Improving Corn Nitrogen Management by Delayed Side-dress Application

(Bruce SCIA Major Grant)

Purpose:

The purpose of this project was to evaluate the advantage of late split nitrogen (N) application in corn. Ongoing efforts to reduce N losses from farmland and the high cost of N fertilizer have increased the interest in the use of side-dress and split applications of nitrogen in corn production. Theoretically, applying some or all of the nitrogen requirements at side-dress timing when corn is in rapid N uptake stage can reduce possible N losses that would occur from pre-plant applications and result in more efficient use of nitrogen. Current side-dress timing based on the pre-side-dress nitrate test (PSNT) has proven to be only moderately successful in predicting nitrogen requirement. Research has indicated that nitrogen use efficiency may be improved by splitting nitrogen application between pre-plant/planting timing and a delayed side-dress application at the 12-14 leaf stage of corn. Some fertilizer dealers are now equipping high clearance sprayers with drop pipes and YDrop technology to side-dress corn without injection. Little field data exists that supports this approach. There is a risk to late side-dress application if weather conditions are wet. One approach to mitigate some of this risk is to apply most of the nitrogen required to meet the 'average' needs of corn yield expectation at pre-plant, and apply side-dress application as a top-up at a later crop stage so that seasonal growing conditions can be accounted for in the final determination of N requirements. The rate of top-up could be adjusted for weather conditions, yield potential or some other assessment such as optical reflectance (e.g. NDVI, Green seeker). This project was used to further explore these theories.

Methods:

Three nitrogen rates (0, 120, 180 lbsN/ac) and 3 split treatments were used in the evaluation (Table 1). Nitrogen rates included a 'normal' rate (120 lb. N/ac) determined by the OMAFRA Nitrogen Calculator and a non-limiting rate (180 lb. N/ac). The three rates would allow for determining a response curve for each site. Pre-plant application was not practical in the trial, so nitrogen treatments were applied as UAN surface dribble following planting. Side-dress application occurred at the 10-14 leaf corn stage.

Table 1. Nitrogen Treatments

Nitrogen Rate lb. N/ac	% Applied at Planting	% Applied at Side-dress
0		
120 (Normal)	100	0
120 (Normal)	70	30
180 (Non-limiting)	100	0
180 (Non-limiting)	50	50
180 (Non-limiting)	70	30

Figure 1. Y-Drop Equipped N Applicator Used in Project

Soil nitrate nitrogen samples were collected from the check (0 lb. N/ac) and 120 lb. N /ac treatment pre-plant prior to side-dressing and 2 weeks following side dressing.

Weather data (rainfall, temperature, wind speed, humidity, and solar radiation) was collected at two sites (Teeswater, Chepstow).

Results:

The corn yield was highest with the non-limiting N rate, but the normal rate (120 lb. N/ac) applied at planting was the most profitable (Table 2). The split N treatments did not improve yields or returns. At 3 of 4 sites, the OMAFRA Corn N calculator did a good job of estimating the most profitable N rate (Table 3). At the Tara site where the calculator did a poor job, the previous crop was winter wheat under seeded to red clover which produced a good stand of clover.

The lack of response to split N was likely a result of the relatively dry conditions between planting and side-dress application. June rainfall was 10-20% below normal, while July rainfall was 10-40% above. Between planting and side-dress application, about 8 inches (20 cm) of rainfall occurred (Figure 2). It should be noted that our pre-plant N application was not true pre-plant, but surface applied just after planting. Soil nitrate-N levels just prior to side-dressing were generally adequate (Table 4). The 120 lb. N/ac (low) all pre-plant N treatments had a soil nitrate-N test level of 60-120 lb. nitrate-N/ac (15-32 ppm) just prior to side-dressing timing. A soil nitrate-N level (PSNT) of 21 ppm (84 lb. N/ac) or higher at side-dress time is considered adequate for corn. Rainfall was received shortly

following the side-dress timing. Soil nitrate levels 2 weeks following side-dress timing were similar between the 120N all pre-plant and 120 N 70:30 split treatment. This would indicate there was little loss of N between planting and side-dress timing.

Table 1. Corn Yield Response to Applied N Summary

Location	N Rate (lbsN/ac)					
	0	120		180		
	N Timing (Planting:Side-dress)					
		70:30[1]	100	70:30	50:50	100
	Corn Yield (bu/ac)					
Chepstow	144	168	173	170	174	171
Teeswater	114	172	174	183	184	181
Teeswater 2	110	169	168	174	173	173
Tara	127	144	152	143	145	154
Average Yield	124	163	167	168	169	170

[1] 70:30 refers to 70% applied at planting; 30% applied side-dress

Table 2: Trial Site Crop and Field History

Location	Soil Type	Previous Crop	Corn Yield Goal (bu/ac)	OMAFRA N Calculator Recs (lbs N/ac)	MERN[1] (lbsN/ac)
Chepstow	Loam	Soybeans	160	93	90
Teeswater	Sandy Loam	W.Wheat	160	135	140
Teeswater 2	Loam	W.Wheat	160	135	140
Tara	Silt Loam	W.Wheat (red clover)	160	50	

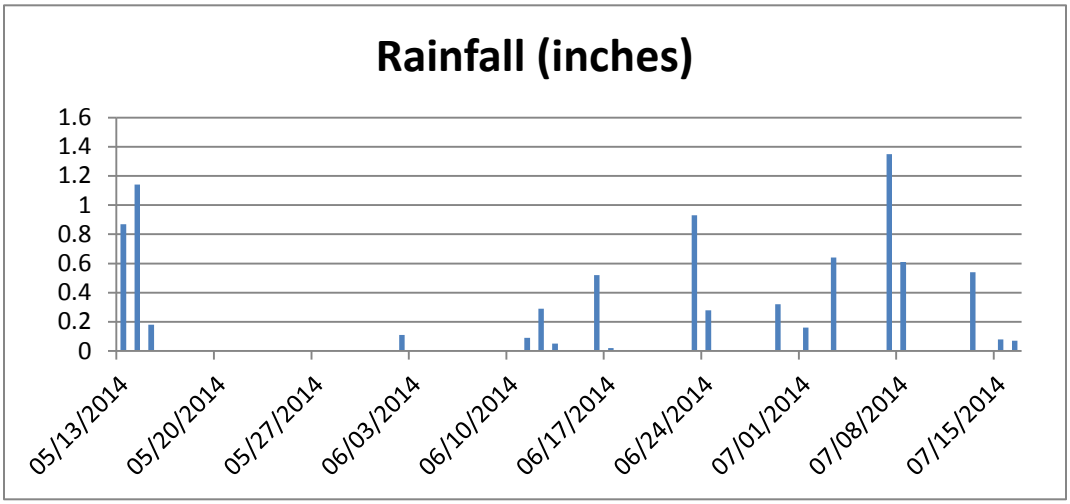
[1]Maximum economic response to nitrogen (MERN) is based on corn price of $4.85/bu., nitrogen cost $0.63 /lb. N, and drying cost $0.50/bu. (10 pts. H^2O)

Table 3. Soil Nitrate Levels by Sampling Timing

Location	Sample Timing			
	Pre-plant	Pre Side-dress	2 weeks Post Side-dress	
	100%	70:30	100%	70:30
	Nitrate N (ppm)[1]			
Chepstow	18	32	28	18
Teeswater	15	23	14	14
Teeswater 2	15	15	24	17
Tara	8	30	23	25

[1]To convert ppm to lb. /ac multiply by 4

Figure 2. Daily Rainfall (inches)-Teeswater



Summary:

In 2014, there was no advantage to split nitrogen application. The relatively low amount of rainfall between planting and pre-side-dress application resulted in little nitrogen loss from the pre-plant application.

The OMAFRA N Rate calculator was relatively accurate in estimating the most economical rate of nitrogen (MERN) in 3 of 4 trial locations. To evaluate the economics of routine splitting of nitrogen applications, trials need to be conducted over several years.

Splitting N applications is an effective way to spread the risk of potential N loss, reduce costs through more efficient N use, and potentially better match nitrogen rate to potential corn yield.

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