Optimal grove replanting to mitigate endemic HLB

By Allen Morris, Ronald P. Muraro and William S. Castle

Prior to the discovery of HLB in Florida, resetting diseased/unproductive trees was usually the most economically viable strategy for maximizing the economic life of citrus groves. In some situations, replanting the entire grove at one time was required, but the replanting decision was obvious since the grove had probably suffered serious damage or been destroyed. However, the introduction of HLB into Florida citrus groves has made the grove-replacement decision less obvious and more critical to maximizing the profitability and economic life of citrus groves.

In the past, resetting was preferable to replacing the entire grove because annual tree loss rates were low, averaging around 2.5 percent to 3 percent. However, with HLB, in many cases annual tree loss rates range from 3 percent to 20 percent or higher and the attrition rate from greening is probably increasing every year.

Resetting lost trees is also much more risky now since young trees are more susceptible to HLB infection and decline than older trees. Anecdotal evidence suggests that if HLB infection is at or below 2 percent, resets will survive, but if HLB infection rates are above that, resetting is increasingly risky due to the higher levels of inoculum in the grove. At some point, growers must decide whether it is time to remove the remaining trees and replant the entire grove or convert the property to other uses.

ADVANCED CITRUS PRODUCTION SYSTEMS

Higher-density plantings enable greater fruit production for trees 4 to 10 years old because of the greater number of trees per acre, which increases the present value of earnings over the life of the grove. However, before greening, there was no advantage to higher-density plantings after the grove was 10 years old, and some anecdotal evidence indicates that the higher density crowds the trees and actually leads to reduced grove yield after 10 years of age.

To offset increased tree attrition from HLB and increase the productive life of future groves potentially infected with HLB, an advanced production system (APS) could be used where the higher planting density (225-350 trees/acre) is combined with nutrients and water, precisely managed through a drip irrigation system. The additional trees per acre should offset higher tree mortality from HLB unless HLB transmission is more efficient with closer tree spacing.

Table 1. Establishment Costs for a Traditional Orange Grove Planted at a Density of 150 Trees Per Acre

	Year 1	Year 2	Year 3	Year 4
		(Dollars)		
Land Preparation And Irrigation				
Tree removal and land preparation	875			
Irrigation investment	1,025			
Permits and fees	260			
Sub-total	**2,160**	**0**	**0**	**0**
Planting				
Tree Cost	1,275			
Staking, planting and watering	231			
Sub-total	**1,506**	**0**	**0**	**0**
Grove Care				
Irrigation	98	108	118	128
Fertilizing	151	166	181	196
Spraying	142	156	170	184
Sprouting	26	26	0	0
Cultivation, mowing and herbicide	80	88	96	104
Ridomil/Aliette	46	46	0	0
Disease-related costs	23	26	28	30
Miscellaneous	11	12	12	13
Supervision and overhead	29	31	31	33
Sub-total	**606**	**659**	**636**	**688**
Total Establishment Costs	**4,272**	**659**	**636**	**688**

Total Four Year Establishment Costs: 6,255

Table 2. Establishment Costs for an APS Orange Grove Planted at a Density of 270 Trees Per Acre

	Year 1	Year 2	Year 3	Year 4
		(Dollars)		
Land Preparation And Irrigation				
Tree removal and land preparation	875			
Irrigation investment	1,025			
Permits and fees	260			
Sub-total	**2,160**	**0**	**0**	**0**
Planting				
Tree Cost	2,295			
Staking, planting and watering	416			
Sub-total	**2,711**	**0**	**0**	**0**
Grove Care				
Irrigation	132	145	159	172
Fertilizing	203	223	243	263
Spraying	190	209	228	247
Sprouting	35	35	0	0
Cultivation, mowing and herbicide	107	118	129	139
Ridomil/Aliette	62	62	0	0
Disease-related costs	31	35	38	41
Miscellaneous	15	17	16	17
Supervision and overhead	39	42	42	44
Sub-total	**814**	**886**	**855**	**923**
Total Establishment Costs	**5,685**	**886**	**855**	**923**

Total Four Year Establishment Costs: 8,349

ANALYSIS AND RESULTS

It is assumed that the grower's objective is to maximize the net revenues generated by the operation of a citrus grove over its life. For grove-replanting decisions involving APS, this objective is best accomplished through marginal analysis, where the net revenues from operating the existing grove (defender) for another season are compared with the opportunity to earn higher future net revenues that would be initiated by replanting the grove with an APS grove (challenger) during that season.

It should be noted that no single replacement analysis can be used to determine the most profit-maximizing replacement policy. Since the optimal replacement decision entails maximizing streams of net revenues, variables that can affect optimal replacement include all those affecting net revenues, such as fruit yields, fruit prices, costs of grove replanting and operation, opportunity costs of capital, etc.

Investment costs for the traditional grove and the APS grove are shown in Tables 1 and 2, respectively. They consist of land preparation, the cost of obtaining and installing the irrigation system, planting the trees and annual grove care costs through year four, after which the trees are yielding a commercial crop. The costs that are higher for the APS grove include the tree cost, planting and grove caretaking through four years when the trees start to become a hedge row and costs are the same for both groves. The APS grove costs $8,349 per acre to establish while the traditional grove costs $6,255 per acre.

Table 3 shows yields per acre for

Table 3. Yields Per Acre for an APS and a Traditional Hamlin Orange Grove.

Year	APS Grove	Traditional Grove
	(90 pound equivalent weight boxes)	
1	0	0
2	0	0
3	0	0
4	157	84
5	233	125
6	361	194
7	533	300
8	630	365
9	699	415
10	721	440
11	718	463
12	716	487
13	699	477
14	684	468
15	668	459
16	655	471
17	660	457
18	637	449
19	642	453
20	663	478

Notes: (1) Small amounts of fruit are produced in years 2 and 3, but not enough to cost-effectively harvest. (2) The base rate of annual attrition is 3 percent and it is assumed that neither grove is infected with HLB.

Source: Unpublished data provided by commercial Florida growers

both types of groves. Over the 17 years the groves are producing fruit in this example, the APS grove yields an average of 206 more boxes per acre than the traditional grove. Moreover, during the first five years, which heavily impacts net present value, the APS grove yields 79 per cent more fruit per acre than the traditional grove.

Both groves had a planning horizon of 20 years, produced Hamlin oranges for processing, and were covered by fruit contracts with a price of $1.30 per pound solids. A discount rate of 10 percent was used for net revenues and 12 percent for determining terminal values of the defender and challenger. The discount rate for terminal values was 12 percent because of increased risk due to the unpredictability of future net revenues as a result of continued tree attrition from greening into the future. Annual tree loss rates for the defender were 6 percent due to greening and 3 percent from other causes, while those rates for the challenger were 2 percent due to greening and 3 percent from other causes. The lower tree loss rate for the challenger was due to employing the standard greening management protocol from the start, rather than after greening infection rates had advanced too far to get under control.

Table 4 (page 16) shows four

Become an FCM Allied Member Now!

By Michael W. Sparks

Florida Citrus Mutual has long recognized the importance of the associated businesses that help support the Florida citrus grower, whether they are fertilizer manufacturers, crop insurers or a myriad of mom and pops across our production regions.

In 2003, we created the Allied membership program which is available for non-citrus producing businesses that rely heavily on the viability of the Florida citrus industry. The program is designed to create relationships, foster greater industry unity and encourage proactive responses on current issues.

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• Company information and link on FCM's Web site: www.flcitrusmutual.com.

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• Invitation to Allied membership meeting at the FCIAC.

• Allied dedicated cocktail reception at the FCIAC

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If you have additional questions about Allied memberships, please contact Melanie Burns at (863) 682-1111 ext 212 or melanieb@flcitrusmutual.com.

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replanting scenarios. Scenario 1 is replanting a traditional grove with an APS grove, scenario 2 is replanting a traditional grove with another traditional grove (self replacement), scenario 3 is self replacement for an APS grove where resetting is practiced, and scenario 4 is self replacement for an APS grove where no resetting is practiced. Replacement of the defender for scenario 1 was when fruit yields for the defender were 180 boxes per acre and net revenues were $56 per acre. Grove replacement for scenario 2 was when net revenues for the defender reached $23 per acre and fruit yields were 171 boxes per acre. For scenario 3 with resetting, the grove had perpetual life and did not need to be replanted. For scenario 4 without resetting, optimum replacement was at 28 years, and yield and net revenue were 101 boxes and $18 per acre, respectively.

Thus, replanting groves infected with HLB with APS groves enables the grove to have an economic life as long as traditional groves had before HLB was found in Florida. Different fruit prices, attrition rates, costs, etc. may result in different replacement times at different net revenues.

Table 4. Optimal Replacement Scenarios for Traditional and APS Groves.

Grove Type: Defender	Grove Type: Challenger	Net Revenue in $/Acre	Yield in Boxes/Acre	Replacement Year
Traditional	APS	56	180	9
Traditional	Traditional	23	171	10
APS Resetting	APS	Perpetual economic life; no replanting required		
APS No Resetting	APS	18	101	28

Notes: (1) The number of trees per acre is 150 for the traditional grove and 270 for the APS grove.
(2) Net revenue and yield is at the time grove replacement occurs.
(3) Replacement year is the number of years after greening is discovered.
(4) Both types of groves were being managed for HLB. Trees lost were reset until attrition from all sources reached 9 percent per year, when resetting was discontinued.

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Later this year, the authors plan to put an electronic version of the model required to determine economically optimal grove replanting times on the economics page of the Citrus Research and Education Center Web site.

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