Validation of Ontario's N Fertilizer Recommendations For Corn In High Yielding Environments: 2013 Summary

Purpose:

With the increase in corn yields over time, more Ontario producers are achieving yields which are not well represented in existing nitrogen yield response data. It is unknown how greater yield potential may impact yield response to nitrogen, and as a result the accuracy of current recommendations under high yielding environments is unknown. In conjunction with calibrating nitrogen recommendations, development of tools which aid in tailoring side-dress nitrogen rates to deliver the maximum economical rates of nitrogen while accounting for changes in nitrogen supply have also been an ongoing effort. Validation of these tools is limited in Ontario, though some are advertised in the marketplace for this purpose. The objective of this research is to calibrate the nitrogen recommendations for corn in high yielding environments, and to evaluate the ability of existing nitrogen management tools such as the SPAD meter, Greenseeker and pre-sidedress soil nitrate tests for their ability to quantify nitrogen requirements at sidedress time.

Figure 1. Yetter© Toolbar Applicator Designed For Preplant And Sidedress Nitrogen Applications

Methods:

Nitrogen rate trials were conducted at seven locations in 2013, where nitrogen treatments were applied across at least two randomized replications. Seven nitrogen treatments addressed nitrogen rates and timing, and included a control (no nitrogen except for starter fertilizer), four preplant-only application rates (50, 100, 150 and 200 lb-N/ac), a split application (100 lb-N/ac preplant and 50 lb-N/ac sidedress) and a sidedress only application (150 lb-N/ac). All nitrogen was applied as UAN + Agrotain, with preplant being applied as a top-dress after planting, and side-dress being applied at the 6-8 leaf stage. Both preplant and side-dress applications were completed with a Yetter© toolbar equipped with a 30' spray boom with 3 hole streamer nozzles on 20" centres, and Ag Systems coulter injection knives (Fig. 1). Nitrogen management tools were evaluated for their ability to predict a yield response to nitrogen, and included a SPAD meter to measure chlorophyll content, a Greenseeker® to measure NDVI, and a pre-sidedress nitrate test for soil nitrate levels. Plant sampling was conducted during the second and

fourth weeks of June and again the second week of July. Soil nitrate sampling was conducted during the second week of June. Hand harvesting was completed at pre-flagged “benchmarks” where plant measurements had been taken in order to reflect yield at those specific locations. Whole plot yields were determined by combine and weigh wagon, with moistures samples taken by moisture meter to correct all yields to 15.5% moisture.

Results:

Maximum economic rates of nitrogen (MERN) were successfully determined within the nitrogen rates (preplant + planter N) applied at all locations except Woodstock South where yield response failed to plateau (Table 1). Excluding Woodstock South, MERN ranged from 96 lb-N/ac at Ancaster to 212 lb-N/ac at Woodstock North. When investigating yield response to application timing for the 150 lb-N/ac treatment, few significant differences in yield were observed except for at Woodstock South where the full side-dress was significantly greater yielding than the preplant application (+17 bu/ac), and at Ancaster where the split application was significantly greater than the preplant application (+24 bu/ac) (5% level, statistics not shown).

Table 1. Planter nitrogen rates and average plot yields for seven nitrogen treatments at seven sites in Ontario, 2013

Location	Planter N (lb/ac)	------ Pre Plant Nitrogen (lb-N/ac) ------							MERN lbs/ac
		0	50	100	150	200	100	0	
		----- Side Dress Nitrogen (lb-N/ac) ----							
		0	0	0	0	0	50	150	
		---------- yield (bu/ac) ----------							
Moorefield	27	103	132	158	169	168	171	173	146
Elora	11	111	149	170	179	175	178	182	133
Bornholm	0	110	142	172	188	183	182	180	146
Ilderton	30	104	141	171	183	178	179	172	168
Woodstock North	25	69	117	139	178	177	183	178	212
Woodstock South	4	108	135	175	186	204	196	203	204
Ancaster	25	109	160	157	162	170	186	175	96

An effective nitrogen management tool must predict where a response to nitrogen is likely. Given the positive yield response to increasing nitrogen rates at all locations, and MERNs that were within application rates at most locations, comparisons of nitrogen management tool readings across nitrogen treatments provides an opportunity to evaluate their ability to predict nitrogen response.

When side-dressing was conducted during the third week of June, visual differences in plant colour were not evident at most fields. In order to correct for differences in factors which may affect readings across different locations (light, hybrids, crop growth), plant measurements and yields are presented as indexes where values for each nitrogen

treatment are expressed relative to the value of the highest (200 lb-N/ac) preplant nitrogen rate (Table 2). An index value of less than one demonstrates a reading that is less than the N-rich strip.

Table 2. SPAD, NDVI index values and PSNT values at side-dress timing (3rd week of June) relative to hand harvested benchmark yields indexed across five preplant nitrogen rates at seven locations in Ontario, 2013

Location	Measure	Preplant Rate (lb-N/ac)				
		0	50	100	150	200
Moorefield	NDVI Index	0.85	0.88	0.94	1.01	1.00
	SPAD Index	0.97	0.98	1.01	1.01	1.00
	PSNT (ppm)	18	25	25	38	45
	Yield Index	0.70	0.86	1.05	1.05	1.00
Elora	NDVI Index	1.11	1.03	0.95	1.03	1.00
	SPAD Index	1.02	1.00	1.06	1.09	1.00
	PSNT (ppm)	14	20	34	33	31
	Yield Index	0.64	0.85	0.97	1.03	1.00
Bornholm	NDVI Index	1.11	1.09	1.09	1.05	1.00
	SPAD Index	0.97	0.97	0.99	1.00	1.00
	PSNT (ppm)	18	24	31	35	57
	Yield Index	0.60	0.78	0.94	1.03	1.00
Ilderton	NDVI Index	1.01	1.00	0.97	1.01	1.00
	SPAD Index	1.04	1.02	1.01	1.04	1.00
	PSNT (ppm)	13	19	21	30	24
	Yield Index	0.59	0.77	0.89	0.99	1.00
Woodstock North	NDVI Index	0.94	1.03	0.96	0.98	1.00
	SPAD Index	0.99	1.01	0.99	1.02	1.00
	PSNT (ppm)	12	17	27	35	42
	Yield Index	0.55	0.75	0.92	0.99	1.00
Woodstock South	NDVI Index	1.05	1.08	1.12	1.08	1.00
	SPAD Index	0.93	0.98	0.98	0.97	1.00
	PSNT (ppm)	17	17	27	24	35
	Yield Index	0.56	0.71	0.84	0.91	1.00
Ancaster	NDVI Index	0.89	0.99	0.98	0.97	1.00
	SPAD Index	1.02	1.02	1.03	1.06	1.00
	PSNT (ppm)	13	19	.	32	34
	Yield Index	0.64	0.94	1.00	0.95	1.00

When sampled at sidedress time, NDVI values were able to identify low nitrogen rate treatments where large nitrogen responses occurred at some locations (Moorefield, Woodstock North, Ancaster) but not at others (Elora, Bornholm, Ilderton, Woodstock South). At locations where yield response potential was identified for very low N treatments, it often failed to identify yield response potential for higher rate treatments that were still below MERN.

Similar to NDVI, SPAD measurements did not appear to predict yield response potential for nitrogen at most locations in 2013. While the lowest rate plots had slightly lower index values at some locations (Moorefield, Bornholm, Woodstock South), they were not definite enough to separate treatments that were below and above MERN.

NDVI and SPAD measurements were also conducted during the 4th week of June and 2nd week of July when greater differences in nitrogen deficiency symptoms are expected. While greater separation in values of low nitrogen treatments was clearly evident, these measurements still failed to accurately identify treatments that were above and below MERN (data not show).

PSNT values of the zero nitrogen treatments and corresponding trial MERNs for all locations for the past three years are averaged and presented in Table 3. Clearly the PSNT has value in indicating years where soil supplied N is higher or lower depending on weather conditions. In the warm relatively dry spring of 2012 N supply was high and MERNS were low; this was captured reasonably well with the PSNT.

Table 3. PSNT and MERN values averaged across all sites in a given year for 2011, 2012 and 2013. PSNT samples taken from Zero N plots.

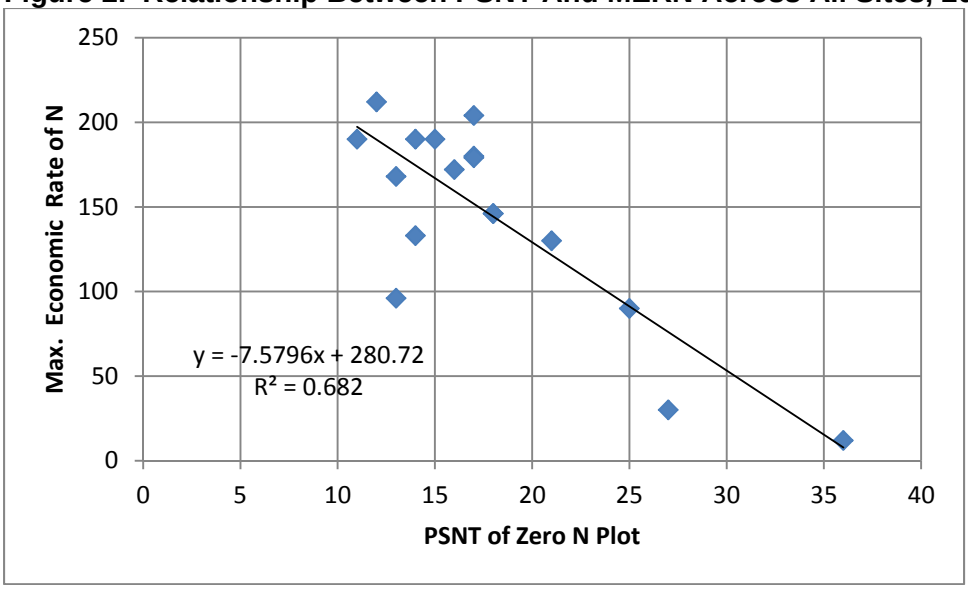
Year	Number of sites	Average PSNT	Average MERN
2011	4	14.3	188
2012	6	23.7	102
2013	7	15.0	158

The relationship across all individual sites between PSNT values and MERN is illustrated in Figure 2. For field data this is a good relationship that shows that as PSNT values increase (i.e. more residual N) that optimum fertilizer N rates (MERNs) decrease. The one challenge with this data is that N rate recommendations for a given PSNT value are considerably higher than the current recommendations used by OMAF in the Agronomy Guide. This will need to be explored more in future research.

This work also attempted to use the PSNT as a threshold indicator for plots that had already received pre-plant, broadcast N. Generally the PSNT has been calibrated for samples that have been taken in plots or fields that have received no fertilizer N but in this work we sampled into plots that had received 100 lbs N/acre pre-plant broadcast UAN and used the PSNT as an indicator as to whether the sidedress 50 lbs N/acre was warranted. The data generated a threshold PSNT of 36 PPM. This meant that if the plot PSNT value in mid-June did not reach 36 PPM sidedressing 50 lbs N/acre was recommended. If the plot PSNT value was 36 or greater no further N was recommended. Using this threshold the correct decision was made 14 out of 17 times. The anticipation is that this finding may expand the use of PSNT for growers who broadcast N pre-plant and then are looking for a technique to evaluate if additional N

may be needed. The 36 PPM value is tentative and may require further research so growers are advised to apply it with some caution until further validation work can occur.

Figure 2. Relationship Between PSNT And MERN Across All Sites, 2011-2013.



Summary:

Significant yield responses to split applying or sidedressing nitrogen were observed at two locations in 2013, while no yield penalties were observed for delaying N. When conducted at conventional side-dress time, SPAD measurements appeared to be able to identify nitrogen deficiencies for the low application rate treatments at some nitrogen locations, but not others. NDVI measurements did not appear to reflect nitrogen yield response potential. Soil nitrate tests for zero nitrogen plots appeared to have a solid relationship with final MERNs, though MERNs appeared to be much higher than current OMAF PSNT recommendations. The PSNT seemed relatively reliable in indicating seasonal variation in MERN. Using a PSNT threshold value for triggering sidedress N on fields that had received planting time broadcast N showed promise for future use.

Next Steps:

This was the final year of this three year project. The complete final report of this project will be made available at www.gocorn.net.

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