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End of Project Report

New Techniques for Enhanced Citrus Production in Barbados
and
the Eastern Caribbean

USAID Program in Science and Technology
Project Number 936-5542
Prepared by Stan Michelini
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(Author's note: We will be forwarding a finished copy of all manuscripts generated by this research as they are accepted by the journals.)

Container Experiment

The continuation of the container experiment was executed as planned. The 380 grafted trees were removed from their containers with root samples and stem caliper measurements obtained. Each tree was labeled as being from one of 16 treatments, one of 4 replicates, and being one of 5 trees within the replicate. Root samples from the middle three trees of each replicate were pooled and assayed for presence of hyphae or vesicles, with percent of root infection recorded. One month after planting, a visual rating was obtained. Two more are planned at three and one half months and seven months after planting. Stem caliper measurements will also be taken at those times. In May, coinciding with Dr. Nemeč's final visit, the transplant part of the experiment will be terminated.

The orchard is being hand weeded, to avoid possible herbicide/VAM interaction, and is drip irrigated with a pressure compensating drip system, through which we apply fertilizer minus P.

Forty-nine grafted trees, on both sour orange and citrus macrophylla, were taken without regard to specific treatments. Root samples were obtained and assayed with infection data recorded. Stem caliper measurements and extension growth (the combined length of all growth above the graft union) were measurements taken at the beginning of the experiment.

trees were divided into 7 replicates of 7 trees each treated with varying concentrations of paclobutrazol and in one instance, XE 1019. The concentrations ranged from .001 grams AI per tree to .5 grams AI per tree. Paclobutrazol and XE 1019 are both gibberilic acid synthesis inhibitors, presently gaining acceptance on a wide range of ornamental and food crops. They are both reputed to possess fungicidal activity, but the effects on VA mycorrhizae are presently unreported. The trees are presently under drip irrigation and receive nutrients regularly; 1/2 oz. 20-0-18 per tree every three weeks. Caliper and growth measurements are to be taken at 8 and 12 weeks after treatment.

Workshop

The June workshop was attended by the same representatives of the respective Ministries of Agriculture from Barbados, St. Lucia, and Grenada. The technician from Dominica was unable to obtain study leave to attend. Dr. Nemeč arrived and was briefed on the progress to date. The technicians arrived with wet sieved soil for us to attempt spore species identification. The St. Lucia samples contained live mature spores, but in insufficient numbers for species identification. The Grenada samples were immature and contained few spores. We decided to collect more from the St. Lucia trap crops and wait for better development from the Grenana trap crops.

The workshop participants were provided with spores from the local trap crops. Dr. Nemeč, Dr. Chinnery, and John Phillips worked together to positively identify Gigaspora marguerita.

Otherwise, spores belonging to Glomus and Sclerocystis were found. Species identification was not possible due to lack of sufficient spore numbers. The trap crops should have produced more spores, but we are finding that under our conditions, spore production is either limited or sequential, not regularly resulting in large spore populations. This further points to the importance of maintaining root inoculum in new plantings or in providing procedures for modifications on the existing methods to insure spore production on a time schedule.

A trip to St. Lucia was made by Dr. Chinnery to obtain more spores from their trap crops. With the larger number of spores, it is expected that positive species identification will be made. At the workshop, the 8 participants were all technicians receiving specialized instruction in mycorrhizae lab work. The attendees left with our expectation that they are fully competent in carrying out the basic procedures in collecting root pieces and spores, and processing them for assay of infection or categorizing the genus of spores.

Species identification is continuing, with samples from St. Lucia recently having been obtained, and with the addition of Mr. John Phillips to the team to assist with the identification of local species. Dominica and Grenada will soon be sending spores for us to look at and determine the infecting species. The slow trap crop development is responsible for the delay in species identification.

Presentation

Investigator Michelini traveled to Davis, California to attend the International Horticultural Congress. He gave an oral presentation of the paper entitled "A Survey of VA Mycorrhizal Infection in Four Southeast Caribbean Islands." The presentation was well received with discussions centered upon the practical aspects of the findings; where citrus could best be grown. It was Mr. Michelini's opinion that, based upon visual and mycorrhizal observations, Dominica's highlands were most amenable to citrus culture. Contrarily, the drier coral island of Barbados had the most difficult environmental constraints. Soil structure presented difficulties in Grenada and St. Lucia. While at the Congress, conversations with the USDA's Dr. Eric Curry resulted in the design of an extension of the project to include the effect of growth regulators on VAM fungi.

Training

In addition to the first two workshops which attracted approximately 30 participants, others have been involved with the project. Six University of the West Indies technicians have received instruction and experience working with the soil and root samples. Dr. Chinnery has lectured on the subject with increased frequency, and has involved students with investigations. Over 100 students have participated in lectures, labs, or both.

Findings

The seedbed experiment manuscript is being submitted to Tropical Agriculture for publication. The survey manuscript

is presently being prepared with the first draft of the manuscript being circulated among the authors. The results of the container experiment, after augmentation with orchard transplant data, may be sufficient to publish. The growth regulator experiment may be a part of the overall container experiment.

The principal finding of the seedbed experiment is that when fumigating, reinoculation should be practiced and will result in increased growth over non-inoculated sections. If there are not suspected high concentrations of pathogens in the soil, fumigation is probably unnecessary.

The survey showed large differences in performance and in VAM infection between the volcanic islands and the coral island. Within the volcanic island group, smaller but still significant differences in infection levels were found. The best island for citrus and VAM fungal growth was Dominica, with Barbados having the worst, considering both aspects. There were positive correlations with regard to elevation and rainfall, and negative correlations with increases in soil nutrient levels. Multiple regression analysis showed that VAM fungi are sensitive and responsive to environmental factors encountered in the West Indies, and VAM effect can be predicted.

Regional Impact

The respective Ministries of Agriculture in Barbados, St. Lucia, Dominica and Grenada have been cooperating with this project. They have provided technicians, assistance to the principal investigators while on the islands, and access to personnel

in planning the areas of sampling. Significant inroads have been made in altering the CAO's to the soil rhizosphere implications of unrestricted pesticide use and the importance of VAM fungi in fumigated soils or nursery situations. The Chief Agricultural Officers have additional information as inputs for nursery production.

Following the presentation of results at the 1985 Trinidad meeting of the American Society for Horticulture Science, Tropical Region, Trinidad requested and received a VAM fungal researcher from the Fulbright Foundation. The Barbados government has assigned one of the project researchers, John Phillips, to work on the possible mycorrhizal interactions with onion blast, a substantial problem in Barbados. Mr. Noel of Grenada has questioned the soil P levels found during our survey, an investigation into the P levels islandwide. While he expected some soils to be deficient, the deficiency was considered widespread. Dominica's Colin Bully asked me to investigate the possibilities of finding a market for the Dominican mycorrhizae, which we found to be highly active and heavy spore producers, in contrast to the other islands. He is interested in commercial possibilities both regionally and extra-regionally. St. Lucia's Dave Demarque strongly supported his technicians' continuing involvement with the research. Mycorrhizal topics have been increased at the University of the West Indies, with many students now familiar with concepts of mycorrhizal infection and the basics of laboratory work. There remains on lands at FRESCA in Barbados, a planting of citrus with substantial data recorded. Additional

work with the planting is proposed to continue with notes on the performance of VAM inoculated plants over the long term, especially considering the large number of plants inoculated with imported VAM species. When the articles resulting from this work are published, they will be the first on mycorrhizae from this region since Johnston's work in the 1940s.