USE OF LIME AND GYPSUM: WHEN, AND WHICH PRODUCT?

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The role of lime and gypsum

Healthy soils are foundational to sustainable and profitable crop production. Under certain conditions – in particular in the rainfed areas of the industry – soil health may be compromised by a build-up of acidity in the soil profile. The problems linked to excessive acidity commonly include the following:

- Deficiencies of calcium (Ca) and magnesium (Mg).
- High solubility of aluminium (Al) resulting in aluminium toxicity.
- Deficiencies of silicon (Si) and micronutrients such as zinc (Zn) and molybdenum (Mo).
- Low biological activity.

Applications of lime and/or gypsum are effective in addressing most of these problems. Table 1 provides an indication of the impact of various products on soil properties. Importantly, limes and slags generate alkalinity in the soil. When applied at correct rates, these products thus increase pH (see Figure 1, left) and eliminate aluminium toxicity by rendering the aluminium insoluble. In addition, the large amounts of calcium supplied by the products (Figure 1, right) are of crucial importance in terms of root growth and crop performance.

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<thead>
<tr>
<th>Product</th>
<th>Impact on:</th>
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<tr>
<td></td>
<td>pH</td>
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<tr>
<td>Dolomitic lime</td>
<td>↑</td>
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<tr>
<td>Calcitic lime</td>
<td>↑</td>
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<tr>
<td>Calcium silicate slag</td>
<td>↑</td>
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<tr>
<td>Gypsum</td>
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↑ = increase  
ne = negligible or very small effect
Figure 1: Effects of dolomitic lime, steel-industry slag and gypsum, all supplied at 5 t/ha, on soil pH (left) and soil calcium levels (right), as reflected by samples taken at 4 and 8 weeks after treatment of a Cartref soil (13% clay) from the North Coast.

What to look for in selecting a product

A wide range of products, differing appreciably in specifications and pricing, is available on the market. Below are important factors to take into account in selecting a product.

Factors determining the quality of a lime are its neutralizing value (gives an indication of the potential impact on soil pH), calcium, magnesium and silicon (if a slag) contents and the fineness of the individual particles comprising it. Fineness of particles has a major bearing on the speed of reaction in the soil. To be registered as an agricultural lime, the product must have a neutralizing value (calcium carbonate equivalent, or CCE) of at least 70%, while all particles must be <1.7 mm in diameter, and 30% must be <0.25 mm. Importantly, the specifications for the product – as determined by an accredited laboratory service – should be readily available from the supplier. If there is any doubt regarding product quality, a sample should be submitted to FAS for analysis.

Much of the value of limes and slags is in their nutrient content. Calcium, magnesium and silicon are of great importance for high-yielding crops, and the application of these products represents by far the most cost-effective option of supplying these nutrients. Data presented in Figure 1 (right) provide striking evidence of the massive and rapid increases in soil calcium levels following an application of 5 t/ha of the various products (dolomitic lime and the slag also supplied large amounts of magnesium).

In recent times there has been aggressive promotion in the industry of ‘alternative’ lime products, such as ‘liquid lime’ and granulated limes. Growers would do well to view the claims for these products with a good deal of scepticism:

- A frequent marketing pitch is that very low rates (e.g. 1 to 10 litres/ha) of these ‘new’ products are equivalent to 5 or more tons per hectare of ‘conventional’ lime. Although this sounds highly attractive from a logistical perspective, claims of this nature are patently flawed, and simply defy the laws of chemistry! By way of illustration, an increase in soil test calcium of 600 mg/L as shown in Figure 1 requires approximately 1200 kg/ha of pure calcium – vastly more than the 1 to 2 kg of calcium in 10 litres of liquid lime.
• ‘Conventional’ liming materials take years to react in the soil, whereas because of their fineness, liquid limes react very rapidly. These claims regarding conventional limes reflect either a meagre knowledge or a strong bent to dishonesty. As shown quite clearly in the study reported in Figure 1, reaction of lime and slag was well advanced after only one month. Thus for all practical purposes, speed of reaction of conventional limes is not an issue.

• In terms of the granulation of lime, this approach is at variance with the imperative of ensuring a thorough and intimate mixing of the liming material with the soil matrix in order to promote the uniform and complete neutralization of the acidity (see Figure 2). The point is that applying lime as granules will inevitably result in ‘pockets’ of high alkalinity interspersed with un-treated acid soil.

Importantly, these ‘new’ products are more often than not exceedingly costly per unit of product. In comparing them with conventional liming materials, the key issue is how much calcium, magnesium and neutralizing value is supplied per unit cost.

Figure 2: Illustration of the ‘pocket neutralization’ effect of granular or coarse lime particles (left), as opposed to uniform neutralization by a conventional fine lime.

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