

36 ppm Pre-Sidedress Soil Nitrate Threshold Test

Purpose:

Pre-sidedress soil nitrate test (PSNT) provide a method of estimating soil nitrogen supply, and can aid producers in fine-tuning their nitrogen application rates for corn. One drawback of current soil nitrate tests is that they are only calibrated for situations where all of the nitrogen being measured has come from soil mineralization: that is cores need to be taken in soil that has not received any commercial nitrogen fertilizer. Soil nitrate samples are taken 12" (30 cm) deep. Past research indicates that the soil nitrate in the top 12" of soil, under most conditions, represents approximately 60% of the total plant available N in the rooting profile.

Predicted soil nitrogen supply will be overstated under circumstances where additional nitrate has been added through fertilization (i.e. broadcast pre-plant or pre-emerge N applications), and as a result nitrogen requirements will be underestimated. To date, no soil nitrate calibration is available which can aid in evaluating the relative soil nitrogen supply for the large portion of Ontario's corn acreage that receives pre-plant nitrogen.

Recent nitrogen research in Ontario has identified a pre-sidedress soil nitrate threshold of 36 ppm which has been effective in identifying whether additional nitrogen is probable to provide an economic yield response when a modest (i.e. 100 lb-N/ac) amount of nitrogen has been applied around planting. Soil tests less than 36 ppm indicate there will be response to additional application of nitrogen, while those over 36 ppm typically do not. This threshold could allow a grower to apply pre-plant nitrogen, and identify at sidedress time if there is a requirement to add additional N. The purpose of this research is to verify the validity of this threshold concept.

Methods:

Two locations were established in the 2014 growing season and five locations in 2015 to test the 36 ppm nitrate threshold concept. Three sidedress top-up rates were used supplying 45, 90 and 135 lb-N/ac in replicated field length strips to provide a means of estimating nitrogen response at these fields. A 0 lb-N/ac control plot was included to determine yield response to nitrogen above the pre-plant rate. Soil nitrates were sampled just prior to sidedressing. Final plot yields and harvest moistures were collected by a weigh wagon or yield monitor. Site 7 had fall broiler manure applied, Site 3 was following wheat with an excellent stand of red clover.

Results:

Pre-sidedress soil nitrate values were below the 36 ppm threshold at all locations (Table 1), which based on the threshold concept, would suggest that more nitrogen should be applied (Table 3). However, the 36 ppm threshold was developed from research where 100 lbs N/ac was applied pre-plant. Pre-plant N rates at sites 4, 5, 6, and 7 are lower than the original 36 ppm research data: thus the 36 ppm threshold may not be applicable at these lower pre-plant rates. The threshold would be expected to be lower than 36 ppm at the sites with lower pre-plant rates. Where no pre-plant N is applied, the threshold for response at sidedress is 23 ppm.

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Sites 1 through 5 had an economic response to additional N, with most of the sites reaching economic threshold with a sidedress application of an additional 45 lb N/ac.

There does not appear to be an economic advantage to additional N at site 6. However, there is no 45 lb-N/ac treatment, and yields are extremely low. Some other event (probably frost damage) limited the yield potential at this site. If a 45 lb-N/ac treatment was included, and equaled the yield of the 90 lb-N/ac treatment, that treatment would have been economical. With only 45 lbs N/ac applied pre-plant, the 36 ppm threshold would not be expected to be valid at this location. However, with a PSNT of 25, response would really have been expected even at 45 lb-N/ac pre-plant, thus the low yield potential would appear to be the reason for lack of response.

Location 7 was on lighter ground that was hit very hard by frost on May 22nd, 2015. This frost severely impacted the yield potential in many fields, as well as at this site. Low yield potential reduces N demand and response to additional N. As with Site 6, this is the likely reason for no response to sidedress N. Mineralization of organic N from the manure the previous fall later in the growing season may also have reduced the response to sidedress N. The other potential factor at site 7, with extremely low PSNT and yet no response, is the extremely wet June and the well drained nature of the soil. It may be that the soil N had been moved from the top 12" (30 cm) to the 12-24" level (30-60 cm), and was still plant available to the corn plants but not picked up by the 12" PSNT. On well drained sands with high rainfall previous to the PSNT being taken, a 24" sample may result in better N response predictions.

Table 1. Pre-sidedress soil nitrate tests and final corn yields across 4 sidedress application rates at 7 locations in Oxford County, 2014/15.

Year	Location	Pre-plant N Rate (lb-N/ac)	Manure N	PSNT (ppm)	Sidedress N Rate (lb-N/ac)			
					0	45	90	135
					----- corn yield (bu/ac) -----			
2014	1	90	0	30	161	181	185	185
2014	2	100	0	23	-	155	170	175
2015	3	100	0	27	189	209	210	-
2015	4	70	0	19	180	214	224	213
2015	5	65	0	20	137	186	193	199
2015	6	45	0	25	132	-	139	136
2015	7	0	100 (Fall)	12	159	152	154	114

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Table 2. Assumptions made in evaluating economic responses to additional side-dressed nitrogen

----- price of inputs, corn -----		
Price of nitrogen	0.55	\$/lb-N
Cost of side-dress application	10.00	\$/ac
Price of corn	4.50	\$/bu
----- breakeven bushels of corn for input costs -----		
Side-dress application	2.2	bu/ac
Each 45 lb-N/ac increment	5.5	bu/ac

Table 3. Decision process to follow when using the 36 ppm PSNT threshold in deciding whether to apply additional nitrogen following a 100 lb-N/ac pre-plant application.

Year	Location	Pre-plant N Rate (lb-N/ac)	PSNT (ppm)	PSNT Over 36 PPM?	Additional Nitrogen Recommended?	Economic Response to Additional N?
2014	1	90	30	No	Yes	Yes
2014	2	100	23	No	Yes	Yes
2015	3	100	27	No	Yes	Yes
2015	4	70	19	No	Yes	Yes
2015	5	65	20	No	Yes	Yes
2015	6	45	25	No	Yes	No
2015	7	0	12	No	Yes	No

Summary:

Seven trials have been conducted over two years (2014/15) to verify the use of a 36 ppm PSNT threshold as a tool to aid in predicting additional N response where modest (90- 100lbs N/ac) pre-plant nitrogen applications have been made. PSNT values were below 36 ppm at all locations, and 5 of the 7 locations showed economic response to additional N. The 2 sites with no economic response had very low yield potential due to frost damage. This suggests that the use of a 36 ppm threshold could be a useful tool for Ontario corn growers. However, this research also shows that N response is dependent on corn yield potential, and where yield potential is low due to some other stress, that 36 ppm threshold is not effective.

These results also show a very interesting trend between the PSNT result and potential N response. Where the PSNT was close to 30 (Site 1 and 3), response to additional N

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peaked at 45-lbN/ac. Where the PSNT was less than 26 (sites 2, 4, 5), response to additional N continued to the 90-lbN/ac level. This suggests that the PSNT could be a valid tool, not only as a threshold at 36 ppm, but also as an indicator of how much additional N is required.

Further research is required to validate the 36 ppm threshold, as none of the sites actually exceeded 36 ppm over the 2 years of this trial. More research is needed to identify an appropriate top-up rate for any given PSNT value, following a pre-plant application of 100 N, particularly for fields that test much lower than 36 ppm. Additional research may also be needed to learn how the 36 ppm threshold changes with lower pre-plant N rates.

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