# Optimum nitrogen fertilizer management strategies for high-yielding spring wheat in Manitoba

**A. Mangin[1]***, D. Flaten[1], J. Heard[2]

[1]Dept. Soil Science, University of Manitoba; [2]Manitoba Agriculture *(Amy.Mangin@Umanitoba.ca)

UNIVERSITY OF MANITOBA

## Introduction

Manitoba producers are growing varieties of hard red spring wheat with very high yield potential, which has brought out challenges in our nitrogen management strategies. Current provincial guidelines are based on much lower yielding varieties and these recommendations (2.5 lbs. N/bu for milling quality wheat) indicate a large financial, agronomic and environmental risk for these high yielding varieties. Midseason N application may mitigate this risk but there is currently debate over the best method and timing for midseason application to best utilize fertilizer.

### *Research Objectives*

1. Determine appropriate N rates based on yield and protein goals for new high yielding spring wheat varieties.
2. Determine most effective and efficient combinations of timing, placement and source, especially for midseason applications.
3. Evaluate soil tests for measuring potential mineralization of organic soil N that can be released during the growing season.
4. Develop decision tools for midseason evaluation of N sufficiency.

## Methods

Two-year field research project with sites conducted across Manitoba, including two intensive "Gold Sites" hosted by University of Manitoba, and four less intensive "Silver Sites" executed primarily by Manitoba's Diversification Centres. Treatments were designed to address 4R N management for two high yielding spring wheat varieties (Table 1).

### *Mineralization Tests*

To estimate potential organic N mineralized during the growing season three methods were evaluated: Sharifi's sodium bicarbonate extraction, Les Henry's sample incubation test, and Solvita $CO_2$ burst test on the 0-15cm portion of the soil profile sampled at seeding.

**Figure 1.** Midseason N measurements being taken during the 2016 growing season, SPAD meter (left) and soil NO3-N (right)

**Table 1.** Treatment list for U of M (Gold) and Diversification Centre (Silver) sites across Manitoba

| Variety | N Rate (lbs N/ac) | | Source | | Timing/Placement | |
|---|---|---|---|---|---|---|
| | Spring | In Season | Spring | In Season | Spring | In Season |
| Brandon (CWRS) and Prosper (CNHR) | 0 | | Urea (Gold), Agrotain treated urea (Silver) | | Midrow band at seeding (Gold), Broadcast after seeding (Silver) | |
| | 50 | | | | | |
| | 80 | | | | | |
| | 110 | | | | | |
| | 170 | | | | | |
| | 200 | | | | | |
| | 80 | | ESN:Urea (40:40) | | | |
| | 140 | | ESN:Urea (100:40) | | | |
| | 80 | 30 | Urea, Agrotain treated urea | Agrotain treated urea | | Stem elongation, broadcast |
| | 80 | 60 | | | | |
| | 80 | 30 | | | | Flag leaf, broadcast |
| | 80 | 60 | | | | |
| | 80 | 30 | | UAN | | Post anthesis, foliar |
| | 80 | 30 | | Urea Sol'n | | Post anthesis, foliar |

### *In Season N Sufficiency Measurements*

Throughout the growing season a number of measurement tools were used to help estimate if adequate N was present to obtain yield and protein goals. Greenseeker, an active NDVI sensor, and SPAD chlorophyll meter readings were taken before each in-season nitrogen application at stem elongation, flag leaf and anthesis. Flag leaf samples for N content and soil nitrate-N were also taken just before heading.

### *Harvest Measurements*

Biomass was taken at hard dough stage for total grain and straw N content from each treatment. Lodging, height, grain yield and protein (TBD) was taken at harvest. Shortly after harvest, residual soil nitrate-N (0 – 120 cm) samples were taken from each plot as a nitrogen auditing tool.

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## 2016 Preliminary Yield Results

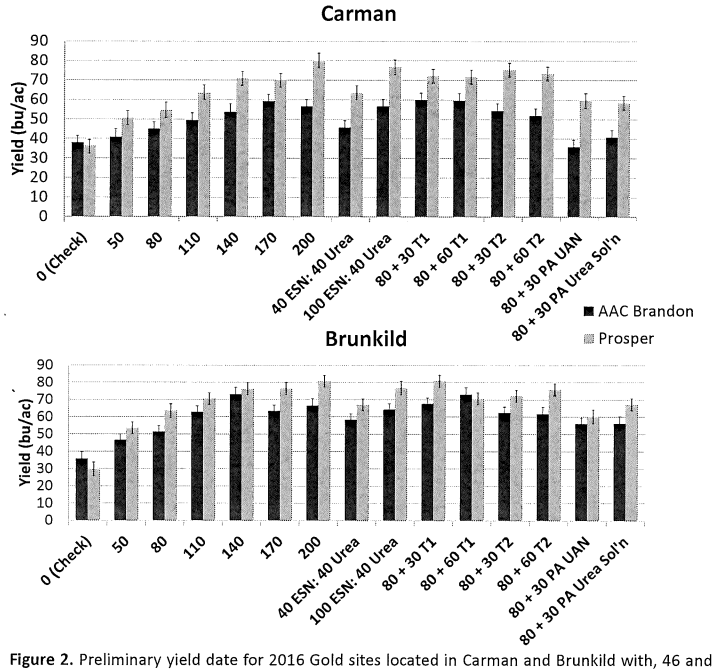


**Figure 2.** Preliminary yield date for 2016 Gold sites located in Carman and Brunkild with, 46 and 40 lbs. background soil-N nitrate, respectively. Yield data is corrected to 14.5% moisture content.

## Observations

Preliminary yield data suggest that the overall supply of nitrogen required per bushel for these high yielding varieties may not be as high as currently recommended. In season applications of N at stem elongation and flag leaf resulted in yields similar to when all N was applied at planting. Post anthesis N applications may increase grain protein (TBD) but leaf burn may reduce yield.


**Figure 3.** Maturity differences in Prosper wheat at Brunkild, MB when 30 lbs. N/ac was applied at stem elongation (A) compared to post anthesis as UAN (B) to 80 lbs. N/ac base rate (left). Leaf burn from post anthesis foliar applied UAN in Carman, MB (right).