low in available N (210 kg/ha) and P (12.3 kg/ha) and medium in available K (183.5kg/ha). Treatments comprised of two transplanting dates (1^{st} May and 1^{st} June) and five nitrogen levels (0, 30, 60, 90, 120 kg/ha) laid out in RCBD with three replications. The P_2O_5 and K_2O were applied basally @ 60 and 30 kg/ha. Sweet corn variety Sugar-75 of Syngenta was used as the test variety. The seeds were sown in greenhouse on 10^{th} April and 10^{th} May respectively and transplanted at an age of 20 days. Seedlings were raised under protected in poly bags using poting mixture of 400 g of soil: sand: manure in the ratio of 2:1:1. The poly bags were teared at the time of transplanting without disturbing the soil. The crop was irrigated four times each at critical stage of the crop. A spacing of 60 cm x 20 cm was used *i.e.*, a population of 83000 plants /ha. Recommended of dose 60 kg/ha P_2O_5 and 40 kg/ha K_2O was applied as basal application.

Germination percentage and seedling vigour was calculated as per the following formulae;

Germination percentage =

$$\frac{\text{Total no of Seeds Germinated}}{\text{Total no of Seeds Sown}} \times 100$$

Seedling vigour index I

Vigour index I = Germination% × Seedling length

Seedling vigour index II

Vigour index II = Germination% × Seedling dry weight (Abdulbaki and Anderson, 1973).

Calculation of economically optimum N dose

The production function was used to estimate the optimum dose of nitrogen that gives the maximum profit. The mathematical computation in arriving the optimum dose was as follows

$Y = a+bx+cx^2$

$$dy/dx = b+2cx$$

$$X_{opt} = \frac{p/q-b}{2c}$$

Where,

X_{opt} = optimum level of N kg/ha
p = price of N ₹/kg
q = price of green cobs ₹/kg
a, b and c represent regression quotients

Results and Discussion

Seedling quality parameters

All the seedling parameters *viz*., seedling shoot length, seedling root length, seedling fresh and dry weight, germination percentage, no of leaves, seedling vigour index I and II were found to be significantly superior in 10^{th} May sown seedlings (Table 1). Temperature during germination is very important factor as it affects germination and emergence. Therefore, it is fundamental to determine the optimum temperature for the plant. Higher temperature was maintained in the poly-house for 10^{th} May sowing that resulted in high growth rate of the seedlings and thus higher values of various seedling parameters were obtained. Inglett (1970) and Bunting (1971) reported that most maize seed germinated slowly below 10^{o}C and germination increases drastically in the higher temperature regimes. Higher rate of growth resulted in taller seedlings with higher dry matter accumulation that resulted in higher seedling vigour for 10^{th} May sowing. Coleptile length and germination rate were affected by different temperatures (Idikut, 2013). Our findings are in agreement with Bockstaller and Girardin (1994), Peterson *et al.*, (1995) and Varga *et al.,* (2012).

Growth attributes

The data pertaining to the growth parameters *viz.* plant height, dry matter production, leaf area index, no of functional leaves *viz.* were observed to be significantly higher in 1^{st} May of transplanting over the 1^{st} June transplanting (Table 2). The plant height, leaf area index, dry matter accumulation and no of functional leaves increased significantly with increase in N levels (Table 2). The significant decrease in growth parameters following the delay in transplanting can be associated with higher temperatures that the plants in 1^{st} June transplanting limiting their growth period and assimilate building because of early maturity of plants (Moosavi *et al.,* 2012).

Significant effect on the increase on the growth parameters in sweet corn with the application of N may be attributed to the fact that nitrogen being an essential constituent of plant tissue favours rapid cell division and its enlargement, which together with the adequate quantity of phosphorus and potassium helps in the development of the cell size and vegetative growth. Similar results were also obtained by Mullins *et al.,* (1999), Bindhani *et al.,* (2008), Paradar (2005).

Yield attributes and yield

Yield *viz.* number of number of grains/cob, cobs/plant, cob length and cob girth was significantly higher in 1^{st} May transplanting the 1^{st} June transplanting. Earlier transplanting experienced a favourable climate commensurate with various phonological stages of the crop which resulted in superior yield attributes. Similarly green cob yield, green fodder yield and harvest index) were observed to be significantly higher in 1^{st} May transplanting. The cob yield and green fodder yield of 1^{st} May transplanting was 35.4% and 19.8% higher over the 1^{st} June transplanting respectively (Table 3). Superior growth and yield attributes in 1^{st} May transplanting was manifested in higher yield. Yield parameters also increased significantly with increasing N doses.

Table.1 Effect of sowing dates on different parameters of seedlings of sweet corn

Sowing dates	Shoot length (cm)	Root length (cm)	Fresh weight (g)	Dry weight (g)	No. of leaves	Germination (%)	Vigour index-I	Vigour index-II
10th April	19.98	12.26	4.21	1.32	3.60	93.80	3,024	123.3
10th May	23.12	15.54	5.27	1.74	4.80	96.00	3,716.	167.4
SEM$\pm$	1.04	0.79	0.31	0.10	0.36	0.47	165.0	8.64
CD($p \le 0.05$)	3.09	3.19	0.98	0.33	1.08	1.89	495.0	25.92

Table.2 Effect of dates of transplanting and nitrogen levels on growth parameters of sweet corn

Treatments	Plant height (cm)	Leaf area index	No. of functional leaves	Dry matter accumulation (t/ha)
Transplanting dates				
1st May	275.1	5.93	11.26	120.8
1st June	227.6	5.28	10.10	107.9
SEM$\pm$	0.37	0.008	0.04	0.46
CD ($p \le 0.05$)	1.11	0.025	0.13	1.39
Nitrogen levels (kg/ha)				
0	231.5	5.19	9.55	81.6
30	242.1	5.45	10.28	111.0
60	250.2	5.61	10.73	118.6
90	258.7	5.76	11.08	126.0
120	274.2	6.04	12.10	134.6
SEM$\pm$	0.59	0.013	0.07	0.73
CD ($p \le 0.05$)	1.76	0.039	0.21	2.20

Table.4 Effect of dates of transplanting and nitrogen levels on green cob yield t/ha (without husk) of sweet corn

	N_0	N_{30}	N_{60}	N_{90}	N_{120}	Mean
1st May	8.19	12.04	14.61	17.01	17.98	13.97
1st June	5.95	9.42	10.67	12.66	12.91	10.32
Mean	7.07	10.73	12.64	14.83	15.44	
	Dates of transplanting	Nitrogen levels				C.D N x D
C.D($p \le 0.05$)	0.30	0.47				0.66

Table.3 Effect of dates of transplanting and nitrogen levels on yield attributes yield of sweet corn

Treatments	No of grains/cob	No of cobs/plant	Cob length (cm)	Cob girth (cm)	Weight/ cob (g)	Green cob yield (t/ha)	Green fodder Yield (t/ha)	Harvest Index (%)
Transplanting dates								
Ist May	568	1.30	16.89	13.39	261.8	13.97	23.30	35.40
Ist June	497	1.21	15.69	12.92	245.0	10.32	19.44	34.19
SEM±	10.48	0.006	0.22	0.10	4.33	0.09	0.07	0.11
CD ($p \leq 0.05$)	31.37	0.017	0.67	0.30	12.97	0.30	0.22	0.34
Nitrogen levels (kg/ha)								
0	324	1.01	13.87	11.90	178.3	7.07	13.22	28.65
30	477	1.15	14.85	12.42	216.5	10.73	18.39	32.30
60	578	1.28	16.50	13.32	251.9	12.64	22.43	35.76
90	617	1.36	17.72	13.95	303.0	14.83	25.26	38.39
120	664	1.48	18.52	14.18	317.6	15.44	27.53	38.87
SEM±	16.57	0.009	0.35	0.16	6.85	0.15	0.11	0.18
CD ($p \leq 0.05$)	49.61	0.026	1.06	0.48	20.50	0.47	0.35	0.53

Fig.1 Effect of dates of transplanting and nitrogen on cob yield t/ha (without husk) of sweet corn

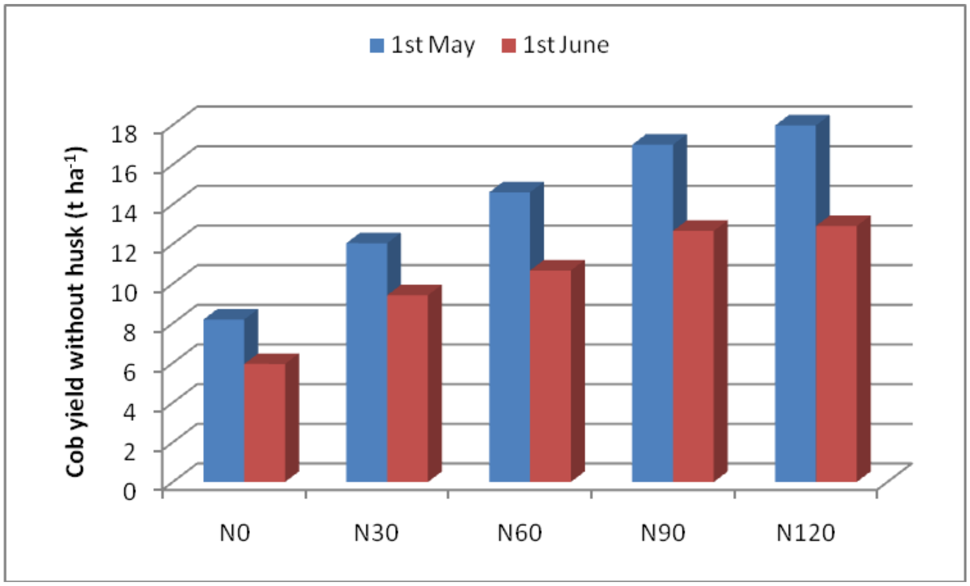
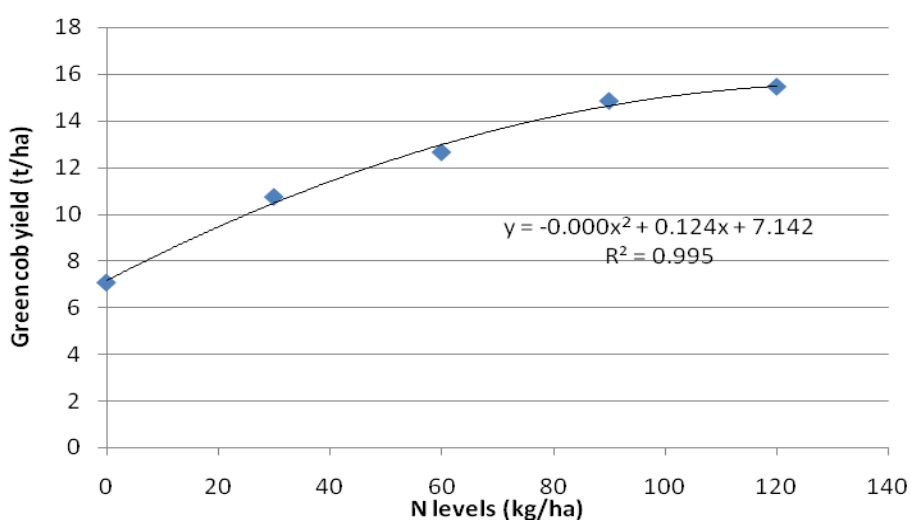


Fig.2 Relationship of sweet corn yield and N levels



The green cob yield increased by 34%, 44%, 52%, and 54% respectively at 30, 60, 90 and 120 kg/ha N over control (Table 3). The data presented in Table 4 also shows that the interaction of dates of transplanting and N levels with regard to green cob yield was significant. The increase in green cob yield with increase in N levels was significant up to 120 kg N/ha in 1st May transplanting whereas the yield increased significantly only up to 90 kg N/ha in 1st June transplanting. A yield of 17.98 t/ha was obtained at 120 kg N /ha in 1st May transplanting whereas, the yield obtained with 120 N kg/ha in 1st June transplanting was only 12.91 t/ha which was at par with 90 kg N/ha (12.66 t/ha). Thus 1st May transplanting showed higher response to N than 1st June transplanting (Fig. 1). Delayed transplanting of sweet corn resulted in a significant decline in the yield contributing components *i.e*. cob length, cob weight, cob girth, number of cobs per plant and number of grains per cob etc. This might be due to reduction in growth period, higher temperature which increased the respiration rate of plant resulted in reduced net photosynthates, decreased translocation rate of photosynthates from source to sink. Khan *et al.,* (2002), Williams, (2008) and Namakka *et al.,* (2008) reported similar results. On the other hand the earlier sown crop was exposed to better growing conditions that resulted in higher biomass production and yield.

The results indicated that application of higher N doses significantly increased cob length, cob diameter, weight of cob with and without husk, number of cobs/plant, grains/cob and number of rows/cob. The increased availability of photosynthates might have enhanced number of flowers and their fertilization resulting in higher number of filled cobs and grains/cob.

Optimum economic dose and relative economics

The economically optimum dose has been estimated through production functions by the procedure discussed in detail in the materials and methods Thus, economically optimum N dose calculated was 132 kg/ha *i.e.,* increasing the fertilizer dose of N even upto 132 kg/ha is economically viable for the farmer and will result in higher returns (Fig. 2). In present investigation it was observed that early sowing on 1st May with 120 kg/N ha recorded higher net profit and benefit cost ratio of ₹ 696423 and 8.5, respectively. The reason was higher number of cobs and green fodder yield in this treatment combination than others without any addition in cost of cultivation. These results are in accordance with the findings of, Sharma *et al.,* (2000), Mokhtarpour *et al.,* (2005), Suthar *et al.,* (2014) and Chouhan *et al.,* (2015).

From this study it was concluded that 1st May transplanting was superior in producing higher sweet corn and green fodder yield. Among the N levels, 120 kg/ha produced significantly higher sweet corn and fodder yield for 1st May transplanting.

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