INTRODUCTION

Gypsum is the common name of hydrated calcium sulphate, which has the chemical formula CaSO\(_4\).2H\(_2\)O. Gypsum is obtained in two ways, being either:

- mined from naturally-occurring deposits, or
- obtained as a co-product from the manufacture of phosphoric acid. This product is known as Phosphogypsum. Very little Phosphogypsum is now available in Australia.

Gypsum is used as:

- a sulphur fertiliser,
- a calcium fertiliser, or
- at higher rates as a soil conditioner.

Gypsum contains sulphur as sulphate, the form taken up by plant roots. The sulphur in gypsum is readily available, so gypsum can be used where a quick response to sulphur is required.

Gypsum has little if any effect on soil pH. It cannot be used as a substitute for lime to correct soil acidity, i.e. to raise the pH.

Naturally occurring gypsum is a soft crystalline mineral which is found in arid inland areas of Australia. Naturally occurring gypsum ranges from white to yellow, through pink to brown in colour. The gypsum content usually varies between 35% and 85%.

COMPOSITION AND LABEL INFORMATION

1  Analysis

Pure gypsum (CaSO\(_4\).2H\(_2\)O) contains 18.6% sulphur (S) and 23% calcium (Ca). Under state legislation in Australia, gypsum is categorised into a number of grades:

- Grade 1 - a minimum of 15.0% S and 19.0% Ca
- Grade 2 - a minimum of 12.5% S and 15.5% Ca
- Grade 3 - a minimum of 10% S and 12.5% Ca

2  Sizing

A fine particle size is important for products that are insoluble or have low solubility.

The percentage of the gypsum that is capable of passing through a 2.0 mm sieve must be stated on the label. The solubility of gypsum is 0.26 kg/100L water at 20°C.
Most naturally occurring gypsums are coarse. Coarse gypsum takes longer to dissolve, which may be either advantageous or disadvantageous. A fine particle size may be of importance where gypsum is dissolved in irrigation water, or a quick response is required.

USES OF GYPSUM

Gypsum can be used as a fertiliser, to supply sulphur (S) and/or calcium (Ca); or as a soil conditioner. It may also be used to improve the infiltration rate of low conductivity irrigation water, and for water clarification.

Use of Gypsum as a Sulphur Fertiliser

Given its low analysis, it is usually uneconomical to use gypsum as a sulphur fertiliser if it has to be transported over any great distance. Its use is usually restricted to those districts in which gypsum is available locally at competitive prices.

Normally, sulphur is applied along with other nutrients, e.g. nitrogen or phosphorus, using fertilisers like ammonium sulphate (Gran-am), ammonium phosphate sulphate fertilisers (Granulock 15) and single superphosphate (SuPerfect and Super).

Situations where gypsum may be applied as a sulphur fertiliser include:
- In legume-based pastures on basaltic soils with high phosphorus levels, where fertiliser phosphorus is not required and legumes are relied on to fix nitrogen.
- In canola, as a pre-plant application, allowing high analysis nitrogen and phosphorus fertilisers with a low sulphur content to be used at planting and during the growing season.

Notes

It is often necessary to apply gypsum at about 300 kg/ha (45 kg/ha S) as it may be difficult to get application equipment to operate properly and spread gypsum uniformly at lower rates, particularly if the product has a fine particle size.

Use of Gypsum as a Calcium Fertiliser

Gypsum may be used as a calcium fertiliser, but it may not be the product of choice. Lime should be used on acid soils that are low in calcium. Not only does lime supply calcium, it also corrects acidity (raises the soil pH). However, while lime reacts in acid soils, it is ineffective in neutral and alkaline soils.

A typical rate at which gypsum is applied as a calcium fertiliser where the pH does not need amending is 1 - 2.5 t/ha. This would normally be applied during the fallow period, and can remain effective for several years.
Use of Gypsum as a Soil Conditioner

1 Causes of Poor Soil Structure

Poor soil structure can be attributed to many factors, such as over-cultivation, compaction and a loss of soil organic matter. It may also be associated with high concentrations of sodium and/or magnesium in the soil, compared to calcium. When soils with high exchangeable sodium are wet, the clay particles disperse, and the soil loses its defined structure resulting in reduced water infiltration and possible reduced seedling emergence.

The structure of sodic and magnesic soils (soils high in sodium and magnesium) can be improved by applying calcium compounds such as gypsum (calcium sulphate) at high rates. As the gypsum dissolves, it releases calcium ions that displace sodium (or magnesium) on the clay colloids.

Good rainfall (or irrigation) and drainage is necessary to leach the displaced sodium (and magnesium) from the topsoil deeper into the soil profile.

2 Recognition of Gypsum Responsive Soils

To start, much can be learnt from the field, e.g. degree of surface crusting, ease of cultivation, ability to store and use soil moisture, and crop yields. Soil tests can further assist in confirming the cause of soil structural problems.

3 Gypsum Rates

The rate at which gypsum is recommended will depend on the soil type (higher rates are required on heavy clays), the severity of the problem, the depth of incorporation, and the value of the crop.

4 Gypsum Applications and Timing

Gypsum is broadcast on the soil surface. Where gypsum is applied to improve soil structural characteristics, apply it as early as possible prior to sowing a crop or pasture. After application, it should be thoroughly incorporated into the soil.

Gypsum improves soil structure by displacing sodium (and magnesium) on the surface of clay particles with calcium. Gypsum (calcium sulphate) is sparingly soluble, but the sodium (and magnesium) sulphates that form in the soil solution are very soluble.

Rain (or irrigation) is required to leach these soluble salts out of the topsoil deeper into the soil profile, away from zone in which crop roots will be growing. If this does not occur, soil structure may be improved, but crop growth may in fact be made worse due to the salt effect.

5 Before applying Gypsum to Sodic Soil check the Soil EC (Electrical Conductivity).

If a soil test reveals high electrical conductivity, sodium and chloride, gypsum should not be recommended. The best way to ameliorate the soil will be to improve drainage, as most of the sodium will be present as soluble sodium salts and not exchangeable sodium.
6 Use of Lime to improve Soil Structure

Sodic and magnesic soils are typically alkaline, i.e. they have a high pH. Lime is insoluble and therefore ineffective if the pH is high. It only reacts in acid soil where, the solubility of lime is adequate to supply calcium and increase pH. Gypsum has little or no effect on soil pH.

On soils that are both acid and sodic, lime should be used, or a combination of lime and gypsum. The gypsum will work quicker in improving soil structure than lime, but lime is necessary to increase the soil pH. Lime is of no use on alkaline sodic soils.

Use of Gypsum to Improve Irrigation Water Infiltration Rates

The use of low conductivity irrigation water can cause clay particles at the soil surface to disperse, causing the surface to seal, thereby reducing water infiltration rates. This can occur in soils of otherwise good structure.

As gypsum is sparingly soluble, the use of agitators in the mixing tank can help get it to dissolve.

Use of Gypsum as a Water Clarifier

Gypsum can be used as a clearing (or flocculating) agent for muddy water, e.g. from dams, bores and in rice paddies. It causes the very fine suspended colloidal particles to clump together, forming particles too large to remain in suspension, so they fall to the bottom.

A fine particle size is essential for the gypsum to dissolve quickly. A suggested application rate is 1 kg of gypsum per 5 000 litres of water.

WARNING

The information contained in this publication is for use as a guide only. The use of fertilisers and soil amendments are not the only factors involved in producing a top yielding crop or pasture. Local soil, climatic and other conditions should also be taken into account, as these could affect responses.

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