FE712

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Economic Evaluation of Citrus Greening Management and Control Strategies[1]

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Introduction

Huanglongbing (HLB), or greening, was discovered in Brazil in 2004 and in Florida in 2005. Since being detected in the Homestead area, greening rapidly spread northward in Florida, and has now been detected in over 30 citrus producing counties. Trees may be infected with greening for one to two years (some possibly longer) before becoming symptomatic. Thus, many believe greening was present in Florida years before it was officially discovered. Significant research efforts are being devoted to finding and implementing strategies to minimize and control the spread of greening. An initial goal of the greening control strategy is to remain in production following a management program that leads to the greatest long-term profitability until better controls are discovered. This article explores the profitability of various types of control measures now being practiced in the citrus industry.

Controlling the Spread of Greening

Recent experience in Brazil has shown that when greening is detected early enough and control practices are followed diligently, groves can remain productive with disease incidence at low levels. The key is early detection, followed by effective control practices. In Brazil, after three years of intensive spraying for psyllids, scouting for the disease, and aggressive removal of infected trees, the rate of greening infection in some of the best managed groves is below 1%. Other diseases are causing more tree losses than greening in these groves.

Discussions with Florida citrus growers who have found greening in their groves indicate that most believe they waited too late to develop survey and vector management programs. Thus, they expect to have difficulty reducing future infection rates. The reality is that greening has rapidly spread throughout Florida's citrus producing areas, and even if it cannot be detected in a specific grove, it is probably still present, but the trees are not symptomatic yet. Researchers in Brazil and Florida as well as growers,

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who have field experience working with greening, agree that whatever level of infection is determined by grove scouting, the true level of infection may be twice that because of asymptomatic trees. Also, while the overall infection rate for a large grove may be low (1% to 2%), some blocks may have much higher rates. For example, some growers with less than a 2% infection rate overall are finding individual blocks with over 50% positive trees.

Learning curves about controlling greening are steep, much experimentation is ongoing, and greening control strategies vary among citrus growers. Some growers do not believe that greening is a serious threat and are following no control programs. Some know that they have greening but, rather than institute control practices, plan to realize profits as long as possible before replanting trees or selling the land. Others believe that because their neighbors are not controlling greening in their own groves, their efforts to do so would be futile, so they plan to realize profits as long as possible rather than destroy currently high-yielding trees. Some are spraying, and scouting from the ground, but are not removing infected trees aggressively. Other growers are aggressively following integrated practices to manage greening.

Some growers contract for scouting and identification services while others have their own in-house services. Contracting for scouting and identification services is still evolving. Prices for contract services currently range from $16 to $35 per inspection per acre, and services vary. The most comprehensive services provide GPS maps and location of each positive tree, send samples to labs, etc. Rates and degree of service should stabilize and become more uniform as the market develops.

Aggressive integrated practices for managing greening include scouting and identification of infected trees from the ground for smaller trees, and from elevated platforms for taller trees, four times a year; prompt removal of infected trees; applying systemic insecticides, such as Temik® for mature trees and Admire® for young trees; and spraying with foliar insecticides at least five times a year. Three of these sprays would be in addition to the regular spray program. If high psyllid populations are observed, additional sprays will be needed. In Florida, the optimum number of spray applications to minimize tree loss still has not been determined. In well-managed Brazilian groves, young trees are sprayed up to 24 times a year and mature trees 12 times a year.

Control of innoculum by removing infected trees is the most critical component of a successful greening control program. Thus, the sooner infected trees are removed, the better the chances of reducing future infections. An experienced scouting crew can identify trees accurately, enabling the removal of infected trees without the turn-around time it takes to send infected leaves to a lab for confirmation. Thus, the number of trees with suspect samples sent to a lab for verification from these programs is a small percentage of the trees removed. In Brazil, the objective is to remove infected trees the day they are identified.

Greening Management Alternatives

A range of greening management alternatives are being followed in the citrus industry and are discussed in this section. The first alternative is no control. Experience in Brazil has shown that once a grove is infected with greening, it only has a few years left as an economically viable grove. Even though the economic consequences of this option are evident, it was analyzed and compared to a similar grove where greening was being controlled in order to quantify the benefits of an effective greening control program.

When greening management practices are being implemented and infected trees are removed, two alternative strategies can be followed. One is to reset trees that were removed. The other is not to reset the trees, but continue to remove infected trees until reduced tree numbers make the grove economically unproductive. Once the grove is economically unproductive, the remaining trees are removed and the grove is replanted.

There are advantages and disadvantages to both of these strategies. Nursery trees are currently scarce and for those who cannot obtain them, resetting is not an alternative until trees become available. New flush is required for psyllids to lay eggs as well as for subsequent development of psyllid nymphs. Young trees that produce multiple flushes throughout the year are at greater risk for infection than mature trees, which produce fewer flushes, and young resets in a grove with mature trees supporting psyllids are at greater risk than solid set young trees. Thus, it may not be possible to successfully grow resets in a grove with greening. In this case, removal of infected trees until the grove is economically unproductive followed by replanting is the preferable strategy.

Alternatively, if resets can be protected with aggressive application of systemic and foliar insecticides, and tree losses from greening can be reduced to levels at or near those being achieved in Brazil, then resetting gives perpetual life to the grove and does not require the investment of capital and lost income of replanting.

Finally, for groves that are not being reset, what do the economics of replanting provide? If resets cannot survive in a mature grove, do the benefits of a higher density grove outweigh the added capital investment in trees and planting compared to a grove of lower densities? The financial performance of two higher density plantings is compared to that of a medium density planting in the last scenario.

Evaluating the Cost of Greening Management Practices

For this economic analysis, production costs reported by Muraro (http://www.crec.ifas.ufl.edu/Extension/Economics) were updated to estimate costs to implement greening management practices. Scouting and spraying to control psyllids were estimated to increase costs of caring for a mature Florida orange grove from $911 per acre to $1,289 per acre, an increase of 41%, or $378 (Table 1). Pick, load, and haul costs were estimated at $2.52 per box while nursery trees were estimated to cost $8.25 each.

Three scenarios were analyzed: no control of greening compared to control; resetting versus no resetting; and replanting to a higher versus medium density grove. The economic performance of the alternatives in the first two scenarios was analyzed by comparing the present values of net revenues among the alternatives under two price scenarios: $1.25 and $1.50 per pound solids delivered to a processing plant. Net revenue in this analysis was delivered-in revenue less pick, load, and haul costs; grove care costs; additional costs related to greening; and other applicable costs.

Present value analysis enables comparing different future income streams among alternatives on an equivalent financial basis. A 12% discount rate was used which, according to discussions with appraisers and lenders, is in the range of rates that investors are using to evaluate alternative citrus investments. This 12% rate reflects a mix of different rates for equity and borrowed capital. An individual firm's discount rate may differ from this, depending on the firm's perception of risks from greening and other factors, their required return on equity, their debt to equity policy, the interest rate they pay for borrowed capital, and other variables. Return on investment, computed as internal rate of return (IRR), under the same prices was used for comparing replanted higher density versus medium density groves.

The grove used for the analyses was a mature flatwoods Valencia grove. For groves where greening was being controlled, a medium rate of greening was assumed. It was assumed that attrition rates due to greening increased 150%, 100%, and 75% over normal attrition for trees 1-3, 4-11, and 12 years old and older, respectively. Based on the age distribution of trees in the grove used in the analysis, this resulted in a weighted average attrition rate from greening of 2.3% (Table 2).

The no-control scenario assumes an average mature flatwoods grove producing 379 boxes per acre before greening is discovered. Once it is discovered, nothing is done to control greening, but normal caretaking activities are continued. Box yields decline rapidly, dropping below 200 boxes per acre in 3 years (Figure 1). These rates of attrition were similar to those observed in Brazilian groves where no control was undertaken.

This no-control scenario was then compared to the same average grove where greening was being controlled and removed trees were being reset (Table 3). The resetting program consists of resetting 100% of annual attrition every other year for trees that were

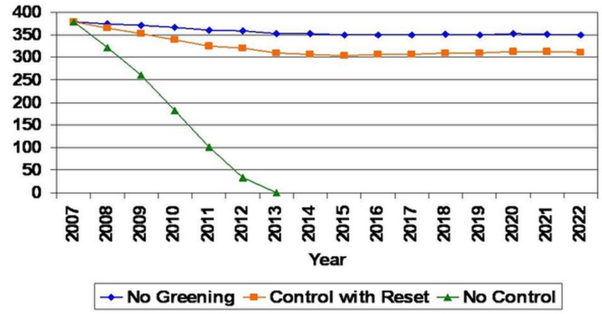

Figure 1. Greening control versus no control: Typical grove.

1-10 years old and 50% of annual attrition every other year for trees that were 11-15 years old. The present values of these scenarios (shown in Table 3) should not be surprising. Even with the costs of scouting, spraying, and tree removal, controlling greening was almost twice as valuable as not controlling it at a delivered-in price of $1.25 per pound solids and 2.4 times as valuable at a delivered-in price of $1.50 per pound solids. Once this grove is economically unviable, the owner must invest the capital to replant if he wants to remain in citrus production.

The reset versus no-reset scenario assumes a more productive mature flatwoods grove, yielding 476 boxes per acre before greening is discovered. The reset program is the same as that for the average grove in the previous analysis. The present values of the reset versus no-reset alternatives are close, but at the rates of tree attrition used in this analysis, resetting does show an economic advantage over not resetting, particularly at higher prices (Table 4). If reset trees can live to become productive, the main advantage is a grove that produces a perpetual income stream and does not have to be completely replanted at some future date (Figure 2).

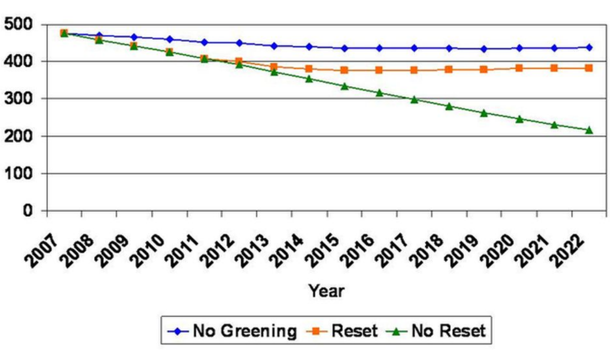

Figure 2. Reset versus no reset: Above average grove.

Once a grove becomes economically unproductive it is assumed that it will be totally replanted. The scenario evaluated here shows returns on investment (IRR) for replanted groves of three densities: 145 trees per acre (TPA), 207 TPA, and 270 TPA (Figure 3). Data for these higher density groves are based on historical data from commercial plantings of Valencias on Swingle rootstock in Hendry County (207 TPA) and Valencias on Rusk rootstock in Polk County (270 TPA). Groves were reset only through year four of age to examine the financial performance of higher density groves if resets cannot survive in a mature grove. The investment for replanting included tree removal, land preparation, re-establishment and modification of the irrigation system, and cost for trees and planting. A price for land was not included in the investment cost because it was assumed that the land was already owned.

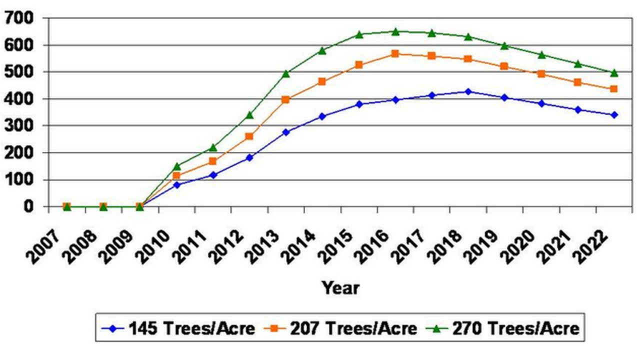

Figure 3. Replanted solidset Valencia grove with greening: Medium density versus higher density.

Yields per tree are lower in mature higher density groves but greater per acre, averaging 593 (270 TPA) and 512 (207 TPA) boxes per acre for the higher density groves in the mature (8-15) years versus 388 boxes per acre for the medium density grove. The medium density grove provided returns on the $4,951 investment in infrastructure of only 6.8% (IRR) at a delivered-in price of $1.25 per pound solids and 11.7% at a delivered-in price of $1.50 per pound solids, the lowest of the three densities analyzed (Table 5). The best financial performance was exhibited by the highest density grove (270 TPA). It provided returns of 11.8% and 16.1% on the $6,533 investment in infrastructure at delivered-in prices of $1.25 and $1.50 per pound solids, respectively. Thus, the added yields for higher density

(270 TPA) groves more than offset the added investment in trees and planting, and was important in maximizing net revenues with the tree attrition from greening.

Conclusions

Experience in Brazil has shown that an aggressive greening management program of scouting and identification, prompt tree removal, and spraying to reduce psyllid populations can keep tree loss rates at economically acceptable levels. The decision not to control greening compromises the effectiveness of neighboring growers who implement disease management practices and is the least profitable strategy in an environment of greening.

If trees can be obtained and resets grown to maturity in a mature grove with greening management, based on the rates of tree attrition used in this analysis, resetting is the preferred strategy. If not, when the grove becomes unproductive, replanting to a higher tree density provides added returns to offset higher costs from tree attrition and greening management.

Table 1. Costs of greening control program for Valencia oranges.

	$ Per Acre	$ Per Acre
Base Grove Care for Mature Groves (includes canker decontamination)		911.48
Additional Costs for Greening		
Additional Spraying (3 sprays + Temik®)	287.82	
Scouting (4 times per year)	90.01	
Sub-Total	377.83	
Grove Care Costs with Greening		1,289.31
Cost of Nursery Trees		$8.25/Tree
Pick, Load, and Haul Costs		$2.52/Box

Grove used for analysis: Processed Valencia grove on Florida flatwoods soil.
Source: Ronald P. Muraro, UF/IFAS, CREC, Lake Alfred, Florida.

Table 2. Tree loss rates from greening.

Tree Age	No Greening	Increase in Loss Rates from Greening	Medium Greening
1-3	1.00%	150%	2.50%
4-11	1.50%	100%	3.00%
12+	3.50%	75%	6.13%

Weighted average loss rate from greening in mature groves analyzed: 2.3%
Grove used for analysis: Processed Valencia grove on Florida flatwoods soil.

Table 3. Financial analysis of Valencia orange grove – no control versus greening control.

Tree Density: 145 TPA (12 x 25)
Pre-Greening Boxes/Acre (Average Valencia Grove): 379

	No Control Rapid Decline		Control with Resetting	
Price/P.S.*	$1.25	$1.50	$1.25	$1.50
Present Value	$2,605	$4,324	$5,129	$10,430

Note: For no control, greening losses begin in second year. Grove no longer producing after 5 years.
* P.S. = Pound Solid.
Grove used for analysis: Processed Valencia grove on Florida flatwoods soil.

Table 4. Financial analysis of Valencia orange grove with greening control – resetting versus no resetting.

Tree Density: 145 TPA (12 x 25)

Pre-Greening Above Average Valencia Grove Boxes Per Acre: 476

	Reset		No Reset	
Price/P.S.*	$1.25	$1.50	$1.25	$1.50
Present Value	$9,746	$16,350	$9,024	$14,479

Reset Program: 100% of trees lost annually reset every other year for trees 1-10 years old.
50% of trees lost annually are reset every other year for trees 11-15 years old.
* P.S. = Pound Solid.
Grove used for analysis: Processed Valencia grove on Florida flatwoods soil.

Table 5. Financial performance of replanted Valencia orange grove – medium versus higher density groves without resetting.

Tree Density	145 TPA (12 x 25)		207 TPA (8.75 x 24)		270 TPA (8 x 20)	
Yield Avg. in Years 8-15 of Grove	388 Boxes/Acre		512 Boxes/Acre		593 Boxes/Acre	
Investment Per Net Acre W/O Land	$4,951		$5,463		$6,533	
Price/P.S.*	$1.25	$1.50	$1.25	$1.50	$1.25	$1.50
IRR**	6.8%	11.7%	10.7%	15.1%	11.8%	16.1%

Reset Program: 100% of trees lost annually reset every other year through year 4.
* P.S. = Pound Solid.
** IRR = Internal Rate of Return.
Grove used for analysis: Processed Valencia grove on Florida flatwoods soil.