Information Sheet

7. NUTRITION

7.5 Recommendations for lime and gypsum

Use of lime and gypsum

- Recommendations for lime and gypsum are made for two reasons:
  - where calcium (Ca) and/or magnesium (Mg) are required as nutrients
  - where toxic levels of aluminium (Al) are present in the soil.
- Lime and gypsum are relatively common minerals available in South Africa and are therefore inexpensive.
- When Ca and Mg are deficient in the soil these can be supplied by dolomitic lime, whereas, when Ca alone is deficient, calcitic lime or gypsum should be used.
- Calcitic and dolomitic lime are equally effective in increasing soil pH in order to neutralise soil acidity and, if present, to eliminate Al toxicity.

Role of calcium and magnesium

Ca and Mg are referred to as secondary nutrients, and their absence can affect plant growth as much as do major nutrient deficiencies. The main functions of these two nutrients can be summarised as follows.

Calcium functions

- Ca stimulates root and leaf development.
- It forms calcium pectate, which strengthens the cell walls of the plant.
- It also forms compounds that promote healthy plant structure.
- It helps to activate several plant enzyme systems.
- It helps to neutralise organic acids in the plant.

Magnesium functions

- Mg is the central atom in the chlorophyll molecule, so it is actively involved in photosynthesis.
- Mg aids phosphate metabolism, plant respiration and the activation of many enzyme systems.

Incorporating lime in the soil.

Soil Ca level	Ca (ppm)	> 200	200	175	<150
	Ca (kg/ha)	> 450	450	400	<335
Calcitic lime (t/ha)		Nil	0.50	0.75	1.0
Dolomitic lime (t/ha)		Nil	0.75	1.0	1.50
Gypsum (t/ha)		Nil	0.75	1.0	1.50

Diagnosing Ca and Mg deficiency

- Soil analysis is effective in determining whether Ca and/or Mg are deficient, and the form and rate of the carrier that should be used. Soil samples should be taken after plough-out or, in the case of ratoon cane, immediately after harvest.
- Samples should comprise about 30 soil cores taken with a Mount Edgecombe sampler along the two diagonals of a field. Complete instructions on the best ways of taking leaf and soil samples are given in Information Sheets 7.9 and 7.10 respectively.
- When the amount of Ca in the soil is less than 450 kg/ha (200 ppm) and the Mg level is above 170 kg/ha (75 ppm), the quantities of calcitic lime or gypsum that should be applied are given in the table.
- When the amount of Mg in the soil is less than 60 kg/ha (25 ppm), dolomitic lime should be applied. When Ca is deficient and Mg is below 170 kg/ha (75 ppm), dolomitic lime is also recommended in preference to calcitic lime.
- Where the soil pH value is greater than 6, the amount of lime applied (calcitic or dolomitic) should not exceed one ton per hectare.

Diagnosing aluminium (Al) toxicity

- It is important to know well in advance if additional lime is required before replanting to correct an Al toxicity problem. For this reason, soil sampling is recommended immediately after harvesting the penultimate crop before plough-out. Mark the FAS label 'FOR LIME REQUIREMENT ONLY'.
- FAS lime recommendations are based on an aluminium saturation index (ASI), calculated by expressing the exchangeable aluminium index (EAI) for all topsoil (0-250 mm) samples where the pH is below 5.4. An ASI threshold value of 20% has been established for all varieties except N12, which is more tolerant of acidity than the other SASEX varieties, and appears to be negatively affected by liming to an ASI value of less than 40%. It is therefore important to specify on the soil sample label if N12 is to be planted, to prevent yield losses from over-liming.

How should lime and/or gypsum be applied?

- In the case of Ca and/or Mg deficiency, lime may be top-dressed on any ratoon cane crop (on bare soil or over trash) as one would apply fertiliser but, where possible, shallow incorporation is preferable. In the case of plant cane, incorporation to a depth of 200 to 250 mm before planting is important.
- For correcting Al toxicity, lime should be broadcast evenly several weeks before planting and thoroughly incorporated with a rotary hoe or at least two passes with a disc harrow, before ploughing to a depth of about 250 mm, to give it time to react with the soil.
- There is little evidence of an economic response to ameliorating Al to depth, so deep application of lime is not recommended.
- Application of lime on steep slopes is a problem. Incorporation using a shallow ripping operation, or by hand hoeing into the soil, is suggested. However, as gypsum is more soluble than lime, a further option is to substitute one third of the lime requirement with gypsum or phosphogypsum.
- Where minimum tillage is practised, lime should be spread evenly over the whole field at the start of the penultimate ratoon, with hand hoeing in the interrows to mix with the soil. The ridging operation at planting will enhance this process. The substitution of one third of the lime recommendation with gypsum is also an option.

Long term and side effects from liming

- Residual effects are long lasting, and re-application of lime should not be necessary for many years if the soil is adequately limed before planting.
- Over-application of lime can induce deficiencies of potassium (K) and zinc (Zn), and also a Ca/K imbalance in the leaf. Where more than 3 tons lime/ha is recommended and soil Zn is less than 1.5 ppm, Zn fertiliser should be applied.
- Allow several weeks for the soil to react with the incorporated lime before applying superphosphate fertiliser. This is particularly important in phosphorus (P) fixing soils, where lime that has not reacted with the soil can reduce P availability.
- Where lime is advised, non-urea N carriers should be used for fertilising the first crop after liming, in order to avoid the adverse impact of high pH on urea volatilisation. This precaution does not apply to the use of gypsum.

Some agronomic differences between lime and gypsum

- Gypsum or phosphogypsum (PG) are somewhat more soluble than lime, and will be slightly more effective than calcitic lime in correcting a Ca deficiency.
- PG may contain between one and 3% P, which can be an advantage where applied to soils with low P reserves.
- Where sulphur (S) is deficient in the topsoil, one ton of gypsum (or PG) per hectare applied to the soil surface will provide sufficient sulphur for a plant crop and four succeeding ratoons. Where S is not deficient, comparative costs should be the main criterion when choosing between lime, gypsum or PG.
- With gypsum (or PG) soil pH is not greatly increased and is not as effective as lime in reducing Al toxicity. Two to three times the quantity of gypsum is required to achieve the same short term effect on Al in the topsoil.
- With gypsum (or PG) a severe reduction of magnesium in the topsoil, together with some leaching of potassium, is likely. For this reason, it should be used in conjunction with dolomitic lime.
- The high moisture content of PG makes it difficult to spread and increases the transportation costs relative to gypsum.