Hard Red Wheat: SMART Trials with Nitrogen and Fungicides

(Interim Report)

Purpose:

Recent Ontario research has shown a strong interaction between fungicides and increased nitrogen rates to increase yield. However, all this research was performed on soft winter wheat (SRW, SWW). Hard red winter wheat (HRW) is generally lower yielding than soft wheat, so it is unknown if HRW will respond as positively. This research also found a significant increase in protein levels, something desperately needed in HRW. This trial will determine the yield and protein potential for Ontario HRW, and what the economic implications might be.

Methods:

Two replicate field scale trials were conducted at 13 locations (7 sites 2011, 6 sites 2012) across southwestern Ontario. Only fields planted with hard red winter wheat were chosen for this trial. The treatments were:

1. 90lbs Nitrogen with no fungicide
2. 90lbs Nitrogen with 2 fungicides
3. 150lbs Nitrogen with 2 fungicides
4. 180lbs Nitrogen with 2 fungicides

Treatment 3 was not included at all locations. The first fungicide was applied at weed control timing (T1) and the second fungicide was applied at anthesis (T3, 2-5 days after heading). A plant growth regulator was applied at 5 of the 13 sites to prevent lodging. Leaf disease ratings were taken at both T1 and T3 fungicide times, head disease ratings after grain fill, and lodging score prior to harvest. Harvest measurements included yield, moisture, test weight, thousand kernel weights, and protein. Soil nitrate samples were collected post harvest to examine the environmental implications of increased nitrogen application. We were unable to complete baking quality tests, unfortunately.

Results:

Yield gains from fungicide supported what previous studies have found (Table 1). On average there was a 6.5 bushel advantage from fungicide. All 10 locations with the no fungicide treatment had some response to fungicide. The financial cost of applying 2 fungicides is approximately $33/acre. At a HRW price of $6.75/bushel, a 5 bu/ac gain is required to cover costs. 70% of the sites received a financial gain from applying fungicides without considering the benefit of Fusarium protection and potential quality impacts.

There was a similar response to increased nitrogen (N). An additional 60 lbs./ac of N coupled with fungicide increased yields 5.5 bu/ac. Calculating N at $0.59/lb. actual N ($600/t urea), generates an additional cost of $35.40/acre for an additional 60 N. Current wheat prices require 5.2 bushels to pay for this extra N. This calculation ignores the impact of increased protein levels (below), and that the yield response from increased N was variable across locations. 7 of the 13 locations received less than a 3.5 bu/ac gain while 4 locations had a response of at least 8 bushels. On average, from a yield perspective only, increased management is at break-even levels, but the variability in the data suggests the benefits will be location specific.

Table 1: Yield Results (13 sites 2011/2012)

Treatment	2011	2012	Trial Average	Gain Over Check
120 N No Fungicide	85.1	81.8	83.8 c[1]	
120 N Fungicide	92.8	86.5	90.2 b	6.5
180 N Fungicide	96.6	94.5	95.8 a	12.0
[1] Means followed by the same letter are not statistically different at the 5% level.				

Analyzing trials that included the 150 N treatment with fungicide become much more exciting (Table 2). 150 N increased yield by 7.5 bu/ac, but yields stagnate with additional N above this level. This limited data set achieves maximum yield at 150 N, requiring only 2.6 bu/ac to cover the added cost. All 4 of these locations increased economic return with 150 N. While this appears very positive, there is a caveat, 5 of the 13 sites included in Table 1 did not achieve a yield response of 2.6 bu/ac with the addition of 60 units of N.

Table 2: Nitrogen Yield Response (4 sites)

Treatment	Yield	Gain Over 120 N
120 N Fungicide	93.0 b	
150 N Fungicide	100.5 a	7.5
180 N Fungicide	100.4 a	7.4

The most important outcome of this trial could well be the impact on protein levels. The protein results from the 10 locations with a no fungicide treatment are summarized in Table 3. Fungicides caused a slight decline in protein levels. This is expected and consistent with previous research. As yields increase with the fungicide application, without additional N the protein content becomes diluted. The addition of nitrogen however, results in a significant increase in protein. The additional 60 lbs. N/ac increased protein level by a full 1% over the 120 N plus fungicide treatment. Protein response to increased nitrogen was also variable across locations, ranging from 0 to 1.7%.

The economics of this increased protein can significantly change the profitability picture. Using the average protein values from the trials, 120 N would not achieve any protein premium. At 11% protein, many purchasers add an additional $8.00/t price premium (+ $15/t > 12% protein). Using this value would add another $20/ac income from the additional N. As increased yield was at the breakeven level, this protein premium would be all profit, making the increased management inputs significantly more viable.

Table 3: Protein Results

Treatment	Protein	Gain Over Check
120 N No Fungicide	10.4% b	
120 N Fungicide	10.2% c	-0.2%
180 N Fungicide	11.2% a	0.8%

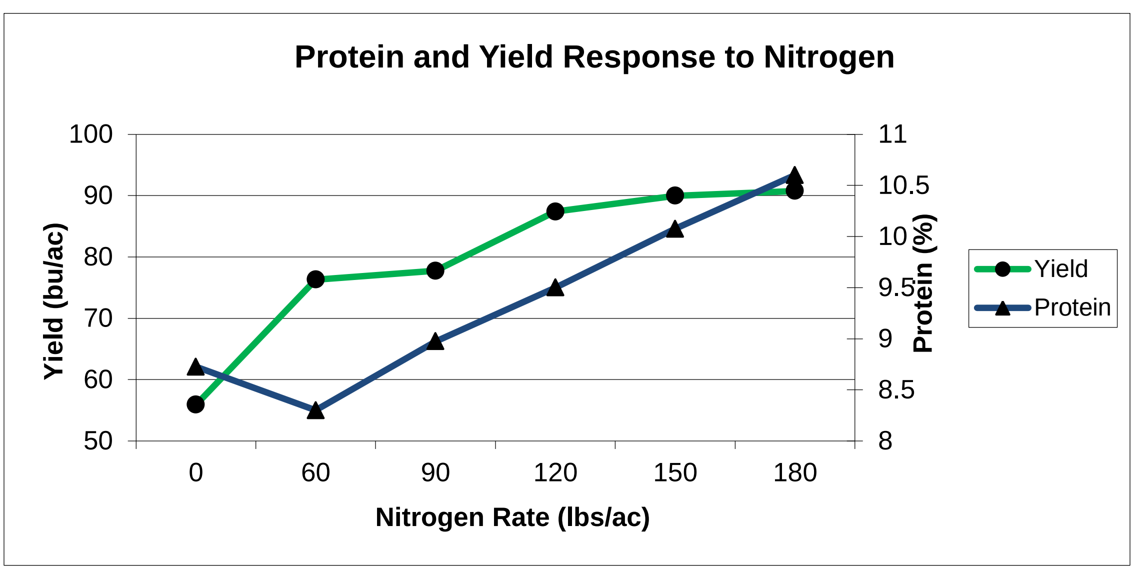
Summarizing the sites that included the 150 N fungicide treatment shows a strong protein response from nitrogen (Table 4). It shows a consistent response of 0.6% increase in protein from every 30 N. All 4 sites had a response to each additional 30 units of N.

Table 4: Nitrogen Protein Results

Treatment	Protein	Gain Over 120 N
120 N Fungicide	10.3% c	
150 N Fungicide	10.9% b	0.6%
180 N Fungicide	11.5% a	1.2%

Figure 1 shows the protein response from the London location, which is a very typical protein response curve. This site contained N rates ranging from 0 to 180 N all with fungicide. Yield response was so significant from the first 60 units of N, it caused protein levels to decrease. Beyond this first increment of N, as nitrogen levels increased so did protein. Protein levels increased by approximately 0.5% for every 30 units of additional N applied. If this was consistent across locations, it would allow growers to calculate whether additional nitrogen would be profitable or not.

Figure 1: Protein Results from London



Summary:

70% of trial locations still had a profitable response from applying fungicide, even though Fusarium levels were low in both years of the trial. A limited data set has shown that hard red wheat is approaches maximum yield with 150 N but protein levels continue to rise with additional N.

A premium of $8/tonne is available for hard red wheat at 11% protein, with proteins of 12% or greater receiving $15/t premium. Protein levels can be extremely variable field. 6 of the 13 locations received an economic advantage by increasing from 120 to 180 N. An additional 3 sites received enough response to just cover the cost of the additional N. Yield response to the additional N was critical to a financial gain from 180 N. Only the sites that had a yield response high enough to cover the N cost (over 5.5 bushels/acre) had a maximum economic return (MER-N) at 180 N. Increased protein levels did result in 3 lower yielding sites (under 3.5 bushels/acre) achieving breakeven economics at 180 N. Of the 4 sites with the 150 N treatment, 2 of the 4 reached MER-N at 150 N. Increasing protein levels resulted in the other 2 locations reaching MER-N at 180 N.

Standability has been extremely good (no lodging) at almost all locations considering that the majority of the sites did not use a growth regulator. Leaf and head disease levels have been low to moderate at most locations but the check treatments (no fungicide) have shown higher disease levels.

Next Steps:

This project will continue for the 2013 growing season. Treatment 3 (150 N) will be investigated more intensively in 2012. Anyone interested in co-operating with this project should contact Peter Johnson at peter.johnson@ontario.ca. or Shane McClure at shane.mcclure@ontario.ca

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