Changes to Florida citrus production systems and an economic outlook based on science

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Over the past several years, the Florida citrus industry has been faced with many challenges, including hurricanes, citrus canker, Huanglongbing disease (HLB, greening), labor shortages and urbanization. To remain viable, the Florida citrus industry will have to adapt to these new pressures in all aspects of production, harvesting, processing and marketing.

Some of these changes are already taking place, such as the new nursery regulations that took effect on Jan. 1, 2007. This article discusses different elements of production systems in Florida citriculture and how they may change over the next several years, along with an economic assessment of production costs in the presence of canker and greening diseases.

The challenges listed above mean that grove life expectancy may decrease; thus, groves must become profitable sooner than they have historically. This may be achieved by increasing the intensity of grove management. Also, orchard design may change, tree density will likely increase, tree nutrient and water management will have to become more refined, and some new (to Florida) horticultural practices may need to be adopted.

Currently, average tree density for Florida orange groves is about 140 trees per acre (12.5 x 25) with the highest recommended planting density being about 218 trees per acre (10 x 20). With current production practices, this highest recommended planting density can lead to increased canopy maintenance and possibly reduced yields due to crowding under some conditions. For discussion purposes in this article, the term "high density" will be used in reference to planting densities that exceed the current recommendations, achieved by decreasing either within or between row spacing, or both.

Microsprinkler irrigation systems have become the norm in Florida. They are less expensive to install and generally use less water than other systems (e.g. permanent overhead sprinklers). They operate at lower pressure which reduces energy consumption and they can be easily automated. Additionally, microsprinklers offer some degree of cold protection during radiation freezes. However, the emitters do require frequent maintenance and can become clogged by minerals, algae and ants. Systems such as drip irrigation are one way in which irrigation efficiency may be further improved in the future. Most growers have adopted the IFAS best management practices (BMPs) for fertilization. The majority of growers still use dry fertilizers applied in three to six light applications per year, but fertigation has become more commonplace and there is some interest in slow-release fertilizers which are more expensive.

Table 1. Increasing grove care cultural costs for managing citrus canker and greening in a mature citrus grove*

	Total costs** ($/acre)	% change	Spray costs ($/acre)	% change
Annual base grove care costs (Mature grove)				
Valencia (Ridge)	769		132	
Hamlin (Ridge)	769		132	
Grapefruit (Indian River)	1,039		383	
With citrus canker				
Valencia (Ridge)	839	9	153	16
Hamlin (Ridge)	877	14	189	43
Grapefruit (Indian River)	1,305	25	418	9
With citrus greening				
Valencia (Ridge)	1,048	36	336	154
Hamlin (Ridge)	1,048	36	336	154
Grapefruit (Indian River)	1,331	28	540	41
With citrus canker and greening				
Valencia (Ridge)	1,048	36	336	154
Hamlin (Ridge)	1,086	41	336	181
Grapefruit (Indian River)	1,450	40	540	41

**Source: "An economic assessment of the future prospects for the Florida citrus industry." UF-IFAS Food and Resource Economics Department. March 2006.*
***Includes spray costs.*

SCENARIOS

There are several scenarios that could develop over the next few years as the industry's response to greening develops. First, growers aggressively scout for and remove greening-infected trees together with an intensive psyllid management program, and abandoned groves are removed, resulting in low levels of inoculum to infect new plantings. Under this scenario, little overall change will occur in the industry aside from the nursery regulations to produce clean trees.

Second, some growers do not remove greening-infected trees, have poor scouting and psyllid control programs, and abandoned groves are left standing, resulting in abundant inoculum and high vector populations. Under this scenario, major industry changes will be required, and unless prices stay high, it may not be economically feasible to produce citrus in Florida.

The most likely scenario is some middle ground between these two. So how may production practices change to adapt to this middle ground over the next five to 10 years?

TREE SPACING

A number of studies of planting density have been conducted in Florida with densities ranging from below the current standard to as high as 818 trees/acre. Important to note is that all of these studies were conducted when the lifespan of commercial groves was still in the 25-30 year range. Thus the timeline for canopy closure and first crop was longer than necessary for early production and returns under greening and canker pressure (probably three-four years). However, one conclusion developed

from that research and corroborated by observations in other citrus producing areas is that moderate vigor rootstocks produce the best results in high density plantings. Apparently, moderate vigor rootstocks result in the best balance between tree vigor to fill the allotted space quickly, but without being too vigorous and difficult to control at high densities. In all cases, these high density trials were maintained using traditional hedging and topping, which may not be the best option for a high density grove.

Far into the future, tree spacing in newly planted groves may decrease both within and between rows, but for the short term, between-row spacing cannot drop much below 20 feet due to equipment limitations. However, within-row spacing may drop to between 6 and 8 feet. The primary benefit of spacing trees this close will be higher early yields, but spacing alone will not be enough to produce early yields.

FLOWERING AND FRUITING

Yield is a function of flowering and fruit set. Flowering in citrus is induced by cool temperatures (<68°F) and/or water stress. In Florida, cool temperatures are the primary stimulus for flower induction. In general, flower induction in Florida is not as good as in a Mediterranean climate where more than sufficient chilling occurs and warm spells rarely interrupt chilling accumulation. For these reasons, setting a heavy crop on young trees may be problematic under Florida conditions. Also, our relatively warm winters prevent, particularly young trees, from becoming as dormant as occurs in Mediterranean climates. This, too, affects flowering and poses issues for psyllid management. Drought stress may be one way to overcome both the low flower induction and lack of quiescence, but with our current production methods and unpredictable winter rainfall, that can be difficult to achieve.

Even if good flowering can be achieved, fruit quality on young trees is generally lower than on mature trees. Anecdotal evidence suggests that this can be overcome by increasing the crop load on young trees so that vegetative growth is reduced and more resources go into fruit development. Horticultural techniques such as girdling have been used in other citrus areas to achieve this. The applicability and effectiveness of girdling in Florida is just one practice that IFAS researchers will be studying as we move ahead.

IRRIGATION AND FERTILIZATION

The current microsprinkler irrigation systems used by most growers will likely continue to be the industry standard for some time. However, one avenue for further increasing irrigation efficiency in Florida citrus production is drip irrigation, particularly in combination with high density plantings. Limited research has been done on the feasibility of using drip irrigation in Florida citrus production. An early conclusion found that the limited root zone coverage of drip irrigation, coupled with the limited lateral movement of water in our sandy soils, would prevent the use of drip irrigation on Florida citrus because it could not meet the evaporative demands of the tree. However, new irrigation controller technology, coupled with a better understanding of irrigation scheduling when using drip irrigation (i.e. pulsed irrigation), will probably allow drip irrigation to be used successfully in Florida citrus. The disadvantages to using drip irrigation will be the lack of freeze protection and the high initial costs of electronic controllers for the irrigation system. However, drip irrigation offers the opportunity to intensively manage the root zone, which has many potential benefits, including intensive nutrient management.

There has been limited work done in Florida to compare the benefits of dry granular fertilizer to fertigation. When properly managed, both methods of fertilization result in adequate plant nutrient status with minimal nutrient leaching. Frequent fertigation (80 times per year) does not result in any greater tree growth, yield, leaf nutrient levels or leaching when compared with less frequent fertigation (37 and 12 times per year). Although, fertigation frequency has not been fully studied in combination with other production changes previously mentioned (planting density, drip irrigation). Frequent or continuous fertigation at low concentration could maximize uptake efficiency, reduce leaching during a heavy rain event, allow for quick replacement of nutrients after a rain event, and provide for easy and rapid changes to nutrition programs in an intensively managed production system that incorporates the other changes discussed. A highly managed nutrition and irrigation system may also aid in controlling flushing — thus, aiding in psyllid and canker management.

SCOUTING AND PSYLLID MANAGEMENT

Scouting must increase. Groves will need to be scouted in their entirety probably no less than three times per year. This process will be hindered if trees are not well maintained since nutrient deficiencies can be easily mistaken for greening. Even the best scouts will have difficulty finding greening-infected trees if nutrient deficiencies are common. Although new methods for detecting suspect trees through spectral analysis and other techniques are being researched, they will never completely replace well-trained scouting crews. In conjunction with scouting, psyllid management will need to be vigilant, with particular emphasis paid to spring and summer when new flush is present.

WINDBREAKS

Living windbreaks have a limited history in Florida citriculture, but they have a longstanding history of successful use throughout the world in a variety of crops including citrus. Windbreaks have a new importance in Florida because of the presence of canker disease which is substantially spread by wind-blown rain. Research and field experience have shown if wind speed can be reduced below about 20 mph, spread of the disease is greatly reduced, if not stopped, as observed in countries such as Argen-tina, Brazil and Uruguay where canker exists. Furthermore, windbreaks also offer the advantage of reducing fruit blemishing from wind scar, an important consideration when fruit are grown for the fresh market. However, windbreaks may reduce air drainage on cold nights, thereby increasing the risk of freeze damage.

INTENSIVE MANAGEMENT SYSTEMS

When all of the aspects above, along with some that have not been discussed (such as canopy management) are integrated, they form an intensive management system. One such system which is being used in citrus production in South Africa, Australia and on a small scale in California is the Open Hydroponic System (OHS). OHS adapts soil-less hydroponic concepts to soil-based production to increase yield and fruit quality. The primary principle of OHS is that nutrients are applied continuously through drip irrigation that is pulsed throughout the day. The goal is to concentrate

root growth in a small wetted soil volume by restricting the number of drippers per tree. OHS, as is any intensive management system, is complex and requires skill and vigilance on the part of the grower.

Whether growers in the future choose to adopt an OHS management system or just a couple of aspects of intensive management, one thing is certain: Inputs to Florida citrus production are going to increase.

ECONOMIC ASSESSMENT OF CITRUS GREENING AND CANKER IN FLORIDA

Implementing the strategies to manage citrus greening and canker described above will result in higher costs for all horticulture grove practices. In Table 1, the estimated additional costs for managing these two diseases are summarized. For citrus canker, total grove care costs will increase between 9 percent and 14 percent for processed oranges and 25 percent for fresh market grapefruit. Spray costs will increase 16 percent for Valencia oranges, 43 percent for Hamlin-early oranges. Since the fresh fruit pest and disease program already includes more sprays than for processed fruit, the spray cost increased only 9 percent.

However, when the costs for managing citrus greening are included, total costs for processed oranges would increase 36 percent over non-greening costs with spray costs increasing by 154 percent. Total costs including greening would increase by 28 percent for fresh market grapefruit with spray costs increasing 41 percent. As stated above, the base non-greening spray program for fresh market grapefruit already includes several more sprays than a processed orange spray program.

For a review of an economic analysis to assess the future of citrus investment in Florida, refer to a 2006 report compiled by the UF-IFAS Food and Resource Economics Department (FRED): Economic Analysis-Assessment of Florida's Citrus Industry Under Citrus Greening and Canker (http://www.fred.ifas. ufl.edu/files/economic_assess_flcitrus_indus.pdf). The analysis on future citrus investment included the following situations: 1) existing mature citrus groves; 2) replanting of existing citrus groves; and 3) planting a citrus grove on new purchased land. Land value cost was included only in the new land purchase scenario, but not in the mature grove and replanting scenarios. The analysis compared five scenarios: 1) no canker or greening; 2) canker only; and 3-5) greening and canker at a low, medium and high rate of greening infection. The analysis assumed that the recommended citrus greening and canker management strategies would be successful.

CONCLUDING COMMENTS

The challenges facing Florida's citrus growers and industry with managing citrus greening and canker will require implementing new horticultural strategies. These new strategies will result in higher costs that will have to be overcome through higher fruit production to lower unit costs. As in the past, Florida's citrus growers working with the UF-IFAS faculty can overcome these new challenges to assure a productive and profitable future for Florida's citrus industry.