

## Winter Wheat Nitrogen Response X Fungicide Interactions

### Purpose:

Until recently, winter wheat nitrogen recommendations were based on research conducted 30 years ago. Production practices have changed significantly, with increased yield potential through better genetics (varieties), fungicides, and growth regulators. In the pursuit of higher wheat yields using improved management techniques, N recommendations were found not be sufficient. N recommendations were increased (2012) based on research which is the precursor to this study (Hooker et al, 2014, Johnson and McClure previous CropAdvances).

This study continues the evaluation of nitrogen recommendations, with a shift in focus to the difference in response between with fungicides applied and without fungicides. A wheat nitrogen calculator is hoped to be developed from this and previous research efforts.

### Methods:

Six trials were established in the spring of 2014 across southwestern Ontario. Plot design was field scale, two replicate, randomized with 6 N rates, both with and without fungicides (total 24 plots/site). Post-harvest soil nitrate tests were collected to evaluate soil residual N and potential environmental impact from higher N applications.

Other than the nitrogen rate and fungicide applications, all variables at each field location were consistent, following the normal production practices based on the producer. At all of the sites, spring nitrogen was applied by broadcasting urea with a Valmar airflow applicator. The treatments are as followed, although treatments 6 and 12 were only included at 2 of the 6 sites.

Urea applications were made between late April and the beginning of May. Data collected from these sites included yield, moisture, test weight, 1000 kernel weights, protein, disease ratings and lodging. Post-harvest soil nitrate samples were collected to observe environmental impact with increase nitrogen application.

1. Check (No nitrogen applied) with fungicide
2. 60lbs Nitrogen (60N) with fungicide
3. 90lbs Nitrogen (90N) with fungicide
4. 120lbs Nitrogen (120N) with fungicide
5. 150lbs Nitrogen (150N) with fungicide
6. 180lbs Nitrogen (180N) with fungicide
7. Check (No nitrogen applied) without fungicide
8. 60lbs Nitrogen (60N) without fungicide
9. 90lbs Nitrogen (90N) without fungicide
10. 120lbs Nitrogen (120N) without fungicide

- 11. 150lbs Nitrogen (150N) without fungicide
- 12. 180lbs Nitrogen (180N) without fungicide

**Results:**

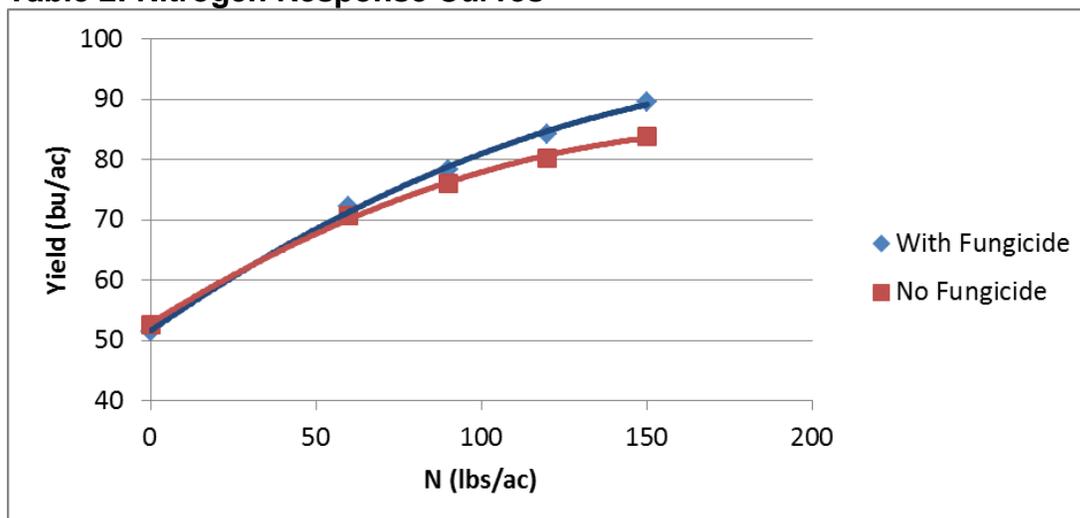
Yields increased with the addition of N (Table 1). Yield increase was the greatest with the first addition of nitrogen, with subsequent increases being less with each addition of 30 lbs N. As indicated in previous research, zero N yields were essentially equal regardless of fungicide application. Yield increases are higher with fungicides applied than without fungicides for each additional increment of nitrogen (incremental gain). Additionally, without fungicides yield gains drop quickly above 90N, while yield gains with fungicides hold constant to 120N, and remain significant even to 150N.

There was no impact of N rates on test weight, moisture or thousand kernel weights.

**Table 1: Breakdown of Yields With and Without Fungicide (bu/ac)**

Treatment	With Fungicide	Incremental Gain	No Fungicide	Incremental Gain
0N	51.4	-	52.7	-
60N	72.2	20.8	70.7	18.0
90N	78.3	6.1	76.0	5.3
120N	84.2	5.9	80.2	4.2
150N	89.5	5.3	83.9	3.7

**Table 2: Nitrogen Response Curves**



**Economic Analysis:** Using urea at \$550/tonne (\$0.53/lb of actual N) and soft red wheat at \$6.00/bushel, less than 3.0 bushels of wheat are required to cover the cost of 30lbs of N ( $\$0.53/\text{lb} \times 30\text{lbs} = \$15.90 / \$6.00/\text{bu} = 2.65$  bushels). With the addition of fungicide application, you increase your costs by \$24.00/ac (fusarium fungicide \$14.00/ac + \$10.00/ac application). In order to cover the cost of the fungicide, you would have to have an increase of 4 bushels ( $\$24.00 / \$6.00 = 4$  bu). Using these assumptions, the 150 N with fungicide is the most profitable treatment on average.

The interaction of nitrogen and fungicides is intriguing in this economic analysis. While 2014 yields were lower than trend line due to harsh winter conditions and winterkill, the synergy between nitrogen and fungicide use still exists. This indicates that even on crops with lower yield potential, management still pays. Additionally, it is intriguing to note that while economic impact is small between 90, 120 and 150 N, it is only at the highest N rate that use of the fungicide becomes more profitable (average numbers).

Although yields are expected to increase with the more N that is applied, that is not always the case. As shown in Table 3, increasing N from 150N to 180N did not increase yield. Although this is limited data (2 sites), previous trials have also verified little or negative response to 180N, although protein increases can occur with these higher N rates.

**Table 3: Summary of Trials Including 180N Treatments**

Location (2 Sites)	Applied Fertilizer N (lbs/ac)					
	0N	60N	90N	120N	150N	180N
	Wheat Yield (bu/ac)					
<b>With Fungicide</b>	44.6	58.9	67.9	71.3	78.2	78.2
<b>Without Fungicide</b>	46.9	64.4	63.4	68.7	74.3	74.2

**Summary:**

The results from this trial prove that there are great opportunities to increase yield through the use of N and fungicide. The synergy between N and fungicide in winter wheat was evident again in 2014. Response to fungicide was very minimal in this trial, but response to fungicide increased as N rates increased, giving support to the synergy concept. At 90N there was only a 2.3 bu/acre yield increase from fungicide. At 120N yield response was 4.0 bu/acre and 150 N it increased to 5.6 bu/acre.

Yield response to increasing N without fungicide was greater than expected. If no fungicide was applied 120 N was the most economic rate. At 150 N without fungicide, the yield increase is essentially breakeven.

The treatment with the highest profit was 150N with fungicide. However, differences in profit between the treatments above 90N were quite small in this dataset. If the cost of the fungicide is mitigated by any quality concerns (fusarium), the economics of high N rates with fungicide use increases substantially.

**Next Steps:**

This is the initial year of this project. Research will be gathered and continued for another 2 years (2014-2016). Data collected from this trial will be used in multiple articles, as well as presentations.

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**Location of Project Final Report:**

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