Iron and Zinc Foliage Sprays

radioactive tracers being used in basic studies on factors influencing absorption and translocation of micronutrients

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Sprays have been the most effective method—to date—of supplying the micronutrients iron and zinc to many crops. Although considerable research has been done in recent years on the use of metal chelates for soil application of these two nutrients, the use of such materials is recommended only for high-value plantings. Spray application is still indicated for most crops. For this reason basic studies are being conducted on factors influencing the absorption and the subsequent translocation of these two elements.

The radioactive technique makes possible evaluation of spray materials under different conditions in a few days' time. Information that would ordinarily require several years to obtain by field studies and at considerable expense has been collected in a few months' time. Of course the promising leads found in this type of study must be subjected to adequate field trial before any can be adopted for general use.

The technique used in the present studies involved dipping of soybean leaves, avocado leaves, and orange leaves into vials containing radioisotopes of iron or zinc compounds. A variety of chemicals were added in addition to endeavor to increase leaf absorption of the iron or zinc. All solutions contained either a wetting agent or a commercial spreader. After several days the treated leaves were washed in detergent and dilute acid and counted for the radioisotopes. New growth and sometimes stems and roots were also counted to measure translocation.

Urea sprays, which are commonly used to supply nitrogen, have been reported by some citrus growers to result in good correction of iron chlorosis when applied in combination with certain iron chelates. The inclusion of 1% urea with the tagged iron and zinc solutions resulted in increased uptake of iron with the chelate EDDHA—ethylene-diamine di(o-hydroxyphenyl) acetic acid—and reduced uptake with some other chelates. Urea resulted in a decreased uptake of all zinc compounds studied.

In addition to urea, 1% of a weed killing oil and 1% glycerol each increased the uptake of iron EDDHA for each of the three plant species. Oil in contrast decreased uptake of zinc compounds and glycerol decreased uptake of some other iron compounds.

Zinc sulfate was absorbed by leaves about twice as readily as was the zinc chelate of EDTA—ethylenediamine tetraacetic acid. Zinc from two other chelating agents was absorbed about as readily as was zinc sulfate. These were dihydroxy ethyl ethylenediamine diacetic acid and an unnamed compound.

Although inorganic zinc sprays are reasonably satisfactory for most crops, inorganic iron sprays result only in irregular green spotting. The present studies indicate that very possibly the reason for these poor results with inorganic iron sprays since the first reported trial more than 100 years ago is that ferri hydroxide is extremely insoluble and that it begins to form at a pH—relative acidity-alkalinity—value of 3.5—a relatively acid pH. At pH 6.5—almost neutral—it is almost completely precipitated. In treatments where inorganic iron was applied at pH 3.0, both absorption and translocation equaled or exceeded that of other treatments. Field tests with acidified inorganic iron have verified the above findings.

In general the amount of either iron or zinc translocated to other plant parts was a function of that absorbed. Because it has been taught that iron is a nonmobile element in plants, it was slightly surprising to note that the tagged iron was moved to other plant parts almost as readily as was the zinc. From 1% to 10% of the iron absorbed by avocado leaves was translocated to the new growth in 17 days. From the chelate HEEDTA—hydroxyethyl ethylene diamine triacetic acid—a slightly greater percentage was translocated. This iron chelate as a spray has given commercial control of lime-induced chlorosis on deciduous fruits in England. On the average about 5% of the iron absorbed by the soybean leaflets was translocated to new growth, stems, and roots.

Although the amount of either iron or zinc translocated to new growth may appear to be of little consequence, a limited field trial with avocado has indicated that the inclusion in the spray of oil and urea separately resulted in considerable improvement of new growth relative to sprays containing the same iron compounds but without either oil or urea.

The search continues for more effective means of getting iron and zinc into plants.

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Response of chlorotic macadamia leaves two weeks after receiving a 200 parts per million iron spray. *1*—Control. 2—Iron-EDDHA. 3—Ferrous sulfate pH3. 4—Ferrous sulfate pH2. *5*—Ferrous sulfate pH1. pH adjusted with hydrochloric acid.