Winter Wheat Sulphur Response
(Interim Report)

Purpose:

Atmospheric deposition (acid rain) supplied ample sulphur (S) to meet crop needs throughout the last 50 years. As efforts to clean up emissions become effective, these free S additions have been greatly reduced. It is a matter of when, not if, we will need to apply sulphur to many of our field crops. The purpose of this trial is to assess response to S, and be proactive in terms of crop needs for applied S as a fertilizer.

Environment Canada records show that in 1990 atmospheric S deposition equated to 30lbs/ac/yr. By 2005 that had dropped to only 15lbs S. Canola crops require more than 15 lbs, alfalfa crops have been found S deficient on low organic matter sand soils, and good wheat crops require about 13 lbs S. This trial will determine: if there is response to fertilizer S under current reduced deposition levels: what the S response curve looks like: our current sulphur requirements.

Methods to predict S response will also be evaluated. Critical values for S soil tests and S tissue tests will be investigated.

Methods:

Two replicate field scale trials have been evaluated at 16 locations (5 sites in 2011, 11 sites in 2012) across southwestern Ontario. A list of the treatments is below:

1. No Sulphur (Check)
2. 5lbs/acre Sulphur
3. 10lbs/acre Sulphur
4. 20lbs/acre Sulphur
5. 40lbs/acre Sulphur
6. 20lbs/acre Sulphur + 30lbs/acre additional nitrogen
7. 0lbs/ace Sulphur + 30lbs/acre additional nitrogen

Ammonium Sulphate was applied at 9 of the 16 locations while Calcium Sulphate (pelletized gypsum) was used at the remaining 7 sites. Nitrogen levels were held constant across all S treatments at each site, except treatment 6 and 7. 12 inch soil samples were collected from the check strips in the spring to determine soil S levels. Tissue samples were collected from each strip at 3 different stages (first node, flag leaf, and heading) to monitor plant S levels through the growing season. Harvest measurements included yield, moisture, test weight, 1000 kernel weights, and protein. Quality analysis of harvested grain samples is being conducted by Dr. Jayne Bock and Dr. Koushik Seetharaman, at the Food Quality Laboratory, University of Guelph.

Results:

Sulphur response varied significantly from site to site and year to year. Average yield response was 3.3 bu/ac over the two years of the trial (Table 1). S response in 2011 was significantly higher (5.1 bu/ac) than 2012 (2.5 bu/ac). This is supported by trials across the industry where 28 trials in 2011 averaged a 5.5 bu/ac response, and 29 trials in 2012 averaged 2.3 bu/ac response (data not shown). This indicates a significant year effect: the spring of 2011 was cool and very wet, the spring of 2012 warm and dry.

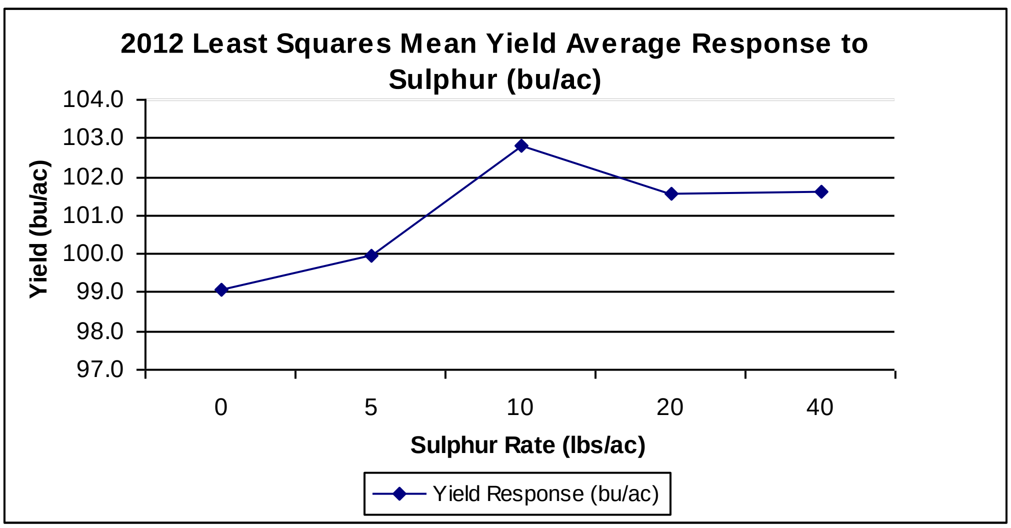
Whether this year effect is due to leaching, or a lack of S from delayed soil activity and organic matter breakdown is not clear.

Table 1: 2 Year Summary of Sulphur Response (5 locations 2011, 9 locations 2012)

Sulphur Applied	2011 Average Yield (bu/ac)	2012 Average Yield (bu/ac)
0	102.8	100.2
20	107.9	102.7

Yield response of the 6 responsive sites clearly show maximum benefit at 10 pounds/acre S, with no additional yield gain from added applications (Figure 1). This is a critical finding, as it gives an application level above which growers can expect no response. With variable response field to field and year to year, many growers will opt to apply some sulphur. Yield penalty when no S is applied on deficient fields can be quite high (20 bu/ac). If a small amount of S can be applied to avoid a significant yield loss, and average yield gain will cover the cost of this application, many growers will consider this a reasonable "insurance" application. 10 lbs/ac S would appear to be that breakpoint.

Figure 1: Sulphur response at 6 responsive sites (P=0.05)



Protein levels were unaffected by S applications, however protein quality was impacted in 2011. Sample analysis is ongoing from the 2012 harvest. A further update on protein impacts of S applications will be given when analysis is complete. S applications had no impact on moisture, test weight, or thousand kernel weight.

Tissue samples were taken at three stages of crop development to evaluate critical tissue concentrations. This was an attempt to develop guidelines which could be used by growers to determine which fields were deficient in S, and which fields would not respond to S fertilizer. Unfortunately, stage of development of the crop had tremendous impact on S concentrations in the wheat plant. While S concentrations were significantly increased at 8 of 11 sites where sampling was conducted, it became apparent that tissue concentrations would have to be tied to stage of growth if they were to be of any value. S concentrations increased from 0.20% S at the tillering stage (Zadok's 21) to 0.50% S at the heading stage. Thus it is impossible to say that a S concentration of 0.30% is the critical value. The critical value changes as the crop advances through its growth stages. Using a tissue test, then, to determine S applications, is unlikely to be a viable tool for the average producer.

Summary:

Sulphur response in wheat continues to occur, but year to year variation is greater than expected. Average yield gains have been small: 5 bu/ac in 2011, 2.5 bu/ac in 2012. Using tissue S levels as a predictive tool for S applications has proven to be very difficult, and in fact, not practical. S applications appear to have a small improvement in baking characteristics of the harvested grain. Growers concerned about potential S deficiency should apply 10 lbs/ac S, as an insurance policy to avoid significant yield loss.

Next Steps:

This project will continue for a third year in 2013. New soil sampling techniques will be evaluated for their potential to determine deficient fields. If you are interested in participating in this trial, contact Shane McClure at shane.mcclure@ontario.ca or Peter Johnson at peter.johnson@ontario.ca

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