reduce sulfates can, under suitable conditions, rapidly kill citrus feeder roots. Many of the raw materials for the reaction are supplied in the nutritional program and citrus feeder roots could furnish the energy sources necessary for their own destruction. Root damage by sulfides is more rapid at low soil pH and in the leached horizon of the subsoil.

in the leached zone of certain acid soils of the flatwoods. In columns of Leon fine sands in the greenhouse, poor root growth was not entirely corrected by applications of adequate water and nutrients.

Certain popular citrus rootstocks were grown in 3-foot fiber cylinders containing reconstructed Leon fine sand profiles at two pH levels. The

3. *Block 3, Bed 4, Minute Maid H. R. Cloud Grove*—This experiment was designed to check the value of several treatments, mostly at high concentration, for both prevention and cure of foot rot. All trees were Valencias on Rough lemon rootstock which were propagated at the Wauchula nursery of Minute Maid Groves Corporation and planted in 1961. About 7 percent of the trees on this bed showed active lesions at the time the experimental treatments were applied. Eight treatments were chosen. Randomized and replicated plots aggregating 80 trees each were arbitrarily laid out for each treatment. The number of trees with active foot rot at the outset ranged from 3 to 10 within the various treatments.

4. *Block 12 of the Minute Maid H. R. Cloud Grove*—Block 12 consists of 320 acres of Valencia trees on Rough lemon rootstock planted in December 1960. All trees with active foot rot were selected for treatment. Trees on every fourth bed were designated as checks and trees on the remaining beds were treated surgically to remove the infected bark and wood. Surgical treatment was followed by painting the exposed wood with Avenarius carbolineum on trees in half the grove area and with a mixture of Captan 50 WP and water in the other half. Both the surgery and painting operations were performed by the regular grove crew after instruction. Results in this trial were recorded from approximately 1400 trees for each of the 3 treatments. All trees were from the Wauchula nursery of Minute Maid Groves Corporation.

B. Effect of Early Foot Rot Infection on Subsequent Yield in a Tahiti Lime Grove

More than half the trees in a planting of Tahiti limes at the Sub-Tropical Experiment Station at Homestead, Florida, developed severe foot rot lesions in 1957 within one year after planting. Although about 5 percent of the trees died, the lesions healed on almost all remaining trees the following year. Yield records have been kept for individual trees. All trees are Tahiti limes of the same clone on Rough lemon rootstock.

Results

In the Sposato grove experiment after 13 months, active foot rot had almost disappeared regardless of treatment (Table 1). Percentages mentioned in Table 1 and in other tables in this paper refer to the percentage by weight of the dry whole material in the water mixture except that Plyac, a liquid material, was used in the amount of 10 percent by volume.

In December 1962 of the 590 Pineapple orange trees in the entire block 36 percent had active foot rot and 19 percent additional had inactive foot rot lesions; by January 1964 less than 7 percent of the total had died and lesions were healing on all except 1 percent of the remaining trees in the block.

Ninety-six percent of the trees in the Crooks

TABLE 1

SPOSATO GROVE
NUMBER OF TREES WITH ACTIVE FOOT ROT
(treatments applied December 1962)

Date	30% Tri-basic Copper Sulfate	Surgery + 30% Tri-basic Copper Sulfate	Surgery + 30% Tri-basic Copper Sulfate + 10% Plyac
December 1962	59	59	58
April 1963	5	0	1
January 1964	1	2	0

TABLE 5

EFFECT OF SURGICAL TREATMENT ON FOOT ROT IN 3-YEAR-OLD VALENCIA TREES ON ROUGH LEMON ROOTSTOCK. BLOCK 12 OF THE MINUTE MAID H. R. CLOUD GROVE AT FORT PIERCE

Treatment	December 1963 Total No. of Trees with Active Foot Rot	August 1964 No. of Trees Recovered	August 1964 % Trees Recovered
Surgery plus Captan paint	236	197	83.5
Non-treated Checks	293	165	56.5
Surgery plus Carbolineum paint	194	167	86.0

Cloud grove the untreated checks showed as little foot rot as any of the treatments. In the cases mentioned no treatment or limited treatment was about as helpful as extensive treatment but they do not, and cannot, prove that such treatments are never effective in young trees.

The observations on Tahiti lime trees show that the size of bark lesions of foot rot on young trees in this planting did not affect later fruit yield. Caution must be observed here also not to make too broad a generalization from this experience. Foot rot in other situations may have a different effect on yield.

Experiences reported here and observations made by the authors do point to a possible explanation for the failure of control and prevention measures in these cases. It appears likely that infection of the young trees occurred in the nursery rather than in the grove in many cases and that fungus mycelium or spores were in trees in a resting or arrested condition when the trees arrived at the grove. Evidence for the association of the nursery with foot rot in the grove is found in observations in the H. R. Cloud grove which received trees from a number of nursery sources to be planted in scattered portions of a relatively uniform terrain. A high incidence of foot rot was associated with trees which had been propagated in one nursery at Wauchula (1). It had been recognized that a number of trees in the Wauchula nursery were infected with foot rot but only healthy trees from this nursery were used in the Cloud grove plantings. Similar observations have been made in other groves where plantings of trees from different nurseries have been compared.

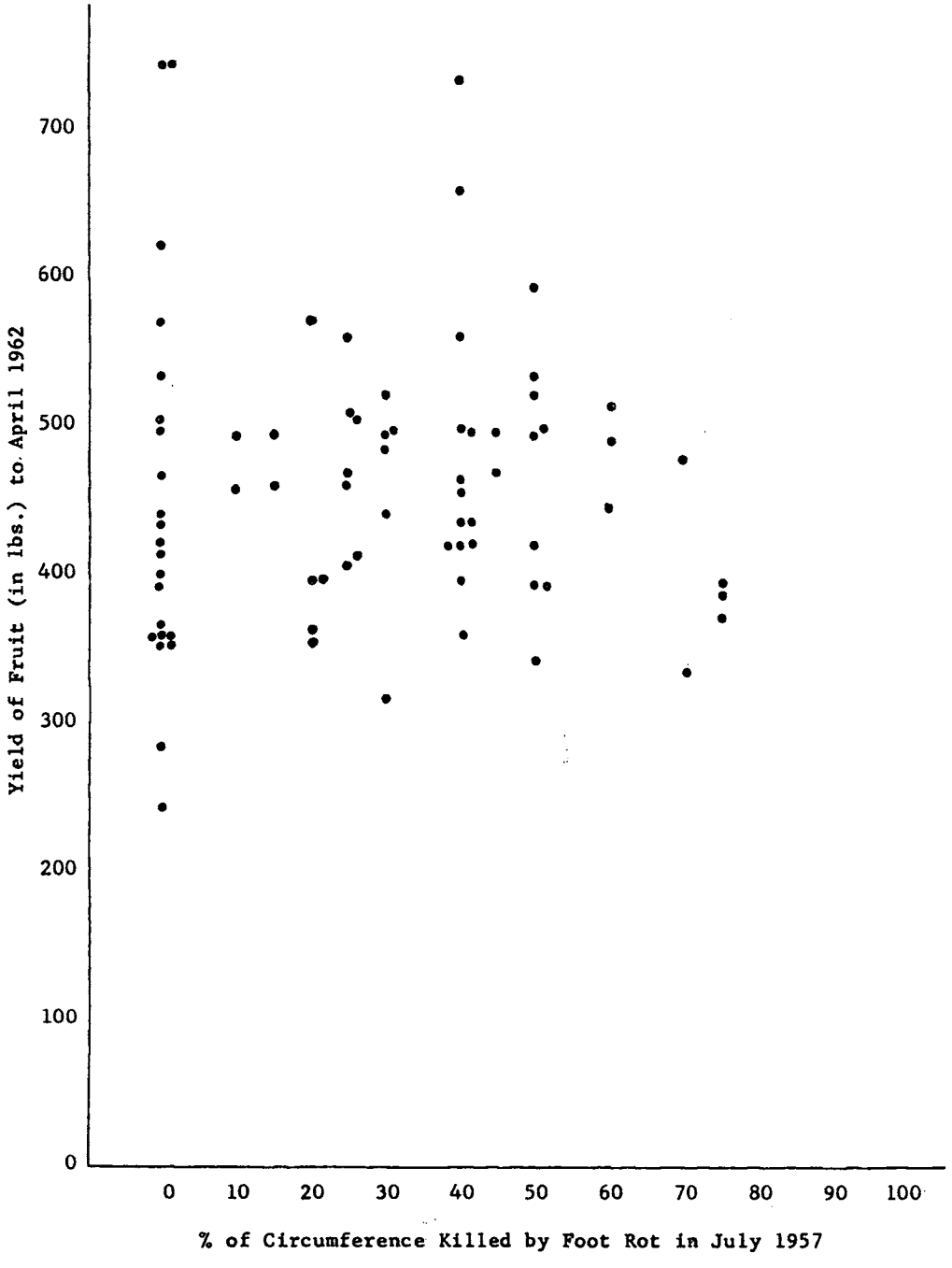
It is quite possible to mistake an infected tree for a clean tree since it has been a common experience in greenhouse and laboratory experiments to be able to recover the foot rot fungus from apparently healthy bark. Bark that had been inoculated with *P. parasitica* and incubated for 2, 3 and 4 months and never revealed the slightest symptoms of foot rot has yielded the fungus when surface sterilized and cultured in the laboratory. (Unpublished data, G. R. Grimm).

It is suggested that one course for future research should be to try to determine how to prevent nursery infections and, where such infections are not prevented, how to treat trees to kill any infestations which they may be carrying. In this connection it might be useful to investigate the possibility of using a hot water treatment such as that described by Klotz (4) as effective against *P. citrophthora* in California, despite the fact that Klotz himself felt that it would not be useful against the thick-walled oospores of *P. parasitica*.

It must be noted, however, that nursery infection is probably not the cause of foot rot in old trees which succumb to foot rot after many healthy years in the grove.

FIGURE 1

EFFECT OF FOOT ROT IN YEAR-OLD TREES ON THEIR EVENTUAL FRUIT YIELD. TAHITI LIME TREES IN BLOCK 12W AT THE SUB-TROPICAL EXPERIMENT STATION



SUMMARY

Comparative tests were made of some of the measures most often recommended for the prevention and treatment of foot rot using young trees in groves in the Fort Pierce area. Methods tested included surgical removal of affected bark, application of various protective paints to the lower trunk, and exposure of crown roots. Where observations were made over a period of a year or more, no method of treatment substantially reduced the incidence of foot rot below that observed in untreated checks. In one case in which trees were observed 8 months after being treated surgically by 2 methods, however, untreated checks showed 56.5 percent recovery as compared with 83.5 and 86 percent recovery for the 2 surgical methods.

A block of Tahiti lime trees on Rough lemon rootstock in the Homestead area was studied. Many trees had been affected by foot rot soon after planting. About 5 percent died, but foot rot lesions on most trees had healed over by the time trees were 2 years old. Cumulative yield figures for all trees in this block for the first 5 years did not show a reduction in yield for trees which has been affected by early foot rot.

It appears likely that foot rot in young groves often follows infection of the trees in the nursery.

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BARRIERS FOR SPREADING DECLINE CONTROL

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One phase of the program used by the Division of Plant Industry, Florida State Department of Agriculture, for the control of spreading decline of citrus trees caused by *Radopholus similis* (Cobb) Thorne is the use of buffer zones to prevent the migration of the nematode from one area to another. The use of barriers, or buffer zones, for preventing the spread of this nematode was first proposed in 1957 by Suit and Brooks (2). Since that time, additional evidence has been obtained from tests in commercial groves and from experimental barriers. This is a progress report of the status of the barrier studies in progress to inform the grove owner as to what to expect from a buffer zone or barrier.

PROCEDURE

Commercial Grove Test Barriers.—A barrier is here considered as a root-free zone of soil of a given width and depth extending between diseased and healthy trees. The strip of soil is treated to eliminate plant and tree roots in the zone and then retreated every six months to maintain the zone root free. The placement of the barrier is governed by the distribution of the diseased trees. In our work, all barriers in commercial groves were placed at least four trees in advance of the trees that were infected with *R. similis*, with the exception of Barrier 1.

Twenty test barriers were established in five commercial groves from 1955 to 1957. The width of the barriers varied from 8 to 40 feet. The soil in the barrier was treated with DD (1,3-dichloropropene, 1,2-dichloropropane) at the rate of 100 gallons per acre every six months with a tractor-drawn soil treater that injected the nematocide into the soil at a depth of 12 inches. A drag and a packer were used to firm the soil after treatment. In some cases, weed control was obtained by disking the barriers lengthwise every month. The trees adjacent to the barrier on the healthy side were sampled every six months before treatment of the barrier with the nematocide to determine if *R. similis* was present.

Experimental Test Barriers.—Experimental test barriers were established in 1958 in a 15-year-old grove with spreading decline. Barriers 30, 65, or 90 feet wide were made by removing rows of trees and leaving at least two rows of diseased trees beside each barrier as a source

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