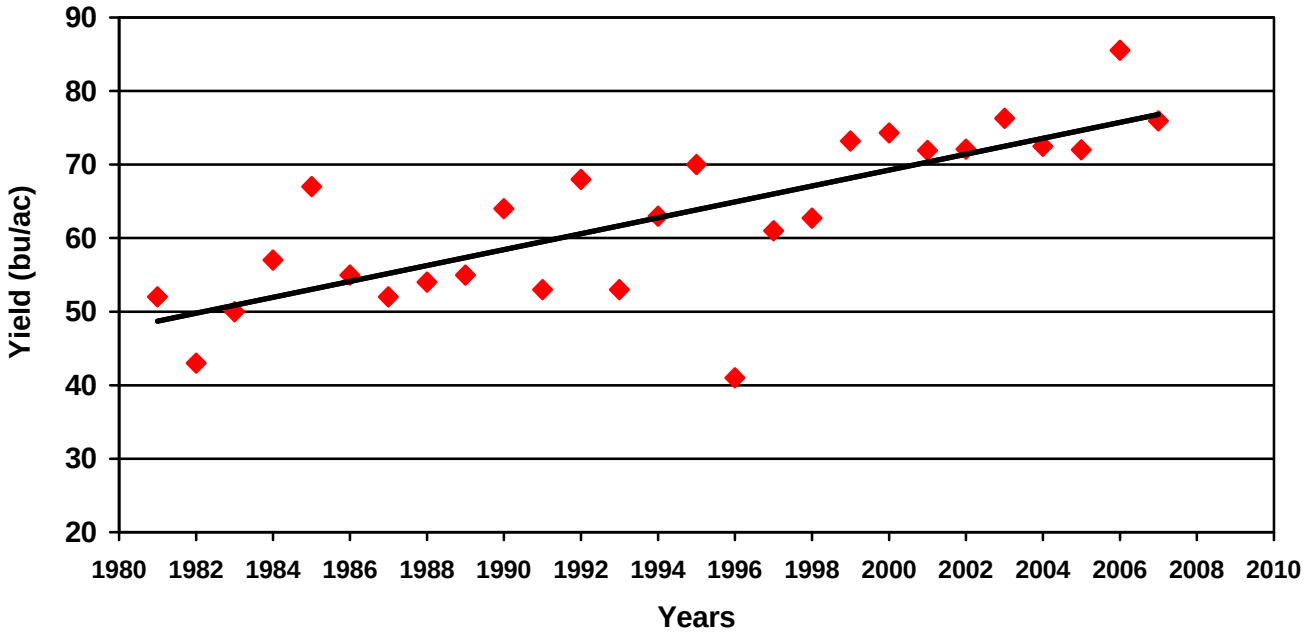
Nitrogen Rates for Winter Wheat

Purpose:

Wheat yields have increased over time, breaking the 80 bushel mark for the first time in 2006 (Figure 1). Provincial nitrogen rate recommendations for winter wheat are based on historical data from the 1970's and 1980's. With higher yields, many top growers consistently apply more nitrogen than current provincial recommendations. With the evolution of much higher yielding varieties and higher yields in general, nitrogen recommendations need to be re-evaluated. As nitrogen costs escalate, economic analysis of nitrogen applications and yield impact is key. Environmental considerations of increased nitrogen applications must also be considered. This study attempts to re-evaluate nitrogen rate responses, to assess if rates need to change.

Figure 1: Ontario Provincial Average Wheat Yields 1980-2007



Methods:

Forty one field scale two replicate trials were established on farm fields from 2003 to 2005, with an additional three intensive sites each year evaluating rates, split applications, and timing of applications. Field trials were randomized, field length tests, with each nitrogen rate strip corresponding to the width of the nitrogen application equipment. Applications of all rates were made using whatever form of nitrogen the grower was using, at the normal timing of application for that farmer. Rates of 60, 90, and 120 pounds actual N were targeted, with some growers including 0, 30, and/or 150 pound rates. Weed control and fungicide applications were maintained across

treatments, as per the farmers' standard practice. Yield, test weight, and moisture data were taken at harvest, with thousand kernel weight and protein levels recorded where possible.

Results:

Tables 1 to 3 summarize field results from the 2003 crop year, table 4 is aggregate data for 2004, tables 5 through 7 assess 2005 aggregate data, and tables 8 and 9 contain three year aggregate data. Economic analyses were calculated using wheat at $3.50/bu ($129/t), and nitrogen at $0.45/lb actual N ($1.00/kg N). Results were very similar over all three years, although there was slightly less response in 2003, and greater response in 2004.

On average, the results give a typical nitrogen response curve. The Most Economical Rate of Nitrogen (MER-N) is calculated at 80 pounds per acre, despite the extremely high yields achieved in all three years of the trial. This is exactly what current OMAFRA guidelines would recommend, based on 80 bu/ac yields (5.4 t/ha) and $0.45/lb nitrogen ($1.00/kg N). On average, current OMAFRA recommendations are correct. However, at some individual sites, response was economical to rates of 120 pounds per acre. Several of these sites were higher yielding sites (above 100 bu/ac), but not all high yield locations responded to increased nitrogen rates. Whether this is just "chatter" in the data, or actually a differential response at higher yield locations, was not able to be determined in these tests. Wheat is not grown on these sites more than one year in three.

Interestingly, the net economic risk from either an increase of 30 pounds, or a decrease of 30 pounds, is extremely small inside this nitrogen range. The average loss from reducing nitrogen rates is less than $6.00/acre, while the net loss from an increase in nitrogen rate is not more than $8.00/acre. This is a much tighter range than what most growers would expect, and should help to give some level of confidence in maintaining nitrogen rates within a reasonable range. A grower appears less likely to lose money by reducing the nitrogen application rate to 60 pounds/acre, rather than increasing the N rate to 120 pounds/acre. This outcome will surprise most growers, but should help grower confidence when lower rates are applied by accident.

Yield loss associated with zero N or 30 pound N applications is significant, as indicated in Table 1 and 2. This data supports previous research indicating from 20 to 35 bu/ac yield loss from zero N, and from 10 to 22 bu/ac yield loss with application rates of 25 to 30 pounds. With yield loss of this significance, most growers were not interested in maintaining these treatments in trials beyond the first year.

Table 1: 2003 Zero Rate N Comparison

Co-operators	Nitrogen Application Rate (lbs/ac)			
	0	**60**	**90**	**120**
Lucan	70.3	92.5	100.7	102.5
Kerwood	64.8	88.1	95.3	99.5
Average	***67.6***	***90.3***	***98.0***	***101.0***

Table 2: 2003 Yield Data

Co-operators	Nitrogen Application Rate (lbs/ac)		
	60	90	120
Kent	99.8	95.9	94.8
Elgin	86.0	86.7	84.5
Lambton	90.0	94.3	94.3
Peel	57.9	61.5	62.1
Lucan	92.5	100.7	102.5
Kerwood	88.1	95.3	99.5
Watford	90.9	85.0	97.0
Bothwell	81.0	93.7	94.1
Average	***85.8***	***89.1***	***91.1***

Table 3: 2003 Yields 30 Pound Rate Comparison

Co-operators	Nitrogen Application Rate (lbs/ac)			
	30	60	90	120
Peel	43.3	57.9	61.5	62.1
Kerwood	79.3	88.1	95.3	99.5
Average	***61.3***	***73.0***	***78.4***	***80.8***

Table 4: 2004 Aggregate Yield Data

#Trials	Nitrogen Application Rate (lbs/ac)		
	60	90	120
10 Trials		88.8	90.5
7 Trials	77.9	87.2	90.1

Table 5: 2005 Yield Summary

# Trials	Nitrogen Application Rate (lbs/ac)					
	60		90		120	
	bu/ac	t/ha	bu/ac	t/ha	bu/ac	t/ha
27	76.8	5.16	82.3	5.53		
23	75.7	5.09	80.7	5.43	82.4	5.54
25			81.8	5.50	83.3	5.60

Table 6: 2005 Economic Summary

# Trials	Nitrogen Application Rate (lbs/ac)		
		Return after additional N cost above 60 lbs/ac ($'s)	
	60	90	120
27	268.74	274.56	
23	265.12	268.97	261.26
25		272.68	264.62

Table 7: 2005 % Wins Summary

# Trials	Nitrogen Application Rate (lbs/ac)		
		% Wins Over 60 lbs/ac Rate	
	60	90	120
27	0.30	0.70	
23	0.48		0.52
25		0.68	0.32

Table 8: 2003 - 2005 Yield Summary

# Trials	Nitrogen Rate (lbs/ac)					
	60		90		120	
	bu/ac	t/ha	b/ac	t/ha	buac	t/ha
41			84.8	5.70	86.6	5.82
38	78.3	5.26	83.7	5.63	85.6	5.75

Table 9: 2003 - 2005 Economic Summary

# Trials	Nitrogen Application Rate (lbs/ac)		
		Return after additional N cost above 60 lbs/ac ($'s)	
	60	90	120
41		296.80	289.60
38	274.05	279.45	272.60

Summary:

These results support current OMAFRA recommendations as accurate for predicting MER-N on soft winter wheat fields in Ontario. On average, the MER-N rate is 80 lb/acre (90 kg/ha), with 70% of fields showing this as the actual MER. The economic impact of being 30 pounds/acre above or below the MER-N rate is remarkably small. Growers are likely to lose less money by reducing nitrogen applications slightly below MER-N, than by increasing these applications above MER-N. Reducing N rates outside of this range has significant economic impact. These results are very positive in the potential to

produce high yields of wheat, while minimizing any environmental impacts on soil nitrate levels.

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