

SMART II Wheat Trials

Purpose:

The majority of research is conducted analyzing a single factor in crop production. The Strategic Management Adding Revenue Today (SMART) project was initiated in 2008 to investigate additive or synergistic effects that may exist in winter wheat production. After an extremely successful SMART wheat project involving the interaction between nitrogen and fungicide, the SMART II project was initiated in 2011. 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 conducted at 22 locations (9 in 2011, 8 in 2012, 7 in 2013). 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 million seeds/acre and 2.1 million seeds/acre. Treatments were made wide enough to match application equipment and allow field scale equipment to harvest each treatment. Treatments 5 and 6 received 30lbs of actual nitrogen as early as possible, **mid-April in 2011, mid-March in 2012, and mid-April in 2013**. The balance of the nitrogen was applied to treatments 5 and 6 at the normal time, when the cooperator was applying his own nitrogen. Nitrogen was also applied to treatments 1 - 4 at this time. Fungicides were applied at 21 out of the 22 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 rates. Due to the wet spring in 2013 early nitrogen was only applied at 4 of the 7 sites. Treatments 5 and 6 were replaced with an additional replication of treatments 1 through 4 at the other 3 sites in 2013.

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 and 2013 all plots received 120 N as the “normal” rate. The yield results from 2011 - 2013 are summarized in Table 1. The 2011 sites have been separated according to whether we used 90 N or 120 N as the normal nitrogen rate. Yields increased by approximately 7 bushels/acre after increasing nitrogen from 90 to 150lbs/acre. Over the 3 years yields increased by approximately 5 bushels/acre when nitrogen rates were increased from 120lbs/acre to 150lbs/acre. Yield response from

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increasing nitrogen past 120 N varied across locations, ranging from no response to an additional 10 bushels/acre.

Table 1: 2011 - 2013 SMART II Yield Data (bu/ac)

Treatment	2011	2011	2012	2013	2013	3 Year Average
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	76.5	85.2	90.2
2.1 120 N		95.4	96.7	80.2	88.1	91.6
1.5 150 N	76.0	98.1	102.0	81.2	88.9	94.9
2.1 150 N	77.7	97.5	102.5	84.0	90.5	95.8
1.5 Split	80.5	98.9	102.0	82.0		95.4
2.1 Split	79.2	96.5	103.8	83.9		96.1

Response to split applied nitrogen has been very disappointing. 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. 8 of the 16 sites with a split vs no split comparison had a 2 bu/ac response to the split nitrogen application. A 2 bu/ac yield increase would be needed to cover additional application costs (breakeven point). 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. Weather also plays a major role in yield response to split N. If no rainfall occurs after the application at the second application timing, the crop may not be able to access all applied nitrogen through a critical stage, resulting in little or no yield gain.

Yield response from increased seeding rate has also been disappointing: seeding rates appear to have little impact on yield. There are some intriguing differences between the results year to year. In 2011 increasing seeding rates resulted in no yield gain, and even a slight yield reduction, while 2012 showed a very slight yield gain from higher seeding rates. 2013 tells a completely different story with moderate response to higher seeding rates. This can be explained by the difference in planting dates across the 3 years. 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. While most of the sites in 2013 were planted in early October, most of the response has come from the 2 sites that were planted in November.

The yield results from all 3 years are summarized in Table 2 by planting date. There was only 1 site planted between Oct 15 and Oct 31 so that time period has been left out of the table. The response to higher seeding rates is dramatically different for September planted wheat compared to wheat planted in November. There is actually a negative yield response to higher seeding rates when the wheat is planted in September. This is largely due to increased lodging in the high seeding rate strips (Image 1+2). 2 of the 3 sites planted in September had lodging in the high seeding rate strips. Early seeded

wheat at high plant populations is much more prone to lodging, a fact well supported in literature worldwide.

Table 2: Wheat Yields by Planting Date (bu/ac)

Planting Date	1.5 ¹ 120 N ²	2.1 120 N	1.5 150 N	2.1 150 N	1.5 150 Split	2.1 150 Split	# of Sites
Sept 15 - Sept 30	114.2	112.3	115.8	114.0	115.5	113.2	3
Oct 1 - Oct 15	82.7	85.4	88.6	89.9	89.5	88.7	5
Nov 1 - Nov 15	80.6	83.1	85.4	88.1	85.9	90.9	4

¹ Seeding Rate (million seeds/ac), ² Applied Fertilizer N Rate (lbs/ac)

As wheat planting moves into October the yield reduction disappears but yield response to high seeding rate is still minimal. Only 1 of the 5 sites planted during early October had a yield response above 2 bushels/acre. The response to high seeding rate at the sites planted in November is completely different. All 4 sites seeded in November show a positive response to higher seeding rates, ranging from 2 to 6 bushels/acre. A yield advantage to higher seeding rates with November seeded wheat is expected; these results support the concept that as seeding dates are delayed, seeding rates should increase, although the impact remains quite small

Image 1: Increased Lodging in High Seeding Rate



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Image 1 and Image 2 show the impact of seeding rate at one site near Forest planted September 30th. This is a very early seeding date for that location. The left side of the sprayer tracks was seeded at 2.1 million seeds per acre while the right side was seeded at 1.5 million seeds per acre. Both sides received 120 N/ac 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 spots 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. Since the storm the wheat has started to “gooseneck” back up, but it was knocked completely flat at the time of 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 Image 1.

Image 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

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split nitrogen application has shown some promise on late planted wheat but has been a breakeven application at best.

While yield increases have not justified split N applications, there are some other factors that should be noted. Split N applications utilizing an ultra-early first application have shown more uniform heading across the field. This is due to early stimulation of tillers and weaker plants, allowing this more uniform crop development. This is a definite advantage when applying the fusarium fungicide, as timing of that application is often difficult due to in field variability. Split N applications also resulted in less crop lodging at high N application rates. This is a result of less N available during early stem elongation, resulting in less lush growth and stronger stems.

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:

More research needs to be conducted on split nitrogen applications to determine correct application timing and proportions. Early nitrogen applications may benefit from use of protected N sources, and as such allow for a higher proportion of N to be applied early without the normal result of increased lodging. A canopy management trial was initiated in 2013 to further examine these potential management options and will be continued again in 2014. Anyone interested in participating in these trials is encouraged to contact Peter Johnson at peter.johnson@ontario.ca or Shane McClure at shane.mcclure@ontario.ca.

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, administrator Marian Desjardine, and statistician Ken Janovicek. This project would not be possible without the financial support of Agriculture and Agrifood Canada through the CanAdvance 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, along with many agribusiness' that support this work. 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. Heartfelt thanks to you all!

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