Winter Wheat Response To Applied Sulphur

Purpose:

Atmospheric deposition (acid rain and dry deposition) supplied ample sulphur (S) to meet crop needs throughout the last half of the 20th century. Significant efforts to reduce sulphur emissions from industry and diesel fuel began in the 1990's. As these efforts take effect, 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. 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: and 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 26 locations (5 sites in 2011, 11 sites in 2012, and 10 sites in 2013) across southwestern Ontario. A list of the treatments is below:

1. No Sulphur (Check)
2. 5 lbs/acre Sulphur
3. 10 lbs/acre Sulphur
4. 20 lbs/acre Sulphur
5. 40 lbs/acre Sulphur
6. 20 lbs/acre Fall Sulphur

Ammonium Sulphate was applied at 10 of the 26 locations while Calcium Sulphate (pelletized gypsum) was used at the remaining 16 sites. Nitrogen levels were held constant across all S treatments at each site, regardless of S source. Twelve inch deep soil samples were collected from the check strips in the spring to determine soil S levels. Tissue samples were collected from each strip at multiple stages (targeting green up, first node, and flag leaf) to monitor plant S levels through the growing season. Harvest measurements included yield, moisture, test weight, 1000 kernel weights, lodging and protein. Quality analysis of harvested grain samples was conducted by Dr. Jayne Bock and Dr. Koushik Seetharaman, at the Food Quality Laboratory, University of Guelph, on the 2011 and 2012 samples. That report is available on request.

Results:

The yield results from 2012 and 2013 are summarized in Table 1. In both years yield response to sulphur stabilized with 10 lbs/ac of applied S. On average there is no benefit to applying more than 10 lbs/ac S but results were variable across locations. The slight yield loss to 5lbs of S may be due to tramp damage from the valmar airflow during sulphur application, without sufficient S applied to overcome any deficiency.

Table 1: Average Wheat Yield Response (bu/ac for 2 Years @ 17 Sites)

Treatment	2012	2013	Average
Check (No Sulphur)	101.4	80.2	90.9
5lbs Sulphur	100.9	80.2	90.6
10lbs Sulphur	102.6	81.2	91.8
20lbs Sulphur	102.0	81.5	91.8
40lbs Sulphur	102.2	-	-

The average 1 bu/acre increase from applying 10 lbs/ac of S was, of course, not consistent across all sites. Table 2 contains the average yield data from the 8 sites that showed a consistent response to sulphur. Yields increased steadily up to 10 S. Yield increases from 10 to 20 lb/ac S applications were not significantly different. This suggests that we are approaching maximum response with 10 S. Yield response to 10 S ranged from 2 to 10 bu/acre.

Table 2: Average Yield Response From 8 Responsive Sites (bu/ac)

Treatment	Yield	Gain
Check (No Sulphur)	89.6	-
5lbs Sulphur	91.6	2.0
10lbs Sulphur	93.8	4.2
20lbs Sulphur	94.9	5.3

In 2013 a fall sulphur treatment was added at 6 locations. The average yield data from these locations is summarized in table 3. The data has been split between responsive and non-responsive sites. The non-responsive sites had no yield response to any sulphur treatment. At the responsive sites, the 20 lbs Fall S treatment had a yield response slightly less than the 10 S spring applied treatment (no statistical difference).

Table 3: Fall Applied Sulphur Yield Response (bu/ac)

Treatment	Responsive (4 sites)	Non Responsive (2 sites)	Average Yield
Check (No Sulphur)	86.4	92.1	86.0
5lbs Sulphur	86.8	90.2	85.4
10lbs Sulphur	88.9	90.5	86.9
20lbs Sulphur	90.1	92.5	87.8
20lbs Fall Sulphur	88.2	91.8	86.7

Summary:

Yield response to sulphur seems to reach a breaking point at 10 lbs/ac. The current cost of sulphur is roughly $0.50/lb of S: thus 10 lbs of sulphur would only cost $5/acre. Wheat prices are currently above $5/bushel: a response of 1 bu/acre covers the sulphur cost. With 55% of the sites achieving an economic advantage at 10 S, our current

recommendation is to apply 10 S in the spring on winter wheat as a blanket application. However, growers should place test strips of sulphur in their own wheat fields to see if they are responsive or not. Responsive fields have averaged a 4 bu/acre yield increase with 10 S applied and showed the potential to increase yields up to 10 bu/acre. It is hard to risk this amount of lost yield potential for a $5.00/ acre investment ("insurance policy").

Fields that receive manure on a regular basis appear to be less likely to respond to sulphur fertilizer, as do soils with high organic matter levels. Sandy soils and eroded areas with low organic matter respond the most consistently. Sulphur can be applied as early as possible in the spring (first application timing in a split N program), as spring S is not likely to disappear before the crop can use it.

Fall S

Plant tissue and soil results are still pending. Data collection is still in its early stages and more results will need to be collected before agronomic recommendations can be made. No attempt is being made at this time to "build" soil test levels of sulphur. Due to the biological process required to make elemental S available to plants, it is unclear if higher soil test levels from elemental S applications would be effective on wheat or not.

Next Steps:

This trial will be conducted again in 2014. Due to the wet fall in 2013 only 2 sites containing the fall sulphur treatments were established, thus the trial will continue in 2015 if funding allows. Soil and plant tissue sampling will continue so that more data can be generated to try and develop a test to predict which fields will respond to sulphur.

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