

Short Note 3.2

Long Distance Transport of Citrus Canker by Hurricanes and Tornadoes

1. Introduction

The Department maintains that canker can travel up to 6 to 7 miles, based on articles appearing in scientific journals. These articles generally authored or co-authored by Dr. Gottwald. This includes the Letter to the Editor in the *Phytopathology* as published in 2001, article in *Fruits* as published in 1997, poster presentation at the International Congress of Plant Pathology in 1998, and presentation in the June 2000 at the International Citrus Conference Workshop. The full quote from Dr. Gottwald's Letter to the Editor in *Phytopathology* journal [1] reads:

The validity of the 125-ft rule for containment of the pathogen spread came into question for three reasons: (i) spread of Xac in a central Florida grove in the early 1990s was as much as 2600 ft in association with common rainstorms (ii) catastrophic weather conditions including hurricanes and tornadoes was documented by subsequent disease survey to cause spread of bacterium up to 7 miles (17) and (iii) destruction of 125 ft in citrus groves and urban areas failed to reduce the progress of the disease.

The reference to (17) is his article in *Fruits* magazine article [2] which states (page 375):

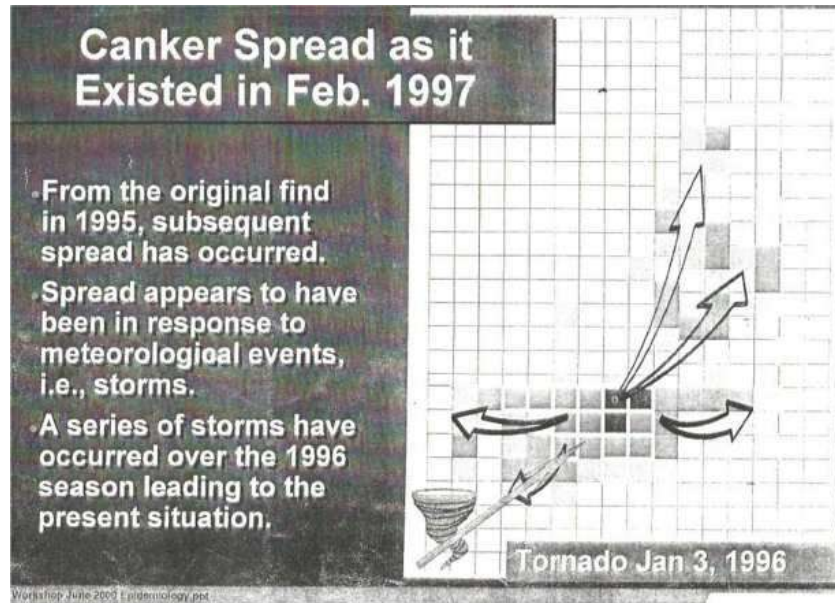
During a local 3 January 1996 rain storm, a tornado passed through the citrus canker infected area of Miami on a Southwest to Northeast track of the main infected of Miami on a Southwest to Northeast track. By mid summer of 1996, numerous infections of citrus canker were found to the North and Northeast of the main infected area. The age of the oldest lesion in the newly infected areas to the North and Northeast was consistent with a January dispersal event. The distribution patterns and age estimates of new infections in late 1996 suggest that Xac may have been spread over 6-7 miles from a single event about this time.

The following is from an abstract of the the 1998 poster presentation at the International Congress of Plant Pathology (paper 2.4.2) by Dr. Gottwald (copy posted to the website):

The presumed infection cycles and age of infections in newly infected areas correspond well with five major meteorological events: hurricane Gordon (November 1993), and Erin (August 1995), tropical storms Jerry (August 1995) and Josephine (October 1996) and a tornado crossing urban Miami area (January 1996)

Dr. Gottwald made a presentation in the November 2000 Broward Court case, which is shown in Figure 1. It is likely the same as presented in the International Citrus Canker Conference in June 20, 2000 because at the bottom of the slide it is noted, "Canker Workshop June 2000 Epidemiology. ppt." The article in *Fruits* [2] states a tornado coming in a SW to a NE direction on January 3, 1996, passed directly over Sweetwater area, near the initial discovery of citrus canker in urban Miami.

Figure 1: Presentation of Canker Spread and tornado path as presented by Dr. Gottwald in year 2000 in the Broward Court case



Each section is one square square mile. The longest arrow would be approximately 12 miles, pointing to a section approximately 2 miles from the Broward/ Miami-Dade county line.

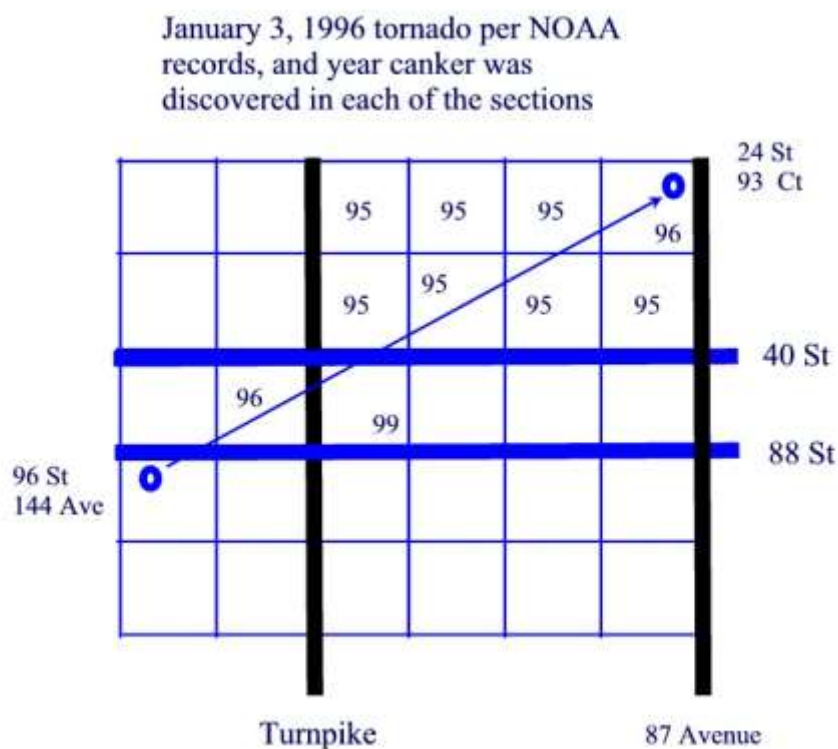
2. Review of the Jan 3, 1996 Tornado

Weather records are available from the National Oceanic and Atmospheric Agency (NOAA). The January 3, 1996 tornado is described as follows:

The tornado's first touched down near SW 96 St and 144 Ave, knocking down a small tree. The tornado's path was intermittent for the first 3 1/2 miles, then became continuous from SW 67 St and 123 Ave to where it lifted on the north side of 24 St and 93 Court. The tornado became active at 8:07 am and ended about 5 minutes later at 8:12 am. It was 40 yards wide and 7 miles long.

The year citrus canker was first discovered in Miami-Dade was obtained from a FDACS map as provided on their website, and shown in Figure 2, with the tornado path.

Figure 2: Tornado path and discovery of citrus canker



The tornado passed mainly through sections where canker had been discovered previously. The section where the tornado began, is in the Hammocks area, just south of Kendall Drive (88th St). Citrus canker was discovered in this section in year 2000. With winds of 110 mph, it damage trees making them more susceptible to canker. However, it is more likely any citrus in its path would be destroyed. Given a tornado 7 miles long, and 120 ft wide, the affected area is only 0.16 square miles. Therefore, its impact was likely minimal.

3. Review of Hurricanes as cited in articles by Dr. Gottwald

The Fruits journal article (vol 52, 1997) discusses Hurricane Erin and tropical storms Jerry and Lili.

Hurricane Erin (August 2, 1995) made landfall near Vero Beach. Not surprising, hurricane Erin had no effect in Miami with less than a quarter inch of rain, but was a fairly breezy day with gusts up to 29 knots. Dr. Gottwald concludes that hurricane Erin had a slight effect on canker spread.

Tropical storm Jerry hit on August 25, 1995. Weather conditions as report at Miami International Airport according to NOAA records indicate no rain and peak wind gusts up to 18 knots. Although there was no rain reported, Dr. Gottwald states that tropical storm Jerry was a “main contributor to *Xac* distribution found in 1995” in the Fruits article. Wikipedia reports about 1-3” for the period August 22 to 29, 1995. Heavier rainfall occurred in West Palm Beach.

Hurricane Lili pass through the eastern part of Cuba, then veered to the north in October 14 to 27, 1996. According to Dr. Gottwald, it was not effective in spreading canker as it was too far south and there was only rain in Miami.

At the Task Force meeting on November 16, 1999, Dr. Gottwald made a presentation, where he emphasized the effects of Hurricanes Floyd, Harvey and Irene. Hurricane Irene (Oct 12- 17, 1999). resulted in 18” of rain and 90 mph wind gusts. There were no hurricane force winds on the mainland of Florida. The hurricane passed over Big Pine Key in the Florida keys, and then proceeded along the coastline up to Boynton Beach.

Citrus canker was discovered on Big Pine Key in 2001. It is speculated that asymptomatic infected citrus trees were planted after the Hurricane Irene.

At the November 16, 1999 Task Force meeting, Dr. Gottwald indicated he developed a model to predict new incidences of citrus canker based on wind and rain data. This model is reviewed in Appendix C. It is the conclusion in Appendix C that the model is based on an invalid correlation analysis.

The Fruits article seems to downplay the significance of Hurricane Andrew as contributing to the epidemic. Hurricane Andrew hit the Homestead area of Florida in August 1992. It seemed the following year, there were numerous new pests reported including the brown citrus aphid, vector of citrus tristeza virus (CTV), Asian citrus psyllid, vector of citrus greening and citrus leafminer. It is possibly that due to the high demand for all horticulture plants after Hurricane Andrew and existing nursery stock was in short supply. Thus, it is possible citrus plants carrying both diseases and pests were inadvertently introduced into the nurseries in Florida. This is discussed in Chapter 9.

4. Concluding Remarks

The conclusion reached by Drs. Gottwald and Graham in the 1997 Fruits journal that tropical storm Jerry was the “main contributor to the spread of canker in 1995” appears not supported by weather data, at least within the areas of Miami County where citrus canker was discovered. There may have been more rain further north of Miami, in the West Palm Beach area.

The statement made in the Letter to the Editor in Phytopathology [1] that citrus canker could be spread 6 to 7 miles as a result of tornados and hurricanes was not supported by data. The January 3, 1996 tornado path was very narrow (120 ft) and affected 0.16 square miles. It passed through many sections where citrus canker was already present.

High winds and light rainfall are most conducive to long distance transport as discussed in Chapter 3. Heavy rains for long durations tend to wash off or dilute bacteria. Dr. Gottwald presented numerous times (November 16, 1999 Task Force meeting, the International Citrus Canker Research Workshop, November 9, 2000 Broward Court presentation and the 2002 article in Phytopathology [3]) results of a correlation analysis. The manner the correlation analysis was done is incorrect as shown in Appendix C.

The restocking of nurseries occurring after Hurricane Andrew may have introduced new pests and disease, into nurseries, including citrus canker.

References

1. Gottwald, T.R., Hughes, G., Graham, J.H, Sun, X., Riley, T., 2001. The Scientific Basis of Regulatory Eradication Policy for an Invasive Species, *Phytopathology*, 91:30-34.
2. Gottwald, T. R. and Graham, J. H., Schubert, T.S. 1997. An Epidemiology Analysis of the Spread of Citrus Canker in Urban Miami, Florida and Synergistic Interaction with the Asian Citrus Leaf Miner, *Fruits*, Vol 52-5, 371, 1997.
3. Gottwald, T.R., X. Sun, Riley, T. Graham, J.H., Ferrandino, F. and Taylor, E., 2002. Geo-Referenced Spatiotemporal Analysis of the Urban Citrus Canker Epidemic in Florida, *Phytopathology*, Vol 92, No. 4.