Gypsum Use in Agriculture and Landscape Horticulture

WESTERN MINING AND MINERALS

Deciding to Use Gypsum

Gypsum is calcium sulfate dihydrate ($CaSO4 \cdot 2H2O$). When dissolved in water, gypsum becomes calcium ions ($Ca2+$) and sulfate-sulfur ions ($SO42-$). Both of these ions are required nutrients for growing plants. In addition to being a major plant nutrient, calcium also plays a vital role in establishing and maintaining good chemical balance in soil, water and plants.

Good farming is about establishing and maintaining good chemical balance in soil, water and plants. The soil, water and plant sciences have developed a wealth of information about what constitutes this good chemical balance. The growers challenge is to use this information to create the best possible growing conditions for the crops he raises.

The first step in deciding whether or not to use gypsum is to test the soil, water and plant tissue to define the existing conditions. This basic knowledge of the complex system of soil, water and plants is necessary in deciding what inputs, including gypsum, are required to improve the growing conditions.

Soil Analysis

Calcium is found in the soil in several forms, and the amount of each form is measured by a good soil analysis.

Soluble calcium is the calcium found in the water in the soil. It can come from the water applied to the soil, from soluble forms of calcium (such as gypsum) added to the soil, or from exchangeable calcium (calcium attached to the soil exchange sites). Soluble calcium is directly available for uptake by plants growing in the soil.

Exchangeable calcium is the calcium that is attached to the soil exchange sites. In a well-balanced soil, exchangeable calcium will occupy 70 to 80 percent of the Cation Exchange Capacity (CEC in meq/100g). The CEC is the ability of the soil to attract positively charged ions.

Insoluble calcium is often found in the soil as calcium carbonate (free or excess lime) and is not readily available to plants growing in the soil. Free lime can be naturally occurring in the soil or can be precipitated in the soil from irrigation water high in alkalinity. This form of calcium can only be converted to soluble calcium by reaction with acid.

Soil amendment with gypsum should be considered when:

- The soil is acidic. Acidic soils may require a limestone application to neutralize soil acidity and increase soil pH. While this process will supply some soluble calcium, a gypsum application may be required to supply additional soluble calcium to fully meet crop needs.
- The Sodium Adsorption Ratio (SAR) of the saturation extract is high and/or the Exchangeable Sodium Percentage (ESP) is high. ESP is the percent of the cation exchange capacity occupied by sodium.
- The exchangeable calcium percentage is less than 70 %.
- The calcium/magnesium ratio (with the ions measured in meq/l) in the saturation extract is less than 2.
- The calcium level in the saturation extract is less than 3 meq/l.
- Plants being grown in the soil are showing calcium deficiency symptoms.

Water Analysis

Irrigation water can have profound effects on the soil to which it is applied because the irrigated soil will take on the characteristics of the water over time.

Rain and snowmelt water is very pure. When used for irrigation, this type of water will tend to remove calcium and other elements from the soil particles, degrading soil structure and reducing water infiltration.

Well water quality can range from very pure to very high mineral content, and the dominant quality, whether good or bad, will be acquired by the soil. Some well water is not suitable for irrigation.

Irrigation water with high sodium (high SAR) will create a high sodium soil. Irrigation water with calcium/magnesium imbalance will create a soil with calcium/magnesium imbalance. Irrigation water with high alkalinity will tend to precipitate calcium carbonate in the soil increasing soil pH. All of these conditions will tend to degrade soil structure and reduce water infiltration.

Water amendment with gypsum should be considered when:

- Irrigation water is very pure (ECw less than 0.2 dS/m). The water should be amended with dissolved gypsum at a level of at least 3.0 meq/l (700 lbs/ac-ft).
- Irrigation water has high sodium (SAR greater than 3). The water should be amended with dissolved gypsum to a level where the SAR is less than 3.
- Irrigation water has calcium/magnesium imbalance (Ca/Mg ratio less than 1, concentration in meq/l). The water should be amended with dissolved gypsum to a level where the Ca/Mg ratio is 2 or higher.

Plant Tissue Analysis

Calcium is found in plant tissue in two forms, either as calcium ions being taken up by the plant or as calcium combined in the plant tissue structure. As plants grow, they require a continuous supply of calcium because calcium becomes fixed and immobile within the plant structure.

Calcium deficiency occurs most often at the growing tips of the plant during periods of rapid growth when the calcium supply cannot keep up with demand.

Leaf analysis measures the result of the growing process. If a leaf is deficient in calcium, the plant has been grown in calcium deficient conditions. Petiole (leaf stem) analysis measures the supply of nutrients to the leaf. If a petiole is deficient in calcium, the plant is not receiving adequate calcium at the time the petiole was taken.

Soil or water amendment with gypsum should be considered when:

- Leaf analysis or petiole analysis show a calcium deficient condition.
- The plant displays calcium deficiency symptoms.

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WMM11 08/01