CONTROLLED AVAILABILITY FERTILIZERS

PART I OF A FIVE-PART SERIES

Coated Fertilizers:

General description and applications

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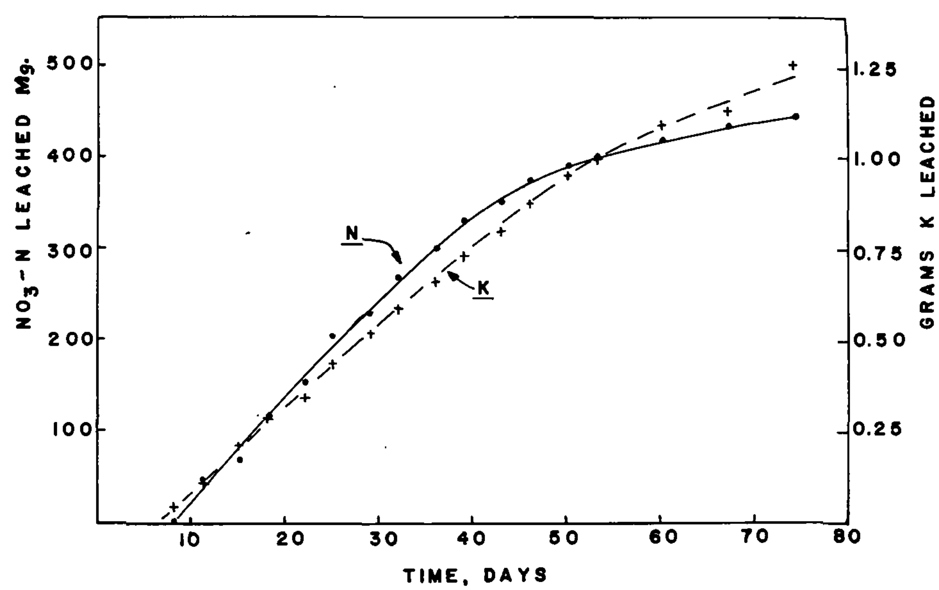
The recent development of coated fertilizers by industry offers a promising new tool to regulate the availability of minerals for the nutrition of plants. The new controlled-availability fertilizers cannot be expected to replace the liquid-fertilization techniques now widely used in the production part of the ornamentals industry. However, they will be useful in promoting the rapid start of seedlings and cuttings, as a supplement to liquid-fertilization programs, and for producing short-term crops. It is now possible for the potted-plant producer to incorporate enough fertilizer in his mix to grow a 3-month crop to maturity with no further fertilizer additions. Likewise, landscape contractors will benefit from the new materials, which will assure adequate nutrition to new plantings for a prolonged period. Longevity of nutrient supply and a high degree of safety from injury by excess application should be important for home-grounds maintenance. Another possible benefit is to minimize the large flushes of growth associated with the use of soluble nitrogen sources on turfgrass.

In the coating process, individual granules of inorganic fertilizers are coated with resinous, polymeric membranes. When such granules are placed in contact with water or moist soil, water passes through the membranes and dissolves some of the fertilizer. A saturated solution with considerable osmotic pressure develops within each capsule. The coated granules swell and become spherical in shape. Apparently the dissolved fertilizer materials diffuse through the membranes into the outside solution. The rate of diffusion is regulated by the thickness of the membranes and is relatively steady until about two thirds of the fertilizer has been released. The rate of transfer through the membranes is not markedly influenced by steam sterilization of soils or by other conditions occurring in soils, except dryness. The influence of soil conditions on diffusion rates will be the subject of a subsequent article.

Nitrogen (including urea), phosphorus, potassium, and mixed fertilizers can be coated. With some coatings, the minerals have been released over a period exceeding six months. A depletion time of 4 or 5 months is adequate for many crops.

After all the minerals have passed through a membrane, the solution is withdrawn from the capsule, apparently by soil-moisture suction. The membrane shrinks, becomes brittle, and is easily crushed between the fingers. The swollen condition distinguishes coated particles which are still functional from those which are exhausted.



Cumulative removal of nitrate nitrogen and of potassium by repeated leaching from 1 kilogram of krilium-treated Yolo loam into which 644 milligrams of nitrate nitrogen and 2,175 mg of potassium had been incorporated from a coated source.

Duration of supply

To illustrate the duration of mineral supply from coated fertilizers, 500 granules of coated 20-10-5 fertilizer were examined after 112 days in soil with a growing crop. Of the lightly coated granules, 37.4 per cent were still swollen; of the medium coated, 49.6 per cent; and of the heavily coated, 58.2 per cent.

The graph shows cumulative quantities of nitrate nitrogen and of potassium released from a 60-centimeter column containing 30 grams of coated 10-10-10 fertilizer uniformly incorporated in 1 kilogram of krilium-treated soil. The column was leached every few days. At the end of 74 days, some 68 per cent of the added nitrate nitrogen and 57 per cent of the added potassium had been recovered. On the graph, the relative linearity of the curve showing the amounts of minerals recovered demonstrates the utility of coating in sustaining the nutrition of a planting during a prolonged period.

Practical uses

Possible uses for materials with these properties are exciting, but application will be influenced by the cost of the coating process. Probably coated fertilizers will find application first for high-value plantings such as ornamentals and turfgrass. They show promise, along with other materials to be reported later in this series, of solving some difficult management problems in California's 100-million-dollar commercial flower and nursery industry.

The occasional rapid deterioration of vigorously growing canned nursery stock after it leaves the hands of the grower has been a problem. Liquid fertilization is now widely used by nursery stock producers in conjunction with highly permeable soil mixes, which have little retentive capacity for several of the fertilizer elements. Thus, while the grower may do an excellent job of producing stock, the retailer may not be equipped to maintain the stock properly, or the consumer may be disappointed with the rapid decline of a vigorous plant, caused by inadequate nutrient supply.

Coated fertilizers are capable of minimizing or eliminating this problem. The philodendrons pictured here were grown in a typical nursery mix and were uniform in size at the time a coated source of nitrogen and potassium was applied. The plant on the left received 12 grams of nitrogen as heavily coated urea; the plant in the center received 1.5 grams of nitrogen as lightly coated urea—somewhat more than could be given safely in a single application of a soluble, uncoated source. The plant on the right received no nitrogen. Adequate quantities of other fertilizer elements were supplied to the plants. After fertilization the plants were maintained with only tap water. When the picture was taken, 5 months after the fertilizers were applied, new foliage on the largest plant was highly acceptable, though not quite the dark, glossy green which had been achieved previously.

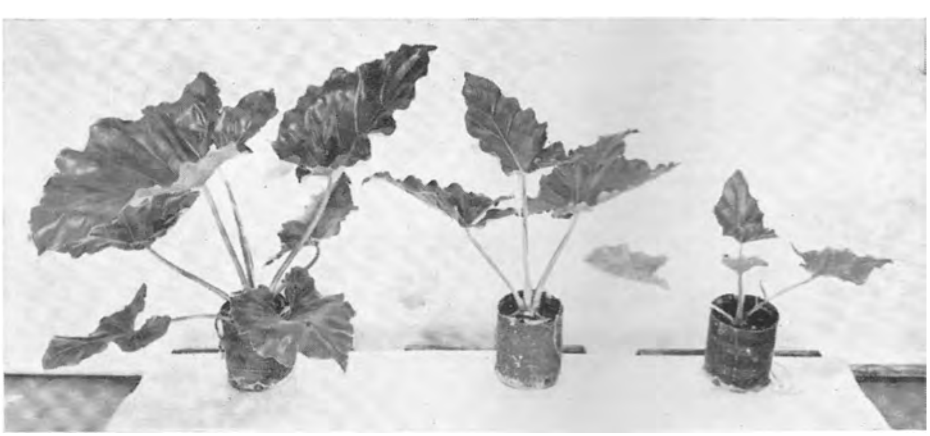
Heavy applications safe

Relatively large applications of coated fertilizers can be made safely, because the coating separates the fertilizer from the soil solution at the start. However, if the proper amount of deep leaching does not take place, salinity conditions can develop rapidly, as with other soluble fertilizers. Prolonged storage of moist soil containing coated fertilizer is not good practice, because the minerals released during storage may be excessive when a planting is finally made in the soil. In practice, one pound of actual nitrogen from a heavily coated source per cubic yard of soil has given excellent results with potted chrysanthemums and has grown them to maturity without further fertilization. (With granules 1/8 to 3/16 inch in diameter, the coating would represent 12 to 15 per cent of the total weight.)

Aside from the field of ornamentals, coated fertilizers will be of interest and probable value wherever leaching losses are high. Coupled with sprinkler irrigation, they may increase the utility of very sandy soils. At the proper rate and coating thickness, fertilizer can safely be placed directly with or beneath seeds to give a rapid plant response, which may be of particular importance where the growing season is short.

Foresters have sought a long-lasting fertilizer source which could be used at the time of planting seedlings. Looking at the broader soil resource in relation to population problems, the techniques of controlling and extending nutrient availability from fertilizer materials may be an important tool in more efficient utilization of soils in the tropical regions.

Philodendron plants, maintained with tap water for 5 months following the application of coated nitrogen and potassium sources. The plants were of equal size when fertilizer was applied. The plant on the left received 12 grams of nitrogen from heavily coated urea, the center plant 1.5 g of nitrogen from lightly coated urea, and the plant on the right no nitrogen at that time. During the 5 months following fertilizer application, an estimated 8 to 10 feet of water was applied to each plant, with about one half this quantity passing through the container.



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WOODY GALLS ON CITRUS

Woody galls occur commonly on trees of Rough lemon and lime in California. Experimental studies have shown that they develop on trees infected with the vein-enation virus originally described in 1953 by the authors. The galls commonly developed on vein-enation infected trees, near the base of thorns and around the wounds made when the plants were inoculated by means of tissue grafts. This suggested that gall initiation was associated with both experimental and natural growth wounds.

Studies proved that citrus woody galls are frequently induced by a combined action of tissue wounding and the vein-enation virus. It has not been determined if the galls are initiated in the absence of wounds. There are no clues to the nature of combined action of wounds and virus that stimulates gall development.

Although serving as hosts of the virus, sweet and sour orange and Eureka lemon have not developed galls even when experimentally wounded. Two commonly used rootstock species, Rough lemon and Rangpur lime, are subject to gall development. There has not been sufficient time to determine if this disorder will become of economic importance. The vein-enation virus is insect-transmitted and is widespread in California citrus. It is known to be present in Australia, South Africa, and South America, where Rough lemon and Rangpur lime are important rootstocks for citrus. Early infection and extensive gall development on young trees would be expected to retard their growth.

Woody galls on citrus, particularly Rough lemon, were first described by Fraser in Australia.—*J. M. Wallace and R. J. Drake, Dept. of Plant Pathology, Riverside.*