Variety Trials

Response of Selected Sweet Corn Cultivars to Nitrogen Fertilization

C.A. Mullins,¹ R.A. Straw,²
B. Pitt, Jr.,³ D.O. Onks,⁴
M.D. Mullen,⁵ J. Reynolds,⁶
and M. Kirchner⁷

ADDITIONAL INDEX WORDS. **vegetable production, genotypes, nutrition**

SUMMARY. 'Silver Queen', 'Incredible', and 'Challenger' sweet corn (*Zea mays* L.) cultivars were evaluated at

Use of trade names does not imply endorsement by the Univ. of Tennessee. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

¹Professor, University of Tennessee Plateau Experiment Station, 320 Experiment Station Road, Crossville, TN 38555-2133.

²Research associate, University of Tennessee Plateau Experiment Station, 320 Experiment Station Road, Crossville, TN 38555-2133.

³Research assistant, University of Tennessee Highland Rim Experiment Station, 3181 Experiment Station Road, Springfield, TN 37172.

⁴Former superintendent, University of Tennessee Highland Rim Experiment Station, 3181 Experiment Station Road, Springfield, TN 37172.

⁵Associate professor, University of Tennessee, Institute of Agriculture, Department of Plant and Soil Sciences, P.O. Box 1071, Knoxville, TN 37901-1071.

⁶Professor, University of Tennessee, Institute of Agriculture, Department of Plant and Soil Sciences, P.O. Box 1071, Knoxville, TN 37901-1071.

⁷Research associate, University of Tennessee, Institute of Agriculture, Department of Plant and Soil Sciences, P.O. Box 1071, Knoxville, TN 37901-1071.

different nitrogen (N) fertilization rates at Springfield, Tenn., in 1993, 1994, and 1995. 'Incredible' was more productive than 'Silver Queen' and 'Challenger'. Of the three cultivars, 'Silver Queen' had the tallest plants, longest ears, and most attractive ears. Nitrogen fertilization rates were 0, 50, 100, and 150 (100 lb/acre at planting and 50 lb/acre sidedressed) lb/acre (0, 56, 112, and 168 kg·ha⁻¹). The 100 lb/acre rate of N applied at planting appeared to be sufficient for producing sweet corn in soils with an annual cropping frequency. Height of plants and ear diameters were larger at the higher fertilization rates, but differences among treatments were not great and were usually not significant. The cultivars of different genetic types did not differ in response to N fertilization rates. Cultivar × year interactions were significant for most factors evaluated, but most other interactions were not significant.

Corn requires relatively high N fertilization rates compared to most other field crops. The recommended N rate for field corn is from 120 to 240 lb N/acre (134 to 269 kg·ha⁻¹) when grown for grain and 120 to 180 lb N/acre (134 to 202 kg·ha⁻¹) when grown for silage and based on anticipated yields (Savoy, 1996). A split application is recommended for N rates >120 lb N/acre (132 kg·ha⁻¹).

The N rate recommended for sweet corn in Tennessee is 90 lb/acre (101 kg·ha⁻¹) at planting and 30 lb/acre (34 kg/ha) sidedressed when plants are 12 to 18 inches (30.5 to 45.7 cm) tall (Savoy, 1996). Present recommendations are for all cultivars and all soil types. Maximum yields were obtained between 60 and 90 lb N/acre (67 to 101 kg·ha⁻¹) in previous research trials on the Cumberland Plateau in Tennessee (Straw et al., 1993). This trial was on a Lily sandy loam soil and cultivars were 'How Sweet It Is' and 'Silver Queen'. Recommended N fertilization rate for sweet corn in the midwestern U.S. is 100 lb/acre (112 kg·ha⁻¹) broadcast preplant and 12 lb/acre (14.4 kg·ha⁻¹) banded at planting as starter fertilizer (Foster et al., 1995).

Several genetic types of sweet corn are commercially available. Most Tennessee producers grow *normal sugary* (*su*) genotype cultivars. Several cultivars of the *sugary enhanced* (*se*) sweet

corn genotype have become popular for roadside stands due to their excellent flavor and better keeping quality characteristics. *Shrunken-2* (*sh₂*) genotype corn cultivars have improved post harvest storage quality characteristics compared with the *se* genotype and have become quite popular among growers and consumers. Therefore, *sh₂* genotype cultivars are grown for shipping or storage for long periods of time. The University of Tennessee (UT) Extension Service recommends several *sh₂* genotype cultivars. 'Challenger' was the first *sh₂* genotype cultivar to be recommended and is a currently recommended cultivar (Rutledge, 1996b). Some *sh₂* genotype cultivars are difficult to establish in the field, especially in cool and wet soils (Rutledge, 1996b). These cultivars also require isolation from other types of corn for successful production.

Sweet corn is grown commercially, mostly for local sales, in every county in Tennessee (Rutledge, 1997b). Cultivars of all three genotypes are grown in the mostly small acreage plots, although 'Silver Queen' is one of the most widely grown cultivars. Tests were conducted at the UT Highland Rim Experiment Station at Springfield in 1993, 1994, and 1995 to evaluate the effect of different rates of N fertilization on plant growth, yield and ear size and ear appearance of selected sweet corn cultivars.

Materials and methods

Cultivars selected for the study were 'Silver Queen' (*su* genotype), 'Incredible' (*se* genotype), and 'Challenger' (*sh₂* genotype). These cultivars have excellent flavor, mature late (85- to 90-d growing season), yielded well in previous UT trials, and are recommended for production in Tennessee by the UT Agricultural Extension Service (Rutledge, 1997a). 'Silver Queen' has white kernels while 'Incredible' and 'Challenger' have yellow kernels. Preplant P and K fertilizer applications were based on soil test results and were 250 lb/acre (280 kg·ha⁻¹) of 0-20-20 fertilizer. Nitrogen fertilization test rates were 0, 50, 100, and 150 lb/acre (0, 56, 112, and 168 kg·ha⁻¹) and N source was ammonium nitrate. The 50 and 100 lb/acre (56 and 112 kg·ha⁻¹) rates of N were applied preplant broadcast while the highest rate of N included 100 lb/acre (112 kg·ha⁻¹) preplant broadcast and 50 lb N/acre (56

kg·ha⁻¹) sidedressed ≈7 weeks after planting when plants were 18 to 24 inches (45.7 to 60.9 cm) tall. Plots were of 4 rows, each 30 inches (76.4 cm) apart and 30 feet (9.1 m) long. Plots were overseeded with an Almaco cone plot planter (Almaco; Nevada, Iowa) and thinned ≈3 weeks after planting to a desired population of 23,500 plants per acre (58,045 plants/ha).

Soil type at the test sites was a Dickson silt loam (fine-silty, siliceous, thermic, Glossic) and soil pH was near 6.0. The sites were cropped regularly with tobacco, field corn, or soybeans. A different site was used each year. Planting dates were 11 May 1993, 20 May 1994, and 8 May 1995. Insecticides, primarily pyrethroids, were applied as needed for insect control on a 3- to 5-d frequency, starting at silking. Corn was hand harvested at maturity, which occurred 85 to 90 d after planting. Two harvests were made for each cultivar each year. Records taken at harvest included plant population, plant height (average of five plants per plot from ground to tip), plant diameter [average of five plants per plot taken 12 inches (30.5 cm) above ground], ear set height (average of five plants per plot taken from ground to base of the ear), yield, ear weight, leaf

total nitrogen level, ear length, ear diameter, external appearance rating, and internal appearance rating. Five ears per plot were selected and used for each measurement.

Total leaf N concentrations were determined by collecting ear leaves from 10 plants selected randomly in each plot. Leaves were dried and ground in a cyclone mill to pass through a 1-mm sieve. Total N was analyzed using a N analyzer (model N1500; Carlo-Erba Instruments, Milan, Italy) in 1993 and 1994 and using a C, N, and S analyzer (CNS2000; LECO Corp., St. Joseph, Mo.) in 1995. External and internal ear appearance was rated on a 1 to 10 scale, with 10 being the most attractive. External appearance was based on shuck color, ear cover, and presence of flag leaves. Internal appearance was based on straightness of rows of kernels, brightness of kernels, size of kernels, and general appearance of the ears after removing the husks.

The experimental design was a randomized complete block with a split-plot factorial arrangement of treatments in each of four replications. Main plots consisted of N fertilization rates, while split plots were comprised of cultivars. Data were analyzed by

analysis of variance and regression methods. Means were separated by Duncan's multiple range tests ($P < 0.05$). Although the high N rate was applied in a split application, regression analysis was for the total rate of applied N.

Results and discussion

Plant population was not significantly influenced by nitrogen fertilization rate or cultivar (Table 1). The population of productive sweet corn plants was near 22,000 plants/acre (54,340 plants/ha), slightly lower than the target of 23,500 plants/acre (9,518 plants/ha). Some plants failed to develop properly after planting and some plants were lost to various causes. The seed size and germination variability among cultivars and seed lots can make planting very difficult, especially with plate-type and finger-type planters. Adverse weather conditions reduce germination and seedling establishment, adding another problem to achieving a precise stand (Rutledge, 1997b).

The *sh₂* genotype sweet corn cultivars often have over 3,000 seeds/lb (6600 seeds/kg), a relatively large number for sweet corn. These small seeded cultivars often do not germinate well, especially in cool and wet

Table 1. Effect of N fertilization rate, cultivar, and year on plant population, plant height, plant diameter, and height^a of ears above ground, Highland Rim Experiment Station, Springfield, Tenn., 1993–95.

Parameter	Population (plants/acre)	Plant ht (inches)	Plant diam (inches)	Ear ht (inches)
N rate (lb/acre)				
0	22,409	70	0.81	31
50	21,756	70	0.81	29
100	21,465	70	0.82	30
150	21,756	70	0.82	31
Linear	NS	NS	NS	NS
Quadratic	NS	NS	NS	NS
Cultivar (C)				
Silver Queen	21,635 ^y	80 a	0.85 a	36 a
Incredible	21,925	70 b	0.84 a	30 b
Challenger	21,980	60 c	0.76 b	24 c
Year (Y)				
1993	21,236 b	58 c	0.77	27 b
1994	20,782 b	83 a	0.86	33 a
1995	23,522 a	70 b	0.82	---
Interaction				
N × Y	NS	NS	NS	NS
N × C	NS	NS	NS	NS
C × Y	*	*	*	*
N × C × Y	NS	NS	NS	NS

^a1 acre = 0.4 ha, 1 inch = 2.54 cm, and 1 lb = 0.4536 kg.

^yTreatment means within a column followed by the same letter are not significantly different at $P = 0.05$. Absence of letters following means of cultivar and year parameters indicates no significant difference.

NS, *Nonsignificant or significant at $P = 0.05$.

soils. Some lots of 'Silver Queen' have been observed to have relatively small seed which are comparable in the number of seeds/lb for *sh₂* genotype cultivars. Small seeds of the *sh₂* genotype cultivars and probably of the *su* genotype cultivars do not germinate well in cool and wet soils. However, if 25,000 seeds are planted/acre (61,750 seeds/ha), this should result in a final population that exceeds 20,000 plants/acre (49,400 plants/ha) (Rutledge, 1997b). 'Challenger' (*sh₂* genotype cultivar) seeds appeared to germinate well in this planting as the plant population was equal to that of the other cultivars even though soils were still moderately cool at 55 to 60 °F (12.8 to 15.5 °C) at the early May planting dates.

Plant height and diameter were not influenced by N fertilization level (Table 1). 'Silver Queen' had the tallest plants with ears set higher above ground while 'Challenger' had the shortest plants with ears set closer to the ground. 'Silver Queen' and 'Incredible' had a larger plant diameter than 'Challenger'. A shorter plant with larger diameter usually has less lodging and is usually more suitable for mechanical harvest. 'Silver Queen' is usually not mechanically harvested due to excessive plant growth and lack of

uniform maturity. This cultivar has been widely grown and hand harvested for local sales in Tennessee and in the southeastern U.S. 'Challenger' is well adapted to mechanical harvest (Rutledge, 1997b).

Plant height and height of ear above ground were highest in 1994 and lowest in 1993 (Table 1). The growing seasons were characterized as very hot and dry in 1993, moderate in 1994, and moderately hot and dry in 1995. Yield of field corn was 2240 lb/acre (2,511 kg-ha⁻¹) lower in 1993 than in 1992 due to the hot dry weather conditions (Guinn, 1994). Although overhead sprinkler irrigation was utilized at critical ear development periods to compensate for evapotranspiration, the unusually high temperatures encountered at the test location in 1993 were a limiting factor to plant growth and crop production. The cultivar year interaction was significant for plant population, plant height, plant diameter, and height of ear above ground.

Marketable yields in ear number and yield, individual ear weight, and total nitrogen were increased linearly in response to increasing N fertilization rate (Table 2). 'Incredible' was the most productive cultivar. Ears of 'Challenger' had the least mass, but

were acceptable size for packing in boxes for fresh market shipment. Nitrogen levels in the ear leaf increased as N fertilization rates increased (Table 2). 'Challenger' had lower leaf N levels than 'Silver Queen' and 'Incredible'. The Cultivar year interaction was significant for yield in doz/acre, yield in tons/acre, individual ear weight, and total N. 'Incredible' had high yields in all three years of the trials (data not shown). 'Silver Queen' yields were as high as those of 'Incredible' in 1994, but lower than yields of 'Incredible' and 'Challenger' in 1993 and 1995 (data not shown). These results suggest that 'Incredible' may be less sensitive than 'Silver Queen' to adverse environmental conditions, especially to heat stress.

Ear diameter and external appearance were significantly different due to N fertilization rate (Table 3). Increased N, as expected, increased ear diameter. Ears of 'Silver Queen' and 'Incredible' were longer than ears of 'Challenger'. Ears of 'Silver Queen' had the smallest diameter. 'Silver Queen' and 'Incredible' had higher ratings than 'Challenger' for internal ear appearance. Perhaps some partiality was shown because of the familiarity with 'Silver Queen', a popular cultivar in Tennes-

Table 2. Effect of nitrogen fertilization rate, cultivar, and year on yields, ear weight, and leaf tissue total N² of sweet corn, Highland Rim Experiment Station, Springfield, Tenn., 1993–95.

Parameter	Yield (doz ears/acre)	Yield (tons/acre)	Ear wt (ounces/ear)	Total N (%)
N rate (lb/acre)				
0	974	2.5	7.0	1.50
50	1,133	3.1	7.4	1.71
100	1,262	3.6	7.7	1.81
150	1,256	3.7	7.8	1.89
Linear	*	*	*	*
Quadratic	NS	NS	NS	NS
Cultivar (C)				
Silver Queen	1,019 b ^y	3.2 b	8.1 a	1.81 a
Incredible	1,398 a	4.0 a	7.9 a	1.86 a
Challenger	1,053 b	2.5 c	6.4 b	1.54 b
Year (Y)				
1993	1,204 b	2.9 b	6.4 b	1.74
1994	1,352 a	4.1 a	8.1 a	1.78
1995	914 c	2.7 b	7.8 a	1.69
Interaction				
N × Y	NS	*	NS	*
N × C	NS	NS	NS	NS
C × Y	*	*	*	*
N × C × Y	NS	NS	NS	NS

²1 acre = 0.4 ha, 1 ton = 907.2 kg, 1 ounce = 28.35 g, and 1 lb = 0.4536 kg.

^yTreatment means within a column followed by the same letter are not significantly different at $P = 0.05$. Absence of letters following means of cultivar and year parameters indicates no significant difference.

NS, *Nonsignificant or significant at $P = 0.05$.

Table 3. Effect of nitrogen fertilization rate, cultivar, and year on ear dimensions^z and appearance^y of sweet corn, Highland Rim Experiment Station, Springfield, Tenn., 1993-95.

Parameter	Ear length (inches)	Ear diam (inches)	Internal appearance (rating)	External appearance (rating)
N rate (lb/acre)				
0	7.3	1.6	7.4	8.0
50	7.5	1.7	7.9	8.0
100	7.5	1.8	7.9	8.1
150	7.5	1.8	7.8	7.8
Linear	NS	*	NS	*
Quadratic	NS	NS	NS	NS
Cultivar (C)				
Silver Queen	7.6 a ^x	1.6 c	8.7 a	9.5 a
Incredible	7.5 a	1.8 a	7.6 b	7.1 b
Challenger	7.2 b	1.7 b	7.1 b	6.5 c
Year (Y)				
1993	7.3 b	1.6 b	8.0 a	7.6
1994	8.0 a	1.8 a	8.3 a	7.8
1995	7.1 b	1.8 a	7.1 b	---
Interaction				
N × Y	NS	NS	NS	NS
N × C	NS	*	NS	NS
C × Y	*	*	NS	*
N × C × Y	NS	NS	NS	NS

^z1 inch = 2.54 cm, 1 lb = 0.4536 kg, and 1 acre = 0.4 ha.

^yAppearance ratings of 1 to 10, where 1 = poor appearance and 10 = excellent appearance.

^xTreatment means within a column followed by the same letter are not significantly different at $P=0.05$. Absence of letters following means of cultivar and year parameters indicates no significant difference.

NS, * Nonsignificant or significant at $P=0.05$.

see for ≈30 years. 'Silver Queen' had darker green husks than 'Incredible' and 'Challenger'. And two very prominent and attractive flag leaves that were not present with the other cultivars and resulted in it's better appearance rating.

The cultivar year interaction was significant for ear length, diameter, and external appearance (Table 3). The cultivar nitrogen interaction was significant for ear diameter.

Conclusions

Although the 0 lb/acre N fertilization rate did not result in a crop failure of sweet corn, the 100 lb/acre (112 kg/ha) rate of N applied at planting appeared to be sufficient for production of sweet corn in soils with an annual cropping frequency. Nitrogen fertilization slightly increased plant growth and ear size, but differences among treatments were not great and were usually not significant. This test supports the 120 lb N/acre (134 kg/ha) recommendation for production of sweet corn in Tennessee as adequate and probably not in great excess for a high value crop. 'Incredible' was the highest yielding cultivar. 'Silver Queen' had the largest plants, longest ears,

and most attractive ears. The cultivar year interactions were significant for most factors evaluated, but most other interactions were not significant. The cultivars of different genotypes did not respond differently to N fertilization.

Literature cited

- Foster, R., R. Latin, E. Maynard, R. Weinzierl, H. Taber, and B. Barrett. 1995. Midwest vegetable production guide. Purdue Univ. Coop. Ext. Serv. ID-56.
- Guinn, B. 1994. Tennessee farm facts. Tennessee Dept. Agr.-Agr. Stat. Serv. 94(01):1-14.
- Rutledge, A.D. 1997a. Recommended commercial vegetable cultivars for Tennessee 1997-1998. Tenn. Agr. Ext. Serv. PB 418.
- Rutledge, A.D. 1997b. Guidelines for producing sweet corn for shipment. Tenn. Agr. Ext. Serv. P+SS# 289.
- Savoy, Jr., H.J. 1996. Lime and fertilizer recommendations for the various crops of Tennessee. Tenn. Agr. Ext. Serv. P+SS Info#185.
- Straw, R.A., C.A. Mullins, D.L. Coffey, and G.M. Lessman. 1993. Nitrogen fertilization of sweet corn varieties. Tenn. Farm Home Sci. 166:20-24.