

The potential threat of exotic diseases to Florida citrus

By K.R. Chung

Diseases have been destroying crops since the beginning of agriculture in human history. Citrus diseases are not substantially different from disease situations of other crops. As with many plants, fungi, bacteria, viruses, phytoplasmas, spiroplasmas and nematodes can cause diseases in citrus.

Citrus is Florida's leading agricultural crop, providing countless jobs and contributing several billion dollars of annual income to the state. Economic losses in marketing, production, and the trade implication of diseases can be severe, but fortunately, not all pathogens attacking citrus are present in Florida.

This situation is changing rapidly due to international activities and globalization of markets. Frequent travels and increased tourism and immigration have increased the likelihood of importing exotic pathogens into the state, and thus have significantly changed the methods of citrus production and profitability and stability of the industry in Florida.

Citrus canker eradication and the newly identified citrus greening (Huanglongbing) disease have highlighted the adverse economic impact on the Florida citrus industry, and also have shown the vulnerability of Florida citrus to catastrophic losses caused by exotic pathogens. This article is intended to discuss the potential exotic disease threats to Florida citrus in the hope of preventing further imports of unwanted pathogens.

Due to the increasing globalization travel and commerce, the citrus industry of Florida is now facing enormous challenges posed by exotic diseases. Exotic diseases have diverse impacts on the Florida citrus industry, affecting the viability of the industry and the cultivars that can be profitably grown. Any exotic citrus diseases, if introduced into Florida, will increase production costs and decrease profitability for Florida growers.

As with all cases of invasive species, importation of exotic pathogens into Florida is accidentally or deliberately mediated by human movement. Any

exotic pathogens, once introduced, will likely become established.

CANKER AND GREENING

Florida growers are very familiar with citrus canker and its impact on citrus production. The current outbreak of canker was discovered near Miami in late 1995, and one of the largest regulatory programs in the history of agriculture was launched to eradicate the disease in Florida.

The level and magnitude of the impacts of citrus canker is far beyond those initially projected. Recognizing the futility, the citrus canker eradica-

tion program was ended in 2006 after the severe hurricanes in 2004 that spread the disease widely. Now Florida growers are forced to live with citrus canker as an endemic problem. As with many disease management programs, control of citrus canker is costly and time-consuming and there is no single pest management approach that is effective in mitigating citrus canker.

Another destructive disease, citrus greening, was identified in Florida for the first time in 2005. It further showed that the Florida citrus industry is vulnerable to attack by new diseases.

Table 1. A list of citrus diseases exotic to Florida.

| | Diseases | Casual agent | Distributions | Cultivars affected | Relative Importance (%) |
|----|------------------------------------|---|--|---|-------------------------|
| 1 | Citrus greening (Huanglongbing) | Psyllid-transmitted, phloem limiting bacterium (<i>Candidatus Liberibacter</i>) | Asia, South Africa, Brazil | All citrus | 100 |
| 2 | Black spot | Fungus (<i>Guignardia citricarpa</i>) | Asia, South Africa, South America | All citrus | 75.4 |
| 3 | Tristeza-stem pitting (CTV-SP) | Aphid-transmitted virus | Asia, Australia, South Africa, Brazil, and Colombia | Lime, grapefruit, sweet orange | 56.5 |
| 4 | Phaeoramularia leaf and fruit spot | Fungus (<i>Phaeoramularia angolensis</i>) | Africa | All citrus | 24.9 |
| 5 | Citrus Variegated Chlorosis (CVC) | Sharpshooter-transmitted, xylem-limiting bacterium (<i>Xylella fastidiosa</i>) | Brazil | Sweet orange | 23.0 |
| 6 | Citrus canker | Bacterium (<i>Xanthomonas axonopodis</i> pv. <i>citri</i>) | South Asia, Africa, Central America, Japan, Brazil, Florida | All citrus | 22.3 |
| 7 | Citrus Sudden Death (CSD) | virus | Brazil | Sweet orange on Rangpur lime or Volkamer lemon rootstocks | Unrated |
| 8 | Citrus Chlorotic Dwarf (CCD) | Bayberry whitefly-transmitted virus | Mediterranean | All citrus | 6.9 |
| 9 | Leprosis | Mite-transmitted virus | Brazil, South America | Orange, mandarins | 2.2 |
| 10 | Vein Enation (Woody gall) | Aphid-transmitted Virus | Asia, Australia, South Africa, Spain, South American, California | Mexican lime, Rough lemon, sour orange | 0.48 |
| 11 | Sweet Orange Scab (SOS) | Fungus (<i>Elsinoe australis</i>) | South America | Sweet orange | 0.46 |
| 12 | Satsuma Dwarf | Soil-borne virus | Japan | All citrus | 0.19 |
| 13 | Australian Citrus Dieback | Phytoplasma-like | Australia | Grapefruit, sweet orange, mandarins | 0.18 |
| 14 | Citrus Yellow Mosaic | Virus | India | All citrus | 0.15 |
| 15 | Stubborn | Spiroplasma (mollicute) | California, Africa, Mediterranean, Middle East | All citrus | 0.10 |
| 16 | Powdery Mildew | Fungus (<i>Oidium tingitaninum</i>) | Asia, Central and South America, California | | 0.02 |
| 17 | Lime Witches' Broom | Phytoplasma | Oman, UAE | Lime | 0.02 |
| 18 | Mal Secco | Fungus (<i>Phoma tracheiphila</i>) | Mediterranean | All citrus | 0.01 |

(Source: The Workshops of the Exotic Citrus Pathogen Threat Project led by Drs. S. M. Gamsey and H. W. Browning)

EXCLUSION AND QUARANTINE

Exclusion and quarantine measures associated with inspection at ports of entry and at sites of production is the most effective approach to control exotic pathogens not known to be widely established in a region. In principle, preventing exotic diseases from entering Florida is much easier and effective than trying to eradicate or control them once introduced and established.

To create a risk-based framework in dealing with exotic pathogens, a review panel comprised of more than 10 members from various scientific disciplines was formed several years ago. The team led by Steve Garnsey and Harold Browning evaluated 18 potential exotic diseases of citrus that threaten Florida (Table 1). The work was funded by the Florida Agricultural Experiment Station and grants from the Florida Citrus Production Research Advisory Council (FCPRAC). Background information and an evaluation sheet for each disease was developed and distributed to reviewers.

The relative importance of the diseases based on the criteria of economic impact, potential for introduction, establishment, spread, difficulty for detection, and control was thoroughly discussed and debated and rated (on a scale of 1-5 for each criterion) by all participating reviewers. Consequently, consensus recommendations for each individual disease that posed a potential threat to Florida's citrus industry were generated to gain better understanding of those diseases and to pre-

vent their introduction and spread.

As shown in Table 1, citrus greening (Huanglongbing), black spot and Tristeza-stem pitting (CTV-SP) had a high probability in all factors, and thus were predicted to have the most impact on Florida citrus. Citrus greening affects all citrus cultivars important in Florida and can rapidly destroy existing groves and prevent commercial production.

CTV-SP isolates are widespread in Asia, Australia, South Africa, Brazil, Colombia, and other areas.

Florida also has the brown citrus aphid vector that is capable of transmitting CTV-SP. There is clearly a potential for the introduction and natural spread of CTV-SP in Florida.

All reviewers agreed that *Phaeoramularia* leaf and fruit spot, Citrus Variegated Chlorosis (CVC), canker, and Citrus Sudden Death (CSD) might also have substantial impacts to our Florida citrus industry. Climatic conditions in Florida are favorable for the occurrence and establishment of all these diseases.

It appears that if *Phaeoramularia* leaf and fruit spot, or CVC, is introduced, it has the potential to become a significant problem for Florida citrus production.

In contrast, other diseases such as leprosis, sweet orange scab, and vein enation are less important due to lower probabilities of introduction, establishment or spread if introduced, or ease of control.

Some diseases such as stubborn,

Citrus Chlorotic Dwarf (CCD), and Mal secco that are found primarily in the Mediterranean areas may have less impact since their causal agents have low probability of becoming established in the environmental conditions of Florida, and thus can be likely contained if introduced.

Background information for each exotic citrus disease is being presented in a series of fact sheets and some of them can be found at http://edis.ifas.ufl.edu/TOPIC_SERIES_Citrus_Diseases_Exotic_to_Florida.

Control of diseases in citrus is difficult if the causal agents become widespread and the vectors are well established. To protect the Florida citrus industry, it is important to avoid the introduction of any citrus propagation materials from high risk areas to Florida. Illegal importation of citrus and related materials must be stopped. Any citrus and live plant propagating materials MUST be introduced by proper procedures through the Florida Department of Agricultural and Consumer Services, Division of Plant Industry.

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