Increasing Crop Yields with Sulphur Application
Interim Report

Purpose:

Develop recommendations for source, rate and timing of sulphur (S) application. Refine tools to identify S-responsive sites, such as tissue and soil testing**.**

Methods:

In fall 2012, five alfalfa sites were established (Mitchell, Hesson, Wallenstein, Thunder Bay, and Winchester) with the following treatments:

- Control - no nutrients (0);
- Control - muriate of potash, spring-applied, 142 lb K_2O/ac (KCl);
- Elemental, fall-applied, 50 lb S/ac (Ele50);
- Elemental, fall-applied, 100 lb S/ac (Ele100);
- Sulphate of potash, spring-applied, 50 lb S/ac (K_2SO_4).

Treatments were arranged in a randomized block design with 3 or 4 replications. Elemental S was broadcast mid-November 2012 on Ele50 and Ele100 treatment plots. In 2013, sulphate of potash was broadcast, and muriate of potash on the KCl and both Ele treatments. Yield was measured from 2-cuts, other than Mitchell, which was a 3-cut system. Diagnostic tissue (top 6" late bud/early bloom) was collected prior to 1st and 2nd cut for S analyses. Soil was sampled in 2012 and 2013 for extractable S (Mehlich) and basic test, in most cases from both 0-6 and 6-12" deep.

For canola, 5 sites in Southern Ontario (all on-farm) and 1 at Thunder Bay (on station) were established with S rates: 0, 10, 20 and 40 lb S/ac. S-source was ammonium sulphate. Primary N source was urea at Thunder Bay and ammonium nitrate for the Southern ON sites. Soil was sampled several times for S. For Southern ON sites, whole plant tissue samples were collected from 0 and 20 lb S/ac treatments at rosette stage, the latest feasible for rescue treatment; and yields were determined by weigh wagon. For all experiments, soil samples were dried unless sent immediately to the lab.

Results:

Visual responses to S fertilizer in forage height and colour were observed, particularly in later cuts (Fig. 1). For forage yield summed over all cuts, there was no location by treatment interaction across the three Southern ON sites. Yield increase with spring-applied sulphate of potash at 50 lb S/ac was the same as with fall-applied elemental S at 100 lb S/ac – about 620 lb/ac more than without S (Fig. 2). For individual cuts, at Hesson 2nd cut and Mitchell 3rd cut, yield was greater where S had been applied than with no S, indicating later cuts were more responsive than early. The Winchester site was not responsive. At TB, there was no significant response in total- or 1st cut yield; for 2nd cut there was a small yield response to the Ele50 (265 lb/ac) and K_2SO_4 (190 lb/ac) treatments. There was no yield response to muriate of potash at any site. Soil test K ranged 111 - 132 ppm in Southern ON sites; was 85 ppm at TB; and 128 ppm at Winchester.

S concentration in diagnostic alfalfa tissue in the controls with no S was equal to or less than 0.25% (critical level) for the 3 responsive Southern ON sites, and

was 0.32% at TB. In S-treated plots, tissue S concentrations increased, usually the most with K_2SO_4 in 1st cut (ranged 0.35 - 0.48% S) and with Ele100 in 2nd cut (0.31 – 0.45% S).

Fall 2012 soil S concentration in the controls (no S) was equal to or less than 8 ppm (considered low) for the 3 responsive sites; greater than 8 ppm at TB (11 ppm) and Winchester (9 ppm), top 6 inches. There was variation in soil extractable S across sample time of year at some sites.

Wet conditions, hot weather at bloom, insect pressure and N deficiency (particularly at Shelburne and Walkerton) limited canola yields and potential for response to S. Canola yield increased with rate up to 40 lb S/ac at 3 of 5 South ON sites. At Thunder Bay, yield was greater with 20 than zero or 40 lb S/ac. Tissue for diagnostics (whole plant at rosette) had greater S concentration with 20 lb S/ac than without S at 4 of the 5 South ON sites (Fig. 3). At the most responsive site (Owen Sound), tissue in the control treatment had lowest S concentration (Fig. 3), and had N/S ratio = 12.8. For canola in rosette stage N/S ratio >10 is a predictive criteria. Soil extractable S increased by 1-3 ppm at most sites in late June/early July as compared with mid-May.

Figure 1. Visual response to sulphur fertilizer application (100 lb S/ac fall-applied elemental to the right of the stake), third cut, Mitchell site.

Summary:

Alfalfa response to S fertilizer application was profitable on some sites, with similar yield for fall-applied elemental S and spring-applied sulphate of potash. The observed responses supported a critical concentration of 0.25% in top 6 inches of the alfalfa plant at late bud to early bloom. Tissue testing of canola at rosette stage warrants further investigation for use as a diagnostic tool. Identification of critical values and sampling protocol for S soil testing requires more study. Time of sampling matters for soil testing.

Figure 2. Forage response to sulphur fertilizer source and time of application, sum of 2 or 3 cuts, average of 3 South ON sites, 2013. Means with the same letter are not significantly different ($P \leq 0.05$) as determined by protected LSD test.

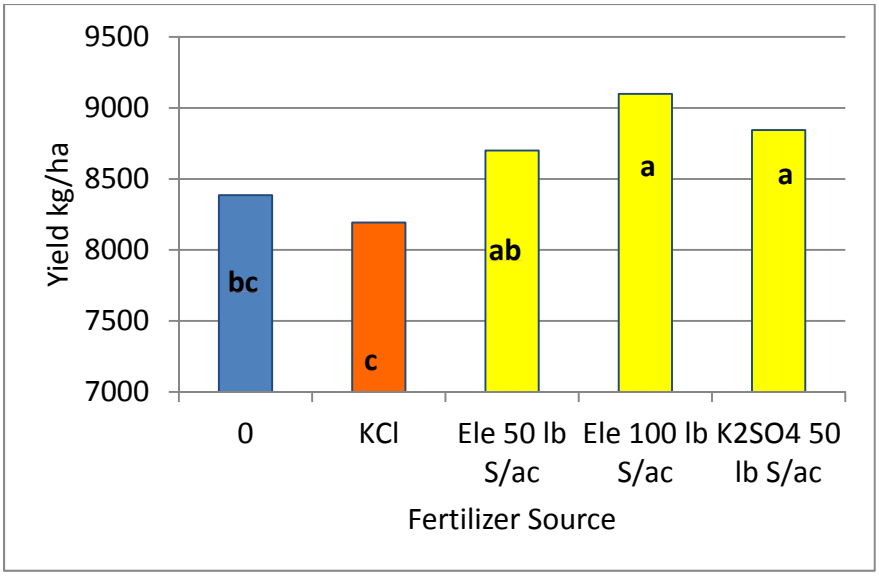
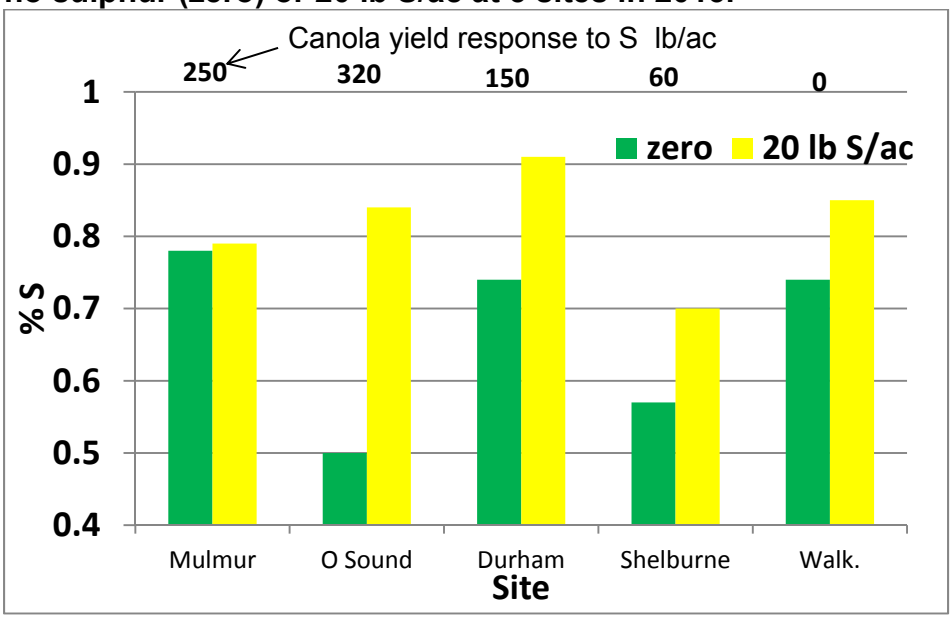


Figure 3. Sulphur concentration in whole plant canola at rosette stage with no sulphur (zero) or 20 lb S/ac at 5 sites in 2013.



Next Steps:
Data will be collected from existing and new alfalfa and canola experiments to provide additional site years and determine residual effects.

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