New York State Flower Growers

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CALCIUM

This element is characterized as an alkaline earth metal and falls in the same chemical family as Magnesium, Barium and Radium. In a pure state it is silvery, soft and malleable. Calcium constitutes about 3.6 per cent of the earth's crust. The pure form of metallic calcium was first prepared by Davy in 1907 and quantities of a hundred thousand pounds or so are still produced each year for use in the steel industry as a de-oxidizer.

The commonest form of calcium is limestone or calcium carbonate ($CaCO_3$). Other sources of calcium carbonate are coral, pearls, calcite, marble, shells and chalk.

Various salts of calcium are used in agriculture. Lime, hydrated lime, limestone, and gypsum are commonly used as soil amendments while Portland cement, Plaster of Paris and hard water are forms of calcium familiar to all. Let us consider each of these substances in order.

Lime or CaO is formed by heating limestone to drive off all of the carbon dioxide and is often called quicklime. It is sometimes used to correct soils of low pH and has been used as a substitute for sterilization. It is very reactive and combines readily with water to liberate heat. Because of its corrosive powers and super reactivity, it is best not used as a soil amendment and should never be used as a substitute for sterilization since it does not liberate enough heat for that purpose and does ruin soil and equipment very easily.

Hydrated lime or slaked lime is quicklime to which water has been added. This water combines chemically so the material remains dry but is no longer reactive or corrosive.

$$CaO + H_2O \longrightarrow Ca(OH_2) + 16000 \text{ calories}$$

Quicklime + water ⟶ Slaked lime + heat

This material is considerably more soluble and, therefore, faster acting than limestone when used as a soil amendment but still is not recommended for correcting soil pH. It is too strong and the common error is to apply too much which results in crop injury and semi-permanent injury to the soil. Applications to the soil will often result in the earthworm population coming to the surface where they can be picked up. Until Mowrah meal returns to the market, this remains one of the best ways of eliminating worms.

Limestone is universally used as a soil amendment for correction of soil pH and as a source of Calcium for plant nutrition. It is readily available, cheap and safe to use. Over application cannot raise the pH above 8 since the material will not dissolve further. It is slow to act because of its limited solubility but this is often an asset since changes in pH bring about many chemical changes in soils and time should be allowed for the conversions of phosphorus, iron, aluminum, manganese, etc. back to their alkaline forms.

When purchasing limestone, use only that which is prepared for agricultural use. This has been ground fine for faster action (still slow) and a large portion of it must pass a 100 mesh screen. On soils where magnesium may be deficient, such as sand, use Dolomitic limestone. This has the same properties as regular limestone but is slightly more expensive, less soluble and is the cheapest source of magnesium.

Calcium is removed from soils by leaching and, therefore, it is most often deficient in limed areas, in surface soils and on sandy soils. Many times, deep plowing will bring up enough lime to grow good crops for awhile. Otherwise, on sandy soils in humid areas, plan on adding limestone and mixing it with the soil on a regular schedule of every 2nd or 3rd year or so.

Gypsum or calcium sulfate is also used in quantity in the agricultural field but not so often by the floriculturist. It is considerably more soluble than limestone but has little or no effect on soil pH. It does serve, however, as an excellent source of calcium for peat soils where this nutrient must be added without changing the pH.

In the western states, gypsum is often added to field soils in order to reclaim soils saturated with sodium carbonate. These soils, known as alkali soils, become useable after gypsum is applied with a series of waterings. This practice in the west has led to a rather common practice in the greenhouse of using gypsum as a cure for high soluble salts troubles. Gypsum does not and cannot cure a soluble salts problem since it is soluble in itself and only makes a bad situation worse. Better to use water for curing this problem. Gypsum has also been used with soils to be sterilized in an attempt to eliminate sterilization injury. If sterilization injury is due to ammonia production, gypsum may help. But sterilization injury is usually not due to ammonia but to other as yet unidentified factors. In any event, the elimination of easily decayed organic matter and the substitutions of peat moss, when preparing soils for sterilization usually results in better crop growth as well as elimination of sterilization injury.

Plants use calcium in several ways and it certainly should be considered an element of prime importance. Primarily, calcium combines with pectin as a calcium pectate and cements cell walls together by the formation of the middle lamella. No new cell walls are laid down when calcium becomes limiting, even though cells may continue division. For this reason, a calcium deficiency shows up as a stoppage of growth and the death of growing tips. This deficiency occurs only rarely, however, and then most often on peat soils. Generally calcium deficiencies are no problem.

Calcium also plays an important role in the soil as a regulator of nutrient uptake. Because of the peculiar properties of roots, they have the ability to take up some elements and leave others behind. Calcium is instrumental in this process of selection. Without calcium in the root, the cells of the root are not able to exclude such elements as sodium and small concentrations of iron and aluminum would likely be injurious.

Calcium is rarely added to soils to serve as a nutrient element. When this does become necessary calcium sulfate (gypsum) or calcium nitrate are the best forms to use. Generally, calcium as limestone is added for pH control and limestone is the preferred form. It should be mentioned, however, that limestone is often a constituent of mixed fertilizers where it is present as a diluent and to counteract the presence

of acid forming salts. Gypsum or calcium sulfate is also present in all superphosphate and is added in quantity with each phosphorus treatment.

Growers commonly try to maintain soil pH in a rather narrow range. This is often not necessary. Plants grow over a wide range of pH as long as the various nutrients are present in the proper amount. These nutrients can be measured by soil testing. When soils are sent to the Soil Testing Laboratory, of the Floriculture Department, one of the nutrients tested is calcium (Ca). As long as this measures 100 ppm or more and the pH is between 4.5 and 8, and other nutrients are present in proper proportion, the soil is most likely proper for plant use. In fact, it may be better if the pH is low since soil bacteria are less likely to be troublesome and aeration is improved at low pH.

If when the soil is tested, the calcium is below 100 ppm and the pH is low, limestone is called for. Generally it will take five pounds of limestone per 100 square feet of soil to raise the pH one whole number. This will also be ample to supply calcium as a plant nutrient. Excess limeing can cause many troubles, some as yet unidentified. It will tie-up iron, magnesium, manganese, copper, aluminum and phosphorus if present in excessive amounts. It also stimulates bacterial activity (hence is used on legumes). This stimulation can result in rapid breakdown of organic matter, rapid use of soil oxygen and the development of soil pathogens in some situations. Just because lime is cheap, and relatively fool-proof, don't use it unless necessary.

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