SMART Wheat: "Managing Wheat Intensively to Assess Yield Potential"

Purpose:

Many trials have been done investigating the impact of single factors on winter wheat yields. However, information from the United Kingdom and elsewhere indicate a strong interaction between nitrogen and fungicide inputs. Studies of these as independent variables may overlook these interactions. This project was undertaken to assess if an interaction exists in Ontario, as well as to assess what the maximum yield potential of wheat might be under Ontario environmental conditions. While economics must always play a role in final management decisions, this trial included one treatment where economics was ignored, to assess potential yield. Environmental impacts of this treatment were also investigated.

Methods:

Two replicate field scale trials were initiated on 17 farms across southwestern Ontario from Sombra to Amberly in the fall of 2008. High yield, early planted fields were targeted, and only fields planted to soft red winter wheat were considered (soft red has the highest yield potential). Treatments were applied in the spring of 2009, and included a check (normal N rate, no fungicides), a fungicide treatment (normal N rate, a weed control fungicide and a head fungicide (Prosaro) applied), and a high N treatment (double N rate, both fungicides applied, and a plant growth regulator to prevent lodging). Leaf disease ratings were taken on a weekly basis, head disease ratings were taken bi-weekly following heading, and lodging scores taken prior to harvest. Harvest measurements included yield, moisture, test weight, thousand kernel weight (TKW), protein, and fusarium damaged kernel (FDK) scores. Soil nitrate samples were collected and analyzed post harvest.

Results:

Yields increased dramatically with the interaction of adding both extra nitrogen and fungicides. Response to fungicide only was much more modest, in line with what previous studies had shown.

Standability was excellent on all treatments across all locations, even high rate nitrogen strips without a growth regulator, the result of cool May and June temperatures decreasing stem elongation, and increasing stem thickness. Leaf disease ratings remained low across locations, although check treatments (untreated) did show higher disease levels. Head disease ratings remained low across locations. Moisture was not significantly different across treatments.

Table 1 summarizes the yield data. There was an average yield increase of 6.4 bu/ac over all trials, with only one negative response (Wallacetown 2). However, this level of yield increase would not be sufficient to cover the costs associated with two fungicide applications. This outcome is consistent with fungicide data collected over previous years.

The data in Table 1 show a significant and consistent response to the combination of fungicide and higher nitrogen applications at every location. The one exception to this is the Arva location (data not shown), where there was a significant negative impact of the growth regulator/herbicide/fungicide combination applied to the high nitrogen strip. The injury symptomology was extremely short, green plants that did not mature normally, which is consistent with Cycocel injury. Despite this injury, there was only a 3 bu/ac yield penalty to this treatment.

The average yield increase of 14.8 bu/acre is incredibly exciting. This repeats the 2008 outcome, and will more than pay for the added nitrogen cost. However, data from the SMART small plot trials (not shown) indicate that this yield increase is only possible with the application of at least 1 fungicide, either at heading or at flag leaf. The total yield increase of 21.2 bu/ac will cover the cost of all added inputs, dependent on the price and need for the growth regulator.

Table 1: Wheat Yields

Cooperator	Wheat Yields (bu/ac)		
	Check	Fungicide	High N
Mitchell	89.8	104.5	111.0
St. Thomas	79.9	84.1	98.6
Lobo	98.1	108.9	121.6
Bryanston	73.0	86.7	101.7
Ilderton	86.9	94.7	112.6
Lucan	84.8	85.8	101.3
Watford	71.8	74.5	87.9
Sparta	83.5	88.7	116.1
Foldens	73.1	73.9	85.8
Melbourne	81.9	88.6	94.1
Wallacetown 1	81.4	92.4	107.3
Wallacetown 2	82.0	79.4	101.9
Goderich	88.0	97.0	104.8
Amberley	85.2	93.8	116.4
Woodstock	104.5	111.3	131.4
Sombra	111.7	113.9	122.0
Average	**86.0**	**92.4**	**107.2**

Table 2 shows the impact of increased inputs on protein. Higher nitrogen rates increase protein levels by 0.8% on average in 2009, and 0.5% in 2008. This outcome is anticipated, and well supported in research literature. The impact of this increased protein is less clear. Domestic users generally prefer low protein soft wheat, while export buyers prefer high protein. 50% of our SRW currently is exported, but the domestic market is the most consistent and important to supply. Whether this added protein is a benefit or detriment remains open to debate.

Table 3 gives test weight results. There is a small increase in test weight with fungicides (0.6 lb/bu), and an additional small increase from added nitrogen (0.6 lb/bu). On years

with low test weight issues, these increases might increase the grade, but generally there will not be an economic benefit to this increase.

Table 2: Protein Level Results

Cooperator	Protein Levels (%)		
	Check	Fungicide	High N
Mitchell	10	10.1	10.5
St. Thomas	9.7	9.8	10.4
Lobo	9.6	9.5	10.4
Bryanston	9.7	9.8	10.7
Ilderton	8.5	8.4	8.8
Lucan	9.3	9.3	10.1
Watford	9.2	8.8	9.4
Sparta	9.8	10.1	10.5
Foldens	9.9	9.9	10.9
Melbourne	10.1	9.9	11.2
Wallacetown 1	9.0	8.8	9.5
Wallacetown 2	9.0	8.7	9.7
Goderich	9.8	10.0	11.4
Amberley	8.1	8.2	8.9
Woodstock	9.6	9.8	11.1
Sombra	10.8	10.5	11.2
Average	**9.5**	**9.5**	**10.3**

Table 3: Test Weight

Cooperator	Test Weight (lbs/bu)		
	Check	Fungicide	High N
Mitchell	55.7	55.2	53.7
St. Thomas	56.3	56.9	56.5
Lobo	57.1	57.3	58.3
Bryanston	57.5	59.2	59.6
Ilderton	55.7	56.4	57.0
Lucan	58.4	58.8	60.1
Watford	55.2	56.3	56.2
Sparta	57.0	58.1	58.1
Foldens	57.9	58.5	59.5
Melbourne	55.7	56.1	58.0
Wallacetown 1	57.4	57.8	59.4
Wallacetown 2	57.2	56.7	57.5
Goderich	60.3	61.0	61.7
Amberley	58.2	58.7	60.0
Woodstock	57.0	58.9	59.3
Sombra	57.3	57.2	58.0
Average	**57.1**	**57.7**	**58.3**

Table 4 shows TKW (thousand kernel weight) results. There was a significant increase in TKW results when fungicides were applied (1.7 g). Higher nitrogen rates had no effect. TKW is a significant factor in the seed industry, which shows the value of fungicides when producing seed. There is no other economic impact of increased TKW.

Table 4: Thousand Kernel Weight

Cooperator	'000 Kernal Weight (grams)		
	Check	Fungicide	High N
Mitchell	33.6	38.0	38.8
St. Thomas	37.4	37.2	38.6
Lobo	37.9	40.3	37.8
Bryanston	35.9	36.7	36.9
Ilderton	33.4	35.7	33.2
Lucan	38.2	38.6	45.1
Watford	37.2	40.4	38.2
Sparta	39.5	38.6	40.8
Foldens	39.6	40.2	38.3
Melbourne	36.1	40.5	40.1
Wallacetown 1	37.5	38.0	37.5
Wallacetown 2	38.2	38.5	39.1
Goderich	43.9	47.4	49.5
Amberley	37.9	40.6	40.2
Woodstock	38.2	41.0	39.8
Sombra	39.1	39.4	38.8
Average	**37.7**	**39.4**	**39.5**

Summary:

These results show exciting opportunity to dramatically increase wheat yields in Ontario. However, both years of this trial have had cool, moist grain fill periods. The impact of a hot dry grain fill period is unknown.

Next Steps:

This project is entering its third and final year in 2010. Anyone interested in cooperating should contact Peter Johnson at peter.johnson@ontario.ca.

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