move all the magnesium nitrate from the leaf surface because both the magnesium and nitrogen contents continued to increase with each sampling. However, the increase was much smaller in leaves from trees washed with water than in those from trees not yet washed with water. This indicates more or less continuous absorption of magnesium and nitrogen by the leaves from the magnesium nitrate sprays. Fisher and Walker (4) reported that after 24 hours, 71% of the magnesium from the magnesium nitrate spray applied to the lower surface of apple leaves was apparently absorbed. It appears that the period required for absorption of magnesium by citrus leaves is longer than that of apples. Both magnesium and nitrogen contents were higher in leaves sampled one month after the last washing. This was true of all treatments including the controls.

Based on this study, it is suggested that for maximum absorption, magnesium nitrate should remain on the leaves for 72 hours or longer before rain or irrigation. This would suggest that growers should avoid spraying magnesium nitrate during the rainy season.

CONCLUSIONS

1. Foliar application of magnesium nitrate is effective in correcting magnesium deficiency on calcareous soils. One to two applications of 1.75 or 3.50 pounds of MgO per 100 gallons of water are recommended as a corrective spray, the concentration depending on the severity of magnesium deficiency. For prevention of magnesium deficiency on calcareous soils, an annual application of the 1.75-pound rate is suggested.

2. For maximum absorption, magnesium nitrate spray residues should remain on leaf surface for 72 hours or longer before rain or irrigation.

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LITERATURE CITED


PLANT PROPAGATION, A HALF CENTURY OF PROGRESS IN FLORIDA

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The quest for improved methods for increasing selected plants has continued from man's earliest civilizations. The improvement of vegetative plant propagation techniques for tropical plants during the past 50 years in Florida provided the plant production efficiency required for developing an extensive industry in both fruit and ornamental crops.

Information on various techniques of plant propagation has been disseminated to many areas of the world through the activities of the several horticultural organizations in Florida, and from the exchange of ideas at the annual meeting of the Tropical Region, A.S.H.S., which is held in a different country each year. Professional plant propagators have also done considerable amount of consulting work in many areas. Training courses for local and for foreign students have been made available at high schools and the universities in the state.

The 10 years after World War II was a period when considerable progress was made in developing more refined and reliable methods for increasing plants economically by graftage,
cuttings, and by air-layers. Notable advancements were in the use of plastic film in grafting and marcotting and the use of mist-propagation for rooting cuttings.

Modern air transportation has stimulated the growth of a highly organized world-wide nursery industry. Millions of plants from Florida are air-freighted each year to markets in the United States and overseas.

More economical air-freight allowed greater exchange of varieties by institutions and by commercial growers. At the present time there is some apprehension by Florida growers that the ultimate production from varieties that were exported to other fruit growing areas in tropical regions may eventually eliminate the Florida fruit industry due to the lower cost of production in the countries where land and labor is less costly. The availability of Florida varieties may have hastened the development of foreign competition but this would occur in one way or another over a period of time as these countries develop their resources.

In Florida, the ornamental nurseries dominate the business in contrast to the predominance of fruit tree nurseries which were in existence at the period of the first nursery inspection report given to the Florida State Horticultural Society in 1912. At that time, 69 nurseries comprised of 753 acres were inspected. Presently, the number of all kinds of nurseries are recorded at 4,049 and cover 14,577 acres. This intensive industry would not exist if growers lacked the ability to produce large numbers of true to type plants, upon demand, and at a reasonable price.

The proceedings of the Florida State Horticultural Society provides an excellent history of the development of our agricultural industry. A great deal of credit and admiration is due the early settlers in Florida who struggled to develop improved varieties of plants by selecting superior seedlings. The record of their attempts to develop workable methods of reproducing these seedling selections is the history of plant propagation in Florida.

When we consider the meager resources of experience and research that was available to these pioneer Florida growers, they indeed accomplished some remarkable achievements. While some of their methods might be considered crude by present standards, many of the techniques of budding and graftage have not been greatly improved upon to this day 1, 2, 5.

In our current agricultural pursuits, our problem is not so much the lack of information, or the experience in how to do things. The task is to find people who are willing to learn and do skilled work. Plant propagation is no exception. The majority of skilled practitioners of the art of budding and grafting are now reaching middle age or are older. It is difficult to obtain the services of propagators skilled in topworking mangos and avocados. Many of the grove owners and owners of nurseries are forced to pick up their grafting tools once again in order to get the job done. Power saws aid in some of the more difficult pruning which in past years was done with hand saws.

The discussion of propagation methods in this paper is not intended to imply that they necessarily have originated in Florida. Most propagation methods are usually only variations of basic techniques discovered long ago. Some improvements of old techniques have been used in Florida and were reported upon (9, 11, 14). The use of mist propagation has had wide usage in Florida and other places (7, 8, 10, 22, 23). Improved graftage methods have greatly simplified the propagation of tropical plants, particularly mangos, avocados, lychees, sapodillas, guavas and carambolas (6, 14, 15, 16, 18, 20).

Florida's role in contributing to tropical agriculture has been far more than a source of fruit varieties and an information center. Many of the leaders in this field during the past half century spent some of their most active years in Florida. Many of these, both researchers and growers, later moved to other tropical areas where their training and experience helped in the development of tropical crops.

Dr. Wilson Popenoe has described some of these pioneers, many whom he knew personally, in "Ceiba," Vol. 4, 1956, titled "Tribute to Florida (24)." In it he mentions the Reasoner Brothers, who started one of the first nurseries at the beginning of the century on the west coast of Florida. They were virtually a private plant introduction station, bringing a wealth of plant material, including mangos from India, lychees from China. Their activity in plant introductions, together with that of the Plant Introduction Garden of the United States Department of Agriculture at Miami, later moved to Chapman Field, provided the source for the plant varieties which originated from the seedling
progeny of the many plants distributed to various locations in Florida. It is worthy of mention, that all commercial varieties of avocado and mango now popular, have originated as chance seedlings from commercial growers or from yard tree seedlings.

Another pioneer horticulturist, George B. Cellon, lived in Miami, and contributed to the advancement of mango and avocado propagation. Popenoe says that Cellon was the first to commercially propagate mango and avocado by graftage in Florida. The method used was a patch bud (5). Professor Herbert S. Wolfe (27), discussing the history of the mango in Florida, states that Cellon used the patch bud method until 1909, even though others had used a shield bud when budding methods were attempted. During this year, Orange Pound of Coconut Grove proved to Cellon that shield budding was a better method for mango propagation. He used this method in all later attempts. It is unfortunate that many of the accomplishments of this somewhat recalcitrant man are not documented. Nevertheless, he had an important role in the development of the mango and avocado industry through his skills as a propagator and his interests in better varieties of avocados and mangos.

John B. Beach, one of the outstanding contributors to tropical horticulture in the early development period, has been credited for developing a new technique of grafting avocados. This was the herbaceous grafting method of using very young rootstocks while the stems were still succulent (3). This concept, with perhaps some modifications, is still widely used in Florida. Lynch and Nelson reported upon a graftage method for mangos, using young seedlings, more than 50 years later (14).

P. J. Wester, a talented propagator, was in charge of the U.S.D.A. Plant Introduction Garden in Miami during its early development. He later moved to the Philippines and in 1920, published the outstanding Bulletin, No. 32, "Plant Propagation and Fruit Culture in the Tropics (26)." His illustrations and detailed procedures of propagation, particularly budding, are contemporary half a century later.

In southern Florida, the Krome family, from the time that Wm. J. Krome settled near Homestead at the turn of the century, to the surviving widow and sons — all have been one of the continuing stabilizing influences on the tropical fruit industry. The pursuit of growing tropical crops has been a family dedication. They have always crusaded for raising the standards of quality of our fruit industry. They have taken an active part in trying to help solve the industry problems for establishing fruit maturity standards on limes and avocados. Their experience has guided the evaluation of avocado and mango varieties. Research efforts have been encouraged by the Krome family through many years of cooperative experiments with the state experiment station. Land for establishing the Subtropical Experiment Station was donated to the state by the Kromes.

Wm. J. Krome reported on a cleft graft method for avocados which he called the "Me-
Fig. 3. Vinyl film wrapped so small opening provided for emergence of terminal bud.

Fig. 4. Completing of vinyl film wrap by underlooping end of film.

Fig. 5. Example of one method of top-working mango.

Fig. 6. Mango, budded by chip bud method.

After the death of Mr. Krome, his wife, Isabel, managed the family business, which included Coral Reef Nursery. This nursery was the source of many of the improvements in graftage and provided the trees for most of the early plantings of mangos, avocados and citrus in south Florida.

Upon the partial retirement of Mrs. Krome, her son, Wm. H. Krome, has managed the family enterprises as well as his own large tropical fruit groves. Bill Krome has helped to establish the existing maturity regulations for avocados new in effect under the Federal Marketing Agreement (12).

The activities of David Fairchild and Wilson Popenoe have had world-wide impact on the development of tropical agriculture. They were great plant explorers and traveled to all parts of the world when transportation was more difficult. Bringing in graftwood or plants was a time consuming task and required great personal care during the lengthy period of shipment by
boat. Dr. Popenoe, during the many years I have known him, has encouraged research on plant propagation and has brought information on graftage methods to the many tropical areas of the world where he has either worked or visited. Even in his present retirement he still takes an active part in promoting tropical fruit study.

I would like to pay personal tribute to the two people whom have had the most influence upon my own interest in tropical fruit and in plant propagation. I had the opportunity to work as an assistant to the late Dr. George D. Ruehle, and then many years later with S. John Lynch. Both of these dedicated researchers distinguished themselves in several areas of agricultural research. Their activities are recorded in the proceedings of the several horticultural societies in Florida and tropical regions. Ruehle, although a pathologist by profession, was a skilled plant propagator and enjoyed working on methods to improve propagation of guava (25). I recall that he successfully grafted sapodillas but was not always satisfied with the percentage of takes of that somewhat difficult species to graft.

S. John Lynch entered commercial agriculture following his many years of research on tropical fruit. He is an excellent plant propagator and during his years as a research worker and administrator, provided the optimism and leadership to his associates by his enthusiastic approach toward life and to a wide range of agricultural projects.

Within the past two decades, the several research institutions in Florida have contributed information and instruction in the improved techniques of propagation of tropical fruit crops. Most of the attention has been directed to mango, lychee, guava, and sapodilla.

Of no less importance, private nurserymen and growers have developed some of the more important improvements in particular techniques of using plastic films in plant propagation. A notable achievement was the adaptation of plastic film for enclosing the moss in air-layering lychees by a retired West Pointer, Col. Wm. R. Grove (9).

Plastic film, as a budding wrap, came into use after World War II. The use of light gage vinyl film for an overwrap for mango budding was reported upon in 1949 (14). Local south Florida propagators devised a particular wrapping technique for mangoes using the heavier vinyl film, .0035 inch thickness, which has since become the standard wrapping material for citrus budding, and for a wide variety of tropical fruit crops (18).

Another important aid in propagation was the adaptation of mist propagation to provide a high humidity environment for rooting cuttings and for establishing the rooted plants after potting (8, 22, 23).

The use of water mist for maintaining a high humidity had been practiced for a number of years in other areas on a limited scale. The improvement of the system when time clocks came into use to control intermittent misting periods made this an integral part of most nursery operations. This controlled high humidity environment provided a method for rooting many plant species which previously had been considered too difficult to propagate economically by cuttage. Leaves are maintained on the cuttings during rooting and their function accounts for more successful rooting.

Recently, there has been a notable increase in the commercial demand for several of the tropical fruit crops which were only planted on a limited scale, usually as yard trees. The large number of Latin people, mostly Cuban, now living in the United States, no doubt, have created this demand. They know tropical fruit and relish the highly nutritious products, fresh or processed. Tropical vegetables are in great demand. Even bananas are being grown commercially on a limited scale by Mr. W. H. (Bill) Krome.

During the spring and summer of this year, 1969, the nurseries have been unable to supply the demand for avocados and mangos, and even limes were in short supply for a while. Grafted sapodillas and carambolas have been unavailable except when grown by contract for an individual.

Perhaps the largest grove of grafted varieties of sapodillas ever attempted in Florida was planted this year by Mr. Vernon Turner of Homestead. This planting consists of 10 acres. Windbreaks of grafted sapodillas have been planted around several new lime plantings and in my opinion are an improvement over the troublesome and unproductive casuarinas.

During a recent visit to the nursery of Mr. Herbert Landrum in south Dade County, I was pleased to see the fine specimens of many tropical fruit trees which he is propagating by bud-
ding and grafting. Currently, his nursery is the main commercial supplier of grafted sapodillas and carambolas. These are grafted by the side veneer method. He is also propagating lychee and longan by graftage. The standard varieties of avocados, mangos and citrus are propagated on a rather large scale by variations of grafting and budding methods, with possible more emphasis on budding for mangos and citrus. Avocados are grafted while the seedling rootstocks are very young and the stems are herbaceous at this period of growth. The mango seedlings are also budded or side grafted while the tissues of the seedling are immature. This family operation is a credit to the nursery business and all the plant propagation is done by teams made up of members of the family.

There are a number of other excellent nurseries which have specialized in grafted tropical plants, both fruit and ornamentals. Newcomb Nursery, Homestead, operated by Mr. Robert Newcomb has successfully grafted most of the tropical plant species, both of the usual species and the unusual, which includes macadamia, sapodilla, carambola and ornamentals such as jacaranda.

In Palm Beach County, Mr. L. H. Zill produced large quantities of mangos by the shield bud method in the early 1940's. Mr. James Miner, another skilled propagator from this area, used budding methods for mangos during this same period.

One of nursery show places of south Florida is the tropical fruit nursery operated by Mr. Marc Ancet. He produces specimen trees of grafted mango and avocado. The side veneer graft using terminal scions are used almost exclusively, except for the citrus which are budded by the chip bud method. He has successfully propagated Mamey sapote (Calocarpum sapota) by the side veneer graft on a limited scale. This is one of the more difficult tropical fruit to graft and research on improved methods is in progress at the Subtropical Experiment Station, Homestead.

Although, all the fine nurseries cannot be discussed in this paper, I would be remiss if I did not mention the nursery operation of one of the leading ornamental nurseries in Florida, Vosters Nurseries and Greenhouses, Inc., of Cutler, Florida. The energetic owner and plant explorer is James Vosters, who involves himself in the operation from propagation to marketing. In addition to growing foliage, miniature pineapples, and flowering bromeliads, thousands of miniature citrus trees are produced from cuttings for sale to the snow-bound people to the north. Leafy stem cuttings are used and are rooted in an environment of intermittent water mist with bottom heat in the rooting media. Calamondin, a citrus relative, is one of the main items grown as a miniature tropical fruit, but limes and lemons are also produced on a lesser scale. This nursery is a scientifically operated plant factory. New plant introductions are under constant experimentation for determining the nutrition requirements and propagation methods best suited to the species of plant under observation.

The production of tropical plants by vegetative methods can be accomplished successfully by the methods now in use. There is a serious lack of information on rootstocks but suited to the varieties of tropical fruit now being grown. This is true for avocados and mangos as well as lychee, sapodillas and carambolas.

This information is needed wherever tropical fruit are being cultivated and should have further research consideration.

LITERATURE CITED

Initiation of entomological and nematological work in Florida many years ago and its continued support helped place the State in responsible leadership of the profession. Seeking solutions for insect problems affecting horticultural crops has continued for over 50 years by men who were able, dedicated, and proud to serve science and to meet the needs of the people. Many rich heritages were left by early workers that are challenges to present day workers, even with the many sophisticated devices and methods of research available. What manner of choices, however, should present-day and future entomologists make in order to keep faith with our entomological pioneers? Are not many people looking to and depending on Florida for the solution of many entomological and nematological problems affecting horticultural crops?

Several organizations in Florida, some closely others remotely related, are concerned with entomology in its various branches. These include the Division of Plant Industry, Florida State Department of Agriculture; Institute of Food and Agricultural Sciences, University of Florida; Bureau of Entomology, Florida State Board of Health; Entomology Research Division and Plant Pest Control of the U. S. Department of Agriculture; and various members of industry. Many hobbyists, amateur and highly skilled insect collectors live and work in Florida. The Florida Entomological Society with its annual meeting tends to hold all in a professional organization.

Florida's Institute of Food and Agricultural Sciences, as part of the University of Florida, has 22 research units placed in various, strategic locations in the State. A budget of over $12,000,000 supports more than 400 projects on current research problems affecting the immediate and future benefit to Florida and to the world. Teachers at the University teach all phases of agriculture and offer graduate students unexcelled opportunities for research in tropical horticultural disciplines.


Cooperative work in which, for example, a large number of Florida scientists have worked in Costa Rica on the Mediterranean fruit fly, Ceratitis capitata (Wiedmann), demonstrates how broad areas of work may be shared internationally. Although such efforts help foreign scientists, they help Florida men become experienced with foreign pests who are thus better able to combat these pests if they invade Florida.

Some Characteristics of Insect and Nematode Infestations in Florida.—Insects and nematodes affect horticultural crops in tropical as well as in other regions of the world. To state that insects and nematodes are “worse”, meaning more numerous, in the tropics than elsewhere is not quite a true statement. It is true that insects have suitable flight and nematodes free moving conditions in tropical areas and are in evidence at all seasons; this may be suggestive of ever present attacks. Certain species, however, may be observed at certain seasonal periods, other species at other periods. Not all species...