Effect of Increasing Population on Ear Size of SE Synergistic Sweet Corn, var. 'Montauk'

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Introduction

The sweet corn variety 'Montauk' is a popular variety among fresh market producers. It is consistently a customer favorite for its excellent flavor and large size. But for wholesale growers it can be a challenge. Variety evaluations at Purdue University in 2010 showed Montauk to be among of the largest in size and the heaviest ear of 11 SE varieties tested. Wholesale growers in Connecticut have complained that Montauk is too large an ear to fit sixty ears in a standard 5-dozen bag.

Several growers have reported increasing sweet corn populations of certain Synergistic SE varieties such as Montauk to as high as 40K plants per acre without a decrease in quality. Typically the effects of increasing population would be a decrease in individual plant size due to limited resources such as fertilizer, water and space. With Montauk, a reduced ear size with no drop in quality would be a good thing. So a field experiment was conducted to determine if increasing population size will decrease ear size, making it easier to pack, while remaining marketable.

Experimental Design 1: This experiment was conducted at the Griswold Research Center in Griswold, CT on a very well drained Windsor loamy sand in 2011 and 2012. The experiment design was a randomized complete block design with four replications. There were five treatment populations (25K, 30K, 35K, 40K and 45K plants per acre) in 2011 and 4 populations in 2012 (Table 1). Treatments were planted in blocks 10 feet by 40 feet. Row spacing was 2.5 feet or four rows per plot. Treatments direct seeded by hand at in-row spacing indicated in Table 1.

Table 1. Treatment in-row spacing.

	2011	**2011**	**2012**	**2012**
Treatment	Population (plants/Acre)	In-row Spacing (inches)	Population (plants/Acre)	In-row Spacing (inches)
1	25,000	8.5	26136	8
2	30,000	7	29870	7
3	35,000	6	34848	6
4	40,000	5.25	41818	5
5	45,000	4.75		

All treatments received 60 lb. N – 120 lb. P – 120 lb. K broadcasted and incorporated before planting and were sidedressed with N in the form of ammonium sulfate as determined by PSNT. Weeds were controlled with Lumax herbicide at 2.5 qt per acre. Insects were monitored but no sprays for insects were applied in either year.

Experimental Design 2: This experiment was conducted at the University of Connecticut Plant Science Research Farm in Storrs, CT on a Paxton and Montauk fine sandy loam in 2011 and 2012. The experiment used a split-plot design with the main factors being conventional tillage and deep zone tillage (DZT). The sub factors were the population treatments with in-row spacing of 8, 6 and 4 inches and between row spacing of 30 inches. Population treatment plots were randomized within each tillage treatment strip and replicated four times. The field was planted with a Matermacc vacuum planter. Weeds were controlled with a single post-emergence application of Impact (topramezone, 0.75 oz./A), 1% methelated seed oil, and 10 lbs./A ammonium sulfate. All treatments received 120 lb. N – 60 lb. P – 90 lb. K broadcast, either incorporated (conventional-till) or unincorporated (DZT), before planting and were banded with 48 - 24 - 36 at planting. An additional 100 lb./A of urea (45 lb. actual N) were sidedressed in 2011 due to excessive rainfall, but not in 2012.

Data collection: Sixty ears were harvested, weighed and packed to evaluate the effect of population on ear size and ease of packing in a five-dozen bag. Ears were harvested from the center two rows of each plot, starting in the center of each plot and leaving at least five feet on each end. From these sixty ears, a random subsample of ten ears was husked and measured in length and width to further evaluate the effect of population on ear size. Tip fill of these ten ears was then evaluated using the following rating scale: 5: kernels filled to tip of cob, 4: < 0.5 inch unfilled, 3: 0.5-1 inch unfilled, 2: > 1 inch unfilled, 1: > 2 inches unfilled. Data was analyzed using linear regression. Tip fill was rated in Griswold and Storrs only in 2011.

Results:
Griswold Yield Data: The data collected in both years and at both sites showed a trend of decreasing weight and size of ears as population increased. The statistical analysis for this study was linear regression. For our study regression analysis tells us how well you can predict the change in the weight and size of the ear as the population increased. If our data followed a linear regression the ear would get smaller at a steady, predictable rate as the population increased. The yield data are shown in the following tables:

Table 1. 2011 Griswold yield averages

Population	Weight (lbs.)	Length (inches)	Width (cm)	Tip-fill rating
25,000	53.5	8.1	4.9	4.3
30,000	48.6	8.3	4.8	4.0
35,000	53.0	8.2	5.0	3.8
40,000	49.1	8.0	4.9	3.4
45,000	43.4	7.6	4.5	2.6
Significance F<0.05	*NS*	*NS*	*NS*	**

In Griswold in both years, weight and size of ears were reduced by increasing population. In 2011 the data did not however follow a linear pattern of decrease. Differences are small until you get to the highest population when it drops off sharply. The tip-fill rating showed a strong fit in the linear regression model indicating that the quality of the ear was dropping as population increased. So, from a marketability standpoint, though the size is still sellable (7.5 inches long and 2 inches wide), 1 inch of no tip-fill might not be acceptable.

The 2012 yield data (table 2) followed the linear regression model much more closely. Population increases caused decreases in weight for every treatment. One possible explanation for this is the weather. We had a dry first half of the summer in 2012 which could have amplified the effect of competition even with small increases in population.

Table 2. 2012 Griswold yield averages

Population	Weight (lbs.)	Length (inches)	Width (cm)	% Skipped
26136	54.3	8.3	5.1	7.3 (64.75)
29870	51.0	8.3	4.9	12.7 (69)
34848	50.1	8.1	4.9	15.9 (71.5)
41818	45.3	8.0	4.8	19.2 (74.75)
Significance F<0.05	*	*NS*	*	*

While harvesting in 2011, both researchers observed a trend that as population increased there seemed to be more plants that were either too small to harvest or still had yellow silk, indicating a delay in maturity. So, in 2012 these skips were counted as part of the data collection. The number of plants that had to be past by in each plot because of immaturity increased steadily as population increased. The numbers in parentheses in table 2 are the average number of plants it took to get 60 ears.

Storrs Yield Data: The weight and ear size decreased as population increased in both years in Storrs for both conventional-till and DZT plots. Tables 3 and 4 show the treatment averages for 2011 and 2012. As was the case in Griswold, the weight of ears stayed relatively equal until the highest population treatment in 2011 which caused a decrease in weight of 14%. In both years, the size of the ear remained similar: length and width measurements varied by 5% or less. All harvested ears had full tip fill in all treatments in 2011 and therefore was not measured in 2012.

Table 3. 2011 Storrs yield averages

		Conv			DZT	
Population	Weight (lb.)	Length (in.)	Width (cm)	Weight (lb.)	Length (in.)	Width (cm)
26134	42.6	7.8	1.6	45.9	7.9	1.7
34846	42.4	7.8	1.6	46.2	8.0	1.7
52269	36.6	7.6	1.5	41.4	7.7	1.7
F<0.05	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*

As part of the experiment design in Storrs, a test was done to compare the main plot treatments of conventional tillage and DZT. A t-test was performed to compare the means of all the measurements in one tillage type versus the means of the other tillage type. In 2011 DZT had significantly higher weight than conventional tillage and visually the kernels and ears appeared more mature. The higher ear weight may reflect improved drainage in the DZT plots in 2011 when over 63 inches of precipitation were recorded in Storrs. There was no statistical difference between the tillage methods for weight in 2012, although weights were slightly higher in conventionally tilled plots. The length was not statistically different in 2011, but it was in 2012, with ears in the conventionally tilled plots being slightly longer than in DZT plots. There were no differences in width between tillage methods in either year.

Table 4. 2012 Storrs yield averages

		Conv			DZT	
Population	Weight (lb.)	Length (in.)	Width (cm)	Weight (lb.)	Length (in.)	Width (cm)
26134	52.5	8.0	2.0	50.8	7.8	1.9
34846	48.1	7.8	1.8	45.8	7.6	1.8
52269	43.3	7.8	1.8	41.8	7.6	1.8
F<0.05	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*

Table 5. Storrs tillage comparison

t-test		2011			2012	
	Weight	Length	Width	Weight	Length	Width
Conv	40.53	7.736	1.585	47.96	7.865	1.867
DZT	44.47	7.896	1.672	46.08	7.625	1.838
P<0.05	*	NS	NS	NS	**	NS

Economic Analysis: The data indicates that increasing planting population on Montauk sweet corn will not impact the marketability. This research was done using standard recommendations for fertilizer and herbicides. Insecticide and irrigation were not used at either site. Increased expenses for producing higher population plantings include higher seed and bag costs. Increased income was generated by harvesting higher marketable yields. Table 6 shows the potential economic gain from increasing population at $8.00 per bag (CT Weekly Ag Report, Aug. 2012).

Table 6. 2012 Griswold economic gain per acre

Seeding Rate	Seed Cost	Ears Harvested	No. Bags Harvested	Gross	Increase[1]
26136	$183.30	21805	363	$2904	$0
29870	$211.50	23469	391	$3128	$184.60
34848	$246.75	26376	440	$3520	$521.75
41818	$296.10	30410	507	$4056	$981.60

1. The increase is the difference between the gross of the standard population (26K) versus the increased population gross. That number is then reduced by the extra cost of seed and bags.

Conclusions: Increasing population of 'Montauk' sweet corn did decrease the weight, length and width of ears, which made it easier to pack and carry 5-dozen ear bags. However, the length and width were not reduced so much as to make the ear unmarketable. At both locations in both years ear length remained about 7.5 inches at the highest population. Quality (tip fill) decreased and the number of immature ears increased when the population was above 40,000 plants per acre. No extra fertilizer or pesticide was needed to produce the crop, only seed, bags and possibly labor. Additional profit should be attained whether wholesaling or retailing using high-density plantings of Montauk.