Short Note 6.5

The Big 3 Articles on Citrus Canker

Introduction

Three extensive articles were published from year 2001 to 2004. Links to these articles are provided in the online supporting documents website. The articles are as follows:

1. Gottwald, T.R,, Graham, J.H, Schubert, T.S., 2002, Citrus Canker: The Pathogen and Its Impact, Plant Health Progress, published online at www.apsnet.org (official website of the American Phytopathology Society) .

2. Graham, J.H., Gottwald, T.R., Cubero, J. and Achor, D. S., 2004, Xanthomonas axonopodis pv. citri: factors affecting successful eradication of citrus canker, Molecular Plant Pathology, 5(1), 1-15.

3. Schubert, T.S., Gottwald, T.R., Shabbir, A.S., Graham, J.H., Sun, X. and Dixon, W., 2001, Meeting the Challenge of Eradicating Citrus Canker in Florida, Again, Plant Science, Vol 85, No. 4.

Gottwald's article is the longest of the "big 3" so it was convenient to begin with his article for comparison purposes. There is considerable overlap in the material presented in each of these articles. Schubert's article in 2001, was published prior to the primary article on the Florida field study in 2002. At the time Schubert's article was published, only Gottwald's 2001 Letter to the Editor had been published in Phytopathology

Drs. Graham and Gottwald are either the author or co-author of each of these articles. Dr. Schubert is author of the first article and co-author of the second one. We consider Gottwald, Graham and Schubert, to be three of the five most influential scientists involved in the eradication program. The others are Dr. Wayne Dixon, FDACS/DPI and Dr. X. Sun, FDACS/DPI. Co-authors Cubero and Achor likely contributed on the microbiology aspects of Graham's article, and had no involvement in canker eradication program.

In this short note, a list of topics covered in these articles is presented. Following this, i focus on two areas covered in these articles- Epidemiology studies and chipper/ landfill experiments. Both of these areas are only briefly discussed. My interest was more in the factual details that were left out of the discussion.

Topics discussed in the Big 3 Articles:

A theme throughout all of these papers is the necessity of canker eradication. Graham's article provides more information on the microbiology and DNA research aspects. Gottwald's summarizes key points in the Florida field study. The topics presented in the articles, noted by reference numbers 1,2 and 3, (Gottwald, Graham, Schubert) are as follows:

I. General Topics

(a) History, 1910 to present - (1) and (2). More details on the chronology (1995 to 2000) are presented in Schubert's article. A brief history is provided in (3).

(b) World wide distribution - Mostly in (1) and (2).

(c) 125-ft policy and supporting research (2,3). Failure of 125-ft rule is discussed in (1) but not the research (1978 Argentina study).

(d) 1900-ft policy and supporting research (1-3)

(e) Control measures including windbreaks, copper sprays (also II.e), (1- 3)

(e) Quarantine rules (1, 2)

(f) Surveys and diagnosis of citrus canker (1) , Logistic issues (1)

(g) Public education, cultural aspects of PR (1)

(h) Compensation to grove owners, crop insurance (1)

(i) Sentinel Program (1-3)

(j) Economic loss (1-3)

(k) Legal actions and results (1- 3)

II. Canker Biology

(a) Canker biology - latency, appearance of lesions and changes with time, infection process (1-3)

(b) Factors affecting infection process - Seasonality, susceptibility of cultivars - (1 - 3)

(c) Citrus leafminer - (1- 3)

(d) Induced systemic resistance - (3)

(e) Copper sprays - timing, environmental effects, references to research (3)

(f) Citrus canker dispersal - rain splash dispersal and windblown rain dispersal (1-3)

(g) Canker hosts and susceptibility (1- 3)

(h) Estimation of lesion ages (3)

(i) Strain types and DNA analysis (1- 3), Reference 3 by Graham et al. provides the most technical details on recent research on microbiology.

III. Other topics

(a) Chipper experiments (3)

(b) Tornado dispersal (1)

(c) Non-citrus hosts (1)

Epidemiology studies

When reviewing these articles, I am keenly interested in how the 1900-ft policy was decided upon and the prior 125-ft rule, from Stall's paper.

As discussed in Chapter 1, Dr. Gottwald testified that it was voted on in a meeting in December 1998 when by all accounts, the Florida field study was not complete. A consensus of attendees agreed upon 1900-ft according to the authors of the study.

Drs. Gottwald, Graham and Sun are authors of the 2002 published article on the Florida field study. Drs. Schubert and Dixon were members of the Citrus Canker Risk Assessment Group, which began in 1995, so they would likely play a key role in deciding the 1900-ft policy.

- 125-ft policy

The 125-ft rule is based on an article published by Stall et al in 1980 (4). All articles reference the 1980 article by Stall et al (4) as the supporting article. This article is in the public domain, and can be accessed through a link on the online supporting documents website.

Reference 1, by Schubert et al, makes no mention of the scientific basis for the 125-ft policy. In reference 2 by Gottwald et al., the Argentina study is stated as:

> Until recently, the scientific basis for the eradication effort of citrus canker was provided by data from Argentina indicating citrus canker can spread up to 32 m (105 ft) during rainstorms associated with wind.

Almost the identical wording was used by Graham (3):

> Until recently, the scientific basis of citrus canker was a study in Argentina that documented bacterial dispersal up to 38.1 m during rainstorms associated with wind (Stall et al. 1980).

The correct distance is 32 m, and Graham cites 38.1 m because this is exactly the radius used (125-ft) in the program. What was actual published was the following:

> In November 8, X. citri was detected 16 meters from the diseased trees and on December 13, cells were detected at 32 meters.

The article does not specifically state that there was any rainfall on these dates. It does not specify how cells were detected and if the concentration of bacteria in the collected sample was identified. There is no information to know if the collected rainwater could cause infection. In fact, there is no indication that pathogenicity testing was conducted. Collection of rainwater at 8 m (26-ft) is somewhat better documented. A positive pathogenicity tests were conducted with rainwater at this distance.

As documented in Chapter 6, it is our conclusion is that beyond 8 m (26-ft) there is inadequate information provided by the authors to support viable bacterial dispersal. In fact, the co-author of Dr.

Stall's article, Dr. Canteros a researcher with 30 years experience of citrus canker in Argentina, apparently agrees as she wrote in an article (5):

> Preliminary data obtain only twice during rainy days has found the bacterium no more than 30 meter from an infected tree. Further studies indicated that it is an exceptional occurrence since most Xac cells were found only under infected trees and could not be detected [more than] a few meters from them.

- Florida Field Study

All three articles discuss aspects of the Florida field study. None of them provides any additional information beyond what was already published. Gottwald's article (2) provides the most information on the epidemiology study results.

In February 1998, according to an official press release from FDACS Commission of Agriculture Crawford, a moratorium on tree cutting was put into effect for Miami-Dade County, a one year study was to take place in Miami-Dade County, 3 sites were to be selected by the USDA, Department scientists and the scientists would meet monthly, and the study would be completed in one year. One would have thought the study would begin in March or April of 1998. From the two articles published on the Florida field study (5,6), we never learned of when the study began or ended, the limits of the sites and many other details as discussed in Appendix A. No new details on the Florida field study are given in any of these 3 articles.

In court testimony in November 2000, Dr. Gottwald stated (as provided in Chapter 1):

> No. the report [1999 Interim Report] does not discuss the meeting that occurred in December 1998 in which there was a group of scientists, regulatory agents and grower present in a room and decided upon 1900 ft. 1900 foot [rule] is not decided upon this, the manuscript or any thing else. It was decided upon by a group of people, a body of regulators, university scientists as well as ARS scientists. It was not decided upon by these reports.

(1) Schubert et al., Meeting the Challenge of Eradicating Citrus Canker in Florida - Again, 2001)

In Schubert's article (reference 1), we learn that it was in "early 1998" that "a moratorium was declared on removal of exposed trees to allow a period of study on urban and suburban epidemiology of CC." He also adds "Public sentiment was growing increasingly negative, mainly because of the unpopular tactic of removing exposed trees." There is no mention of the class action lawsuit against the Department. Our interpretation of events is that the USDA was increasingly concerned of participating in an eradication program for which the Department had legal liabilities in the form of a class action lawsuit.

On page 346 of the article, the authors state:

> Analysis of data collected over the next 12 to 18 months revealed that a much larger exposure radius than 38 m (125 ft) was indicated. In fact the data supported removal of

> exposed trees within a radius of 580 m (1900 ft) that would arise from the inoculum focus.

The time period over which data were collected, 12 to 18 months? Which was it? The wording is clever, as it is not the tabulated results, but the nebulous "data" that supports the eradication radius. It is similar to the FDACS website, that the "composite data" supports 1900 ft as the 95% probability eradication radius.

(2) Gottwald et al. Citrus Canker, the Pathogen and its Impact, 2002, Plant Health Progress

The information on the Florida field study has been taken almost verbatim from Gottwald's prior articles in 2001 and 2002 (5,6). The article does mention in the appendix that Commissioner Crawford announced a moratorium in 1998, and the significance was that this was done due to public outcry. It also allows a study to be done.

As to the origins of the 1900-ft rule, the authors try to make a closer association of the 1900-ft policy to the Florida field study, and still maintain a consistency that the 1900-ft was not the result of any report.

Details are conspicuously absent from Gottwald's version of events. We know the meeting took place in December 1998, at the USDA/ARS center in Orlando, Florida based on court testimony and from the 2001 published letter to the editor. We don't know the actual date in December, but now, most details are gone. As it is written, this could be the December 1998 or the May 1999 meeting:

> The preliminary results were examined by a group of scientists, regulators and citrus producers familiar with the disease. They selected a distance of 579 m (1900 ft) as a radius that would the majority of newly infected trees that can occur within a 30-day period resulting from a prior infection focus. The study and resulting determination of the 579-m distance serve as the scientific basis utilized in Florida at this time.

The is some blurring of the differences between Schubert and Gottwald's articles. It certainly sounds like before the scientists could complete the study, everyone met and agreed to 1900-ft. Schubert does not state that the study concluded or recommended the 1900-ft radius, but the data were in support of this conclusion.

(3) Graham et al., Xanthomonas axonopodis pv. citri: factors affecting successful eradication of citrus canker,

In August 1998, Gottwald in 2002 had stated that a mutual cooperative agreement had been signed between FDACS, USDA-ARS and UF. Now, there is a minor rewording of this statement so it sounds like the field study began in August 1998, as follows:

> To address these concerns [increasing spread of canker with the 125-ft rule], a cooperative research study CCEP, USDA-Agriculture Research Service and University of Florida was established in August 1998.

On page 11, Graham's version of the origins of the 1900-ft rule, is almost exactly the same as Gottwald's with one word deleted, " The results were examined ..." and the word "preliminary" is now gone. It bears noting that Graham is the first author and Gottwald is the co-author.

There is no mention in any of these articles on the Citrus Canker Technical Task Force, which according to the Deputy Commissioner of Agriculture, recommended the 1900-ft rule in March 1999. There is no discussion in any of these articles, of the monthly meetings that were supposed to take place, presumably from February 1998 until the completion of the study a year later, as announced by Commissioner Crawford, by the study's participants.

- Chipper and Landfill Experiments

As discussed in Chapter 7, I have particular interest in the chipper and landfill experiments, simply because I suspect these experiments were not conducted as reported. Graham's article particularly heighten my suspicions with the scant and selective details.

Specifically, Graham's description of the experiments on page 11 of his article skips over many of the important details presented by Dr. Gottwald at the International Citrus Conference Research Workshop (ICCRW) and part of the official transcript.

The author states that chippers allow some fine particles to escape and from air sampling experiments and "in a few cases, when some infected trees were chipped, a few cells were detected in the escaping debris." How was this determined?

There is no mention of surrounding the chippers with grapefruit seedlings, and taking these seedlings back to a containment greenhouse. Later, according to Gottwald, citrus canker lesions developed on these grapefruit seedling. The landfill experiments are referenced as "*Gottwald, unpublished data*."

Concluding Remarks

This note focused on a few selected topics of interest. These are lengthy articles, and cover many aspects of citrus canker. The more technical aspects of these papers, including microbiology are beyond my expertise.

Two areas, the epidemiology research and chipper/ landfill experiments were examined, and the basic details were missing in all articles. At what meeting was the 1900-ft policy decided? Graham's version of events conveniently does not include the word "meeting" nor mention any dates.

Some important facts on the chipper/ landfill experiments as presented by Gottwald at the ICCRW meeting in year 2000 are missing from Graham's article. No publication since Dr. Graham, has claimed to be able to identify bacterial cells of citrus canker from aerosols. In Dr. Gottwald's presentation in year 2000, he claimed that aerosols generated by chippers were capable of landing on grapefruit seedlings approximately 20 ft away and causing infections.

The concept of citrus canker being transmitted as an airborne disease has not been shown in any other technical publication except Gottwald's presentation.

All articles are not protected by copyrights so they have been posted to the online supporting documents website.

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References

1. Schubert, T.S., Gottwald, T.R., Shabbir, A.S., Graham, J.H., Sun, X. and Dixon, W., 2001, Meeting the Challenge of Eradicating Citrus Canker in Florida, Again, Plant Science, Vol 85, No. 4.

2. Gottwald, T.R,, Graham, J.H, Schubert, T.S., 2002, Citrus Canker: The Pathogen and Its Impact, Plant Health Progress, published online at www.apsnet.org (official website of the American Phytopathology Society) .

3. Graham, J.H., Gottwald, T.R., Cubero, J. and Achor, D. S., 2004, Xanthomonas axonopodis pv. citri: factors affecting successful eradication of citrus canker, Molecular Plant Pathology, 5(1), 1-15.

Stall, R.E, Marco, G.M., and Canteros de Echenique, B.I., Population Dynamics of Xanthomonas citri causing cancrosis of citrus in Argentina, Proc. Fla. Hort. Soc., 93: 10-14.

Canteros, B.I., 2004, Citrus Canker in Argentina— A Review, Proc. Int. Soc. Citriculture, Paper No. 9, 2004.