

Incidence of HLB among Commercial Scions in Florida as Observed by Growers

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Survey objective. To collect grower observations on the incidence of HLB among groves of commercial scion varieties.

Background. The State was divided into these traditional regions: NR-North Ridge or essentially Lake County; CR –Central Ridge [Polk County]; SR – South Ridge [Highlands County]; IR – Indian River District; PRV – Peace River Valley; and, GC – Gulf Coast.

An informal survey was conducted in each region via email during May and June, 2013. One simple question was asked: Do you agree or disagree with the list and order of scion varieties presented regarding the incidence of HLB. Respondents were invited to modify a provided initial list of common fresh fruit and juice varieties, to add comments and to include any observations about rootstocks.

A survey was sent to individuals from all Florida production regions. Thirty-eight [38] potential participants were invited to contribute and of those, 33 replies were received of which 32 are presented in Table 1. More than 60% of the replies were from the combined regions of the South Ridge and the Indian River [Fig. 1].

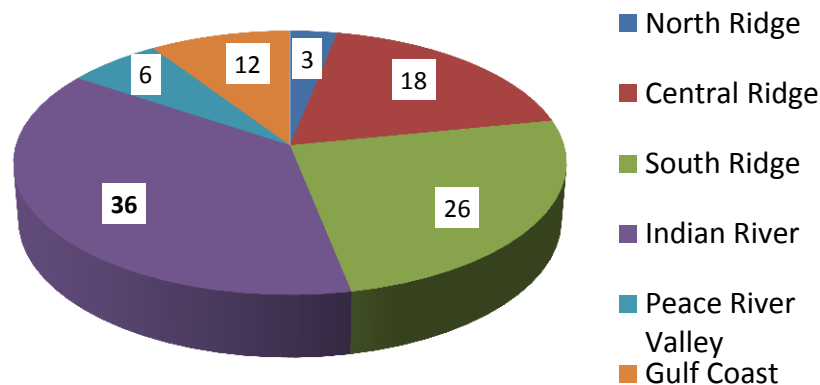


Fig. 1. Replies by region [%].

Responses and their limitations. The survey responses were assembled according to each participant [Table1]. The results represent the broad-scale observations of the respondents from across the State and the ORDER in which they placed the common scion varieties.

The field situations on which these observations are based vary considerably and some growers have production sites in more than one region. Thus, there are many limitations to the results. For example, no information was received about the conditions under which the observations were made, any variability in the particular scion clones, management practices or tree ages. Any number of other factors might also reasonably be invoked to raise questions about the validity of the results.

Survey interpretation. It is also important to note the distinction between ORDER and RANK of HLB incidence. The varieties in the respondents' lists are in a particular ORDER which is essentially a qualitative assessment by each grower of his or her relative comparison among cultivars. The ORDER says nothing about the actual degree of HLB incidence. Such a measurement, i.e., a quantitative expression of the HLB incidence, would be the RANKING. For

example, examination of the Table 1 results shows that navel orange is always listed above Pineapple orange meaning that navel orange has generally been observed to have a lower incidence of HLB infection than Pineapple orange. Trees of Hamlin and Valencia are nearly always listed somewhere in between those two varieties. However, the degree of difference among these cultivars could vary considerably among growers. As a result, the survey as presented in Table 1 is only really useful for observing ORDER.

An example illustrating the difference between ORDER and RANK is given in the sidebar on the left side of the page.

Additional grower comments. Many growers included rather insightful and interesting comments in their reply that expanded the observations about HLB

incidence among scions as well as adding information about rootstocks [Table 2].

Example of HLB incidence, %.

Scion	Site A	Site B
Navel orange	12	22
Hamlin	23	45
Valencia	42	68
Pineapple	55	100

To illustrate RANK, let's say the actual incidence of HLB was measured at two sites and outcomes were those shown above. The ORDER of varieties between the two sites is the same, but the RANK of those varieties is vastly different. A simple Lowest to Highest observation of HLB incidence accounting for both sites is presented in column 1: Navel – Hamlin – Valencia - Pineapple. However, that list does not show RANK, the quantitative differences in incidence as measured between the two sites [columns 2 and 3].

What do the survey results suggest? What follows is mostly a gathering together of the observations and comments received from growers plus a small interpretive addition of the author. *Observations possibly leading to researchable questions are in author-added italics.*

1. Clearly, the most striking result of the survey, despite the possible limitations mentioned above, is the consistency of grower observation [Table 1]. Consistency is a valid tenet of scientific research that has value in this instance.
2. “Stress” seems to be a critical factor explaining differences among scions and scions on different rootstocks. That observation strongly reinforces current thinking that maintaining good tree health is important in minimizing HLB impact.
3. Stress can be induced by soil/site factors; for example, planting trees on Swingle citrumelo rootstock in places known to be unsuitable for that rootstock versus sites more conducive to good growth among trees on Swingle.
4. Stress may result from normal tree behavior like alternate bearing or seediness. Several growers observed that seedy orange varieties like Pineapple and Midsweet had higher incidences of HLB than seedless varieties like Hamlin and Valencia. A special case is noted for **navel orange** [a variety always at the top of the order] which is a large tree that produces seedless fruit and lighter crops [less tree stress?] than either **Hamlin or Valencia**. Few distinctions were observed between Hamlin and Valencia partly because of grower admission that any differences were not always carefully noted.
5. Stress related to seediness and alternate bearing may also explain the high level of HLB incidence noted for **Murcott** and, in some instances, **Sunburst** trees. Moreover, if this form of stress is a critical factor, it is interesting that a relatively low-seeded variety, Minneola tangelo, that produces large trees and small crops like the navel orange, is observed to have relatively high incidences of HLB infection. *Why?*
6. Also notable among scion varieties is the high position [low incidence of HLB] observed for Temple and Nova trees. There are few trees of **Nova** remaining in Florida, but growers still maintaining a few were adamant in noting little to no HLB among their trees. Nova is a hybrid of Clementine x (Bower grapefruit x Dancy tangerine: Orlando tangelo). *Is there something in the Nova parentage that has value in searching for HLB tolerance?*
7. The number and size of **Temple plantings** was surprising as several growers reported having 50-200 acres of solid-set trees. Growers differed somewhat in their observations regarding the apparent “tolerance” of Temple, some noting that once infection started, Temple trees, succumbed like other varieties. *The “tolerance” of Temple [if that’s a valid observation]*

may be more related to some impact the variety has on psyllid behavior and/or the bacterium's behavior in the plant. The author inquired with an entomologist and learned that there apparently are on-going studies to examine this matter.

8. **Do the results suggest any new management approaches?** Maybe. If the differences were examined further and proven to be valid, then growers might be inclined to plant using the variety/clone information to minimize HLB risk and to consider different planting designs and/or management practices.
9. **Rootstocks.** Fewer observations were submitted about rootstocks and all comments are contained in Table 2. Nevertheless, there are remarks like one grower's good experience after 25 years with Valencia trees on grapefruit rootstock. Several growers noted the impact of stress in relation to scions and rootstocks and offered the observation that stress tended to neutralize any positive contributions of scion or rootstock. *Whether current commercial rootstocks offer any advantage [under what circumstances?] may be worth exploring further given the grower comments. For example, right now, x639, a hybrid of Cleo x Rubidoux trifoliolate orange, is in considerable demand. Commercial plantings are uncommon, but there is one 20-acre grove of Valencia trees planted in the Gulf Coast region 15 years ago that apparently has little blight or HLB to date.*
10. **THE BIG question?** In the words of one Indian River respondent, if the differences among varieties are true, then **WHY?**

Acknowledgments. *Sincere thanks to the growers who quite willingly participated in this survey by sharing their observations and insights. The results are testimony to your skills of observation and community spirit as we all continue to address this serious matter: HLB.*

Table 1. Order of incidence of HLB from lowest [top] to highest [bottom] among scion varieties in commercial groves.*

North Ridge- 1**	Central Ridge-1	CR-2	CR-3	CR-4	CR-5	CR-6 & Flatwoods	South Ridge- 1	SR-2	SR-3A	SR-3B	SR-4	SR-5	SR-6	SR-7	Indian River- 1
								Grapefruit							
Temple***	Temple	Temple	Temple	Temple	Vernia	Temple		Temple			Temple	Temple		Temple	
	Navel	Navel	Navel	Navel	Navel	Navel						Parson Brown			
	Grapefruit	Grapefruit	Grapefruit	Grapefruit	Fallglo	Grapefruit			Vernia			Vernia		Fallglo	Grapefruit
	Fallglo	Sunburst		Fallglo	Grapefruit	Fallglo	Valencia				Grapefruit	Valencia			
Hamlin	Hamlin	Fallglo???		Hamlin		Hamlin	Hamlin	Valencia	Hamlin	Hamlin	Valencia	Pineapple	Hamlin	Hamlin	Hamlin
Valencia	Valencia	Hamlin	Hamlin	Valencia		Valencia		Hamlin	Valencia	Valencia	Hamlin	Hamlin	Valencia	Valencia	
Sunburst	Minneola	Valencia	Valencia	Minneola	Midsweet	Minneola	Pineapple	Minneola							
Minneola	Sunburst	Midsweet	Midsweet	Sunburst		Sunburst	Midsweet	Sunburst	Pineapple	Murcott	Midsweet		Sunburst	Sunburst	Sunburst
W. Murcott	Murcott	Pineapple	Pineapple	Murcott	Sunburst	Murcott		Murcott	Murcott	Pineapple	Pineapple		Murcott	Murcott	Murcott
Murcott		Minneola	Minneola		Murcott	Pineapple			Midsweet	Midsweet	Murcott			Pineapple	
		Murcott	Murcott			Midsweet				Queens				Midsweet	
IR-2	IR-3	IR-4	IR-5	IR-6	IR-7	IR-8	IR-9	IR-10	IR-11	IR-12	Peace River Valley-1	PRV-2	Gulf Coast-1	GC-2	GC-3
	Nova			Nova					Nova		Nova				
Temple	Temple	Temple	Temple	Temple	Temple		Temple		Temple	Temple	Navel	Temple	Temple		Temple
Navel	Navel	Navel	Navel	Navel	Fallglo	Navel	Navel	Navel		Navel	Vernia	Navel	Fallglo		
Grapefruit	Grapefruit	Grapefruit	Grapefruit	Grapefruit	Navel		Fallglo	Red grpft			Earlygold	Grapefruit	Grapefruit		Grapefruit
Fallglo		Fallglo	Fallglo	Fallglo	Grapefruit	Grapefruit	Grapefruit	White grpft	Grapefruit			Sunburst	Sunburst		Navel
Hamlin	Hamlin	Hamlin	Hamlin	Hamlin	Hamlin		Sunburst	Hamlin	Earlygold	Grapefruit	Valencia	Hamlin	Navel	Valencia	
Valencia	Sunburst	Valencia	Valencia	Valencia	Valencia	Earlygold	Hamlin	Midsweet			Hamlin	Valencia	Orlando	Hamlin	
Minneola	Valencia	Minneola	Minneola	Minneola	Vernia		Valencia	Valencia				Minneola	Hamlin		Murcott
Sunburst		Sunburst	Sunburst	Sunburst	Sunburst		Minneola		Minneola		Midsweet	Murcott	Valencia		Hamlin
Murcott	Murcott	Murcott	Murcott	Murcott	Minneola		Murcott		Murcott		Pineapple		Pineapple	Pineapple	Valencia
	Ortanique				Murcott						Murcott		Midsweet		
													Murcott		

* The information contained in this table results from an informal survey of citrus growers. Additional **SCION** and **ROOTSTOCK** comments are presented in Table 2.

** North Ridge [NR] is Lake County; Central Ridge [CR] is Polk County; South Ridge [SR] is Highlands County; Indian River [IR] is the east coast; Peace River Valley [PRV] is mostly the area covered by Hardee and Desoto Counties; and, the Gulf Coast [GC] is the southwest region consisting of Charlotte County and south to Collier County.

*** Scions are color-coded primarily for ease of tracking their position within the table. Where a scion name is bolded and italicized, additional comments by a particular respondent are presented in Table 2.

Table 2. Edited comments associated with responses to HLB-scion survey.*

NR-1 Valencia may have higher incidence than Hamlin because of stress associated with two crops on the tree. **W. Murcott** is a difficult variety because of overcropping.

CR-3 The **Murcott** trees that were carrying a really heavy crop load just pretty much completely collapsed during the late fall. The Murcott block that was in its off-year fared much better.

CR-6any other limiting factors, such as weaker soils, nematodes, Phytophthora, water quality, weevils, etc.- I think they trump the variety differences, other than **Murcott** which seems to be losing ground, regardless the plant health. Age of tree also trumps the variety difference such that infected 5 year old **Temple** trees are in worse condition than infected 25 year old Murcott trees with infection.

Pineapple and **Midsweet** might be just after the Murcott for sensitivity to HLB. Rootstocks- kind of like the variety, as far as ranking them to HLB infection. If Swingle likes the environment, they look as good as anything else with infection, but if you have high pH soil and water, this is a big problem.

SR-1have two blocks of Vernia. The majority of the trees are on Benton rootstock and some are on Swingle or Carrizo. The Vernia on Benton seem to do better with the HLB, maybe due to its vigor. As to other rootstocks, we have a lot of Carrizo and Swingle and a lesser amount of Cleo. The trees on Cleo seem to do the best with HLB, probably due to its massive root system. I am not sure if there is a difference between Swingle and Carrizo. In many cases the Swingle look better, but I think this may be due to the fact that a lot of the Carrizo trees are affected with blight and greening at the same time. We have planted quite a few trees on US 812 the last two to three years but do not have any old enough to make a determination.

SR-2 Only a few Temple trees used primarily as pollinizers. For **rootstocks**, we have both old tree Lemon & Volk doing extremely well. Carrizo, Cleo and Swingle doing excellent to poor depending on soils, irrigation system, nematodes, root weevil, high water table, blight, phytophthora, heavy crop load, consistent or inconsistent care etc. Those that are most efficient with least stress appear best to me as long as variety compatibility is OK.

SR-3A As to varieties, seedless oranges are much better than seedy oranges and Murcott. Among seedless varieties, we would rate Vernia best (we have 3 different blocks with a total of 100 acres), then Hamlins, and then Valencias. Among seedy varieties (all of which are bad), we would rate Midsweets the worst of the worst, with Pineapples, Queens, and Murcotts being not quite as awful. **As to rootstocks**, the worst seems to be Swingle, then Milam next to worst, and Kuharske/Carrizo being intermediate. **Our best performing rootstocks are Cleo and grapefruit.** We have several different Cleo blocks with Valencia, Hamlin, and Pineapple, and they are definitely better. We have only one solid set block of grapefruit Rootstock (Valencias). It consists of 600 Valencias on grapefruit (3.8 acres) set in Nov. of 1987 (25 years old) in Hardee Co. The adjacent block to the West is Valencias on Cleo and is fair and not heavily impacted by HLB. But this 25 year old Valencia on grapefruit block is clearly superior to even the adjacent Cleo block and has very little HLB impact.

SR-3B Hamlin is noted as the variety with less incidence. This may be because of not having to produce two crops at once as does the Valencia. Generally speaking, his Earlies are in flatwood soils rather than Ridge soils and therefore could be impacted by poor quality water in the Ridge areas.... Swingle is the least tolerant because it is also least tolerant of high alkaline conditions in soils and water. Before HLB it seemed to be ok, after not. Carrizo may be better in the presence of alkaline conditions as it withstands the disease better because you can amend soils with acid fertilizers.

SR-4 Nearly 200 acres of Temple trees, all in relatively good condition. Our strategy for buying time and remaining economically viable, until such time as the "cure" for HLB is found and made available, has been to replant with trees budded on invigorating rootstocks; to fill the allotted tree space as quickly as possible, while we could protect young trees with neo-nicotinoid soil drenches, supplemented with foliar insecticides. We initially selected three rootstocks: Kuharske (we are reconsidering this option), Volk and X639. These rootstocks are vigorous and produce large, relatively high yielding trees. Kuharske and X639 have good fruit quality and yields. Volk while sacrificing fruit quality, more than compensates with its high pounds of soluble solids per acre. The precociousness of X639 without the slowing of growth was very attractive. We had already selected X639 as one of our preferred rootstocks, before the anecdotal evidence of some tolerance to HLB. This has only increased our interest in this rootstock. It also said to be tolerant of a range of soil conditions including pH, and is relatively cold tolerant. The only knock against it that I could find was an increased incidence of blight reported to begin around year 15. We decided to gamble on it.

SR-5 ...has 120 acres of mature **Temple** trees. In one instance, there are oranges on either side of the block that are 20% infected with HLB while the Temple block has only 3% infection as of Spring 2013.

Rootstocks: Cleo > Swingle > rough lemon > Carrizo.

SR-6 Val/Swingle is not doing well for us. Most Hamlin/Swingle locations are doing fine. So much is site specific what I observe today changes tomorrow, everything seems to be a notch lower than this time last year.

SR-7 Ham/Cleo looks good; Val/Volk looks good; Carrizo looks a little better than Swingle.

IR-4 We have 2 blocks of temples that look better today than 5 years ago. **Rootstocks:** Sour orange seems to be our rootstock most tolerant. New plantings look good and the old ones have withstood tristeza for 40 years. Smooth Flat Seville looks ok too and with Ray Ruby, the Brix is ok. Swingle, Cleo and Kinkoji seem to all be about the same and might not be the ones to plant.

IR-5exception of **Temple**.....it looked great at the beginning of last year but has since gone into rapid decline. One thing I am noticing is all varieties on better soils (more organic) perform better than on sandy soils.

IR-6 My experience is that **Temple** will go down hard once it's infected, but that psyllids don't seem to like it as much as other choices. The entomologists don't agree that it's consistent -- they've seen Temple heavily infested with psyllids -- but there does seem to be a delay in expression between Temple and other varieties.

IR-8 Most **navel orange** trees I see on the east coast are doing fairly well except on Swingle. All **grapefruit** trees are in the St. Johns marsh, on sour orange, 30 years old and doing fairly well with an overall loss of production of 15%. In the Gulf Coast region we have 300 acres of **Valencia** on Benton, **Smooth Flat Seville**, Kuharske, Volk and Swingle. **Swingle** still looks best under heavy HLB pressure. When those trees were 4 years old, the SFS block was clipped to remove what appeared to have been HLB but is more likely to have been trees on off-type SFS. Today, those remaining trees on apparently typical SFS rootstocks are some of the best looking trees of this age that we have. There appear to be little to no HLB issues.....

IR-9 We have several examples of **Navel/sour orange** situated in and around greening endemic blocks with limited greening expression on the navels, all the while continuing to be productive blocks. Although we have no new oranges, we do have some limited experience with Vernia, Earlygold and Midsweet.....I'm not a fan of any and if there is room I would put these scion varieties on the same line as the Murcott.

IR-11 Nova seems to be bothered very little if any. We have about 30 acres of them over 20 years old..... I think they are on Cleo and Swingle. In that same grove there is a 10-20 acre block of **Temple** on Cleo of the same age. They are being bothered a little but I would guess less than 5% are showing very noticeable symptoms. **Minneolas** are particularly sensitive to greening. They seem to be almost an indicator plant of the disease. We have about 30 acres of old sour rooted trees and five other locations of young to middle age trees in St Lucie county that are on Swingle. **Murcott** can kill itself even without a disease bothering them..... are REALLY vulnerable when heavily cropped.varieties that alternate bear, like Murcott and Minneola, are very subject to damage from greening. Varieties that do not face a crop stress and have **heavy crops of small leaves like Nova and Temple are bothered the least**. Two years ago I would have said **Earlygold** was very sensitive to both bacterial diseases, canker and greening. Now we have two of our three blocks perhaps getting out of the most vulnerable age period of 4-7 years old and they are not looking too bad. I would say **grapefruit** is bothered the least BUT I DO NOT ATTRIBUTE THIS TO THE VARIETY. Instead I think the extensive use of copper sprays suppresses the disease. Where grapefruit is dooryard citrus it seems to have problems as serious as do oranges.

IR-12 As for **grapefruit**, all varieties seem to be having a lot of difficulty with the disease. HLB seems to affect dark red varieties even more so than reds and whites. We have many rootstock scion combinations out in the field and I see no advantage of any rootstock over the others. Our healthiest blocks are on sour orange.

PRV-1 *The Good:* **Vernia**- still investigating but we've seen some cases where with an intense nutritional/psyllid program it shows tolerance. **Earlygold**- limited investigation but looks better than Hamlin, we think. **Navel**- we have eight blocks and they look pretty good. **Nova**- still looks pretty good. *The Bad:* Valencia, Hamlin. *The Ugly:* **Midsweet**- you can pick them out going 40 MPH, stunting, dead wood. **Pineapple**- see **Midsweet**. **Murcott**- declining. The only rootstock combination that seems to look special is **Vernia/Kuharske**.

GC-1 I would note sweet oranges are highly dependent upon rootstocks used. Our experience with **rootstocks:** Cleo = Swingle [tied with US 812] > Volk > Milam; then US 897 for which we only have young trees but so far don't seem to handle very well > Carrizo.

GC-4 Note: This participant chose not to order varieties but contribute this observation: We...have...only Valencia, Hamlin, Midsweet and some Sunstar. We haven't seen any obvious trends regarding HLB tolerance of any of the varieties that we do have. We have relatively high infection rates across all our groves, across all varieties and rootstocks.

* Prepared by Bill Castle, UF/CREC.