Losses and Logistics of Alternative Corn N Application Methods: 2013 Summary

Purpose:

In efforts to reduce the weather sensitivity and workload associated with nitrogen applications in corn, there has been a movement towards applying UAN on the soil surface with field sprayers. While efficiency gains may be realized, tradeoffs with this approach is that surface applied UAN is susceptible to nitrogen loss through ammonia volatilization, and that surface applications made in standing corn may lead to yield loss through leaf burn. This project has been developed to investigate three key issues associated with the adoption of surface UAN application methods in corn, and aims to:

i) identify the relative ammonia loss and yield impacts for applying UAN on the soil surface versus a more "protected" soil injection system
ii) identify differences in ammonia loss for surface applications made with different nozzle types
iii) identify the yield impact associated with crop injury brought on by surface applications of UAN made into standing corn

Methods:

Ammonia and yield loss potential of surface applications of UAN was investigated by comparing UAN applied by 3 hole streamer nozzles with or without Agrotain urease inhibitor to UAN injected below the soil surface with an Ag Systems coulter knife injector. Two separate application timings were conducted; one shortly after planting and another at conventional sidedress timing (V6 stage). Nitrogen was applied at 100 lb-N/ac in attempts to be in a rate zone where yields will be responsive to nitrogen loss. Ammonia loss was measured by dosimeter tube traps while final yields were measured by weigh wagon for field-length combined strips. Trials were conducted at four locations where nitrogen rate trials were simultaneously being conducted.

To reduce the ammonia volatilization associated with surface applications of UAN, nozzles which concentrate UAN in a single stream are often recommended. To investigate the impact of nozzle selection on N loss, ammonia volatilization of dribble band, flat fan, 3-hole streamer nozzles and control plots (no UAN application) were measured with ammonia dosimeter tube traps on a bare soil trial at Elora. Each nozzle type was also applied with or without Agrotain urease inhibitor. A hand boom was calibrated to deliver UAN at a rate providing 100 lb-N/ac. Each nozzle treatment was replicated four times within each application timing, and a total of four application timings were conducted during the spring and summer of 2013. To investigate the impact of precipitation on ammonia volatilization, one set of dosimeter traps was moved to "fresh" ground within plots following every rainfall while another set was not moved.

The yield impact of leaf burn from post-emergent UAN applications was investigated at three locations in 2013. All plots received a non-limiting supply of nitrogen (150-180 lb-N/ac) by UAN injection shortly after planting to limit interference from differences in N supply of the application treatments and to isolate yield response to leaf injury. Three post-emergent treatments were implemented with a hand-boom sprayer; a control where no nitrogen was applied, a soil-directed application where UAN was applied with dropnozzles to the soil surface, and a streamer nozzle treatment where UAN was applied by 3 hole streamer nozzles over the crop canopy. Post emergent UAN was applied at a rate delivering 100 lb-N/ac. All application treatments were conducted at the 4, 8 and 10 leaf stages and replicated three times for each timing at each location. Plots were hand-harvested for final yield determination.

Results:

Yields for surface applications of UAN ranged from no different to significantly less than injected applications in 2013 (Table 1). Streamer only (No Agrotain) applications were significantly less yielding than injected applications at 2 locations for preplant applications, and 1 location for sidedress, and resulted in an average yield loss of 6 bu/ac across all locations and timings. Streamer + Agrotain treatments were only significantly lower yielding than the inject method for the sidedress application at Ancaster, and had an average overall yield loss of 7 bu/ac. Across all locations and application timings, ammonia readings were always highest for the Streamer treatments, and were followed by slight declines for the Streamer + Agrotain treatments (data not shown). Ammonia readings for injected applications were in line with control (no nitrogen) treatments which rarely registered any losses.

Table 1. Corn Yields For 3 Application Methods At 2 Application Timings At 4 Locations In Ontario, 2013

Timing	Application Method	Moorefield	Elora	Bornholm	Ancaster
		-------------------- yield (bu/ac) † --------------------			
100 lb-N/ac Preplant	Streamer	157 B	169 B	173 A	174 A
	Streamer + Agrotain	158 AB	170 AB	172 A	169 A
	Inject	168 A	176 A	168 A	184 A
100 lb-N/ac Sidedress	Streamer	164 A	165 B	170 A	173 AB
	Streamer + Agrotain	165 A	169 AB	174 A	163 B
	Inject	168 A	177 A	169 A	184 A
		----------------------- lb-N/ac -----------------------			
	Total N Applied	100	111	100	125
	MERN	146	133	146	96

† Letter comparisons only valid for comparing application methods within locations within application timings

In the nozzle application trials, there was no clear difference in ammonia loss between the three different types tested (Table 2). Supporting investigations from previous years, this data suggests that selection between these nozzle types was not part of an ammonia volatilization mitigation strategy. When Agrotain urease inhibitor was included with UAN, ammonia volatilization appeared to have been consistently reduced across all nozzle types and most dates, suggesting Agrotain was a more effective tool at minimizing ammonia volatilization than nozzle selection.

Table 2. Ammonia dosimeter values two weeks after UAN application on bare soil for various nozzle and Agrotain combinations for four application dates at Elora, 2013

Application Date	Control	Dribble		Flat Fan		Streamer	
		- AgT	+ AgT	- AgT	+ AgT	- AgT	+ AgT
	------------------ ammonia dosimeter ppm ------------------						
June 7	0	694	298	725	248	613	219
June 18	0	459	369	423	398	540	425
July 25	0	403	403	288	166	370	315
August 9	0	590	163	621	218	659	209

"- AgT" – No Agrotain included in UAN, "+ AgT" – Agrotain included with UAN

When investigating the impact of precipitation on ammonia volatilization, readings were higher for dosimeter boxes that were not moved than those which were moved after every rainfall as demonstrated by readings following the June 18 application (Figure 1). Non-moving boxes sheltered soil during rainfall and reflect ammonia losses from UAN on soil which received no additional moisture after application while moving boxes would reflect UAN losses from soil surfaces that received rainfall. Soil moisture levels may influence urease activity on the soil surface, while measurable precipitation may influence solubilization and downward movement of UAN below the soil surface. Significant rainfall events occurred during the duration of these dosimeter readings. The differences observed may offer insight into how rainfall events following UAN applications may influence ammonia volatilization losses. It also was very evident in this work that when soil surfaces were dry that the risk of ammonia volatilization from surface applied UAN was much lower than when the UAN was applied to wet soil surfaces.

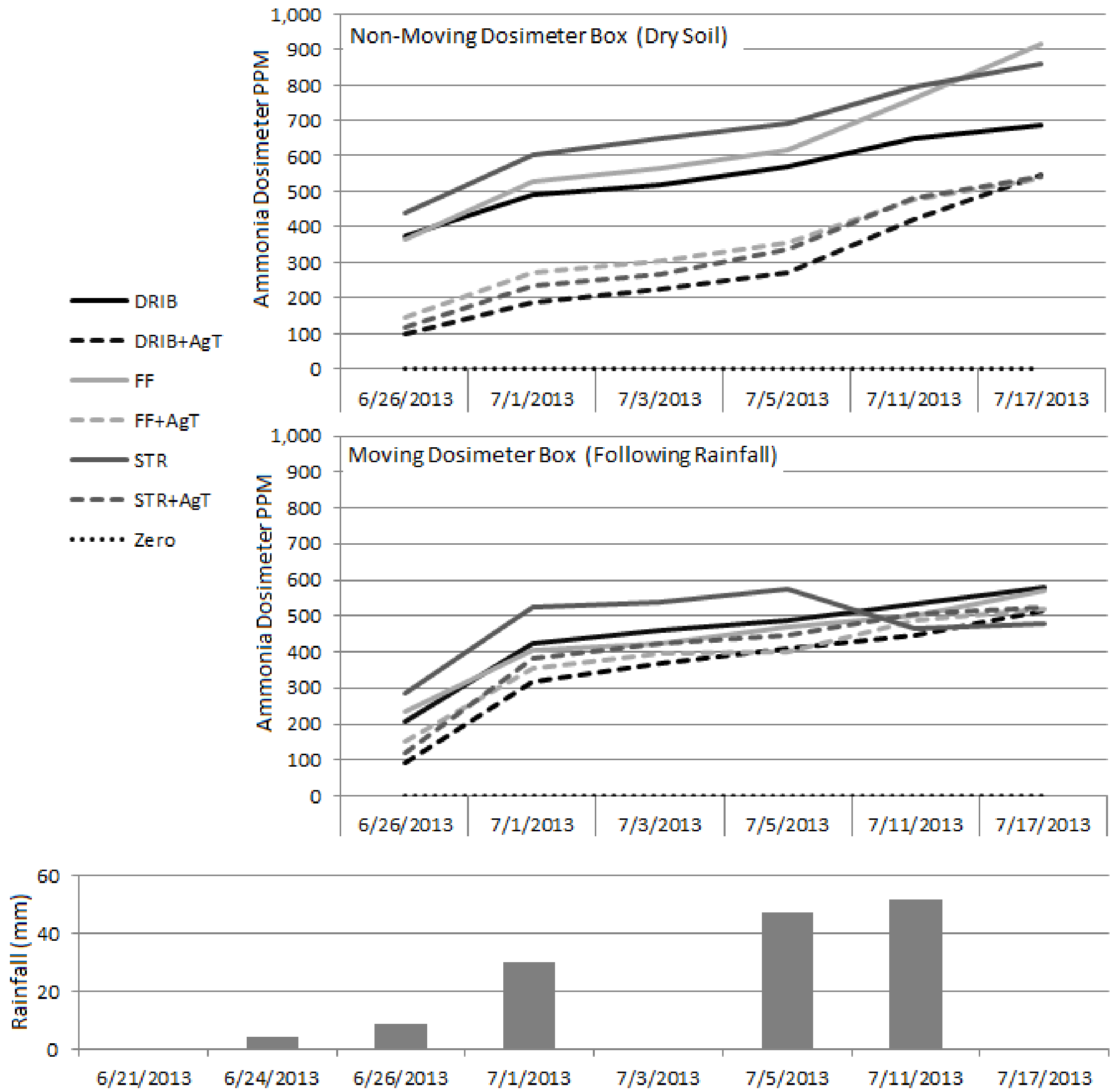
Results investigating the yield loss associated with crop injury from post-emergent UAN applications are presented in Table 3. At the 4 leaf stage yields were not significantly different among all three application methods suggesting that planting N was sufficient for maximum yields and that the burn associated with 4 leaf corn streamers did not have a negative impact on yield. At later growth stages there is a trend for UAN applied with streamers to have yields lower than where UAN was directed below the canopy. Streamer nozzle applications may be associated with some yield reducing leaf injury and/or less N availability at these later growth stages.

Table 3. Corn Yields For 3 Post-Emergent UAN Application Treatments For 3 Different Timings Averaged Across 3 Locations In Ontario, 2013

Post Emergent UAN Application Method	Corn Yields (bu/ac)*††* for Corresponding Application Timing		
	4 Leaf	8 Leaf	10 Leaf
Control (no post emergent application)	179 A	179 B	179 AB
N Soil (100 lb-N/ac directed below canopy)	184 A	191 A	185 A
N Streamer (100 lb-N/ac streamer over canopy)	176 A	179 B	168 B

†† Letter comparisons only valid for comparing application methods within application timings

Figure 1. Rainfall And Ammonia Dosimeter Values For Non-Moving And Moving Dosimeter Boxes For Four Weeks Following The June 18 Bare-Soil Application Of UAN At Elora In 2013



DRIB – Dribble Band, FF – Flat Fan, STR – Streamer Nozzle, AgT - Agrotain

Summary:

Surface applying UAN did not always result in yield losses when compared to injecting, though significant losses were evident at some locations in 2013. There were fewer instances of significant yield loss for surface applied UAN when Agrotain was included, though the average overall yield loss was similar. No differences in ammonia volatilization was observed between dribble band, flat fan or streamer nozzles, though including Agrotain with UAN did result in measurable reductions in ammonia volatilization across all nozzles. Rainfall appeared to reduce ammonia volatilization as demonstrated by the reduction in ammonia readings for the dosimeter boxes that were

moved following rainfall events compared to those that were not moved. Over-canopy applications of UAN by streamer nozzles did not appear to cause significant yield loss relative to directed applications when applied early (4 leaf stage), but did at later applications (10 leaf). Losses may have been due to a combination of leaf burn and/or less N availability relative to directed applications at these later stages. When soil surfaces were dry that the risk of ammonia volatilization from surface applied UAN was much lower than when the UAN was applied to wet/damp soil surfaces.

Next Steps:

This was the final year of this two year project. The complete final report will be available on www.gocorn.net.

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