REPORT TO THE OREGON PROCESSED VEGETABLE COMMISSION, 1996-97

TITLE: Pre-sidedress Soil Nitrate Testing in Sweet Corn

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PROJECT STATUS: Continuing

FUNDING: $14,000 in 1996-97. Funds spent for plant and soil analysis, sample collection, travel to grower fields, plot maintenance and harvest.

OBJECTIVES FOR 1996:

To evaluate the use of pre-sidedress testing of soil nitrate content (PSNT), leaf chlorophyll content, and leaf tissue N, to predict the level of additional N needed to grow the crop to good yield and quality.

PROGRESS REPORT:

NWREC plots

'Jubilee' sweet corn was planted to 15 x 30-foot plots on 30-inch row spacing on May 26. At planting, N (as urea) was applied at rates of 0, 40, 80, and 120 lb/acre to establish four levels of soil mineral N. Before applying mid-season sidedressed N, a PSNT sample was collected from the surface foot of soil and analyzed for nitrate- and ammonium-N (Table 1). At the same time, 10 leaves from each plot were collected for analysis of leaf N content and chlorophyll meter (SPAD) readings were taken on 10 additional intact leaves/plot. Additional N applications of 0, 40, and 80 lb/acre were then superimposed on each of the initial treatments, resulting in total N rates of 0 to 200 lb/acre. Three weeks after the second N application another set of SPAD readings were made. Corn was harvested from 40 row feet on August 29. Following harvest, soil was sampled for determination of residual nitrate and ammonium.

Highest yields of 10.7 tons/acre were obtained with a total N application of 120 lb/acre (80 at planting, 40 mid-season; Table 2). Three other treatments gave yields not significantly different than the maximum. These were 120 lb N (40 at planting and 80 mid-season), 160 lb total N, and 200 lb total N/acre. These results are consistent with those of 1995. Mean ear weight was highest at 160 lb N/acre but several rates and combinations of at-planting and mid-season applications gave essentially equal ear sizes. When all 120 lb N were applied at planting, yield was significantly lower than when the same rate of N was split. Tipfill and ear length also increased with increasing rates of N. In these plots, the PSNT value was 26.4 ppm when 120 lb N/A was applied at planting. This rate of N at planting was not quite adequate to give maximum yields. However, when the same total rate of N was applied, but split into two applications, maximum yield was obtained. This is in agreement with past research indicating that splitting N applications may result in more efficient utilization of N by the corn plant.

SPAD readings and leaf N correlated with amount of N applied to the soil. However, these tests indicate only that the plant has sufficient N at the time of the test. These tests say nothing about whether the soil will provide sufficient N to maintain the plant through harvest. They may be of more use when the total N rate is divided into several applications such as with feeding liquid N through the irrigation system. However, the late SPAD readings (Tables 3, 4), taken three weeks after PSNT, correlated strongly with eventual yield. A SPAD reading of less than 45 at this point may indicate that additional N is needed.

Residual soil nitrate concentrations were lower than we usually experience in corn plantings (Table 3). Nevertheless, nitrate levels did increase with increasing rate of mid-season sidedressed N. About 68 lb/acre residual nitrate plus ammonium were present on plots fertilized at 200 lb N/acre. This rate clearly exceeded that needed for maximum yield.

On-farm plots

Twelve growers participated in the on-farm Pre-sidedress Soil Nitrate Test (PSNT) trials. Plots were approximately one acre, or large enough to fill a truck at harvest. Growers limited pre-plant and at-planting N applications to a total of 50 lb N/acre. Prior to mid-season N applications, a PSNT sample was collected and analyzed for nitrate-N. Two top/sidedress N rates were then applied; 100 and 150 lb N/acre. The goal of the project was to determine a PSNT soil test value above which a mid-season N application of 100 lb N/acre is sufficient for optimum yield. At three sites, treatments were replicated four times. Plots were harvested into separate trucks by growers. Yield information (weight and grade) was determined by the processor receiving the corn. Following harvest, soil and corn stalk samples from each N rate were analyzed for nitrate-N. N responsive sites were those where yield from the 100 lb N/acre topdress was less than 98% of yield from the 150 lb N.acre topdress.

PSNT values ranged from 8 to 31 ppm NO_3-N (Table 5). The distribution of values in 1996 was similar to 1995 (Fig. 1). Figure 2 shows that sites with PSNT values of 15 ppm or greater did not benefit from the higher N rate, with two exceptions. This indicates if PSNT values are 15 ppm or greater, a mid-season N application of 100 lb N/acre is sufficient for optimum yield. Because data is from a single year, a more conservative PSNT critical value of 18 ppm may be appropriate. The distribution of PSNT values indicates more than half of the sweet corn fields sampled during 1995-96 could benefit from this approach to N management.

The two N responsive sites with high PSNT values were on coarse textured soils in the Stayton and Coburg areas. They were also the only two sites where the low N plots were placed at the edge of the field. Whether the unexpected yield response was due to soil type, plot layout, or something else, is unknown.

The corn stalk nitrate test is designed to identify N deficiency or excess in the crop just harvested. This information would be used to adjust N management in future years. NWREC data in 1995 suggested a stalk nitrate critical value of 2750 ppm NO_3-N. This critical value was accurate for 8 of 12 sites (Fig. 3) in 1996. The two sites that were outliers for PSNT data were also outliers for corn stalk nitrate data.

Residual soil nitrate was higher on the high N plots than on the low N plots for 10 of 12 sites (Table 5). Figure 4 shows the relationship between residual soil nitrate and yield for the low N plots. Maximum yield was attained with the low N rate for all sites with residual soil nitrate above 50 lb NO_3-N/acre with two exceptions (same two outliers as for PSNT and stalk nitrate test). The data agrees with previous estimates that residual soil nitrate above 50-75 lb NO_3-N/acre indicates possible opportunity for improved N management.

The coefficient of variation (CV) is a measurement of variability in data. On the replicated sites, the CV was extremely low (1.5% or less). The low CV's indicate that three replications are sufficient for future field-scale sweet corn research.

There were no statistically significant differences in corn grade (percent no value, grade, cobs per ton) on the replicated sites.

Summary

- Split N applications are more efficient than applying all N before or at planting for sweet corn. Maximum yield was obtained at N rates as low as 120 lb N/acre with split applications at NWREC.

- The PSNT appears promising as an N management tool for sweet corn. Tentatively, PSNT values above 18 ppm NO_3-N indicate a mid-season N application of 100 lb N/acre is sufficient for optimum yield. Confidence in the PSNT is greater on silty clay loams (Woodburn, Willamette, etc.) than on coarse textured and gravelly soils, such as those found in the Stayton and Coburg areas.

- The corn stalk nitrate at harvest test remains promising as an indicator of N management. Data from more years and sites are needed to establish a critical value.

- Residual soil nitrate can be reduced while maintaining optimum yield by using N management tools such as the PSNT. In most cases, reducing residual soil nitrate to 50 lb NO_3-N/acre in the surface foot is a reasonable goal.

- Field-scale replicated trials resulted in good data that was believable to participating growers. For future trials, three replications are sufficient.

Table 1. Effect of N at planting on soil nitrate and ammonium levels and leaf chlorophyll (SPAD) readings and N content at time of PSNT, NWREC, 1996

N at planting (lb/acre)	Soil nitrate-N (ppm)	Soil ammonium-N (ppm)	SPAD	Leaf N (%)
0	7.1	2.4	36.8	2.9
40	14.3	4.7	39.9	3.2
80	23.1	8.2	41.0	3.5
120	26.4	7.4	42.2	3.5
Significance[z]	**	**	**	**

[z]**, significant at 1% level.

Table 2. Effect of N at planting and mid-season sidedressed N on yield and quality parameters of sweet corn, NWREC, 1996

N at planting (lb/acre)	Mid-season N (lb/acre)	Yield (tons/A)	No. ears per plot	Ear wt. (g)	Ear length (inches)	Tipfill[z]
0	0	2.7	55	102	7.1	1.5
0	40	7.0	81	181	7.7	2.1
0	80	8.7	83	218	8.1	2.5
40	0	6.3	78	169	8.2	2.2
40	40	8.1	86	196	8.2	2.2
40	80	10.1	90	236	8.3	2.5
80	0	8.5	87	203	7.9	1.9
80	40	10.7	94	238	8.1	2.3
80	80	9.1	86	225	8.3	2.4
120	0	9.0	87	217	8.3	2.7
120	40	10.2	89	240	8.4	2.6
120	80	9.4	90	218	8.4	2.7
	LSD (0.05)	1.6	10	28	0.6	

[z]Based on 5-point scale with 5 = perfect fill, 1= 2 inches unfilled kernels.

Table 3. Effect of N at planting and mid-season N on leaf chlorophyll (SPAD) readings three weeks after second N application and residual soil nitrate and ammonium content, NWREC, 1996

N at planting (lb/acre)	Mid-season N (lb/acre)	Late SPAD	Soil nitrate (ppm)	Soil ammonium (ppm)
0	0	31.3	1.8	4.9
0	40	40.5	1.6	4.2
0	80	46.2	5.0	5.1
40	0	41.3	1.4	4.3
40	40	45.6	2.7	4.2
40	80	48.2	5.4	4.7
80	0	46.6	2.5	5.7
80	40	47.6	5.0	5.6
80	80	46.2	4.0	5.2
120	0	46.4	3.3	7.1
120	40	49.0	2.6	7.2
120	80	50.3	10.3	6.7
	LSD (0.05)	3.9	3.1	0.7

Table 4. Correlation coefficients (Pearson's pairwise) for SPAD readings, leaf N concentration, and sweet corn yield, NWREC, 1996

Variable	by Variable	Correlation coefficient	Probability
PSNT-SPAD	Leaf N	0.7649	0.0007
PSNT-SPAD	Yield	0.4592	0.0006
PSNT-SPAD	Tipfill	0.1534	0.2777
PSNT-SPAD	Ear wt.	0.3980	0.0035
Late-SPAD	Yield	0.8818	0.0000
Late-SPAD	Tipfill	0.6477	0.0000
Late-SPAD	Ear wt.	0.8863	0.0000

Table 5. On-farm PSNT trial data.

Site	PSNT (ppm NO3-N)	Yield (ton/a) Low N*	Yield (ton/a) High N*	Relative Yield (%)	Residual Soil NO3-N (lb NO3-N/a) Low N*	Residual Soil NO3-N (lb NO3-N/a) High N*	Corn stalk NO3-N (ppm) Low N*	Corn stalk NO3-N (ppm) High N*
Grover	8	9.4	10.1	93.5	12	20	2219	5761
Dickman	11	9.7	10.1	95.7	16	26	5358	6124
Coleman	12	12.5	12.5	100.0	91	113	8131	7318
Kenagy	15	10.2	10.4	98.5	43	37	9219	8860
Green	18	9.7	10.6	91.3	110	296	3584	2918
Freeman	21	9.7	9.8	99.5	75	123	9385	9089
Volker	21	8.7	8.9	98.0	17	21	9586	10575
Jager	22	10.7	10.9	98.7	no data		8364	11288
Hendricks	24	9.6	8.7	110.6	96	149	6975	7950
Schlechter	26	393 a	385 a	102.2	142	242	6286	5461
Horning	26	12.4	12.1	102.4	92	107	2467	3630
Keudell	31	8.3	9.0	92.2	64	46	9492	7013

* Low N = 100 lb N/a topdress High N = 150 lb N/a topdress

a - fresh market grower, yield is in cases/acre

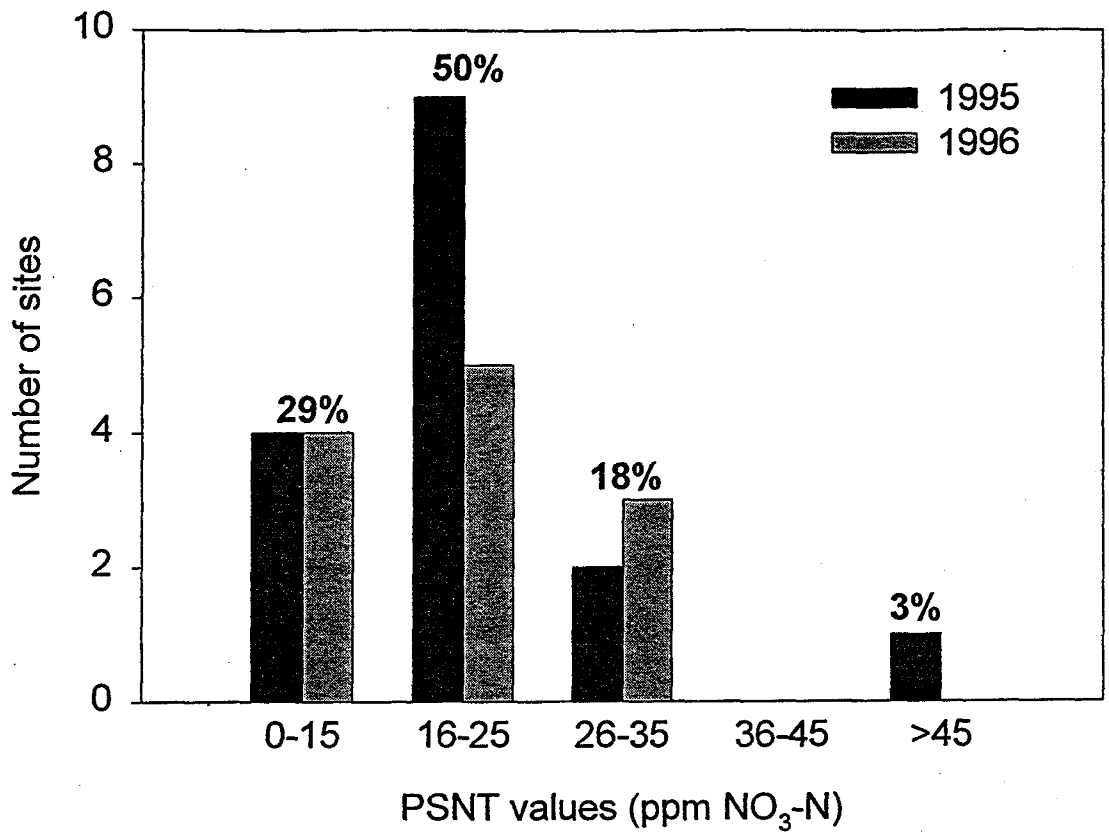

Fig. 1. Distribution of PSNT values on cooperating farms in 1995 and 1996. Percentages are for both years combined.

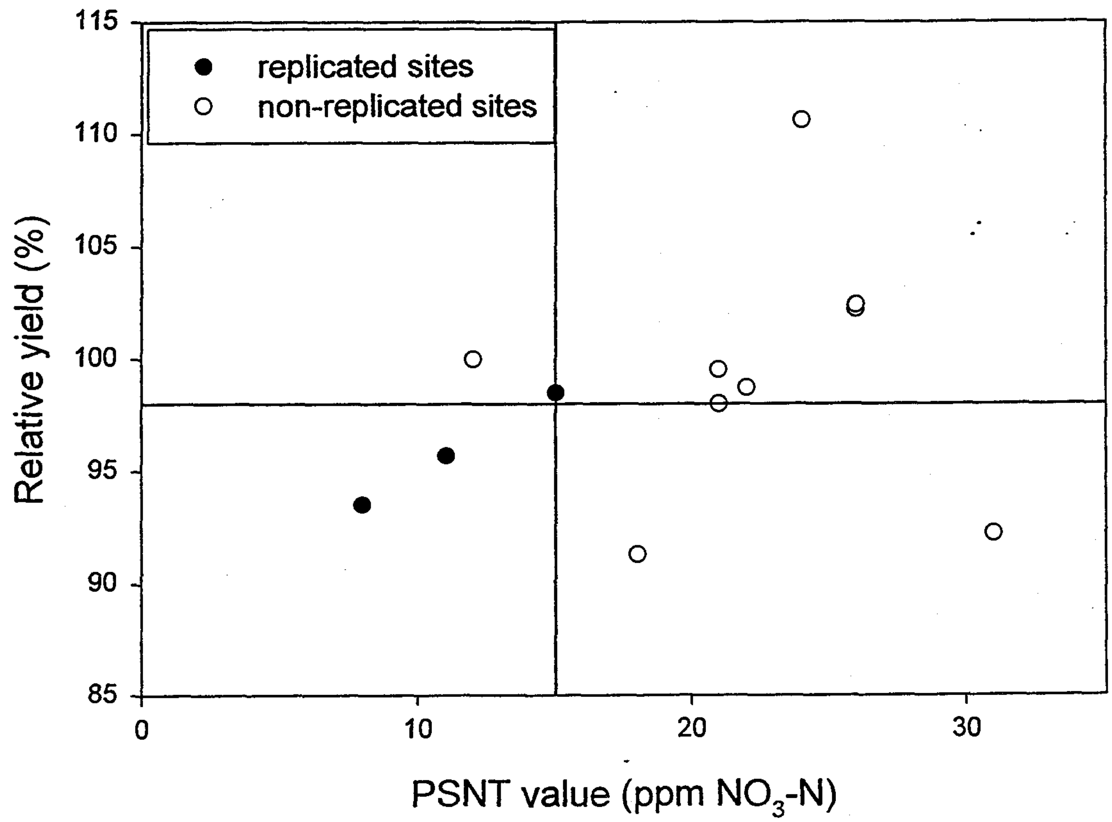

Fig. 2. PSNT values and relative yield. Horizontal line at 98% relative yield separates responsive and non-responsive sites. Vertical line at 15 ppm NO_3-N represents possible critical value.

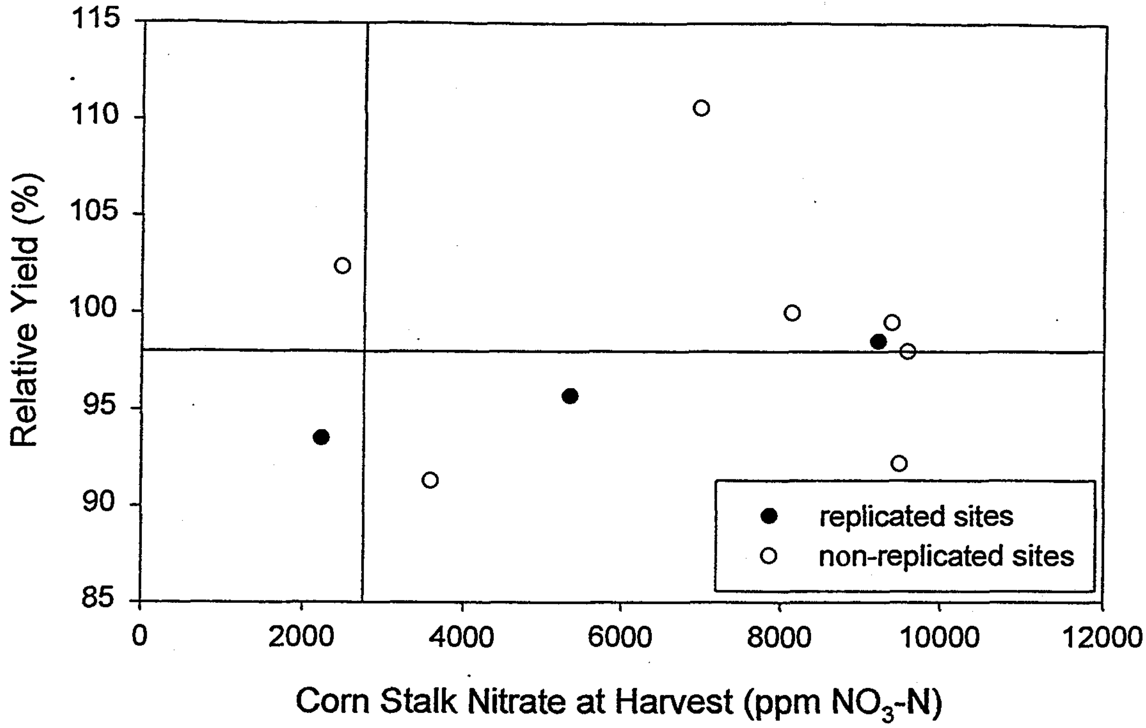

Fig. 3. Corn stalk nitrate at harvest and relative yield for 1996 sweet corn project. The vertical line at 2750 ppm NO_3-N indicates the expected critical value based on previous research. The horizontal line at 98% relative yield separates responsive from non-responsive sites.

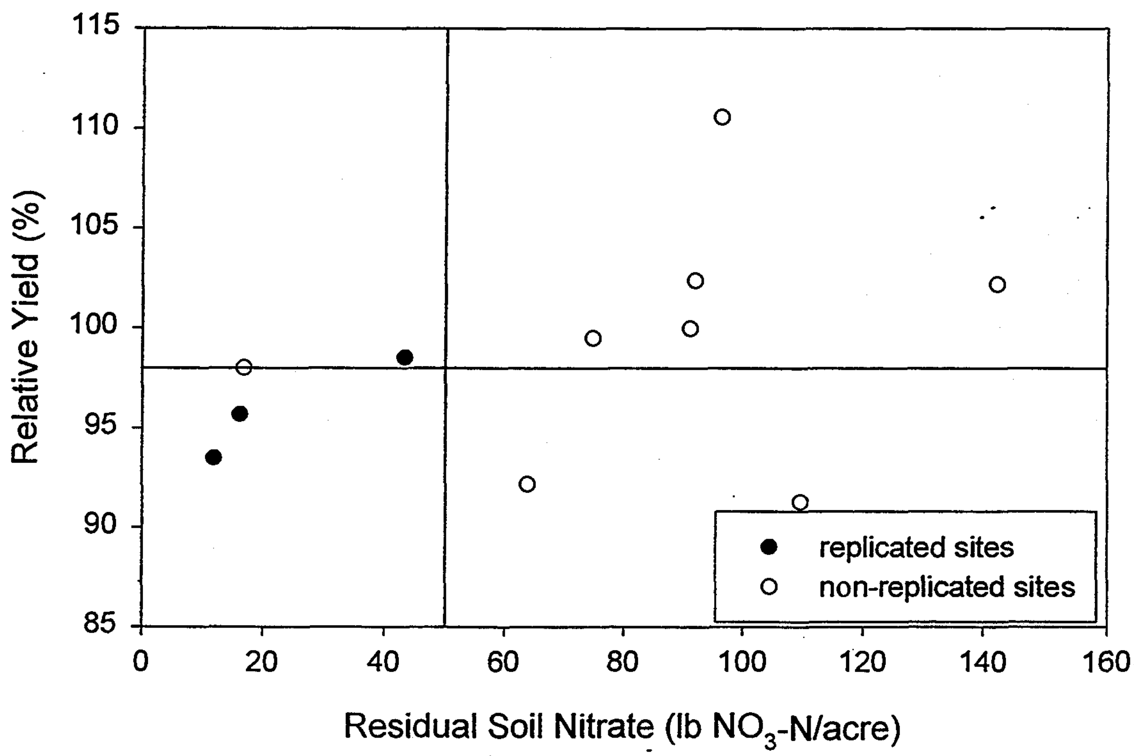

Fig. 4. Residual soil nitrate and relative yield for 1996 sweet corn project. The vertical line at 50 lb NO_3-N/acre indicates the expected critical value based on previous research. The horizontal line at 98% relative yield separates responsive from non-responsive sites.

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