MANITOBA CORN MEETS 4-R NITROGEN MANAGEMENT (YEAR 2): EFFECTS ON CROP PERFORMANCE AND THE ENVIRONMENT

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ABSTRACT

Replicated corn trials to evaluate previous research on fertilizer technologies were conducted in 2015 under farm conditions at three sites Manitoba as well as in Quebec. Sites were located northwest of Elm Creek, MB on a loamy fine sand, near Carman, MB on a loamy very fine sand and at Culross, MB (southeast of Elm Creek) on a Red River clay.

Treatments in the Manitoba trials included: a zero N Check; three rates of urea/ESN (50% each by weight) broadcast/incorporated prior to planting; three rates of urea ammonium nitrate banded at crop stage V6-V8; urea broadcast/incorporated at 120 lb/ac pre-plant; urea broadcast at 120 lb/ac at crop stage V6-V8; and urea treated with Agrotain® broadcast at 120 lb/ac at crop stage V6-V8. Two additional treatments were added in Year 2: broadcasting urea treated with Agrotain® at 120 lb/ac within one week after planting; and applying UAN as a surface dribble at 120 lb/ac at crop stage V6-V8). All plots received a base application of N plus blanket applications of starter P and K fertilizer prior to planting (60-40-40 actual).

To evaluate crop performance, plant heights, SPAD chlorophyll meter and Greenseeker® measurements were taken to assess their ability to predict yield. Corn stalks were sampled prior to harvest to determine nitrogen sufficiency within the plant. Plots were harvested by hand and threshed, cleaned and weighed to determine yield, grain moisture and kernel density. Residual soil nitrate-N to 24-inch depths was measured to determine potential environmental impacts due to excess nitrogen applications or leaching events.

Initial review of yield data showed sites were responsive to N fertilizer treatments by reduced crop performance in most of the check plots. Differences among treatments will be confirmed by statistical analyses. Elevated soil nitrates from specific treatments at all sites were due to rate and/or timing factors.

INTRODUCTION

Since Manitoba farmers are achieving higher yields of corn over time it is important to use the 4R Principles for Nitrogen Management – meaning the application of the Right Source at the Right Rate at the Right Time and the Right Place to optimize yields through efficiency and to minimize losses (http://www.nutrientstewardship.com/what-are-4rs).

This project aims to evaluate previous research on new fertilizer technologies (such as nitrogen sources and inhibitors as well as optical sensors) and established technologies such as side dress placement (Grant et al, 2012) on corn at sites in Manitoba and Quebec, as well as evaluate new nitrogen fertilizer strategies of rate, placement and other means of tracking optimal nitrogen uptake and performance.

METHODOLOGY

In 2015, three sites in south-central Manitoba were selected for the second of three years of field trials: Elm Creek (loamy fine sand); Carman (loamy very fine sand); and Culross (heavy clay). The following treatment list was applied, on top of starter N-P-K fertilizer, to the three corn sites, incorporating some aspects from each of the 4R principles – source, rate, time and placement, with the last two additional treatments added in 2015:

Table 1. 2014-15 Nitrogen Fertilizer Treatment List.

Treatment	Source	Rate (lb/ac)	Placement	Timing
1	Check = no additional N (starter only)	0	-	-
2	50% urea; 50% ESN	60	Broadcast	Pre-plant
3	50% urea; 50% ESN	120	Broadcast	Pre-plant
4	50% urea; 50% ESN	180	Broadcast	Pre-plant
5	Urea	120	Broadcast	Pre-plant
6	UAN	60	Banded	V6-V8
7	UAN	120	Banded	V6-V8
8	UAN	180	Banded	V6-V8
9	Urea	120	Broadcast	V6-V8
10	Urea+Agrotain®	120	Broadcast	V6-V8
11	Urea+Agrotain®	120	Broadcast	<7 days after planting
12	UAN	120	Surface dribble	V6-V8

ESN = Environmentally Smart Nitrogen (44.5-0-0)
UAN = urea ammonium nitrate (28-0-0)

Along with corn yield and residual soil nitrogen, factors such as plant height, SPAD meter readings and a nitrogen stalk test for corn were measured to subsequently determine their ability to predict corn yields in a timely fashion to allow for supplemental N fertilizer applications if warranted. All sites were planted and managed for weeds by the cooperating producer. Sites were hand harvested in October and immediately soil sampled for residual nitrogen once the remainder of the field was harvested by the producer.

Table 2. Site Characteristics and Management Factors.

	Elm Creek	Carman	Culross
Soil Series and Surface Texture	Willowcrest loamy fine sand	Kronstal loamy very fine sand	Scanterbury heavy clay
Soil Classification (Canadian System)	Gleyed Black Chernozem	Gleyed Black Chernozem	Gleyed Black Chernozem
Internal Drainage	Imperfect	Imperfect	Imperfect
Agriculture Capability	3MW	2M	2W
Spring Nitrate-N soil test (lb/ac, 0-24")	21	74	27
Recommended N fertilizer rate for 120 bu/ac corn yield target	123	40	117
Starter fertilizer applied (N-P-K), lb/ac	60-40-40	60-40-40	50-40-40
Corn variety (CHU rating)	Pride H4415 (2200)	Pride A4631 (2300)	Pioneer P7632HR (2200)
Pre-plant fertilizer application date	April 29	April 29	April 30
Seeding date	April 30	May 2	May 6
V6-V8 fertilizer application date	June 24	June 16	June 15
Harvest date	Oct 13, 15, 19	Oct 9	Oct 19
Growing season issues	Early season wetness	High soil test N	Wetness and wind damage

RESULTS

Table 3. Corn yields (bu/ac) corrected to 15.5% moisture for two trial sites.

Treatment	Carman	Culross
1	148.7	109.9
2	133.8	137.6
3	148.0	155.7
4	150.0	111.0
5	142.4	130.2
6	152.6	133.3
7	153.3	145.9
8	150.6	153.2
9	146.8	134.4
10	146.8	164.0
11	144.9	144.6
12	149.4	121.0
LSD @ 0.05	12.06	40.07

Table 4. Other corn data collected for possible yield target prediction and validation.

Site	Elm Creek				Carman				Culross			
Trt #	Residual nitrate-N (lb/ac)	SPAD reading	N Stalk (ppm)	Plant Height* (inches)	Residual nitrate-N (lb/ac)	SPAD reading	N Stalk (ppm)	Plant Height* (inches)	Residual nitrate-N (lb/ac)	SPAD reading	N Stalk (ppm)	Plant Height* (inches)
1	29.0	48.9	169	73.8	40.7	51.7	1126	86.5	60.7	41.1	106	92.0
2	52.5	54.0	1171	75.3	69.4	50.6	4310	83.0	53.1	50.1	136	88.3
3	84.9	56.5	1763	75.1	126.0	46.2	6017	88.7	72.6	50.2	2588	94.0
4	91.9	54.5	2033	75.2	121.7	46.3	7921	85.7	94.9	57.0	2215	91.5
5	69.4	51.7	1080	70.4	105.4	45.9	6339	90.8	57.7	49.1	1229	80.9
6	74.9	55.1	1254	72.6	66.8	44.4	5747	82.4	57.7	46.5	169	80.0
7	132.8	55.6	1250	68.6	128.0	47.2	6209	82.2	64.3	50.6	967	86.5
8	160.1	55.4	1459	70.8	192.7	47.1	6159	83.3	111.7	52.6	1841	85.9
9	44.9	53.4	617	69.0	51.1	50.2	5392	85.5	69.7	51.6	183	87.4
10	64.2	54.9	1250	73.1	66.5	50.7	5538	84.5	64.7	55.4	1473	91.7
11	107.5	55.4	1533	67.9	102.2	45.9	5835	85.2	59.4	52.0	1491	90.2
12	58.7	52.8	1209	69.8	138.9	49.5	5106	85.4	72.9	46.7	513	83.5

*July 27, 2015 measurements

DISCUSSION

With six site-years of data compiled, there are some visible trends but will need more analysis to determine their statistical significance. Individual site conditions such as excess water can negatively impact any treatment effects present; while "wet" environments are sought after to help separate performance of different products, sometimes the wetness causes extreme crop variability, reducing stands and negating significance.

Similarly high soil test N values prior to trial establishment can mask treatment effects.

The treatment effects on yield were site-dependent. In 2014, heavy rains impacted the Elm Creek site in late June after the pre-plant treatments but before the in-crop (V6-V8 stage) treatments were applied. In 2015 these rains came in mid-May just after emergence. Carman received more normal amounts and frequencies of rainfall both years, and Culross experienced excess moisture conditions similar to Elm Creek but negatively affected fewer plots. Weather and soil moisture data will be examined in greater detail to assess these effects.

SUMMARY

Given this is Year 2 of a 3-year project in partnership with Quebec locations, we expect some trends to change over time with additional data and more thorough statistical analyses.

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