lime was not added and, in general, copper decreased nitrification at the 1- and 3-ton per acre levels of lime.

One or more of several conditions may explain the difference in response to copper between virgin and cultivated soils. Copper has been accumulating gradually in the cultivated soils and a large portion of the sulfate probably has leached from the soil. The gradual accumulation of copper may have promoted fixation of copper in an unavailable form. The nitrifying population may have become more tolerant to copper over a period of years. All these conditions are in contrast to the application of all the copper at one time to the virgin soils and the retention of all of the sulfate. Little time occurred for a possible build-up of copper resistance by the nitrifiers in the virgin soils.

At what level copper becomes toxic to the nitrifiers in these cultivated soils cannot be ascertained from this study. The maintenance of a pH above about 5.0 will do much to prevent the presence of sufficient copper in solution to become toxic to the nitrifiers.

ACKNOWLEDGEMENT

The author takes this opportunity to express his appreciation to Mr. Paul H. Everett for his part in the laboratory work and to Dr. Walter Reuther, Dr. Ivan Stewart, Dr. C. D. Leonard, and Dr. Philip J. Westgate for providing the data on the copper content of soils from their respective areas.

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FRUIT AND VEGETABLE MARKETING IN EUROPE

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Fresh fruit and vegetables are expensive for the average worker in most European countries, not because the produce is so high-priced but because the average worker receives very low wages. Thus this relatively high price means that the per capita consumption is decidedly lower than in the United States. Not only is fresh produce high in price, but canned fruits and vegetables are even higher in price and consequently are little used.

We in the United States can be quite thankful that, for the present, at least, we are producing and merchandising fruits and vegetables that can be afforded by most workers. There are a number of reasons for the difference but probably the most important one is the small-scale production units that exist in Europe. A big vegetable farm is one of six or seven acres, a good-sized orchard of apples, pears, peaches or citrus will seldom be over 10 acres in size, and most are less than one-half this size. Each of these production units supports a family with an adequate to good living—that is, a good house, clothes and food —but there is no car, tractor, refrigerator, or washing machine. The farm is operated usually by the family. Power farm equipment would be of little value except that it might reduce the number of hours of work required; it would not increase the total output or reduce the cost of production.

These small-scale units affect production in many ways. We expected to see small production units, but we thought the culture of the crop would be excellent. This is not true. Farmers in general have either not had the advantage of a good extension system or, where a good extension system is available, it is not backed by the proper type of research facilities

to furnish up-to-the-minute information. Europeans who have visited the United States during the past several years marvel, not alone at our Extension methods or our research laboratories, but at the close liaison that exists between the grower and these other organizations. When I use the terms "Extension" and "research," I am thinking of the many private and industrial organizations, as well as those public organizations supported by County, State or Federal monies.

The average grower needs additional information on varieties, fertilizers, insecticides, fungicides and many other production problems. The needs are so varied and great that it is difficult even to single out a good example. But apples produced espalier or cordon or headed 8 to 10 feet high is common practice and I could find no evidence of its economy.

After the produce leaves the farm, marketing costs are in line with ours if you measure them in percent return to the farm. But the system certainly lacks the fine organization that exists in America. There is no such thing as grades or standards, nor is there a good market news system. The produce is nicely packed and they have gone far in the art of "presentation." This has been a necessity. With no grades or standards, the buyer wishes to see each individual fruit or vegetable he buys. Thus, in most instances, the produce is packed in single layer crates or plateaus with each single orange or peach or tomato exposed to view. No lid is placed on the container. These containers are shipped all over Europe and the loss of produce by dumping or stealing is exceedingly low. However, crates are high priced and this method of using them appears quite inefficient. This is partially offset by the fact that all crates are returnable. This is some task. But each crate bears an identification stamp, and it is ultimately returned to the original shipping organization. In Holland returnable crates were even used for export, particularly to Germany. By using returnable crates all German money is actually used in purchasing fruits or vegetables and not for buying expensive crates.

Selling by weight is the usual practice, even at the wholesale level. This may have its advantages at the retail level, but it certainly has many disadvantages at the wholesale level. Every package of produce that passes through the wholesale market at Paris is weighed. A standard weight is given the container but the buyer may bring the empty container and demand a weight adjustment. Even in export weight is the determining factor; if 28 or 32 lbs. is put in the crate, the container is closed irrespective of whether the space is only half utilized. Sale by a standard unit package would help ease the merchandising of produce and would probably make more efficient use of the container.

A great deal of attention is given to the "presentation"—that is to say, to packing the container so that it will look nice. Many of the packages are works of art. Only little effort is given to developing or using methods of handling that will prevent spoilage or deterioration during the period of merchandising. Precooling, top or body-icing, washing, waxing, or color added is generally unknown. Soft fruits and salad vegetables arrive at the market in a condition that means they must be used immediately and, even then, much of the lettuce or escarole plant is not usable.

Fruits and vegetables are utilized very quickly after reaching the central market. There is little or no refrigeration, either in the store or home. The retail merchant goes to the wholesale market early in the morning with his bicycle, cart, or he may hire a conveyance, buy his daily supplies, take them to his retail shop and dispose of them. This procedure is repeated at least six days each week. It is easily understandable that this merchant handles only green goods. In many countries it is even specified that that is all he can handle.

They do have beautiful fruits in Europe—peaches, pears, plums, grapes, apricots, strawberries, raspberries, fresh figs, and vegetables in large variety including artichokes, leeks, asparagus, chicory and many we do not have. You can buy high quality produce on all the important markets. But the fact remains that the system of production and marketing has priced them out of range for the average worker.

In viewing this industry you cannot escape comparing it with our own. I am thankful for our comparative lack of trade barriers. I can eat grapes from California, apples from Michigan, cranberries from Massachusetts and potatoes from Idaho. I know that this produce is being produced at the lowest possible cost. That, when other areas can grow it better or cheaper, I'll be able to get it there. True, this system has provided hardship for certain in-

dividuals. Florida, in our life-time, has stopped producing Boston type lettuce. Apple trees look quaint in parts of Missouri. Vegetable greenhouses are virtually a thing of the past. But the average American is eating more fruits and vegetables of better quality than he did before we learned the value of large production units and developed our modern methods of handling and shipping fruits and vegetables.

Krome Memorial Section

CHELATES FOR THE CORRECTION OF IRON CHLOROSIS IN SUB-TROPICAL PLANTS

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Chlorosis is one of the commonest symptoms of mineral deficiency in plants. Most of the causes have been identified and successfully treated. Iron deficiency has been recognized for a long time, but until the announcement of the use of EDTA for the correction of iron deficiency in citrus by Stewart and Leonard (1) there was no very satisfactory method of correcting this condition in plants growing in the field. Experiments reported in this paper have shown that this chelating agent can be used for the correction of iron chlorosis in sub-tropical fruits and ornamentals on alkaline soils, but that a new chelating agent is more active.

Two compounds were tested. These were the sodium salts of ethylenediaminetetraacetic acid, and of N-hydroxyethylethylenediaminetriacetic acid[1,2] which will be called EDTA and EEDTA respectively. EDTA is a very effective iron chelating agent in acid soils but its activity diminishes rapidly as the medium becomes more alkaline. EEDTA, on the other hand, remains active throughout the entire range of reaction at which plants can be grown. This is a valuable property since almost all soils in Dade County are moderately to strongly alkaline.

EDTA was the first iron chelating agent tested. By the time work was begun at the Sub-Tropical Experiment Station it was already known that this compound was not too effective on alkaline soils. For this reason the iron salt of EDTA was first tried as a foliage spray. Leaf burn without correction of the chlorosis was the usual result of this treatment. After this failure soil applications of a dry mixture of EDTA and iron sulfate were tried. Although no damage resulted, there was no benefit either.

At this point we were ready to abandon further tests, when one of our local growers, Mr. John Tower, requested information on the use of iron chelates on mango trees. No information was available but he was supplied with a small quantity of EDTA and iron sulfate. Since previous use of the dry mixture had failed, it was suggested that he first dissolve the salts, allowing the reaction between the EDTA and iron to take place, and then apply the solution as a drench around his trees. He carried out this test and detectable improvement of the trees followed.

Following this experience, a test of the drench method of treatment was made in the slat house on some severely chlorotic *Cordia superba* plants. These plants were growing in paper tubes containing about one gallon of "potting soil." This soil was a mixture of peat, sand, and "red dirt" screened from the Rockdale soil-limestone complex. The pH of the mixture was 7.2. Several of the plants were treated with a drench and received one gram of the mixture of EDTA and iron sulfate, in the proportions recommended by the manufacturer, containing 0.075 gm. of iron. Greening of the treated plants commenced in one week, while the untreated plants remained chlorotic. Since the drench method of application was effective it was adopted as the standard method in all of the following tests.

Florida Agricultural Experiment Station Journal Series, No. 202.

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