SULFUR

FACT SHEET

In the past decade there has been much publicity about sulfur and its effect on our environment. Do we really understand the effects of sulfur in our environment? What have we changed in our environment when we cleaned up the atmosphere?

Over these periods of time we have reduced the amount of sulfur emitted from air pollutants and have also reduced the amount of sulfur in our fertilizer products.

A research study done in the U.S. in 1972 estimated that the amount of sulfur brought back to the earth by rainfall ranges from 15lbs. /acre in rural areas and about 100 lbs./acre per year near areas of heavy industrial activity.

Due to the growing concern over air pollution less sulfur will be brought down by rainfall. Although emissions of sulfur compounds into the atmosphere by industrial activity has received a lot of publicity, the fact still remains that 70% of the total content of sulfur compounds in the atmosphere is of non man made origin. Volcanic activity, marshes and swamps, decaying organic activity etc. are responsible for the majority of sulfur emitted.

High concentrations of atmospheric $S0_2$ are injurious to plants but at low concentrations all the plants needs can be supplied through the leaves by atmospherically applied $S0_2$. However as atmosphere levels are reduced, in many cases sulfur will have to be applied to agricultural crops.

Sulfur is a very important element in our environment and is required in a fairly constant balance for proper plant nutrition. Over different soil types we see a fairly constant relationship of nitrogen to sulfur approximately 10:1.

	N:S
Acid soils	10:1.2
Calcareous soils	10:1.5[2]
Podzolic soils	10:1.3
Chemozems	10:1.5

This illustrates the importance of sulfur in the formations and decomposition of soil organic matter.

Sulfur may be immobilized in soils in which the ratio of either carbon or nitrogen to sulfur is too wide. Conversely if the C:S or N:S ratio is too narrow and mineral nitrogen is added, some of the added nitrogen will be immobilized. The importance of maintaining a proper balance in the soil between nitrogen and sulfur is obvious.

Research work done by Stewart et al 1966 (SSSA 1966) on wheat straw with a low sulfur content was incorporated into soil fertilized with N, P & K and N, P, K & S. The plots had increasing amounts of straw incorporated into the soil and winter wheat was planted on these soils.

The addition of wheat straw in increasing amounts to the soil to which no sulfur was added progressively decreased the growth of the wheat plants. The addition of sulfur in the fertilizer overcame the limiting effect of the straw.

Apparently the addition of straw with a low sulfur content to the soil used in this study tied up the available soil sulfur because of the immobilization by soil microorganisms during

A & L CANADA LABORATORIES, INC.

2136 Jetstream Rd.
London, ON N5V 3P5

Phone: 519-457-2575
Fax: 519-457-2664
Aginfo@alcanada.com
www.alcanada.com

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decomposition of the straw.

This situation was aggravated by the addition of fertilizer N which further widened the N:S ratio of the soil.

In practical farming operations where large amounts of straw are to be returned to the soil, the grower should take steps to ensure that adequate sulfur is available to promote decomposition of the added straw or a temporary S deficiency may be induced in the following crop.

Sulfur is as important to plant metabolic functions as nitrogen, phosphorus and potassium and it is an integral component in the manufacture of plant proteins. Approximately 90% of the sulfur in plants is found in the amino acids which make up plant protein.

Sulfur plays an important role in the production of enzymes and vitamins of plants. An example on one of these processes is the production of chlorophyll. Plants lacking sulfur will become yellow and chlorotic.

In most cases plant roots as the sulfate ion $S0_4^2$ and some $S0_2$ that is absorbed through plant leaves and used by the plant absorb sulfur.

In crops such as beans, corn, wheat and potatoes sulfur is found in amounts equal to phosphorus in the tissue. Crops such as alfalfa, cabbage and turnips contain larger amounts of S than P in their tissue.

Sulfur deficiency has a pronounced retarding effect on plant growth causing chlorosis, stunting, thin stem and spindly growth usually resembling N deficiency; Sulfur however cannot be translocated from older plant parts to younger plant parts.

Factors Attributing To Increased S Deficiency

1) Increased use of sulfur free fertilizer
2) Decreased use of sulfur as an insecticide and fungicide
3) Decreased concentration of sulfur in the atmosphere
4) Increased crop yields that require larger amounts of S

A deficiency of sulfur can cause accumulation on non-protein nitrogen in plants, which can be detrimental to ruminant animals if it is not corrected by feeding supplements containing sulfur in either the organic or inorganic form. Ruminants are able to utilize sulfate, sulfide and to a lesser extent, elemental sulfur in the synthesis of proteins. Non ruminants cannot and must have methionine in their diets.

In non-leguminous plants that have been given liberal quantities of nitrogen fertilizers, nitrates as well as amides may accumulate in the tissues. Nitrates in large quantities are toxic to animals. If sulfur is limiting, nitrates accumulate in plant tissue.

Sulfur not only plays a major role in plant growth and metabolism as a nutrient it also has a pronounced effect on soil chemistry and the availability of other nutrients.

Test have shown inter relationships between high soil level phosphorus, sulfur, magnesium and zinc. Where soil phosphorus levels are high and soil sulfur levels are low we have often noted low tissue-magnesium levels even though the soil magnesium is abundant.

The application of sulfur with proper placement has not changed tissue sulfur levels to any marked degree but has raised the magnesium levels in plant tissue. In the soil environment, the application of the acid forming sulfur may be causing the release of magnesium that has been tied up by the phosphorus.

Another case more typical to Ontario soils is the competitive effect between K and Ca and how it can influence crop quality and yield, High Ca levels in soil interfere with the uptake of K especially early in the growing season when K is so important.

If percent saturation of K is much lower than ideal and the percent saturation of Ca is high in cold waterlogged soils during the spring, K is less available. The plant replaces K with Ca and yield and quality are greatly reduced, Cell structure, moisture regulations of tissue and root formation can greatly be influenced in later stages of growth.

Due to the excessive levels of Ca in some soils, balancing K:Ca may be difficult and costly. However, tests have shown that the use of sulfur can have a marked effect on this relationship.

The following is data from research work done by A & L Laboratories:

Table #1

Soil Analysis Report Lbs./acre								
pH	**C.E.C**	**%OM**	**P**	**K**	**Mg**	**Ca**	**S**
7.5	**40**	**7.2**	**125-H**	**370-m-1.2**	**528-G-5**	**15000-H-93**	**102 H**
			46-85	**2-3**	**5-20**	**50-70**	**14+**

Table #2

Corn — **Tissue Analysis Early Growth Stage %**

	N	**P**	**K**	**Ca**	**Mg**	**S**
No Sulfur	**4.1**	**.31**	**2.8**	**.88**	**.26**	**.27**
	S	**S**	**S**	**H**	**S**	**S**
10 lbs./acre Sulfur	**4.2**	**.34**	**3.7**	**.85**	**.29**	**.27**
	S	**S**	**H**	**H**	**S**	**S**

From the soil test we identified an imbalance in K:Ca. Our aim was to increase tissue levels of K in early stages of plant growth and intern increase yield and quality of the crop.

The plot was set up that half received a good balanced fertility program including a broadcast application and a planter mix application including micronutrients as recommended except for S. The other half of the plot received exactly the same except we included 10 lbs. of sulfur in the planter mix. The tissue results were as indicated in Table #2.

As you can see, we increased P:K:Mg the tissue where we used sulfur with the major increase being K as we suggested would happen prior to setting up the work.

Imbalances in Ca:K:Mg are quite common in Ontario soils and correction in some cases can be almost impossible. The addition of 10 lbs./acre of elemental S in a planter mix is not costly and results such as this warrants further work.

Sulfur in no way can replace a good fertility program but in cases such as this it may assist in the efficiency of nutrients. In areas of high crop production heavy soils and soils high in Ca (% greater than 80) we have had excellent results in both crop yield and quality.