Agronomy Insights

Calcium Options for Horticulture and Agriculture Crops

There are numerous products available on the market to apply calcium to the soil for amelioration or as a crop nutrient. The product choice will be determined by a range of factors including pH amendment, sodium displacement, crop nutritional requirement, soil phosphorus levels, ease-of-use, particle size and cost.

Mark Coupland
Technical Crop Nutrition Manager

For example, in high phosphorus soils, the calcium could be locked up as calcium phosphate ($Ca_3(PO_4)_2$) and in high pH soils the applied calcium could be locked up as calcium carbonate ($CaCO_3$). When using Calcium Thiosulphate (CaTS) time is required for the thiosulphate to convert to sulphate to displace sodium. The particle size determines nutrient availability and time to effect change.

Lime ($CaCO_3$)

If pH is to be increased bulk lime or liquid products (EzyFlow Nano Lime or EzyFlow Nano Calbud) can be applied. Agricultural grade lime is usually 100 per cent $CaCO_3$ which is approximately 40 per cent calcium and has little to no solubility above a pH of 7.0. Therefore; it is ineffective as a soluble calcium source in calcareous soils. In acid soils, it can be used to amend soil pH or as a calcium source.

Gypsum ($CaSO_4 \cdot 2H_2O$)

If sodium is an issue the most common applied product is bulk gypsum; however, sources should be tested to check the calcium, sulphur and sodium levels in the product. Agricultural grade gypsum is a mix of $CaSO_4 \cdot 2H_2O$ (calcium sulfate dihydrate) and $CaSO_4$ (calcium sulfate anhydrite) and possibly other components like lime ($CaCO_3$). The anhydrite form is approximately 14 per cent less soluble than true gypsum (dihydrate) in cold water and 27 per cent less soluble in hot water.

Depending on the source there can be very large variations in the amount of actual $CaSO_4 \cdot 2H_2O$ and $CaSO_4$ in the product (50 to 90%). Lime is also a component of most agricultural grade gypsum. High purity agricultural grade gypsum contains around 20 to 21 per cent calcium and the total gypsum percentage is usually 80 to 90 per cent in the form of $CaSO_4 \cdot 2H_2O$. Solubility of $CaSO_4 \cdot 2H_2O$ is considered around 20 per cent in water.

Particle Size - The Key Difference for the Ezyflow Nano Range

The word 'Nano' means a particle 1000th of a micron or one millionth of a millimetre. Nano particle size has a vastly positive impact on product efficiency, efficacy and performance. The key features of EzyFlow Nano compared to other formulations currently available are:

- A 180 per cent increase in surface area providing more rapid and sustained absorption by the crop through better bio and soil availability.

- Particles adhere to the leaf more readily, especially waxy leaf surfaces, providing increased leaf coverage and lower risk of localised particle-size scorch, thereby improving crop safety.

- Longer shelf-life as particles stays in suspension for longer, making the products easier to use.

Ezyflow Nano Lime (35% Ca)

The effectiveness of agricultural lime (i.e. ground geological limestone) has been accepted based on particle size to be: 100% effective for particles <0.300 mm; 60% effective between 0.300 mm to 0.850 mm and; 0.10% effective for particles >0.850 mm (Stone et al. 1998). Bulk lime particles can range from 0.075 to 5.0 mm.

A study by B. J. Scott, M. K. Conyers, R. Fisher and W. Lill found the capacity of limestone to increase soil pH was log-linearly related to particle diameter across the entire range of particle sizes studied (3 mm to 0.005 mm). In agricultural practice, the results indicate that finer limestone is to be preferred to effect change in the first year on a responsive acid soil site and the residual benefit extends well into the future.

Ezyflow Nano Lime has an average particle size of 1.5 microns and an approximate surface area of 48572/kg of product making it 100 per cent effective as a lime source.

Ezyflow Nano Gypsum (16% Ca: 13% S $CaSO_4 \cdot 2H_2O$)

In the chemically pure form, gypsum contains 23.28 per cent calcium and 18.62 per cent sulphur. In liquid form, products would have an analysis less than pure gypsum.

Ezyflow Nano Gypsum is a true, calcium sulphate dihydrate gypsum that has an average particle size of 900 nanometres and an approximate surface area of 7490m2/kg of product. When Ezyflow Nano Gypsum is applied to the soil the small particle size increases the bio-availability and rate of reaction compared to other liquid gypsum and bulk form products. More importantly, EzyFlow Nano Gypsum will readily react with sodium carbonate (which is generally the more plant toxic form) to form sodium sulphate which generally has a lower plant toxicity.

Other liquid gypsum products

Some liquid gypsum products available on the market have an analysis which is higher in calcium and sulphur than pure gypsum. They are most likely a combination of lime ($CaC0_3$) and elemental sulphur and therefore; they will react differently to gypsum in the soil.

Calcium Thiosulphate (6% Ca: 10% S)

Another consideration for calcium nutrition and sodium displacement is Calcium Thiosulfate (CaTS- CaS_2O_3). Since the oxidation of S° to SO_4 is a biological process, conditions must favor growth of the organisms (Thiobacillus) for oxidation to proceed at optimum rates. Like most biological processes, S° favour decreases at both low and high temperatures and most S°-oxidizing bacteria require oxygen. Oxidation of S° is most efficient at moisture levels close to field moisture capacity. Both waterlogging and excessively dry conditions greatly reduce the rate of S° oxidation.

Most Thiobacillus organisms thrive best under acid soil conditions and sulfur-oxidizing bacteria require most — if not all — of the nutrients required by plants. The bacteria and plant roots compete for nutrients, causing temporary nitrogen (N) deficiencies in plants under high So oxidation rates. Thiobacillus requires ammonium rather than nitrate N, which at high rates, can be toxic to the bacteria. Therefore; the breakdown of the thiosulfate may be quite slow (2 or more weeks) meaning the sulphur availability is delayed which in turn delays the displacement of the sodium.

In the presence of oxygen and water, CaTS converts to gypsum ($CaSO_4$) and sulfuric acid (H_2SO_4). The sulfuric acid produced will free up more soluble calcium when in the presence of free lime (calcareous soils). However; it is acidifying to the soil, so consideration needs to be given to this effect in certain soils; more frequent applications of lime may be required. In the presence of free lime ($CaCO_3$) in the soil CaTs will solubilize 1.04 kg of calcium for each 1kg of calcium applied via the CaTs.

Sodium

Sodium in soils (and irrigation water) could combine with sulphate-S (SO_4) (from gypsum or after the thiosulphate has converted to SO_4) to create $NaSO_4$ which isn't plant available. If, in this situation, the crop is adequately watered the sodium may be leached out of the root zone. If crops are underwatered, the $NaSO_4$ may not be leached from the root zone. A high level of sodium in the root zone can restrict water and nutrient uptake by the plant. For example, in the presence of high sodium the uptake of potassium may decrease.