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POPULATION DYNAMICS OF XANTHOMONAS CITRI CAUSING CANCROSIS OF CITRUS IN ARGENTINA[1]

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Abstract. **Lesions of cancrosis of grapefruit, that were initiated in the spring continued to enlarge for 200 days after infection and reached 9 mm in diameter. The numbers of living cells of** Xanthomonas citri **in the lesions did not change appreciably during the period and were between 10^6 and 10^7 cells per lesion. The number of bacteria per lesion was similar in leaves, fruit and twigs. Neither invasion by fungi nor varietal resistance altered the number of bacteria per lesion. The number was about 100 times less in lesions that had passed through a winter season, however. Rainwater collected from diseased leaves in the summer contained between 10^5 and 10^6 cells of** X. citri **per ml. The concentration of** X. citri **in rainwater decreased rapidly at increasing distances from a diseased tree, but the bacterium was detected 32 meters distant after one rain. The bacterium was detected in leaves of non-host plants at least 3 weeks after inoculation.**

Copper compounds provided good control of the disease on seedlings and Kocide 101 reduced the number of living cells of X. citri **in rainwater collected from sprayed leaves. No reduction of** X. citri **occurred in rainwater on sprayed leaves after 25 days and 170 mm of rainfall.**

Citrus cancrosis, caused by *Xanthomonas citri* (Hasse) Dow., is epidemic in the Litoral region of Argentina where the disease has spread rapidly since 1976. The disease also is spreading in Brazil, Paraguay and Uruguay. The spread of the disease in South America increases the world-wide inoculum and thus increases the threat of introduction of the disease into Florida.

Cancrosis was previously brought to the southeastern United States around 1911 (1). It was eradicated from Florida by 1927 and the rest of the southeastern United States by 1943. Nearly 20 million trees in nurseries and groves were destroyed by 1934 (2). In addition, many dollars were spent for personnel involved in inspection systems. The cost of eradication of the disease was large, so early detection of the disease is essential for success of an eradication campaign with future introductions of the disease in Florida.

With the above in mind a project was initiated in 1978 to gain experience with the disease (in the field) in Argentina. Populations of the bacterium were determined under various field conditions. The results obtained will be of value in making decisions regarding eradication of the disease in future introductions in Florida.

Materials and Methods

Assays for numbers of cells of X. citri. The numbers of cells of *X. citri* in samples were determined by either a dilution-plating system, or by injection-infiltration into leaves of Duncan grapefruit seedlings. Samples consisted of either lesions or rainwater collected from leaves. Each lesion to be assayed was crushed in 1 ml of sterile saline (0.85%) or tap water to obtain a suspension of bacteria. The rainwater was collected with a sterile syringe and needle from leaves in the field after rains. About 0.5 ml of rainwater was collected for each sample.

In the dilution plate system, samples were diluted through a series of 10-fold dilutions. This was accomplished by transferring 0.05 ml to 0.45 ml sterile saline. The 0.05 ml was delivered with a "Micro-diluter" (Cooke Laboratory Products, Alexandria, VA.). From appropriate dilutions, 0.05 ml of the suspension was transferred to a petri dish containing nutrient agar. The suspension was spread over the surface of the agar with a sterile bent-glass-rod. Usually platings were made from the last three dilutions of a series. Colonies of *X. citri* were counted after four days of incubation at 28°C.

The injection-infiltration method (5) involved flooding the mesophyll of leaves with bacterial suspensions in tap water or rainwater. Care was taken to inject leaves that were less than 3 weeks old. The flooding procedure was accomplished with a sterile 2 ml plastic syringe and 27-gauge needle. After infiltration the plants were kept at 28°C in a growth room. Lesions were usually visible by 14 days and were counted after 3 weeks of incubation. The area of leaf inoculated was determined by the dot method (14). The number of cells of *X. citri* in a sample was extrapolated by comparison with the number of lesions that developed with known concentrations of *X. citri* in inoculum (17).

Sources of bactericides. The bactericides, the percentages of active ingredient and sources used in sprays onto citrus seedlings were: Tribasic Copper Sulfate, 54% elemental copper, (Supplied by Cities Service Company, Atlanta, GA); Copper Oxychloro Sulfate, 50% elemental copper, (Supplied by Crush, S. A., Bella Vista, Corrientes, Argentina); Dithane M-45, 80% of a co-ordination product of zinc and manganese ethylene bis dithiocarbamate, (Purchased from an agricultural supply store in Florida, U.S.A.; formulated by Rohm & Haas, Philadelphia, PA); Kocide 101, 53% elemental copper in form of cupric hydroxide, (Supplied by Kocide Chemical Corporation, Houston, TX); Agrimycin 100, 15% streptomycin and 1.5% tetracycline, (Purchased from an agricultural supply store at Bella Vista, Corrientes, Argentina); Rifampicin, 80% active ingredient, (Supplied by Lepitit Laboratories, Buenos Aires, Argentina).

Results

Populations in lesions

Relationship of size of lesions of grapefruit leaves and number of cells of X. citri. Leaves were collected approximately every 3 weeks during the 1978-79 season from Ruby grapefruit at Ayui, S.A., Tabay, Corrientes, Argentina. The leaves were always taken from the spring flush of growth and contained only a few lesions per leaf. The diameter of the largest lesion of a leaf was recorded and the mean for 100 lesions was determined. Infection probably occurred during a rainy period of August 8 and 10. (This was deduced from experiments on timing of sprays for control). Therefore, August 10 was selected as the date for the beginning of the lesions.

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Three lesions were also selected at random at each collection date and the number of cells of *X. citri* in each lesion was determined by dilution plating and an average number was calculated. The yellow colonies of *X. citri* were distinguished on agar plates that contained 500, or less, colonies of bacteria. When the colonies of bacteria on the plates were separated, saprophytic bacteria did not appear to compete with the growth of *X. citri*.

Increases in diameter of lesions of cancrosis of grapefruit continued for about 200 days and a "S" curve was formed by plotting the lesion diameters with time (Fig. 1). During the logarithmic phase of growth the lesions increased an average of about 50 μ per day, which is about the diameter of a cell in a leaf.

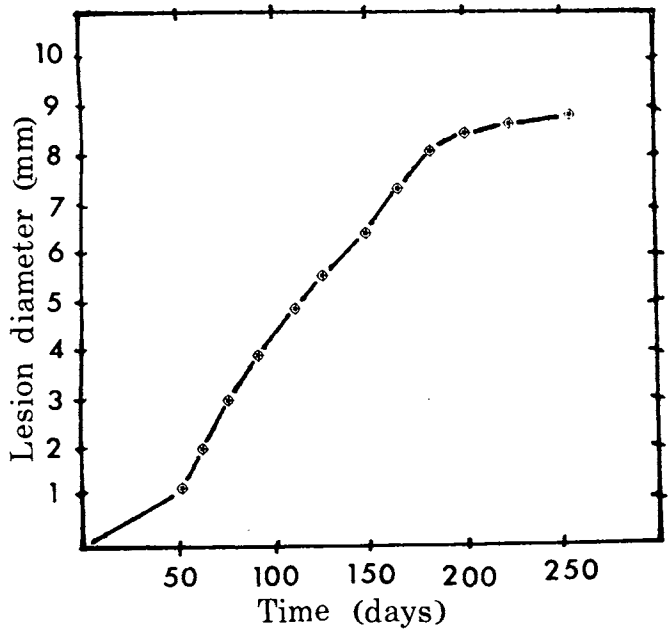

Fig. 1. The graphic relationship between size of lesions of cancrosis on Ruby grapefruit leaves and days after infection. The beginning was assumed to be August 10, 1978.

The numbers of viable cells of *X. citri* in the lesions were remarkably uniform at various times and sizes of lesions (Table 1). The low number of cells was 1.5 x 10^6 and the high number was 1.4 x 10^7. The numbers of viable cells seemed to be independent of the increases in area of the lesions, since small and large lesions had similar numbers of bacteria.

Table 1. Relationship of age and diameter of lesions of cancrosis of Ruby grapefruit leaves and number of cells of *X. citri* in the lesions.

Sample date	Days after infection[z]	Lesion diameter[y]	No. of cells of *X. citri*[x]
		mm	x 10^6
10/24/78	75	2.92	1.7
11/2/78	84	3.58	1.7
11/22/78	104	4.21	14.0
11/30/78	112	5.00	7.3
12/14/78	126	6.00	1.6
1/4/79	149	6.00	2.8
1/23/79	168	8.17	5.2
2/7/79	178	7.33	1.5
3/2/79	203	8.67	4.1
3/26/79	228	8.33	1.5
4/27/79	258	9.33	6.0

[z]Infection was assumed to be August 10, 1978.
[y]Ave. of three lesions.
[x]No. of cells in suspension of one lesion crushed in one ml of sterile saline. Ave. of three replicates.

Numbers of cells of X. citri in lesions in leaves, fruit and stems. Lesions in leaves, fruit and stems of grapefruit were collected in September and October, 1979 and the number of viable cells by *X. citri* was determined *in three lesions* of each type of dilution plating. The lesions in leaves and fruit were between 1 and 2 mm in diameter, but the stem lesions, which were probably initiated the previous fall were between 11 and 14 mm in diameter. The population of *X. citri* per cm^2 of lesion area varied between 8.0 x 10^5 and 8.0 x 10^6. Thus, the numbers of cells of the pathogen in the different types of lesions were not very different.

Numbers of cells of X. citri in lesions invaded by fungi. Leaves with cancrosis were collected from Ruby grapefruit on November 22, 1978. The leaves were left overnight in plastic bags at room temperature. Fungi grew profusely from many lesions. There were two distinct types of fungi. Some lesions contained black mycelia and acervuli and other lesions contained a pink fungus that produced sporodochia. Three lesions with each type and with no fungus present were separated and the number of cells of *X. citri* in each type of lesion was determined by dilution plating.

The average number of cells of *X. citri* in lesions containing the black, pink and no fungus was 7.8 x 10^6, 1.6 x 10^7, and 3.2 x 10^7, respectively. After this date all lesions in the field seemed to be contaminated with the secondary fungi. Even so, the lesions continued to expand at a logarithmic rate. Thus, the fungi apparently had no effect on the rate of expansion of lesions and production of secondary inoculum.

Relationship of resistance in host to number of cells of X. citri in lesions. Leaves were collected from five varieties of orange cultivated in plots of H. Zubrzycki at INTA, Bella Vista. These varieties were Valencia Frost, Valencia Wood, Natal San Pablo, Hamlin, and Petropolis, which ranged from resistant to susceptible, respectively. Leaves were always collected from the early summer flush of growth. The diameter of a lesion from each of three leaves per variety was measured and the number of cells of *X. citri* in each lesion was determined by dilution plating. This test was completed on 3 dates and the results are in Table 2.

Table 2. The diameter and number of viable cells of *Xanthomonas citri* in cancrosis lesions of five orange varieties at three sampling dates.

Orange variety		February 13	April 6	May 23
Valencia Frost	LS[z]	1.4	3.7	4.0
	C/L[y]	3.3 x 10^6	1.1 x 10^7	2.4 x 10^6
Valencia Wood	LS	2.0	3.2	3.2
	C/L	7.4 x 10^5	1.0 x 10^7	4.0 x 10^4
Natal San Pablo	LS	2.1	3.7	5.2
	C/L	3.5 x 10^6	1.7 x 10^7	8.0 x 10^6
Hamlin	LS	2.2	3.2	4.8
	C/L	3.8 x 10^6	3.1 x 10^6	1.5 x 10^7
Petropolis	LS	2.0	3.3	3.2
	C/L	7.9 x 10^6	5.1 x 10^5	4.0 x 10^4

[z]LS refers to mean diameter of three lesions in mm.
[y]C/L refers to cells in suspensions of a lesion crushed in one ml of sterile saline. Ave. of three lesions.

The populations of *X. citri* in the lesions of the orange varieties at the first and second samplings were similar to those in grapefruit. At the last sampling, in early winter, the populations were highly variable. However, the numbers of viable cells of *X. citri* in the lesions did not seem to be correlated with resistance at any sampling date.

Number of cells of X. citri in lesions of previous season.

Diseased leaves from growth of the late summer (old) and spring (new) of 1978 were collected from Marsh Seedless grapefruit on November 2, 1978. This was repeated on March 14, 1979. The number of viable cells of *X. citri* in each of three lesions of each type was determined by the dilution plating.

The mean number of cells of *X. citri* in the old lesions at each date was 1.0×10^4 and 2.0×10^4, whereas the mean number in the lesions of leaves of the spring flush was 1.7×10^6 and 3.8×10^6. Apparently, the populations of viable cells in lesions decreased about 100-fold during the winter months without increasing the following spring and summer.

Populations in rainwater

Rainwater on diseased leaves. The populations of *X. citri* were determined in samples of rainwater that were collected from diseased leaves of Marsh Seedless grapefruit trees. During October 18, 1978, rain fell during approximately 7:00-9:00, 10:00-12:00, and 14:00-15:00 hours. A total of 6.5 mm of rain fell. Duplicate samples were collected at 4 time periods. The number of cells of *X. citri* in each sample was determined by dilution plating.

The mean number of cells of *X. citri* in the rainwater at 8:00, 9:00, 11:00, and 15:00 hours was 1.2×10^5, 1.7×10^5, 1.3×10^5, and 3.4×10^5 cells per ml of water, respectively. Apparently, the bacteria oozed from the lesions very rapidly and populations were maintained in raindrops on leaves in spite of dilution by continued rainfall.

Rainwater near trees. Sterile test tubes were placed under the edge of the canopy of a diseased tree of Marsh Seedless grapefruit on October 18, 1978. Other tubes were placed 1 meter away from the canopy. The number of cells of *X. citri* in water collected in the tubes during a rain was determined by dilution plating. The tubes nearest the tree had 1.7×10^5 cells per ml and the farthest tubes had 6×10^2 cells per ml.

The distance of dissemination of cells of *X. citri* to the west of diseased trees was determined on March 7, April 5, November 8, and December 13, 1979. The total rainfall during the first two dates was 63 and 3 mm, respectively. A strong wind accompanied the light rain on April 5. Samples of rainwater were collected from leaves of grasses and broadleafed plants at various distances from the diseased trees. The presence of *X. citri* in the water was determined by the injection-infiltration method and by dilution plating.

The rainwater collected under the canopy of the tree on March 7 contained over 10^4 cells/ml of *X. citri* because confluent necrosis developed in the infiltrated leaves of grapefruit seedlings. However, no lesions developed in the grapefruit leaves injected with rainwater collected 2 and 6 meters from the diseased tree. With the samples of April 7, the numbers of lesions per cm^2 of the grapefruit leaves infiltrated with rainwater collected at 0, 4, 8 and 12 meters from the diseased tree were 20.0, 3.4, 1.3, and 0.0, respectively. In November 8, *X. citri* was detected 16 meters from the diseased trees and on December 13 cells were detected at 32 meters.

The bacterium was disseminated farther during the light rain of April 5 than during a heavier rain of March 7. However, the strong wind with the light rain was the key factor in dissemination for a longer distance. The total amount of rainfall may not be significant in dissemination of the bacterium, but rainfall and wind may be the essential factors for long distance spread.

Survival of X. citri on and in Selected Non-host Plants

The length of survival time of bacteria in association with non-host plants may play a part in the epidemiology and control of citrus canker, especially if eradication is considered. Tests were performed to determine the length of time *X. citri* survived in and on some selected weeds which are found in and around citrus groves in Corrientes.

After natural dissemination. The foliage of four types of plants was collected on February 14, 1979 from among grapefruit trees at Pindapoy, S.A. at Saladas. These plants were sandbur (*Cenchsus sp.*), *Solanum* sp., bermuda grass (*Cynodon sp.*), and an unidentified broadleafed plant. In addition, young shoots of grapefruit, about 5 cm long, and fully expanded grapefruit leaves, selected for freedom of lesions were collected. The collection was 2 days after a rain. Each group of plant samples was placed in a plastic bag for transport to the laboratory and then immediately transferred to 100 ml of sterile tap water. After 30 minutes of shaking, the wash water was injected into leaves of grapefruit seedlings.

Lesions did not develop in leaves inoculated with wash water from bermuda grass, young shoots of grapefruit, or tap water, alone. However, four, four and two lesions developed in leaves infiltrated with the wash water from the sandbur, *Solanum* sp. and the unidentified broadleafed plant, respectively. Over 1,000 lesions developed in the leaf infiltrated with the wash water from expanded leaves of grapefruit.

The number of cells of *X. citri* in the wash water from the three weed plants was estimated to be near 10^2 cells/ml and over 10^4 cells /ml from the expanded grapefruit leaves. Although the latter were selected from freedom of disease, some small lesions may have been overlooked in the examination of the leaves.

After inoculation. Five weeds were selected over 100 meters from any citrus to prevent the possibility of contamination by *X. citri* during blowing rains. Selected leaves were injected internally and others sprayed externally with inoculum of 5×10^6 cells/ml of *X. citri* to determine survival inside and outside on the non-host plants. Leaves were tested for presence of bacteria at 4 and 14 days after inoculation. A 3 mm^2 piece of inoculated leaf was placed in 3 ml of tap water. A portion of the suspension was injected into leaves of Duncan grapefruit seedlings. After 3 weeks the number of lesions/cm^2 was calculated for those which developed canker.

Survival of *X. citri* in 5 of 5 plant types occurred 4 days following injection and 4 of 5 had survival 14 days following injection. No survival on either sampling day was found following spray inoculation.

In another trial, leaves of 10 different weeds were injected with inoculum of 5×10^5 cells/ml of *X. citri* and then assayed for living cells 2, 9, and 22 days later. Viable cells were found in some weeds at 22 days.

Based on these limited trials *X. citri* can survive within non-host tissues for at least 3 weeks when bacteria are placed into them. Naturally exposed non-hosts should be checked following heavy rains for internal populations of *X. citri*. External survival seems to be not important.

Populations on sprayed leaves

Control by sprays of copper. Sweet orange seedlings were transplanted in the autumn of 1978 in a nursery at Pindapoy, S.A., Saladas, Corrientes. Nine plots, 3 meters long with 0.5 meter between plots, were outlined on each of 3 rows the following spring. A randomized block design was used with 1 replicate per row.

The first sprays of bactericides were applied on October 19, and 13 sprays were applied during the year at about 2 week intervals. The last spraying was on April 10, 1979. Sprays were applied with a knapsack sprayer and applica-

tion was made until run-off. The treatments and amounts are included in Table 3.

Table 3. The amount of citrus cancrosis in plots of sweet orange seedlings sprayed with various bactericides.

Bactericides	Rate g/l	Disease index[z]
Check	—	4.3 a
Tribasic Copper Sulfate (TBCS)	3.0	2.0 b
TBCS + Dithane M-45	3.0 + 1.5	2.3 b
TBCS + Sulfur	3.0 + 9.0	1.7 b
Kocide 101	3.0	2.0 b
Agrimycin 100	1.2	2.3 b
Rifampicin	0.2	4.3 a
TBCS + Agrimycin 100	3.0 + 1.2	1.7 b

[z]The disease index refers to: 0 = no disease, 1 = 0-3%, 2 = 3-6%, 3 = 6-12%, 4 = 12-25%, 5 = 25-50%, 6 = 50-75%, 7 = 75-88%, 8 = 88-94%, 9 = 94-97%, 10 = 97-100%, and 11 = 100%. Figures are means of three replicates and means associated with same letters are not significantly different at P = .05 level.

Seedlings were inoculated at the first two sprayings by placing diseased leaves among the seedlings in buffer rows. Leaves of some seedlings in the buffer rows were also injected on December 6 with a suspension of *X. citri* obtained by soaking lesions from naturally diseased leaves in a flask of sterile water. On February 28, one leaf of every plant in the plots was inoculated by injecting the same type of inoculum into the leaves. The plants were rated for disease with a visual system of Barratt and Horsfall (15), which is given in Table 3.

All treatments that contained Tribasic Copper Sulfate (TBCS) provided excellent control of cancrosis (Table 3). Additions of Dithane M-45, sulfur, or Agrimycin 100 to TBCS did not increase the level of control over TBCS, alone. Kocide 101 provided excellent control of cancrosis, as did Agrimycin 100, alone. Rifampicin did not control the disease.

A similar test was completed with Duncan grapefruit seedlings. The disease was slightly more severe, but TBCS again provided excellent control. Addition of Dithane M-45 to TBCS did not increase control in this test, either.

Residual life of copper on grapefruit trees. Duplicate branches of bearing Marsh Seedless grapefruit trees with leaves containing lesions of cancrosis were sprayed on October 9, 1978, with either Kocide 101, Kocide 101 + Dithane M-45, or Dithane M-45 alone. The concentrations of the materials in tap water were 3.0 g/l, 3.0 g/l + 1.5 g/l, and 1.5 g/l, respectively. Other branches were selected that received no treatment. The sprays were applied with a chromatography sprayer and were propelled by compressed air. Sprays were applied to both surfaces of the leaves until run-off. The number of viable cells of *X. citri* in rain drops that remained on leaves of the treated branches was determined after rains that occurred on 4, 16 and 25 days after the sprays. The number of cells of *X. citri* and of saprophytes was determined by dilution plating and the accuracy of the *X. citri* counts was checked by injection of remaining rainwater into leaves of the grapefruit trees. The rainfall during this test was recorded and 7 rainy periods occurred. These were on October 13, 18, 24, 25, 29, 30 and November 3. The amount of rainfall at each date in mm was 20.5, 6.5, 27.8, 47.5, 35.8, 4.1, and 29.0, respectively. The total rainfall was 171.2 mm for the 25 days.

The mean numbers of cells of *X. citri* on leaves of sprayed and unsprayed leaves of grapefruit are presented graphically (Fig. 2). About 10^6 cells of *X. citri* per ml of rainwater occurred at the first sampling on leaves that were not sprayed and the number declined to about 10^4 cells/ml at the last sampling. The number of saprophytic bacteria also declined during the sampling period.

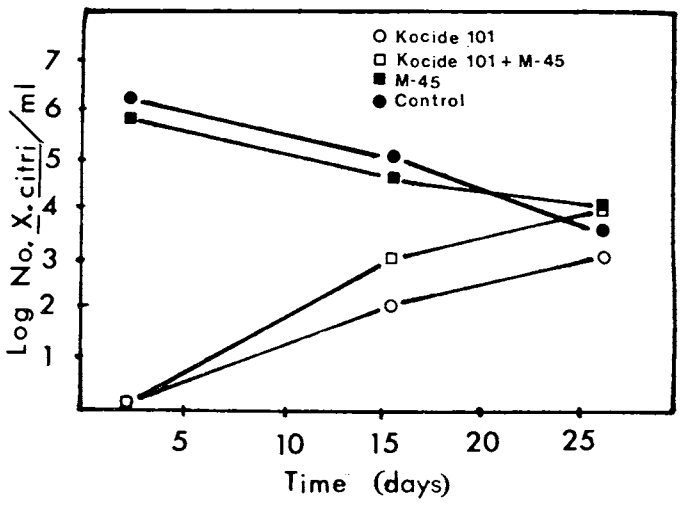

Fig. 2. Numbers of cells of *Xanthomonas citri* in rainwater collected from grapefruit leaves sprayed with bactericides.

Living cells of *X. citri* were not found at the first sampling in the rainwater collected from leaves sprayed with Kocide 101, but 10^2 cells/ml of rainwater were present 16 days after the sprays. After 25 days no differences were found in numbers of cells in rainwater from sprayed or unsprayed leaves. The addition of Dithane M-45 to Kocide 101 did not change the number of living cells of *X. citri* in the rainwater from those recovered from leaves sprayed with Kocide 101, only. Rainwater from leaves sprayed with Dithane M-45 contained a number of cells of *X. citri* that was similar to that from unsprayed leaves.

The survival of *X. citri* on sprayed leaves was assumed to be related to the amount of copper on the leaves. The rainfall of 171 mm was probably sufficient to remove the sprayed copper material from the leaves. Repetition of this test under many types of weather and with different bactericides could give an insight to the factors that reduce bactericidal residues of copper on leaves.

Discussion

The interactions between number of cells of *X. citri* and the amount of disease development under various conditions were investigated by Goto (3, 4), Goto and Morita (7), and Koizumi (10, 11, 12). The populations of bacteria were directly related to the amount of disease development.

The numbers of viable cells of *X. citri* in naturally occurring lesions were remarkably similar despite differences in age, size and variety of citrus. The populations were similar to those found by Koizumi (10, 11) in artificially inoculated leaves, and by Goto (6) in naturally infected leaves in Japan. The number in suspensions of a lesion in 1 ml of water usually fluctuated between 10^6 and 10^7 cells. The only significant variation from this number was in lesions that passed through a winter season.

Lesions on the spring growth are the most important inoculum source for the summer development of cancrosis because of the high numbers of bacteria in them. Therefore sprays in the spring would be advantageous to prevent this important inoculum source. Sprays in the spring should be very effective in reducing lesion numbers because the inoculum from over-wintered lesions is low.

The number of cells of *X. citri* in the rainwater on

diseased leaves reflected the number of the bacterium in the lesions and was about 10-fold less. It was not determined if the inoculum in rainwater was uniform over the whole tree in nature, since rainwater was only collected from leaves that were diseased. However, the numbers of *X. citri* in rainwater collected under the trees were about the same as in rainwater on diseased leaves, so the spatial distribution of *X. citri* throughout the tree should be quite uniform.

The experiments on dissemination emphasized the differences in distance that bacteria are spread during different weather conditions. Cells of *X. citri* were spread for relatively short distances during the rains. The high concentrations of bacteria that are needed for serious outbreaks of the disease probably originate in each tree.

Goto et al. (8, 9) found survival of *X. citri* on non-host plants in Japan and Lima et al. (13) reported survival of the cancrosis bacterium on sourgrass in Brazil. Viable cells of *X. citri* were found naturally on some weeds 2 days after a disseminating rain in Argentina. Whether *X. citri* would survive naturally for long periods on non-host plants without reinoculation with each rain needs to be determined, but must be done in areas where eradication of diseased trees has occurred. On the other hand, enough information was obtained to warrant removal of all vegetation in eradication areas. This can easily be done by incorporating the vegetation into the soil.

Bactericides that contained copper as the active ingredient provided the best control of cancrosis during the 1978-79 year. Additions of materials to copper did not improve control of the disease. The latter was surprising because additions of Dithane M-45 to copper consistently provided better control of *X. vesicatoria* on tomatoes in Florida (16). The combination of copper and Dithane M-45 might be more effective in years when disease is more severe; or with environmental conditions that do not favor control with copper, alone.

Copper reduced the number of *X. citri* in water rather slowly (17). Therefore, for control much time must occur for invasion of the bacterium into leaves. If invasion occurs quickly, such as with watersoaking of leaves during windy rains, copper may not control the disease. During the 1978-79 year in Corrientes, Argentina, high winds seldom occurred with the rains, and copper was excellent in control of citrus cancrosis under field conditions.

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INCIDENCE OF CITRUS BLIGHT ON CARRIZO CITRANGE AND SOME OTHER ROOTSTOCKS

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Abstract. **In 4 areas of Florida, 34 groves with Carrizo and at least one other major rootstock were surveyed for incidences of blight and foot rot, number of young replants and missing trees, and tree losses from other causes. Incidence of blight in trees on rough lemon** (Citrus limon **(L.) Burm. f.) and Carrizo citrange** (C. sinensis **(L.) Osb. X** Poncirus trifoliata **Raf.) rootstocks and, in some cases, on 4 other rootstocks were compared. Incidence was highest in trees on rough lemon and trifoliate orange** (P. trifoliata) **rootstocks, and lowest on sour orange** (C. aurantium **L.), Cleopatra mandarin** (C. reticulata **Blanco), and sweet orange** (C. sinensis). **Blight incidence in trees on Carrizo was intermediate and significantly lower than in trees on rough lemon. The incidence of blight varied among groves, and was highest in the east coast and south Florida areas.**

Citrus blight is one of the most perplexing production problems facing the Florida citrus industry. Considerable