SMART II Wheat Trials: Population, Nitrogen Rates and Timing
(Interim Report)

Purpose:

The majority of research is conducted analyzing a single factor in crop production. The Strategic Management Adding Revenue Today (SMART) project was initiated to investigate additive or synergistic effects that may exist crop production. After an extremely successful SMART wheat project involving the interaction between nitrogen and fungicide, the SMART II project was initiated. SMART II investigates any additional interaction that might exist between higher seeding rates, increased nitrogen, and split nitrogen applications, when the management techniques of the original SMART project are employed.

Methods:

Two replicate field scale trials were initiated at 17 locations (9 in 2011, 8 in 2012). Treatments are as follows:

1. 1.5 million seeds/acre 90 or 120 N
2. 2.1 million seeds/acre 90 or 120 N
3. 1.5 million seeds/acre 150 N
4. 2.1 million seeds/acre 150 N
5. 1.5 million seeds/acre Split N (150 N total)
6. 2.1 million seeds/acre Split N (150 N total)

Cooperators planted alternating strips of 1.5 and 2.1 million seeds/acre. Treatments were wide enough to match application equipment and allow field scale equipment harvest of each treatment. Treatments 5 and 6 received 30lbs of actual nitrogen as early as possible, mid-April in 2011, mid-March in 2012. The balance of the nitrogen was applied to treatments 5 and 6 at normal timing, when the cooperator was applying his own nitrogen. Nitrogen was also applied to treatments 1, 2, 3 and 4 at this time. Fungicides were applied at 16 of the 17 sites. Leaf disease levels were monitored throughout the growing season. Harvest measurements included yield, moisture, test weight, 1000 kernel weight, and protein. Soil nitrate samples were collected post harvest to examine the environmental implications of increased nitrogen application.

Results:

In 2011, half the sites were selected to receive 90lbs of nitrogen as the “normal” nitrogen rate, while the other half received 120 N. As all of our recent research has supported higher N rates, in 2012 all plots received 120 N as the “normal” rate. The yield results from 2011 and 2012 are summarized in Table 1. The 2011 sites have been separated according to whether the 90 N or 120 N rates were uses as the normal nitrogen rate. Yields increased by approximately 7 bushels/acre after increasing nitrogen from 90 to 150lbs/acre. Over the 2 years, yields increased 5 bushels/acre when nitrogen rates were increased from 120lbs/acre to 150lbs/acre. Yield response from increasing nitrogen above 120 N varied across locations, ranging from no response to an additional 10 bushels/acre.

Table 1: 2011 and 2012 SMART II Yield Data

Treatment (million seeds/ac and N rate lbs./ac)	2011 (3 sites)	2011 (4 sites)	2012 (6 sites)	2 Year Average
	Yield (bu/ac)			
1.5 No N	53.8			
1.5 90 N	69.7			
2.1 90 N	70.0			
1.5 120 N		95.6	95.7	95.6
2.1 120 N		95.4	96.7	96.2
1.5 150 N	76.0	98.1	102.0	100.4
2.1 150 N	77.7	97.5	102.5	100.5
1.5 Split	80.5	98.9	102.0	100.8
2.1 Split	79.2	96.5	103.8	100.9

Yield response from increased seeding rate has been very disappointing: seeding rates appear to have almost no impact on yield. There is a small but intriguing difference between the results from 2011 and 2012. In 2011 increasing seeding rates resulted in no yield gain, and even a slight yield reduction. 2012 showed a very slight yield gain from higher seeding rates. This can be explained by the difference in planting dates. In 2011 5 of the 9 sites were planted during September and all the locations were planted before Oct 11. In 2012 the majority of the sites were planted after Oct 11 and 2 of the 8 sites were planted in November. This supports the concept that as seeding dates are delayed, seeding rates should increase, although the impact remains quite small.

Response to split applied nitrogen was also disappointing (Table 1). Split applications of nitrogen using an ultra-early and normal timing had no impact on wheat yields. Response to split applied nitrogen was variable across locations but only 6 of the 14 sites with a split vs. no split comparison showed a 2 bu/ac response to the split nitrogen application. Additional research from the SMART II small plot trials indicate that timing of the late application in the split treatment may have been too early, and did not allow for canopy management for highest possible yields.

Table 2 shows the yield results from selected locations by planting date. The St. Thomas and Belmont locations were both planted during November in 2011. The St. Thomas site had a very strong response to increased seeding rates, while the Belmont site had a slight yield response to high seeding rates. A yield advantage to higher seeding rates with November seeded wheat is expected; these results support this although Belmont response was small. Conversely, the Forest location lost significant yield from increased seeding rates. The yield reduction was due to increased lodging in the high seeding rate strips (Figure 1). Early seeded wheat at high plant populations is much more prone to lodging, a fact well supported in the literature worldwide.

Table 2: Selected 2011 an 2012 Data

Location	1.5 120 N	2.1 120 N	1.5 150 N	2.1 150 N	1.5 150 N Split	2.1 150 N Split	Planting Date
St. Thomas	92.2	93.4	99.2	105.4	99.1	109.7	06-Nov
Belmont	95.4	96.7	99.3	99.8	97.6	100.7	07-Nov
Forest	117.1	112.9	115.4	113.7	112.9	108.8	30-Sep

Figure 1: Increased Lodging in High Seeding Rate

The left side of the sprayer tracks was seeded at 2.1 million seeds per acre on September 30th while the right side was seeding at 1.5 million seeds per acre on the same day. Both sides received 120 N and 2 fungicides but no growth regulator was applied. Strong winds in late June resulted in the lodging seen. The normal seeding rate is slightly leaning and has some spot that are fully lodged but the high seeding rate is almost completely lodged. Image 2 shows how severe the lodging is in the high seeding rate. Following the storm the wheat started to straighten back up from one of the nodes but it was almost knocked completely flat by the wind storm. You can also clearly see the dividing line between the high and normal seeding rate treatments to the right side of the picture.

Figure 2: Close up of Lodging in High Seeding rate

Summary:

The significant response to additional nitrogen supports other ongoing research. It shows an excellent opportunity to increase wheat yields with additional nitrogen.

Using an ultra early and normal split nitrogen application has shown little potential to increase wheat yields, either at normal or high nitrogen rates. Applying an ultra early split nitrogen application has shown some promise on late planted wheat but has been a breakeven application at best.

High seeding rates have shown little benefit for increasing yields in combination with increased nitrogen. Previous research has shown an economic advantage to increasing seeding rates with late planted wheat but no yield benefit when planting early. High seeding rates when planting early has actually shown the potential to reduce wheat yields by increasing lodging risk.

Next Steps:

In the fall of 2012 strips of 1.5 and 2.1 million seeds/acre were planted at 8 locations across southwestern Ontario, marking the third year of this trial. Treatments at these

locations will mirror the previous project, except that the split application will shift to an ultra-early/ second node application timing, to attempt an improvement in canopy management and hopefully a corresponding improvement in yield.

Acknowledgements:

We are indebted to our many co-operators, many of whom stick with us year after year. Thanks to all the summer assistants. Special thanks to technician Shane McClure and administrator Marian Desjardine, and statistician Ken Janovicek. This project would not be possible without the financial support of Agriculture and Agrifood Canada through the Can Advance and Farm Innovation Programs, the Grain Farmers of Ontario and their staff with ongoing support, the many Soil and Crop Improvement Associations that work with us both as cooperators and with financial support, and many and varied sources of agribusiness support. Dr. David Hooker, Scott Jay, Gerald Backx and the wheat research team at the University of Guelph are valued contributors to many of our projects as well

Project Contacts:

Peter Johnson, OMAFRA, peter.johnson@ontario.ca

Shane McClure, Middlesex SCIA, shane.mcclure@ontario.ca

Location of Project Final Report:

Peter Johnson