Hard Red Wheat: SMART Trials

Purpose:

Recent Ontario research has shown a strong interaction between fungicides and increased nitrogen, resulting in increased yield. To date, this research focused on soft winter wheat (SRW, SWW). Hard red winter wheat (HRW) is generally lower yielding but higher in protein than soft wheat, so it is unknown if HRW will respond in the same manner. The SMART soft wheat research also found a significant increase in protein levels, something often lacking in HRW. This trial will determine the yield and protein potential for Ontario HRW under the nitrogen by fungicide management regime, and what the economic implications might be.

Methods:

Two replicate field scale trials have been performed at 18 locations (7 sites 2011, 6 sites 2012, 5 sites 2013) across southwestern Ontario. Only fields planted with hard red winter wheat were chosen for this trial. The treatments are listed below:

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 6 of the 18 sites to prevent lodging. Leaf disease ratings were taken at both T1 and T3 fungicide timings, head disease ratings at late grain fill, and lodging score prior to harvest. Harvest measurements included yield, moisture, test weight, thousand kernel weights, lodging and protein. Soil nitrate samples were collected post harvest to examine the environmental implications of increased nitrogen application. Treatment samples were not evaluated for baking quality, but this would have been valuable information had it been able to be accomplished.

Results:

Yield gains from fungicide supported what previous studies have found (Table 1). On average there was an 8.3 bushel advantage from fungicide. All 14 locations with the no fungicide treatment had some response to fungicide. The financial cost of applying 2 fungicides is approximately $30/acre. At a HRW price of $7.00/bushel, a 4.3 bu/ac gain is required to cover costs. 78% of the sites received a financial gain from applying fungicides without considering the benefit of Fusarium protection and potential quality impacts. The yield data from 2013 shows just how massive yield response to fungicide can be in a year with high fusarium pressure. 3 of the 4 sites in 2013 had a yield response of over 13 bu/acre to fungicide while the 4th site had a yield response of 7 bu/ac.

There was a similar response to increased nitrogen (N). An additional 60 units of N coupled with fungicide increased yields 5.2 bu/ac. Calculating N at $0.49/lb actual N

($500/t urea), generates an additional cost of $29.58/acre for an additional 60 N. Current wheat prices require 4.9 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. 60% of the locations received less than a 3.5 bu/ac gain while 30% 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 (bu/ac @ 14 sites 2011/2012/2013)

Treatment (N lbs/ac)	2011	2012	2013	Trial Average	Gain
120 N No Fungicide	85.1	81.8	77.5	82.0	
120 N Fungicide	92.8	86.5	90.4	90.3	8.3
180 N Fungicide	96.6	94.5	94.5	95.4	13.4

Analyzing trials that included the 150 N treatment with fungicide, the additional N becomes much more exciting (Table 2). 150 N increased yield by 5.4 bu/ac, but yields were stagnate with additional N above this level. This data set achieves maximum yield at 150 N, requiring only 2.4 bu/ac to cover the added cost. 5 of the 7 locations had an increased economic return with 150 N, while the remaining 2 sites broke even. This data appears very positive, but there is a caveat. 5 of the 18 sites included in Table 1 did not achieve a yield response of 2.4 bu/ac with the addition of 60 units of N, thus it is unlikely those 5 sites (28%) would have had economic response to 150 N.

Table 2: Nitrogen Yield Response (bu/ac @ 7 sites)

Treatment (N lbs/ac)	Yield	Gain
120 N Fungicide	90.4	
150 N Fungicide	95.9	5.4
180 N Fungicide	96.3	5.9

The most important impact of this trial could well be the increase in protein levels. The protein results from the 13 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, N content becomes diluted in the albescence of additional N. 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. Note that protein response to increased nitrogen was 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 $5.00/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. 11of the 16 locations received an economic advantage by increasing from 120 to 180 N when additional revenue from both yield and protein are considered.

Table 3: Protein Results

Treatment (N lbs./ac)	Protein	Gain Over Check
120 N No Fungicide	10.5%	
120 N Fungicide	10.3%	-0.2%
180 N Fungicide	11.3%	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 roughly 0.5% increase in protein from every 30 N.

Table 4: Nitrogen Protein Results

Treatment	Protein	Gain Over 120 N
120 N Fungicide	10.4%	
150 N Fungicide	10.9%	0.5%
180 N Fungicide	11.5%	1.1%

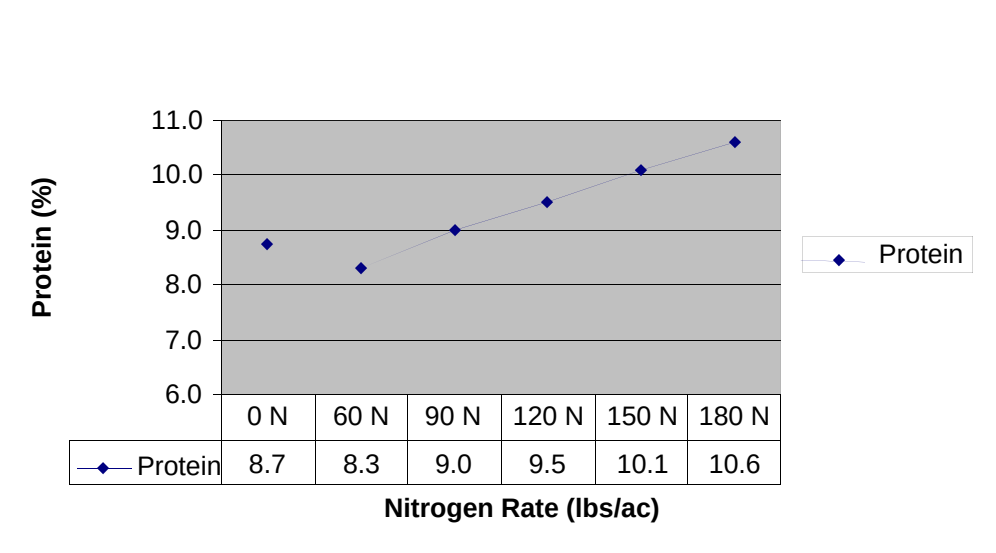
Figure 1 shows the protein response from the London location, which is a very typical protein response curve. This site contained N rates ranging from 0 to 180 N, all with fungicide applied. Yield response was so significant from the first 60 units of N, it caused protein levels to decrease. Beyond this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

Summary:

78% of trial locations had a profitable response from applying fungicide, even without considering any quality benefit that might be gained. A limited data set has shown that hard red wheat approaches maximum yield with 150 N but protein levels continue to rise with N applied above that rate. 5 of the 6 sites locations including the 150 N treatment had an economic advantage to increasing N from 120 to 150 with fungicide applied. 4 of these 5 sites had a yield response of over 4 bu/acre which would easily pay for the additional 30 N without even considering the protein impact. There was little benefit to increasing N from 150 to 180. 5 of the 6 sites had a slight economic advantage (<$6/acre) with the 180 N treatment but the risks might out weight the gain. Growers who have not had lodging concerns in the past are encouraged to try increasing N on HRW to 150 on a couple of strips to see what the response is like on their farm. Standability has been extremely good (no lodging) at almost all locations considering that the majority of the sites did not use a growth regulator. Caution should always be used when increasing N rate. Leaf and head disease levels have been low to moderate at most

locations but the check treatments (no fungicide) consistently show higher disease levels.

Figure 1: Protein Results from LondonSite



Next Steps:

This project is now complete (2011- 2013). Further research will be conducted to attempt to further increase protein levels in HRW. Starting in 2014 a project will begin looking at split nitrogen applications on HRW, if funding allows. 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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Project Contacts:

Peter Johnson, Provincial Cereal Specialist, peter.johnson@ontario.ca

Shane McClure, Research Lead, shane.mcclure@ontario.ca

Location of Project Final Report:

Peter Johnson