On-farm nitrogen tests to minimize nitrogen inputs and optimize yields in vegetable crop production.

2005 Research Report

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The small plot yields presented in this report are for comparative purposes only and may not accurately reflect commercial yields. We welcome any questions, comments, concerns on this report, particularly suggestions on how to improve or make the trials more meaningful.

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On-farm nitrogen tests to minimize nitrogen inputs and optimize yields in vegetable crop production.

Objectives:

Determine accuracy of on-farm nitrogen tests to measure soil and plant nitrate in processing pepper production.

Evaluate different in-season nitrogen application rates to improve nitrogen use efficiency in processing pepper.

Optimize nitrogen use efficiency in processing pepper production.

Provide preliminary data for the development of a pre-sidedress soil nitrogen test (PSNT)

Methodology:

CROP: Green bell peppers — Variety: Aristotle
Plant population: 12000plants/ac — Plant spacing: 18 in
Row spacing: 5 ft between beds with twin rows 18 in apart

DESIGN: Randomized complete block design — Replications: 4
Plot width: 20 ft — Plot length: 26 ft

PEST CONTROL was according to typical Ontario production practices.

ON-FARM NITROGEN QUICK TESTS:

Table 1. Brief description of the on-farm nitrogen quick tests evaluated in this study.

On-farm N quick tests	Description
Cardy® meter	-Hand-held meter with selective electrodes to measure nitrate with digital display
NECi kits	-Enzyme -based test-tube kit with liquid reagents that turn shades of pink with the concentration of nitrate
Reflectoquant®	-Test strips dipped into liquid and turn different colour according to nitrate concentration (similar to pregnancy test). Nitrate concentration determined by reflectometry meter, RQflex 2, which gives a digital reading
SPAD® meter	-Hand-held meter applied to leaf, which measures chlorophyll content
LAB	-samples submitted for Ontario certified laboratory analysis

All on-farm nitrogen quick tests are set up to analyze liquids. Therefore, soil was soaked in 2 parts water. After 20 minutes, a drop of water was used for analysis. To obtain plant sap, the petioles (leaf stem) of 30 pepper plants were crushed in a garlic press. A drop of sap was either used directly for nitrate-nitrogen analysis or diluted in water before analysis.

Table 2. Nitrogen treatments in peppers.

N application	N source	N rate (lb N/ac)
Preplant broadcast incorporated	Ammonium nitrate	0 31 62.5 125 187.5
Preplant broadcast incorporated	UMAXX® a urea-based fertilizer with a urease inhibitor and a nitrification inhibitor	62.5
Split application	Ammonium nitrate	31+31 62.5+31
Split application –soil test recommended *	Ammonium nitrate	0+31 31+62.5 62.5+62.5

*Soil nitrate-nitrogen at time of split application suggested that no additional nitrogen fertilizer was required but these treatments were already included, so additional fertilizer was added to evaluate the effect on yield.

Table 3. Site characteristics.

Characteristic		Location	
		Ridgetown Campus	Harwich
Planting date		2 June	4 June
Date of split application		21 July	25 July
Harvest dates		5 August 22 August 8 September 12 October	9 August 23 August 22 September 17 October
Monthly rainfall:	June	1"	1.9"
	July	1.5"	2.9"
	August	0.8"	1.8"
	September	1.4"	3.2"
	October to harvest	0.1"	0.25"
Soil characteristics:	pH	7.3	7.8
	Soil texture	Loam	Loam
	% sand:silt:clay	51:33:16	45:47:8
	% OM	4.8	2
	CEC (MEQ/1 00g)	23	18
	P (ppm)	22	23
	K (ppm)	109	107
	Ca (ppm)	3928	3032
	Mg (ppm)	167	149

2005 Results:

YIELD: There were no statistical differences in marketable yield between the different nitrogen treatments. Likewise, there was no difference between nitrogen treatments in first pick yields. These results indicate that there was no yield advantage of split applying N, or using UMAXX® (a urea-based fertilizer containing a urease inhibitor and a nitrification inhibitor). Therefore, in-season N applications and UMAXX® did not improve nitrogen use efficiency in peppers. The lack of response to nitrogen may be because of the relatively dry growing season, where moisture, not N, was a limiting factor on pepper yields.

Table 4. Green pepper yield response to different nitrogen applications [*].

N Application [**]	Marketable yield (ton/ac)			
	Ridgetown		Harwich	
lbs N/ac	1st Pick	Total	1st Pick	Total
0	3.9	16.9	2.8	23.3
31	3.9	15.8	5.9	27.0
62.5	2.8	15.8	3.3	23.6
125	3.8	17.7	2.8	25.0
187.5	2.8	15.5	2.8	23.2
31+ 31	3.8	16.6	2.7	22.8
62.5 + 31	2.6	15.2	3.8	24.4
UMAXX	3.5	18.5	3.4	25.6
0 + recommended	4.1	17.0	3.2	25.2
35 + recommended	2.6	16.8	4.1	24.9
70 + recommended	4.2	16.8	2.9	22.6

[*] Data are expressed as averages of 4 replicates.
[**] There were no statistical differences in marketable yield between the different nitrogen treatments.

IN-SEASON SOIL N: Soil nitrate-nitrogen was monitored throughout the growing season at the Ridgetown Campus site. At the highest nitrogen treatment of 187.5 lb N/ac of ammonium nitrate applied preplant broadcast incorporated there was more soil nitrate-nitrogen compared to the zero nitrogen and 63.5 lb N/ac treatments (Figure 1). Throughout the season, soil nitrate-nitrogen was more than 20 ppm at all the sample dates for the nitrogen treatments tested, including the zero nitrogen control. Moreover, without nitrogen fertilizer applied, the zero nitrogen plots had 48 ppm on 15 August 2005. These data indicate that there was adequate soil nitrate-nitrogen during the growing season. Adequate soil nitrate-nitrogen throughout the growing season provides an explanation for the lack of yield differences between the nitrogen treatments.

SOIL NITROGEN CONCENTRATION AT SPLIT APPLICATION: Certified laboratory analysis of soil at the time of split application indicated high levels of nitrate-nitrogen, on average 29.3 ppm to the 1 ft depth (Table 5). At the time of split nitrogen application, there was no difference in soil nitrate-nitrogen between plots which received either 0, 27, or 62.5 lb N/ac preplant. Plots fertilized with 187.5 lb N/ac had significantly higher nitrate-nitrogen (63.1 ppm) at the time of split application. Considering that there were no heavy rainfalls, leaching or denitrification were not likely. The lack of differences in

nitrate-nitrogen at the time of split application between the 0, 27 and 62.5 lb N/ac indicates that the fertilizer nitrate was likely immobilized (converted to organic N) by microbes.

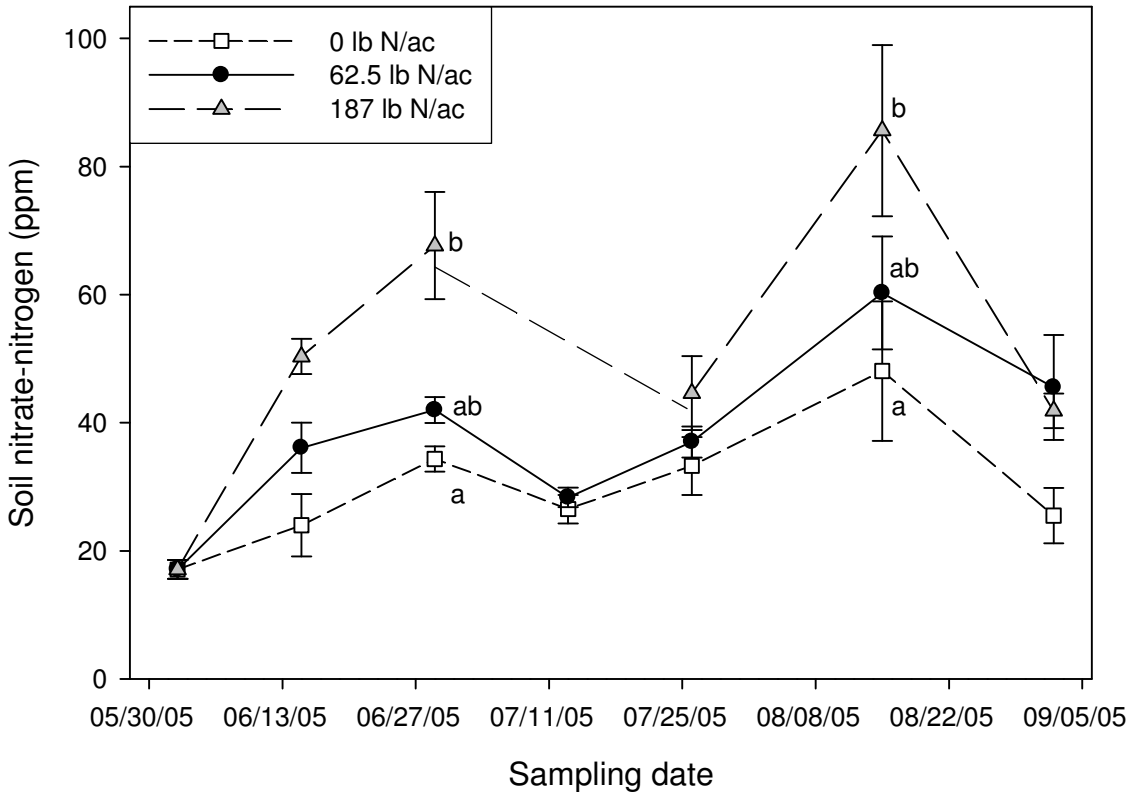

Figure 1. Seasonal nitrate-nitrogen concentration (ppm) at the 1 ft depth (For each sample date, letters indicate a statistical difference between nitrogen rates).

ON-FARM QUICK nitrogen TESTS - SOIL: Certified laboratory analysis of soil nitrate-nitrogen was not different than any of the on-farm tests (Table 5). Therefore, based on 2005 results, growers can use either the CARDY® meter, Reflectoquant®, or NECi kits to accurately assess nitrate-nitrogen in soil. However, because of precision, cost and easy of use, we recommend the CARDY® meter and/or the Reflectoquant®.

These data provide preliminary information for the development of a pre-sidedress soil nitrogen test (PSNT). Results from 2005 indicate that soil nitrate-nitrogen test value of 24 ppm or greater at the time of the split nitrogen application was sufficient for optimal yield and that the addition of more nitrogen fertilizer did not increase yields. However, further research will be necessary to accurately pin-point the PSNT value.

Table 5. Soil nitrate-nitrogen (ppm) at the time of split application as determined by certified laboratory analysis and on-farm quick tests.

Location	N rate	LAB*	CARDY®	NECi kits	Reflectoquant®
Harwich	0	28.8 a	37.0	13.5	21.6
Ridgetown	0	24.0 a	26.5	11.0	29.3
Harwich	31	30.0 a	33.0	11.5	24.8
Ridgetown	31	32.8 ab	31.0	22.4	32.1
Harwich	62.5	30.2 a	37.9	27.5	30.1
Ridgetown	62.5	29.9 a	28.3	21.1	30.7
Harwich	187.5	63.1 b	57.6	29.7	28.8

*For the certified laboratory analysis, different letters indicates a statistically significant difference in soil nitrate-nitrogen between nitrogen rates and locations.

ON-FARM QUICK nitrogen TESTS - PLANT: Certified laboratory analysis of leaves collected at the time of the split nitrogen application indicated no difference in the total percent nitrogen between all treatments tested (0, 31, 62.5, 187.5 lb N/ac). The average total percent nitrogen was 5.7% nitrogen, which indicates an adequate to high nitrogen status in the pepper plants. Thus the plants were not nitrogen deficient. These results were similar to nitrogen soil results. Results on nitrate-nitrogen concentrations in leaf tissue from laboratory analysis were not available at the time of submission (mid-December 2005).

GENERAL 2005 CONCLUSIONS:

- No difference in pepper yields with the different nitrogen treatments –likely due to soil available nitrogen and moisture stress
- In-season nitrogen applications and UMAXX® did not improve nitrogen use efficiency in peppers
- Sufficient nitrate-nitrogen concentrations (≥20 ppm) in soil throughout the growing season – which supports the lack of yield differences between different nitrogen treatments
- For soil, on-farm quick tests accurately determined soil nitrate-N, we recommend the CARDY® meter and/or the Reflectoquant®
- Pepper plant tissue analysis indicated an adequate to high plant status for nitrogen – which supports the lack of yield differences between different nitrogen treatments
- A preliminary PSNT value of >24 ppm indicated no yield benefit with additional nitrogen fertilizer applied at the time of split nitrogen application