A SMORGASBORD OF PRELIMINARY RESULTS FROM FIELD TRIALS IN ONTARIO

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Abstract

Field scale trials may be established to support local needs, but the results seldom reach a wider audience. This paper summarizes two recent field studies by staff of the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) on fertilizer use in soybeans and corn. A study of starter fertilizer response in soybeans found that yield responses to fertilizer tended to be relatively small, and seldom large enough to cover the cost of the added fertilizer. A second study of ammonia volatilization from N application to corn showed that moderate amounts of incorporation can cause significant reductions in ammonia loss from preplant applications, but that complete coverage of the fertilizer band is important to prevent losses of side-dress N.

Introduction

Commodity specialists in the Field Crops Unit of the Agriculture Development Branch of OMAFRA have undertaken a number of fertilizer response studies in recent years. These may have been demonstrations to support an extension program, or providing support for updates to fertilizer recommendations. It is unlikely that results from any of these studies would appear in a peer reviewed journal, but the information gathered is still valuable enough to share. This paper presents preliminary results from two recent studies.

Starter Fertilizer on Soybeans

Traditionally, soybeans in Ontario have been grown without added fertilizer, depending instead on N fixation in the nodules and residual P and K from other crops in the rotation. Over the past decade, some areas have switched to rotations dominated by soybeans, leading to nutrient deficiencies in some fields, and questions about soybean responses to fertilizer.

Materials and Methods

Field scale trials were established in three fields in each of 2009 and 2010, consisting of 6 treatments including a check replicated three times (except for one field in each year that only had two replications). Plots were planted on field length strips using a modified John Deere planter (38 cm row spacing) equipped to apply liquid or dry fertilizer either with the seed or banded 5 cm to the side of the row and 5 cm below the seed. One field in 2009 suffered from low population compounded by frost damage, resulting in very low yields, and so was excluded from the data analysis.

Table 1: Soil test values and tillage for soybean plots

Location	Soil test values		Tillage
	P	K	
Dufferin 2009	25	103	Spring Cultivate
Perth 2009	7	118	Spring Cultivate
Middlesex 2010	8	147	Spring Cultivate
Huron 2010	47	200	No-till
Perth 2010	19	89	No-till

Granular fertilizer treatments consisted of a blend of MAP and KCl to provide 40 lb P_2O_5 per acre and 70 lb K_2O per acre, applied either as a preplant broadcast treatment or as a 2x2 band. Straight MAP was also applied with the seed in one treatment to supply 25 lb P_2O_5 per acre. The liquid fertilizer treatment consisted of Nachurs Alpine 6-24-6 liquid starter fertilizer, applied with the seed at a rate of 3 US gallons per acre, either alone or in combination with the banded granular fertilizer.

Results and Discussion

Yield responses to fertilizer by soybeans were relatively small. Only the Perth 2009 and Middlesex 2010 plots showed statistically significant yield increases from applied fertilizer ($p = 0.10$). Despite the low coefficients of variation in the other plots (<10%), the yield differences were not large enough to be statistically significant. There did not appear to be any correlation between yield responses and either tillage system or soil fertility.

Average yield results are shown in Table 2. At current soybean and fertilizer prices, the income from the increased yield is generally much less than the cost of the fertilizer, or at best just a little above break-even.

Table 2: Average yield responses to fertilizer additions on soybeans in 2009-10.

Treatment	AVERAGE Yield (bu/ac)	Yield Advantage (bu/ac)	Cost ($/ac)	Net Income @ $10/bu Soys
Check (No fertilizer)	47.75	-	-	-
40 P_2O_5 + 70 K_2O, Broadcast	49.74	1.93	$51.50	**-$32.20**
40 P_2O_5 + 70 K_2O, 2X2 Band	51.39	3.79	$51.50	**-$13.60**
40 P_2O_5 + 70 K_2O, Broadcast + 3 gallons 6-24-6	51.04	3.35	$67.00	**-$33.50**
3 gallons 6-24-6	49.55	1.88	$15.50	**$3.30**
25 P_2O_5 with seed	50.53	1.79	$12.50	**$5.40**

Ammonia Volatilization from Various N Materials and Application Methods

Urea, or fertilizers containing urea, when they are hydrolyzed by the urease enzyme, release nitrogen in the form of ammonia. If this occurs on the surface of the soil, this ammonia may be lost to the air rather than dissolved in the soil water and held as the ammonium ion. Measurement of ammonia losses has been cumbersome, so relatively little work has been done comparing the impact of different application systems on ammonia volatilization under field conditions.

Materials and Methods

In 2010, field plots were established at three locations in Ontario, in conjunction with the Ridgetown Diagnostic Days, Elora FarmSmart Expo and the Eastern Crop Diagnostic Day in Winchester. Planting (and fertilizer application) was delayed until late May so the corn crop would be at an appropriate growth stage for the field days, which may have influenced the results. At all three sites, preplant treatments to apply a target rate of 165 kg N ha^{-1} included:

1. Broadcast urea, with no incorporation.
2. Broadcast ESN, with no incorporation
3. Broadcast urea, incorporated shallowly (1”) with a RTK unit
4. Broadcast urea, incorporated to a depth of 2.5”
5. Broadcast UAN (flat fan nozzles) with no incorporation
6. Broadcast UAN (flat fan nozzles), incorporated shallowly (1”) with a RTK unit

At Ridgetown and Winchester, sidedress N applications were also included, as follows:

7. UAN dribbled on the soil surface
8. UAN injected just below the soil surface (trench not completely closed)
9. UAN injected 3-4” below soil surface, with good coverage.

Immediately after fertilizer application, ammonia dosimeter tubes were placed at a height of 15 cm above the soil surface within each treatment, and covered with a perforated plastic chamber (blue recycling bins, with holes drilled to allow air exchange) to prevent cross-contamination from neighbouring treatments. Cumulative ammonia concentration within the chambers was read directly off the dosimeter tubes at one week and two weeks following fertilizer application. Since this was a demonstration, the treatments were not replicated at each site, but there were multiple dosimeters placed within each treatment and the values were averaged.

Results and Discussion

Work is underway to correlate the ammonia concentrations measured with the dosimeter tubes with the quantity of ammonia volatilization, but the calibrations are not complete as yet. For the purpose of this article we will present the losses as a relative index in order to compare treatments. Remember also that since the chambers allow very little rainfall to reach the soil these losses are essentially comparing the potential losses if two weeks elapsed after application without rainfall and with relatively warm temperatures.

Relative losses of ammonia from the various treatments are shown in Table 3. The extent of losses from ESN are surprising, although we did note that the losses were minimal during the first week but began to climb rapidly in the second week. The impact of incorporation on reducing ammonia losses is clear, although it should be noted that the amount if tillage required for significant reduction in losses is quite modest. Losses from surface applied UAN were significantly less than from urea, and a modest amount of tillage was adequate to reduce these losses almost to zero.

For side-dress applications of UAN, it appears that good coverage of the fertilizer band is important to minimize volatile losses of ammonia. Our numbers clearly suggest that it is worth the time to get the coulters and injectors working properly to cover the UAN.

Table 3. Summary of Ammonia loss demonstrations done at Ridgetown, Elora and Winchester in 2010.

Treatment	**Nitrogen Loss Index**
Planting time (late May) application of nitrogen	
Urea Surface Broadcast	100
ESN Surface Broadcast	62
Urea Broadcast - Shallow Incorporation (1 inch)	40
Urea Broadcast – Moderate Incorporation (2.5 inches)	16
UAN Flat Fan - Bare Soil	27
UAN Flat Fan - Shallow Incorporation (1 inch)	4
Side-dressed (mid-June) applications of nitrogen (Ridgetown and Winchester values only)	
UAN Side-dress Surface	100
UAN Side-dress Shallow (Depth: 1 inch)	112
UAN Side-dress (Depth: 3-4 inches)	6

Summary

Field scale demonstration trials, with careful planning, can provide useful data to supplement small plot research at universities and government facilities. This can be a valuable part of an extension program, or support changes to existing recommendations. The data gathered from these field trials is only useful, however, if care is taken to ensure consistency between different sites, and sufficient replication in the field to allow statistical evaluation of the data.

The data presented here are preliminary results, and will be updated as the projects are completed.

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