Short Note 1.2:

Contributions of Dr. Jack Whiteside

> *"The measures that are currently aimed at canker eradication are costly, laborious and the prospects for success are extremely limited."* J.O. Whiteside, April 1988, Fruits and Vegetables Journal.

Introduction

It was necessary to condense the contributions of Dr. Whiteside to a short paragraph in my book. I hope the posting of his articles, will in some way make up for this.

In the above quote, Dr. Whiteside was not referring to Canker War III, but to Canker War II, which by 1988 was in its second year of eradicating "true" citrus canker. The declaration of eradication in January 1994 would last only 22 months, as Canker War 3 began in October 1995. The quote seems equally applicable to Canker War 2.

Dr. Whiteside attempted to bridge the gap between the scientific knowledge of citrus canker at the time, and the unfortunate rhetoric being repeated by the Department, the USDA and citrus associations in support of the eradication programs from 1912 to 1988. The Florida Department of Agriculture in support of the two prior eradication programs maintained citrus canker is a devastating and highly contagious disease. The Department stressed for decades that the obvious choice was eradication, and should be a top priority of the Department. It was simply impossible to have a viable citrus industry and the presence of citrus canker disease anywhere in Florida at the same time. Further, the Department in various publications, argued that the 1912- 1933 campaign was proof that canker could be eradicated by healthy tree cutting.

However, this viewpoint is disputed by the writings of Dr. Whiteside. Dr. Whiteside worked as a plant pathologist with the University of Florida/ IFAS during the 1980's and participated in the Citrus Canker Advisory Task Force during Canker War 2. He is an expert in citrus diseases with extensive published research and had first hand experience with canker in his 19-year career in Zimbabwe and at the University of Florida from 1967 to 1988 He had also traveled to Japan and Argentina to further extend his research in citrus diseases, in particular citrus canker. He was the co-author of the Compendium of Citrus diseases. Some of his professional background is provided in Reference 4

Dr. Whiteside also gave expert testimony in the October 2000 Broward Court case, which discussed the epidemiology study. Although he has not published any article within the last 20 years on citrus canker, the FDACS posted on their citrus canker website a series of comments critical of some of his observations.

All references in this short note are posted on the online website, and the FDACS critical comments as well.

Control of Citrus Canker Dissemination

Dr. Whiteside provided extensive discussion of control measures, using windbreaks and copper sprays to limit the dissemination of citrus canker in commercial groves. Dr. Whiteside formed conclusions based on practices in Argentina. He states in the 1986 article[2], that "the climatic conditions in the northeastern citrus producing providences of Argentina probably come closer to those in Florida than do of any other major canker-infected citrus-producing country. Furthermore, most of the varieties grown in Argentina are the same in those grown in Florida."

He wrote in November 1985:

> Protection from the wind by the citrus trees themselves as they grow larger or by windbreaks has an extremely important role in the severity of canker attack...,

This was based on observations made in Argentina.

He recognized the susceptibility of citrus canker is tied to growth patterns, as follows:

> Canker bacteria invades leaves only while they are still young, but generally not before they have partially expanded.[3]

Since young trees produce more flushes than older trees, he suggests older trees can provide some protection to younger trees. Of course, the preferred option is to select non-citrus trees in creating a windbreak.

The 2014 UF/IFAS Citrus Pest Management Guide: Citrus Canker states that for areas where citrus canker is endemic, then control methods such as windbreaks, copper sprays and control of citrus leaf miner are recommended. As far as windbreaks, the guide states,

> Windbreaks are the single most effective means of dealing with canker. In our observations in Argentina, the number of canker lesions was ten times greater on the side of the tree exposed to the prevailing winds than on the protected side of the same tree. In tests in nursery situations, artificial windbreaks greatly diminished the distance of spread of canker down the nursery row and reduced disease to only a few scattered lesions."

Dr. Whiteside wrote extensively about control of canker using copper sprays and the need to correctly time the applications. An extension of Whiteside's work, is the UF/IFAS timing model for copper applications.

As stated in his 1989 letter, Dr. Whiteside notes in Argentina, copper sprays were being applied 5 times a year. He discovered that only two sprays need to be applied if the timing of the spraying is correctly done. Whiteside states:

> I estimated that two spray treatments of copper applied postbloom to young fruit should have provided acceptable control and this was confirmed by an Argentine plant pathologist. Infection of leaves was not sever enough to justify their protection from canker.

He also mentions that windbreaks appear successful. His writings pre-date the arrival of citrus leaf miner (CLM). However, it is likely that he would support the existing control measures for CLM in groves and nurseries.

The differences between the Department and Dr. Whiteside was not what constitutes control measures, but whether they are a realistic alternative to an eradication program. The Department considers control methods viable when citrus canker is endemic. But, how does one determine when this point has been reached?

Damage Caused by Citrus Canker

In the 1985 article (1), Dr. Whiteside traces the origins of the exaggerated impact of citrus canker to a 1915 article by Stevens, in which the author suggests canker attacks all parts of the plant including exposed roots, trunks and limbs. Whiteside concluded his article by stating:

> If citrus canker is not eradicated, canker would probably not be a major problem in Florida because of certain climatic limitations.

The question of whether to eradicate or control citrus canker was an economic choice, not a foregone conclusion based on exaggerated claims of its impact:

> The measures that are currently being applied against this disease can only be justified if the potential long-term economic losses are likely to be greater than the costs of a disruptive and possibly unsuccessful eradication campaign.

His viewpoint is that after each eradication, there were probably remnants, the undiscovered diseased trees, which help fuel the next outbreak. To Whiteside, it was the was the lack of contagious activity that made the disease elusive:

> If canker were a contagious and devastating disease, the eradication procedures would have clearly proven themselves inadequate. As long as relatively few new cases are found each year, some authorities may believe the pathogen is being conquered. However, even if there are no new finds, the disease could be present in small amounts and later become conspicuous to draw attention."

He also stressed that the damage to the tree is relatively minor as follows:

> Citrus canker has been perceived in the United States as an exceptionally destructive disease, despite its relative unimportance compared with other diseases in the citrus-producing countries where it has long occurred.

Similarly, Whiteside wrote in the 1988 article:

> The infection does not become systemic: that is, the canker bacteria do not move far from their point of entry. .. Defoliation from canker occurs mostly while the leaves are still young... In most countries where canker is endemic, it causes little or no tree debilitation. Essentially, canker is economically significant as a fruit disease, varying from a minor rind blemish to a more serious rind blemish with varying amounts of fruit drop depending on how conductive the climatic conditions are for infection.

Canker War I (1912 - 1933)

Citrus Canker War I is very poorly documented. If I did not have Dr. Whiteside's articles, I would only have sparse statistics from the Department. Whiteside provided the following table in his 1986 article, which is the only chronological tally of infected trees cut down during Canker War I.

Infected Trees Destroyed during Canker War I		
Date	Nurseries	Groves
Before May 1, 1915	320,406	5,650
May 1, 1915 to Apr 30, 1916	21,264	5,567
1917	451	2,089
1918	44	372
1919	4	15
1920	1	4
1921	0	540
1922	0	0
1923	6	873
1924	0	11
1925	0	0
1926	0	5
1927	0	85
From 1928 to 1933	0	0
Total	342,176	15,211

Schubert states approximately 3 million trees nursery plants were destroyed. This results in about 9 healthy to every infected tree. It actually sound quite low, considering the very high densities within the nurseries. I believe the 3 million trees might be right but the number of infected trees, particularly in nurseries before May 2015 may be in error.

Canker War I was fought in mainly in the nurseries, as Whiteside states[1]:

> During the years before 1915 that canker had free reign, it appeared in many nurseries and it was found in many new plantings that originated from these infected nurseries. There was, however, little mention of it, in bearing groves. This suggests that the conditions for survival of the pathogen might have been less favorable in groves than nurseries.

I showed the planting density in a nursery may be 100 to 200 times higher than in the groves, so this makes sense. Further the density of planting in groves may be 40 to 50 times higher than residential areas.

Canker would easily be disseminated in nurseries as a result of closely packed seedlings, overhead irrigation systems and the absence of regular inspections before the outbreak. It is difficult to determine how many of the nursery plants were infected with citrus canker. Whiteside states[3]:

> Part or all of those nurseries that had canker were destroyed by burning. In groves, only those trees which were observed to have canker pustules had to be burned. Thus, the measured used in infected groves were much less drastic than in nurseries.

Whiteside has doubts to whether the first Canker War was a success, as he states in his 1988 article:

> The discoveries in 1920, 1922 and 1927 are interesting because they occurred after canker had been eradicated from the nurseries. Perhaps these outbreaks represented a remnant from earlier inductions which had been previously missed by the inspectors. After canker was declared eradicated in 1933, canker inspection surveys were curtailed. This may explain why canker was not found again until the mid-1980's, after surveys were intensified and more publicity was given to the disease.

This is a conclusion which has very strong implications to the last canker outbreak. The increase and spatial distribution of canker incidences may be more closely related to the inspection efforts rather than to the dissemination of the disease.

False Identification of Canker in 1984 - 1986 and Issues of Department loyalty

Whiteside's discussion of the 1984- 1986 erroneous identification of citrus canker is detailed in References 4 and 5. The 1986 letter indicates that when microscopic examination identified bacterial streaming of collected samples, it was sufficient to conclude that the disease was a different strain of Xcc.

The lack of dissemination of this supposedly new strain of citrus canker, beyond the nursery where it was discovered, lead scientists including Whiteside to question whether it was really a new strain or different

bacterial disease. Of course today, scientists agree that the disease discovered at Ward's nursery was citrus bacterial spot or CBS.

In the 1989 letter, Whiteside states how difficult it is to question authorities. Dr. Whiteside states:

> By the end of 1984, I suspect that at least some of the plant pathologists involved with "canker" including some on the Task Force, had begun to realize that there had been a gross overreaction to the discover of the leaf spotting disease in the nurseries. But apparently, none of them was prepared to discuss this matter publically. One of most amazing and seemingly unnatural phenomenon displayed by members of the Task Force was the unanimity expressed on matters concerning citrus canker. This is something that rarely occurs among a gathering of scientists. This poses a question as to whether the members fell under political pressures to always say the "right thing" for fear of being considered disloyal to the canker eradication campaign.

Dr. Whiteside also recalls in the letter to Zachariah, the false identification of citrus canker in Mexico in 1983. The citrus industry representatives (Dr. Griffiths, with Florida Citrus Mutual, and Dr. Hannon, private consultant) pressed Dr. Stephen Poe for more stringent restrictions on imports from Mexico, even though the disease under discussion was not even a bacterial disease. It was a fungal disease.

The Elusive Nature of Citrus Canker

Whiteside expressed concern that any eradication program would be incomplete, and after a declaration of eradication has occurred, these remnants along with new introduction, would be the seeds of a new outbreak. Whiteside wrote in 1988:

> The current eradication campaign [in groves and nurseries] is based on a supposition that canker will eventually become detectable by visual inspection whenever it occurs, by always increasing in severity. However, we know from the Argentine experience that canker can decline in some groves to a level that is very difficult to detect by visual inspection. I believe, therefore, that it would be virtually impossible to eradicate canker from infective citrus groves unless there is extensive tree destruction around areas of noticeable infection. Such tree destruction would be intolerable to citrus growers unless there were convincing evidence they would be unable to economically tolerate the disease. [3]

The comments may seem to support healthy tree cutting, given the uncertainty or elusive nature of the presence of canker. While Whiteside could not have foretold the future, it seems the support of grove owners for an eradication program is more dependent on the level of compensation. If the level of compensation is set too high, then growers may actually want to have canker in their groves, to reap the generous compensation from the USDA.

Whiteside states:

> One particularly important lesson that should be learned from the Argentine experience is that the incidence of canker can vary greatly from year to year; frequently dropping to such low levels that it is difficult or even impossible to find any new symptoms on previously infected trees. While traces of inoculum may still remain in such groves, this decline gives a semblance of self-elimination. A similar disappearing act has been observed in Florida groves with scab. Scab is also a disease which depends on rain for infection and spread and which infects leaves, stem and fruit rind only while they are young. [3]

Unfortunately, others have erroneously interpreted what Dr. Whiteside stated, as to suggest that citrus canker was self-eliminating.

But, a decrease in canker incidences was documented in a controlled experiment in Argentina, as published by Dr. Gottwald of the USDA/ Agriculture Research Service and Dr. Timmer of the University of Florida/ IFAS. A copy of this paper is provided in the online supporting documents website.

In Gottwald's paper, a normal temporal disease progress curve is shown in Figure 1C, consistent with an increase presence of the disease with time within the experimental plot. Figures 1A and 1B are unusual, as the disease incidences decline with time in 1990. The authors explain this decrease as follows:

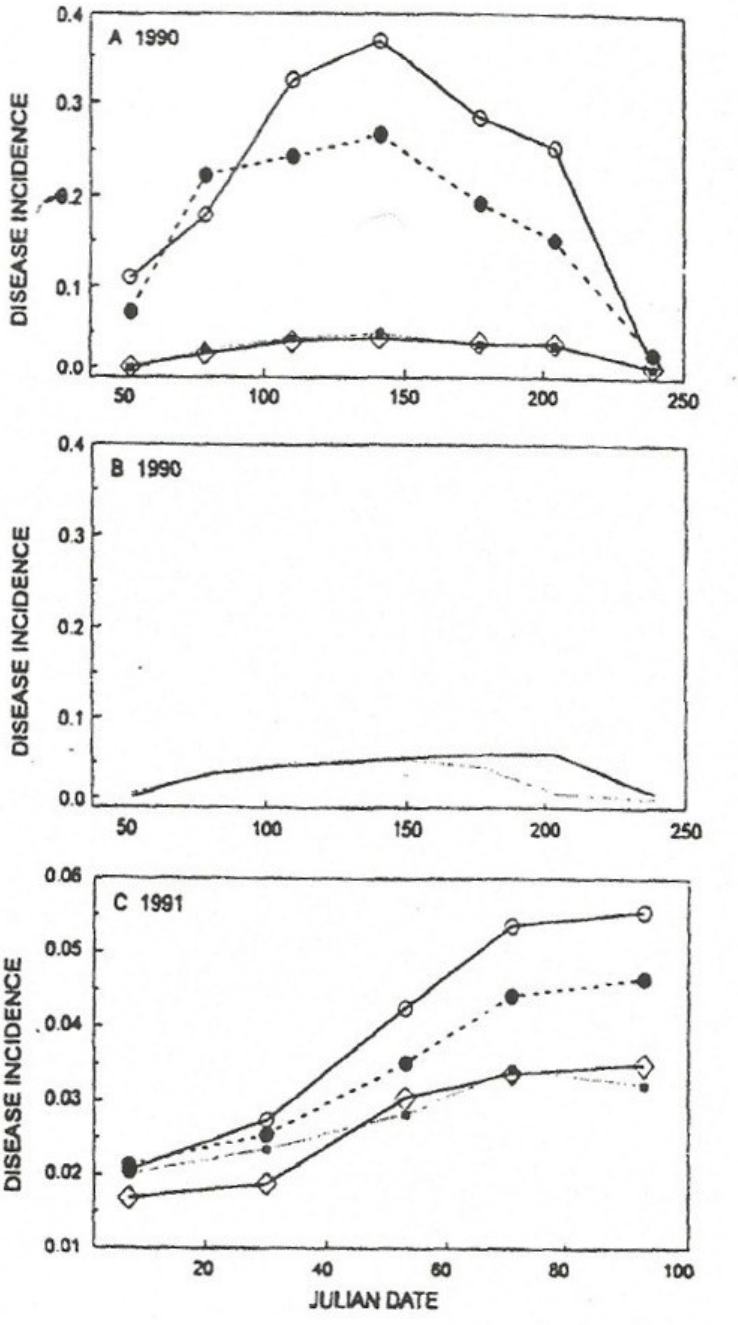
> For the 1990 control strategy plots, disease incidence reached an asymptote by the 141-day disease assessment then began to decline for the remainder of the season (Figure 1A). Similarly, for the 1990 Xcc-A versus Xcc-B comparison on lemon plots, disease incidences reached an asymptote by days 204 and 141, respectively (Figure 1B). This decrease indicated that fewer new infections were being observed because of reduced rainfall which when combined with continued tree growth, resulted in a reduction of the incidence of disease leaves. Older infected leaves fell while new disease-free flushes of leaves continued to form which resulted in a decrease in disease incidence later in the season.

A description of the experimental plots, and data collection are provided in the paper. The paper states: "Disease incidences, i.e. the number of infected leaves divided by the total number of leaves on each tree, was assessed at about 30-day intervals for seven and five months during 1990 and 1991, respectively.".

It is not known if the disease incidences were calculated as the fraction of trees with lesions divided by all trees in the plots, the same decline would occur. It is, however, would be likely to follow the same decline.

The results would seem to collaborate Dr. Whiteside observations that citrus canker can appear to do a "disappearing act" under the right climatic conditions.

Figure 1: Disease Incidence Growth Plots - Reference 6



Final Remarks

In Canker War II, a number of plant pathologists and citrus growers had strong doubts on the attainment of a canker-free Florida, even after millions of dollars had been spent. The time period which Dr. Whiteside published his articles, there was active debate on the approach the Department had taken. Therefore, when the debate re-emerged in year 2000, with the enactment of the 1900-ft rule, his articles suddenly became relevant again.

> The measures that are currently aimed at canker eradication are costly, laborious and the prospects for success are extremely limited." J.O. Whiteside, April 1988, Fruits and Vegetables Journal.

Some of the more important contributions made by Dr. Whiteside are summarized in this short note. On a personal level, I had one brief telephone conversation with Dr. Whiteside in year 2001. At that time, he had already submitted a deposition to the Broward Court, critical of the Florida field study methodology. We discussed how impossible it was to estimate lesion ages to the level needed in the study. A one day error in lesion ages would change the results.

I found that he had kept up well with the citrus canker efforts, but was reluctant to become involved in the current opposition to the program. He commented that he had done his best to spread the word of the exaggerated impact of the citrus canker.

It took a while, but it does look as if post-2006, the program adopted by the Department is more like he advocated in the 1980's.

References:

1. Whitesde, J.O., 1985, Canker Threat, How Serious a Threat is Canker to Florida Citrus Production, The Citrus Industry, November 1985.

2. Whiteside, J.O., 1986, Citrus Canker: Some Facts, Speculations and Myths about this Highly Dramatized Bacterial Disease.

3. Whiteside, J.O., 1988, The History and Rediscovery of Citrus Canker in Florida, Citrus and Vegetables, April 1988.

4. Whiteside, J.O., 1989, Memorandum to Dr. G.L. Zachariah, Vice President for Agricultural Affairs. (Letter is posted with permission from Dr. Whiteside).

5. Whiteside, J. O, 1986, Letter to Dr. Alfieri, Department of Agriculture and Consumer Services, Gainesville, FL 32602.

6. Gottwald, T.R and Timmer, L.W., 1995, The Ffficacy of Windbreaks in Reducing the Spread of Citrus Canker caused by Xanthomonas Campestris pv. citri,, Trop. Agric. (Trinidad), Vol 72, No. 3, July 1995.