THE RIGHT CHOICE
MATTERS

SULPHUR
The fourth macro element

Setting the scene

Without the sulphur containing amino acids cysteine and methionine and other sulphur containing organic compounds, there would be no life as we know it. It plays a major and essential role as plant nutrient and is often called the fourth macro element after nitrogen, phosphorus and potassium due to its utter importance in plant physiology and metabolism. In fact, in the maize and soybean producing areas of the USA, sulphur is regarded as the third limiting major plant nutritional element after nitrogen and phosphorus.

The current situation

The absolute importance of sulphur as plant nutrient has been emphasized even more over recent time due to the following:

- The demand for sulphur has escalated exponentially due to higher levels being produced per unit of land. Advances in genetic material and modern cultivation methods have contributed to this phenomenon.
- The fertilizer industry, for various reasons, has moved to highly concentrated fertilizer products that contain very little or no sulphur. Classic low concentration products such as Superphosphate are scarce.
Sulphur increases yields

More than 100 production functions of various crops around the world were summarised against sulphur nutrition in the graph on the right. It shows that all the crops would obtain a relative yield of more than 90% of the season’s potential if a level of sulphur (as sulphate) in the soil of at least 30 kg per hectare (20 cm depth) is maintained. For most of the grain crops and planted pastures, a sufficiency value of more than 25 kg sulphur per hectare (as sulphate) will be enough to ensure a relative yield of 95%.

The graph was compiled from data published internationally and in South Africa.

Sulphur influences disease incidence and severity

The plant disease resistant capabilities of sulphur are well known and sulphur has been used over the centuries as an effective fungicide. Sulphur induced resistance (SIR) of plant diseases linked to efficient sulphate feeding is getting increasing worldwide attention. It is one of the many ways in which crops could be assisted in combating the onslaught of pathogens in a biologically friendly way. The table below shows different diseases on various crops that can be effectively resisted through sulphur nutrition.

<table>
<thead>
<tr>
<th>Host Plant</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton, tomato</td>
<td>Fusarium wilt, Verticillium wilt</td>
</tr>
<tr>
<td>Crucifers</td>
<td>Club root</td>
</tr>
<tr>
<td>Grape</td>
<td>Downy mildew, powdery mildew</td>
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<tr>
<td>Maize</td>
<td>Leaf blight, Stewarts wilt</td>
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<tr>
<td>Nicotiana glutinosa</td>
<td>Tobacco Mosaic Virus</td>
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<tr>
<td>Peach</td>
<td>Armillaria root rot</td>
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<tr>
<td>Peanut</td>
<td>Cercospora leaf spot</td>
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<tr>
<td>Pine</td>
<td>Needle blight</td>
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<tr>
<td>Potato</td>
<td>Common scab, late blight, stem canker</td>
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<tr>
<td>Rape/canola</td>
<td>Black spot, black leg, late leaf spot, Sclerotinia stem rot, Verticillium wilt</td>
</tr>
<tr>
<td>Rhododendron</td>
<td>Bud Death</td>
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<tr>
<td>Soybeans</td>
<td>Rhizoctonia root rot</td>
</tr>
<tr>
<td>Sugarbeets</td>
<td>Ramularia leaf spot</td>
</tr>
<tr>
<td>Turfgrass</td>
<td>Fusarium patch</td>
</tr>
<tr>
<td>Wheat</td>
<td>Powdery mildew, sharp eye-spot</td>
</tr>
</tbody>
</table>

**Sulphur improves crop quality**

Sulphur has a significant impact on the quality aspects of several crops, from bread baking quality of wheat dough, as well as pungency increases in onions, garlic, cabbage and mustard crops to the increase in protein levels in grains and legumes and the increase in oil content in oil producing crops.

The impact on quality is often quite subtle, for instance the fact that sulphur content in forage enhances the ability of ruminants to digest it. Nitrogen to sulphur ratio is an important indicator and higher than normal sulphur rates are usually necessary to increase forage quality.

![Nitrogen and Sulphur](image)

**Sulphur and WUE**

The contribution of sulphur towards water use efficiency (WUE) is significant, as can be seen from work done in Brazil on grass crops where it was shown that the WUE almost doubled when sulphur was applied at adequate nitrogen levels.

Similar results were obtained with canola as a test crop by the University of Stellenbosch, where WUE has increased by up to 25%.

![Graph of Sulphur applied vs Canola Relative increase in water use efficiency](image)


**Sulphate and its ameliorating effect in acid soil**

Sulphates of the basic cations calcium (gypsum), magnesium, sodium and potassium may combat soil acidity and, more specifically aluminium toxicity, by either precipitating the toxic heavy metal ion (the so-called self-liming effect) or by complexing it in a harmless metal sulphate form.
Sulphur containing products and their efficiency

Perhaps the sting that hurts the most is the use of inefficient sulphur sources for plant nutrition. It has been mentioned that the tendency in current fertilizer products lies towards the production of high concentrates such as Urea and Diammonium phosphate (DAP), primarily because of economy of scale and transport benefits. Such materials are then blended closer to the point of use. The problem, however, is that these materials usually do not contain sufficient secondary elements such as sulphur. The cheap “quick fix” route for blenders is to add elemental sulphur, because of its concentration, availability and favourable price. There are, unfortunately, quite a few hidden drawbacks to the use of these products.

Plants can only utilise sulphate as sulphur source from soil. This means that elemental sulphur needs to be oxidised to sulphate before it is available. The result of sulphur oxidation is sulphuric acid, which is a highly aggressive acid. The use of sulphur is therefore well-known under saline and sodic conditions. Unfortunately, under neutral and acid soil conditions, especially where the sulphur is applied in concentrated rows, the negative effects of acidification outweigh the possible contribution of sulphur nutrition.

Trials done in Canada on canola as test crop showed the poor efficiency of elementary sulphur containing bentonite clay compared to sulphate-containing fertilizer products. The block on the left received the bentonite sulphur, while the one on the right was treated with sulphur in the sulphate form.

Another drawback is the inefficient distribution of highly concentrated sulphur containing products when applied to crops. Elemental sulphur based products usually contain more than 90% sulphur. The quantity therefore added to bulk blends is minimal. From the densities of raw materials, it is calculated that a 3% sulphur containing bulk blend of common raw materials such as Urea, DAP and KCl will only contain 1.4% on a volume basis, of a 90% sulphur containing raw material. In one meter row spacing, only five granules containing sulphur will be applied per meter when putting down 10 kg of sulphur per hectare. If a 3% sulphur containing chemically granulated product is applied, there will be 250 granules per meter containing sulphur in readily available sulphate form.

The above disadvantages lead to poor agronomic efficiency of elemental sulphur products, which can lead to sulphur deficiencies and have a negative impact on yield, crop quality and other factors. Speak to your Omnia agronomist about the best sulphur containing product for your crops.

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