Importance of Sulphur in Crop Production

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Sulphur (S) is essential for plant(s) growth and development. Due to drastic reduction in S emissions and its importance in plant functions such as in sugar production, especially in sweet corn, CO_2 assimilation, N fixation and protein formation, it is becoming one of the most important nutrients. Ontario soils were said to be receiving enough sulphur (S) through acid precipitation, but not anymore. More and more soils are now becoming short of this nutrient due to (i) anti pollution regulations, such as Clean Air Act 1970, which have reduced sulphur dioxide emission from industry and (ii) increased use of high analysis P fertilizers containing only 1.5-2 % S.

- Sulphur deposition to Ontario soils decreased from 25 kg/ha to 8-13 kg/ha/year from 1998 to 2006. In New York, it was only 6.7 kg/ha in 2008.
- The manure, with 8 % solids, contains only 3 lb S/1000 gallons.
- No wonder S content in alfalfa, grasses and corn silage declined by 13, 13 and 29 %, respectively during 1992-2003 and Ontario's winter wheat in 2011 showed S deficiency symptoms.

Reported S removal is 40 lb/acre at 8 ton yield of alfalfa, 20 lb S/acre in barley (100 bu/acre) and corn (120 bu/acre), 10 lb S/acre in wheat (40 bu/acre), 8 lb S/acre in soybean (25 bu/acre), 30 lb S/acre in Bermuda grass (6 ton/acre) and 24 lb S/acre in Fescue (6 ton/acre). Canola has high S requirements; a healthy crop at early flowering will have > 0.25 % S. Its uptake in canola continues till full pod formation.

In S deficient plants, the entire shoot, especially the top half, looks pale green, though S deficiency can occur without expression of any visual symptoms. These symptoms are different from N deficiency symptoms (lower leaves first becoming pale green and then yellow). For cereals and forage grasses, yellowing of newly emerging leaves is a strong indicator of S deficiency. In canola, S deficiency leads to cupping and purpling of leaves. Sandy soils, low organic matter, no recent history of manure application make an ideal set up for S deficiency. Sulphur deficiency will be most likely on knolls and other well drained areas of the field. Cool soil temperatures can restrict root development and reduce S availability. Conservation tillage can keep the soils cool and S may be needed to stimulate early growth in this stressful period. Sulphur is known to help break down of crop residues and enhance availability of other nutrients.

Without adequate S, crops can't reach their full potential in terms of yield, quality or protein content; nor can they make efficient use of applied N. A report from Washington indicates that a hay crop failed to respond to 150 lbs N. But when the same crop was fertilized with 33 lbs S, the crop yield nearly tripled. This was true for wheat, corn and canola. Research findings from the Thunder Bay Agricultural Research Station (TBARS), Thunder Bay, indicate that magnitude of response to S is increasing over time, and also more and more crops have started responding to S. There was no improvement in canola yield with application of N fertilizers alone @ 50-150 kg N/ha. With application of S @ 15-30 kg/ha, along with N at optimum rate, canola yield improved

by ~1.5 t/ha. In the sixth harvest year, alfalfa, supplied with only NPK/or PK (at rates recommended by OMAFRA) produced only 56 % of the yield obtained with application of sulphur and boron in addition to NPK. Dry matter forage yield of timothy was highest when 20 % of N was supplied through ammonium sulphate. Winter wheat grain yield was highest when 25 % of N was supplied through ammonium sulphate. This is in comparison to all N applied as urea that contains no S.

Therefore, for sustainable crop yields, S application should form an integral part of the fertilizer program. Sulphur could be applied at recommended rates until bolting in canola and at seeding for other crops. Recommendation is to apply 1 lb S for every 10-15 lb of N. Important S fertilizers are ammonium sulphate (24 % S), ammonium phosphate sulphate (14-15 % S), calcium sulphate (18 % S), potassium sulphate (18 % S), potassium magnesium sulphate (17-18 % S), ammonium thiosulphate solution (26 % S) and elemental S (90-99 % S). Sulphate sources should be preferred to elemental S that takes 12-18 months to get converted in to the sulphate form. Sulphur from ammonium sulphate accelerates emergence and improves resistance to white mould in dry beans; it makes P and micronutrients more available in early planted cold soils. Beneficial effect of S from ammonium sulphate was also reported in snap beans, cabbage, potatoes and peas for processing.

Since S is the protein forming nutrient (90 % of S is found in amino acids the building blocks for protein), protein yield/acre could be significant with S application. Sulphur is also part of the anti fungal proteins and could therefore help in suppressing fungal diseases. Investment in fertilizer S could bring 6 (Michigan) or 8-10 fold (Thunder Bay) returns. In corn silage, S @ 46 lb/acre improved the NDF-d by 6.7 % and consequently increased the milk yield (lb/ton) by 5.9 % and milk/acre by 1833 lbs.

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