Proc. Fla. State Hort. Soc. 94:21-25. 1981.

CITRUS BLIGHT: ATTEMPTS TO GET REMISSION OF SYMPTOMS BY CHEMOTHERAPY[1]

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Abstract. **Citrus trees showing early symptoms of blight were high-pressure injected with bactericides: oxytetracycline (OTC), 0.5 to 100 g/tree; Penicillin G (Pen G), 15.0 to 37.5 g/tree; gentamycin, 3.75 g/tree; TC-2216, 6.0 to 133 ml/tree; and KT-19827, 133 to 216 ml/tree; fungicides: benomyl, 1.2 to 3.5 g/tree; Ciba Geigy 48988, 30 mg/tree; sodium omadine (NaOM), 0.5 to 14.0 g/tree; and 2-(4 thiazolyl) benzimidazole (TBZ), 11.9 to 15.0 g/tree; viricide: 8 aza 2,6 diaminopurine 0.25 to 0.3 g/tree; growth regulators: 6 benzyladenine (BA), 7.5 to 10.0 mg/tree; gibberellic acid (GA) 7.5 to 10.0 mg/tree; and other compounds: (ethylene-dinitrilo)-tetraacetic acid disodium salt (EDTA), 3.7 to 4.6 g/tree; and sodium erythorbate, 3.0 to 4.5 g/tree. Pen G, KT-19827, and NaOm were phytotoxic at the higher rates. Bioassays indicated that OTC was well distributed and persisted in the tree canopy. None of the compounds injected caused remission of disease symptoms with the possible exception of an experimental bactericide TC-2216. At one location where blight was spreading rapidly, prophylactic injection of OTC into healthy trees did not reduce blight incidence.**

Citrus blight is one of the most serious diseases of Florida citrus (20). Although blight has been recognized for over 100 years, the cause is still unknown (6).

Attempts at chemotherapy, using materials with specific biologically activity to induce remission of disease symptoms, can be a useful technique for indicating the type of pathogen that may be inciting a disease of unknown etiology. For example, treatment with oxytetracycline (OTC) results in symptom remission in several diseases incited by bacteria and mycoplasmas such as citrus greening and likubin disease (14, 21), pear decline (16), aster yellows, mulberry dwarf, rice yellow dwarf, and potato witches broom (13). With Pierce's disease, the observed remission of symptoms in grapevines treated with OTC was instrumental in determining that a rickettsialike bacterium was the causal agent of the disease (8). Systemic fungicidal treatments are used to control Dutch elm disease (15), Verticillium wilt of maple (19), and live oak decline (12).

Previous attempts to cause remission of citrus blight by chemotherapy have consisted of applying materials by soil drench or foliar sprays, or by injecting dilute solutions using gravity flow (2, 10, 11, 24, 26). Symptom remission in 3 of 5 blight trees treated with soil drenches of OTC has been reported (24), but these results have not been repeated (1). Citrus blight trees have extensive xylem blockage which restricts uptake of compounds applied by gravity flow or low-pressure injection (4, 27, 28, 29). The purpose of this study was to inject high rates of compounds with specific activity into blight trees by high-pressure trunk injection to try and obtain symptom remission and thus gain an insight into the possible nature of any blight-inducing organism.

Materials and Methods

Selection of blighted trees. Two groves of 'Hamlin' orange [*Citrus sinensis* (L.) Osb.], one in the Southeast Flatwoods and the other on the Central Ridge, and three groves of 'Valencia' orange on the Central Ridge area were selected for this study. All trees were on rough lemon [*C. limon* (L.) Burm. f.] rootstock and were located in areas where blight was prevalent and spreading. Some 'Marsh' grapefruit (*C. paradisi* Macf.) were also injected in preliminary work. Trees were rated visually on a scale of 0 = healthy; 1 = mild (leaves small with zinc deficiency symptoms, internodes short, slight wilt but little or no thinning of foliage); 2 = moderate (leaves small, often flaccid, with zinc deficiency symptoms, canopy sparse with some twig dieback); 3 = severe (canopy thin, twig dieback substantial, trunk sprouts common). Fifteen to 25 trees with mild to moderate symptoms were selected in each grove. Xylem samples for zinc analysis (27) were taken from 3-4 of the selected trees and water infusion measurements (2) were performed on the same trees. Trees used for zinc analysis and water infusion measurements were not used for injection in order to avoid excessive trunk damage.

Tree injection. Trees were trunk injected below the bud union at high pressure (1300-1700 kPa) using nitrogen gas as a propellent. The injector consisted of a stainless steel injector tank (7 x 38 cm) with a capacity of about 1.5 liters. It was fitted with a sight gauge made of 6 mm diameter teflon tubing, and with outlets at the top and bottom to facilitate filling and cleaning. The pressure was maintained by a regulator on the nitrogen tank. The manifold leading from the injector tank to the taps was made of high pressure rubber tubing, and had quick couplers for easy attachment to the injector tank and taps and to avoid air bubbles in the manifold (Fig. 1).

The taps were modified from the design of Reil and Beutel (18) to facilitate injection of the solutions into the functional xylem in the outer 0.5 cm next to the cambial area (4, 28, 29). The taps consisted of a 1 cm diameter lag screw which had a 3.2 cm diameter washer and male quick coupler welded onto it. A 0.5 cm diameter hole was drilled from the coupler end of the tap to 1 cm beyond the washer, the hole at this point was intersected by a 2 mm diameter

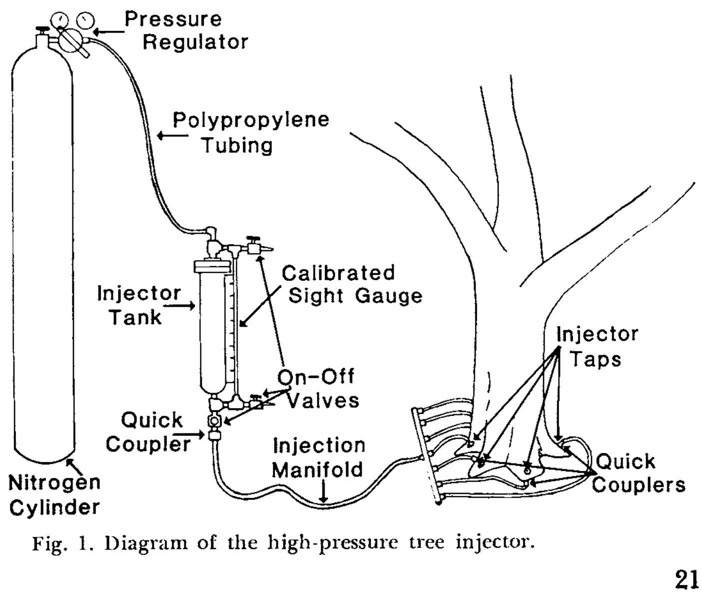

Fig. 1. Diagram of the high-pressure tree injector.

[1]Florida Agricultural Experiment Stations Journal Series No. 3429.

hole which led to 2 mm deep, V-shape grooves down either side of the threads (Fig. 2). The taps were screwed into a 1 cm diameter hole drilled 5 cm deep in the tree. Seven taps were evenly spaced on each tree.

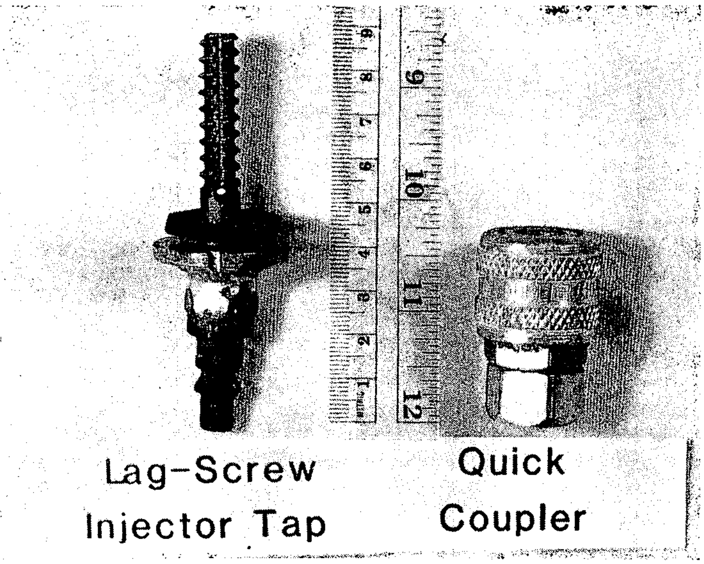

Fig. 2. Lag screw injector tap and quick coupler used in this study.

Compounds injected. The following compounds were diluted in water to the concentrations indicated and injected into blighted trees: *Bactericides*: oxytetracycline (OTC) (Agricultural Terramycin®, 20% active, Pfizer Inc., New York, NY 10017), 50 a.i./liter; Penicillin G (Pen G) (1585 units/mg, Pfizer Inc., New York, NY 10017) 50 g a.i./liter; gentamycin (47.1% active, Schering Corp., Bloomfield, NJ 07003) 3.75 g a.i./liter; TC-2216 (Dr. M. J. Thirumalacher, Jeesnnidhi-Anderson Inst., Walnut Creek, CA 94596) usually 333 ml/liter; KT-19827 (Dr. M. J. Thirumalacher, Jeesnnidhi-Anderson Inst., Walnut Creek, CA 94596) usually 333 ml/liter. *Dual action bactericide and fungicide*: sodium omadine (NaOm) (40% active, Olin Corp., Little Rock, AR 72203) usually 2.5 g a.i./liter. *Fungicides*: benomyl (Lignasan®, 0.7% active, DuPont de Nemours and Co., Inc., Wilmington, DE 19898) 7 g a.i./liter; 2-(4 thiazolyl) benzimidazole hypophosphite (TBZ) (Arbotect 20-S®, 26.6% active, Merck and Co., Inc., Rahway, NJ 07065) 50 g a.i./liter; CGA-48988 (Ridomil®, 24% active, Ciba-Geigy Corp., Greensboro, NC 27409) 100 mg a.i./liter. *Viricide*: 8 aza 2,6 diaminopurine (Sigma, St. Louis, MO 63178) 1 g/liter. *Growth regulators*: 6-benzyladenine (BA) (ABG-3034®, 2.0% active, Abbott Laboratories, North Chicago, IL 60064) 25 mg a.i./liter; gibberellic acid (GA) (Pro-Gibb®, 3.91% active, Abbott Laboratories, North Chicago, IL 60064) 25 mg a.i./liter. *Additional materials*: (ethylenedinitrilo)-tetraacetic acid disodium salt (EDTA) (Mallinckrodt, Inc., Paris, KY 40361) 18.56 g/liter; sodium erythorbate (sodium isoascorbate, Mycoshield®, Pfizer, Inc., New York, NY 10017) 15 g/liter.

Prophylactic treatment of healthy trees with OTC. This test was made on the Central Ridge in a grove of 'Pineapple' orange on rough lemon rootstock where many new cases of blight had been recently observed. Four blocks of 16 apparently healthy trees were selected. Two of these blocks were divided into half, half of each block was injected with OTC, the other half with KT-19827. The remaining two blocks of 16 trees each were injected once with water and served as controls. The plots receiving OTC were injected with an average of 1.3 g a.i. in February 1979; 13.9 g a.i. in July 1979; 28.7 g a.i. in June 1980; and 8.9 g a.i. in December 1980. The plots receiving KT-19827 were injected with an average of 31.6 ml in February 1979 and 122.5 ml in July 1979. Bioassays were performed to determine distribution and persistence of OTC and KT-19827 in the trees. In May 1981, trees were rated visually for blight on a 0-3 scale, and xylem samples taken for zinc determination (27).

Tree measurements. At the Flatwoods location, one of the trees injected with TC-2216 and two of those injected with OTC, all of which had responded initially with a new flush, and one of the control trees injected with water, originally injected in April 1979, were reinjected in May 1980. At the same time, the trunks and seven major branches were painted with reference lines, and circumferences were measured. The trees were measured and rated again in April 1981.

Bioassays. Twigs (3-5 mm diameter), roots (2-6 mm diameter), old mature leaves, and young leaf samples were collected from injected trees 3-4 weeks after treatment. Tissue samples were bioassayed by placing tissue samples on agar plates seeded with a susceptible bacterium or fungus, and measuring the radius of the inhibition zone around the samples (23). *Bacillus cereus* var. mycoides (Flugge) Smith was used to detect OTC, gentamycin, TC-2216, and KT-19827; *Corynebacterium michiganense* (E. F. Sm.) Jensen to detect Pen G; *Fusarium oxysporum* emend. Snyd. et Hans. f. sp. *citri* to detect NaOm; and *Penicillium expansum* Link to detect benomyl and TBZ. *Phytophthora parasitica* Dast. zoospores were utilized to detect CGA-48988 using the bioassay procedure described by Timmer (22).

Results

Compounds injected into blight trees and tree response. Blighted citrus trees have extensive vascular plugging (4, 27, 28, 29) and are difficult to inject even at high pressure. OTC, TC-2216, KT-19827, BA, and GA were difficult to inject and usually 12-24 hr were required to inject 200-300 ml into the tree. Most of the other compounds were somewhat easier to inject, but even then 4-8 hr were required to inject 200-300 ml into the tree.

A total of 119 blighted citrus trees were injected with 13 different compounds at four different locations. The range of dosages and the average amount injected per tree is summarized in Table 1. Twenty-two trees at the four locations were injected with water only and served as controls. The average blight rating for trees when they were injected was about 1.0. When evaluated 2 to 3 months post-injection, the average rating ranged from 1.0 to 1.75, and when evaluated 2 years post-injection, the average ratings ranged from 0.38 to 3.00. All of the average ratings taken 2 years post-injection were worse than the ratings 2-3 months post-injection, except for trees treated with EDTA. Some trees initially may have been disdiagnosed and had problems other than blight. In cases where there were few replicates, e.g. four in EDTA, inclusion of one or two misdiagnosed trees in the treatment gives the impression the trees recovered, whereas they probably had not.

Two OTC trees at the Flatwoods location responded with a fairly vigorous flush 2 months post-injection, but then declined further, even after receiving a second injection of OTC. However, the twenty other trees injected with OTC did not respond in a similar manner but instead continued to decline. Trees treated with TC-2216 also tended to respond with more vigorous flushes than control trees and trees injected with other compounds. At the flatwoods location where the OTC injected trees and one TC-2216 injected tree initially gave a response and were given a second injection, the OTC and water-injected control tree continued to decline while the TC-2216 injected tree de-

Table 1. Compounds injected into blight-affected citrus trees their effects on blight development.

Compound	Total number of trees	Amount a.i. injected/tree: Avg.	Amount a.i. injected/tree: Range	Tree rating: Injection	Tree rating: 2-3 mo post-injection	Tree rating: 2 yr post-injection
Water	22 (4)[z]	—	—	1.06[y]	1.66[y]	1.95[y]
OTC	22 (4)	16.3 g	4-32.5 g	1.02	1.41	1.86
TC-2216	9 (3)	97.2 ml	6-133 ml	1.15	1.10	1.28
Pen G	11 (3)	18.1 g	11.3-37.5 g	1.27	1.50	1.77
Gentamycin	4 (1)	3.8 g	3.8 g	1.00	1.50	1.75
KT-19827	4 (1)	162.0 ml	133-216 ml	1.50	1.75	2.63
NaOm	8 (2)	5.3 g	0.5-14 g	1.00	1.56	2.31
Benomyl	8 (2)	3.5 g	3.5 g	1.13	1.00	1.50
TBZ	4 (1)	15.0 g	15 g	1.00	1.63	2.13
Benomyl + TBZ	4 (1)	1.2 g benomyl 11.9 g TBZ	1.0-1.3 g 10-13 g	1.00	1.13	1.50
CGA-48988	4 (1)	30.0 mg	30 mg	1.00	1.13	1.63
BA + GA	7 (2)	10.0 mg ea.	10 mg ea.	1.00	1.07	1.36
8 aza 2,6 diamino purine	4 (1)	0.3 g	0.2-0.3 g	1.00	1.25	2.00
EDTA	4 (1)	4.0 g	3.7-4.6 g	1.00	1.00	0.38
Sodium erythorbate	4 (1)	4.1 g	3.0-4.5 g	1.25	1.75	3.00

[z]Number in parentheses is number of groves in which the compound was used.
[y]The average rating of all trees injected with that compound, based on a scale where 0 = healthy and 3 = severe blight.

clined only slightly. The trunk circumference increased 7.1% for the TC-2216 injected tree compared to 2.0 and 3.7% increases in trunk circumference for OTC and control trees, respectively. Total branch circumference increase was 6.6% for the TC-2216 injected tree compared to 1.2 and 2.2% increases for OTC and control injected trees, respectively.

Bioassays. Trees injected with bactericides and fungicides were bioassayed to determine the distribution in the tree. OTC activity was well distributed in twigs, old leaves, and young leaves 3 to 4 weeks post-injection, but activity was not found in roots (23). Data on distribution and persistence of OTC in injected blight trees have been previously reported (23). Gentamycin, TC-2216, and KT-19827 activity was detected in old leaves only. Pen G activity was detected in twigs and old leaves. Fungicidal activity was detected on old leaves of trees injected with CGA-48988, trace amounts of benomyl and TBZ were detected in old leaves only. Activity was not detected in the roots of any of the trees injected.

The experimental bactericides TC-2216 and KT-19827 varied from lot to lot. *B. cereus* was used as a bioassay organism, but was not very sensitive to the compounds. The following bacteria were screened for use as possible bioassay organisms to detect TC-2216 by using tryptone agar with up to 100 ppm TC-2216 incorporated in the agar, and they were not affected by it: *Acinetobacter lwoffi* (Audureau) Brisou and Prevot, *Pseudomonas fluorescens* Migula, *P. vesicularis* (Busing, Doll, and Freytag) Galarneault and Leifson, *Alcaligenes faecalis* Castellani and Chalmers, *Enterobacter cloacae* Castellani and Chalmers, and *Escherichia coli* (Migula) Castellani and Chalmers, and *Serratia* sp.

Phytotoxicity of compounds. Severe phytotoxicity has been reported in citrus treated with OTC (21). In this study, we observed no phytotoxic effects in orange varieties which received up to 32.5 g a.i. per tree but some 'Marsh' grapefruit trees injected at 10 g a.i. OTC/200 ml water had elongate, strap-shaped leaves in the first flush after injection. Pen G, NaOm, TC-2216, and KT-19827 produced severe phytotoxicity at higher rates (Table 2). 'Valencia' seemed to be more tolerant than 'Pineapple' or 'Hamlin' oranges, at least to Pen G and KT-19827 (Table 2).

Prophylactic treatment of healthy trees. After 27 months, there was no noticeable difference in the rate of blight incidence in the blocks of trees injected with OTC and those injected with water (Table 3). The monitoring of trees prophylactically treated with KT-19827 was discontinued in July 1979 due to phytotoxicity. It may be too early to draw firm conclusions, but it is apparent that prophylactic injections of OTC did not prevent blight.

Discussion

None of the compounds injected into blighted trees caused a reproducible and clearly defined remission of disease symptoms. We were unable to bring about a remission of blight symptoms with OTC as had previously been reported with OTC applied as a soil drench (24). Only two trees out of the 22 injected with OTC in this study responded with an initial vigorous flush, the rest failed to improve and all trees eventually declined (Table 1). Even some of the apparently healthy trees injected four times prophylactically with OTC developed blight (Table 3).

Trees injected with the experimental bactericide TC-2216, in some instances, appeared to recover. The increase

Table 2. Compounds causing phytotoxicity when injected into citrus trees.

Compound	Range of rates	Rates causing phytotoxicity	Scion variety	Phytotoxic reaction
Pen G	11.3-37.5 g	≧15 g	Pineapple	Leaf drop, fruit remains
		≧15 g	Valencia	None
NaOm	0.5-14.0 g	14.0 g	Hamlin	Leaf drop, branch dieback
OTC	2.0-10.0 g	10.0 g	Grapefruit	Elongate, strap-shaped leaves
	4.0-32.5 g	—	Sweet oranges	None
TC-2216	6-333 ml	≧133 ml	Valencia	Elongate, strap-shaped, thick leaves
KT-19827	4-216 ml	≧ 66 ml	Pineapple	Leaf and fruit drop, branch dieback
		= 216 ml	Valencia	Leaf and fruit drop only

Table 3. Blight incidence in healthy trees prophylactically injected with oxytetracycline (OTC).[z]

Compound injected	No. of trees	Visual rating May 1981	Average zinc in xylem May 1981
OTC	16	8/16 = 0.0[y]	1.6
		5/16 = 1.0	1.5
		2/16 = 1.5	7.4
		1/16 = 3.0[x]	*x
Control	32	21/32 = 0.0	1.8
		7/32 = 1.0	1.6
		2/32 = 1.5	2.8
		1/32 = 2.5	5.1
		1/32 = 3.0[x]	*x

[z]Trees injected with OTC received an average of 1.3 g a.i. in February 1979, 13.9 g a.i. in July 1979, 28.7 g a.i. in June 1980, and 8.9 g a.i. in December 1980. Control trees were injected with 200 ml water in February 1979.
[y]Based on a scale where 0 = healthy and 3 = severe blight.
[x]Tree removed due to severe blight.

in trunk circumference for the tree treated with TC-2216 is in-the range reported by Cohen (3) for healthy trees, while the increases in trunk circumferences for the trees treated with OTC and water are comparable to that reported for blighted trees. The apparent inconsistent quality, the difficulty in finding a bioassay organism sensitive to the compound, and the difficulty in injecting the compound have made it difficult to evaluate the potential effectiveness of TC-2216 as a treatment for blight.

The apparent recovery of blighted trees injected with EDTA probably resulted from the method of tree selection and the small number of trees injected with that treatment. In tree selection, water infusion and zinc analysis were not used to check the visual diagnosis of blight because it would have left a number of test holes in the trees. Therefore, it was not known with certainty that all the trees injected were really blight affected. Some could have been suffering from other problems.

One reason for lack of remission of symptoms could be that any causal organism may have been located in the roots and beyond the reach of the injected compounds. Our bioassay data indicated the materials injected moved into the tree canopy but not into the roots. The xylem-limited bacteria causing phony peach are found primarily in roots (25) and similar bacteria have been found in citrus roots (5, 9). Another possible reason for lack of response is that the vascular plugging associated with blight (4, 28, 29) may not be reversible. Thus, once plugging has occurred, sufficient new xylem free of plugging may not be formed to allow a remission of blight symptoms. Even in Pierce's disease of grapes where plugging is due mostly to the bacteria themselves, it is difficult to reverse disease symptoms, especially in severely affected plants (7, 8, 17). Even prophylactic treatments with OTC provides only temporary relief from Pierce's disease and mycoplasma-like diseases (7, 13, 17). The other possibility is that no pathogen is involved with blight or, alternatively, that the causal organism was not sensitive to the compounds tested.

The information obtained on phytotoxic rates and the bioassay information on distribution of the compounds after injection should be useful in subsequent chemotherapy experiments. The possibility of using combination soil drench and trunk injections to reverse blight symptoms is under investigation.

Acknowledgments

We gratefully acknowledge the technical assistance of H. Lasater, J. Chandler, M. Smith and K. Davis. We thank Pfizer Inc., Schering Corp., Dr. Thirumalacher of Jeesnnidhi-Anderson Inst., Olin Corp., DuPont de Nemours and Co., Inc., Merck and Co., Inc., Ciba-Geigy Corp., and Abbott Laboratories for gifts of the compounds listed in Materials and Methods. We gratefully acknowledge the assistance of Mr. C. Kime, Waverly Growers Cooperative, and Mr. W. Thompson, Caulkins Citrus Co., LTD. in locating the groves used in this study.

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Proc. Fla. State Hort. Soc. 94:25-28. 1981.

CONTROL OF CITRUS BLIGHT DISEASE

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Abstract. **That the filamentous plugs in the vessels of blight-affected citrus trees, reported in 1953, are of fungus origin and cause the citrus blight syndrome, and that deficiencies of certain unidentified essential elements stimulate the fungus growth was suggested in 1979. In a previous experiment, 40% of 227 Valencia trees treated with montmorillonite clay as a source of essential elements, recovered noticeably, whereas 214 untreated trees lost 27 additional trees to blight. In recent experiments, (a) 1,086 "healthy" and 293 blight-affected Valencia trees on rough lemon rootstock were treated for four years with 4 to 5 lbs. of montmorillonite clay/tree/year with recovery of 202 trees (68.9%), whereas 1,173 "healthy" and 242 blight-affected check trees lost 139 (57.6%) additional trees to blight; (b) 586 "healthy" Murcott orange trees and 125 Murcott-decline trees were treated with 5 lbs, of montmorillonite clay per tree for two years and not treated for two years, had recovery of 71 trees (56.8%); and (c) 25 Murcott-decline affected trees treated with 15 lbs. of montmorillonite clay showed recovery of 22 trees (88.0%) in one year.**

Florida citrus blight is perhaps the strangest and most perplexing plant disease known and its causal relations are by no means completely established. It is without question the most economically serious disease of citrus trees in Florida. When the replacement value of a mature tree is $100 or more, and when 1600 blight trees are pulled from 1400 acres of one ranch in one year (40,000 from the entire 3500 acres in four years) and these figures are repeated more or less, throughout the State we have an economically serious problem.

The earliest report of citrus blight seems to be Fowler's (16) publication in 1874 but Swingle and Webber's (30) paper in 1896 and Rhoads' (24) paper in 1936 were the first papers to shed much light on the disease. Swingle and Webber (30) and others (4, 6, 10, 12, 13, 14, 25, 29, 38) generally agree on the symptoms of blight but a detailed discussion would require several pages. Briefly however and in the order of their development, the symptoms are as follows: dehydration, delayed leaf flushes and blooming, deficiency symptoms especially zinc (27), defoliation, twig and branch die-back, usually accompanied by vigorous sprout growth from the trunk and lower branches, absence of tree-to-tree spread or carry-over in the soil and complete failure of all transmission and perpetuation experiments (6, 7, 14, 24, 28, 30). The name citrus blight as used here, includes such names as young tree decline (YTD), sand hill decline (SHD), rough lemon decline (RLD), etc., because the name blight, poorly chosen or not, has scientific priority over later names based on artificial distinctions such as age of trees, area of the State, rootstock, etc.

The presence of filamentous plugs (Figs. 2-7) of peculiar shape in the vessels of blight-affected trees was first reported by Childs (6) who suggested that they impede the flow of water and nutrients from the roots. Later, Childs and Carlysle (8) showed the fungus nature of the plugs with scanning electron microscope (SEM) photographs. The mycological aspects were discussed in detail (7) in 1965. On the basis of citrus specimens examined from many parts of the world, Childs (10) suggested that the fungus in the vessels is an obligate parasite that is present in citrus wherever cultivated, which commonly grows in a benign symbiotic relationship with the host. But, if tree growth is weakened by deficiencies of certain essential elements, fungus growth accelerates and becomes actively parasitic on the pectic materials exposed at vessel junctions and pits in the vessel walls (10, 33, 34, 37), where it forms fungus colonies which constitute the plugs (Figs. 2-7) that impede the flow of water and nutrients through the vessels and cause the symptoms called blight disease, exactly contrary to Hanks and Feldman's (19) opinion.

Impeded water flow (6) is now widely accepted as the cause of blight symptoms (3, 4, 10, 12, 17). While theories regarding the cause of the impeded flow are conspicuously scarce, explanations of the nature of the plugs are more numerous. It has been suggested (22, 32) that many vessel plugs are amorphous (meaning in this case composed of gum) instead of being filamentous. The fungus hyphae composition of the plugs is clearly shown (6, 8, 10) by SEM photographs (Figs. 2, 3, 5, 6), but they are often impregnated with gum. This gum results from Rio Grande gummosis (9), a disease entirely distinct from blight (10). Blight, Rio Grande gummosis and several other diseases are often present in the same tree but the symptoms of one does not implicate the others.

Several other causes of blight have been suggested which fail to fit with the known facts of the disease. It has been implied for example that Pierce's disease of grapevines (20) is implicated in some way because the causal agent (of Pierce's disease) was isolated from a blight-affected citrus tree. Pierce's disease got its name from Newton B. Pierce, who worked on it around 1900 when it was devastating the grape industry of Orange County, California. The destroyed vineyards were replaced with orange trees which were not affected by Pierce's disease. Also, a rickettsia-like organism has been described (15) as possibly having some connection with citrus blight although there is overwhelming evidence that blight is not contageous and cannot be transmitted by budding or grafting (10, 14, 24, 28, 30).

The only cause of blight suggested to date that fits at all well with the known facts of its symptoms and its occurrence is the one mentioned previously (10), namely that of a systemic, obligately parasitic fungus that is present in citrus trees wherever grown, which under favorable conditions produce the plugs that impede the flow of water

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