HEALTHY FOOD SYSTEMS • HEALTHY ENVIRONMENTS • HEALTHY COMMUNITIES • HEALTHY CALIFORNIANS

University of California
Agriculture and Natural Resources
Making a Difference for California

UCCE

Citrus and Subtropical Crops
Kern County

February, 2012

UPCOMING KERN SPRING CITRUS GROWER MEETING

Thursday, April 19, 2012 (1:15 p.m. to 4:45 p.m.) at the U.C./Kern County Office (1031 S. Mt. Vernon Ave, Bakersfield, 93307). The agenda is not yet finalized but put this meeting on your schedule. Topics will include: pest control, alternate bearing in mandarins, orchard design and yield/fruit quality, Glassy-winged sharpshooter update and what will happen if the Asian Citrus Psyllid arrives and more. PCA credit (including some laws and regulations) will be available.

A Decade-Long Success Story!

The area-wide management program designed to control glassy-winged sharpshooter in the southern San Joaquin Valley has been an impressive display of cooperation and success among grape and citrus growers (and various county, state and federal agencies). A decade or so after its implementation, the glassy-winged sharpshooter and Pierce's disease in grapes remain under control. Originally, in the 1990s, when this pest was infesting a big chunk of Kern County, many noted entomologists thought the chance of controlling this bacterial disease of grapes by controlling the glassy-winged sharpshooter vector was poor at best. Cooperation, hard work, the nature of this pest and money have all combined to prove them wrong.

Sometimes with success, though, comes complacency, and there is little room for complacency in efforts to control this pest. Participation in this program should be obvious for many grape growers, especially those with susceptible varieties, but citrus growers benefit too. Even though citrus growers are not directly impacted by Pierce's disease, a very similar Xylella-caused disease of citrus, called citrus variegated chlorosis (CVC) occurs in other parts of the world; notably in Brazil. By assisting in the control of glassy-winged sharpshooter, citrus growers are reducing the chance of finding CVC in the San Joaquin Valley and other California citrus-producing areas. Efforts to control glassy-winged sharpshooter will also help prevent establishment of the Asian Citrus Psyllid, should it arrive in the San Joaquin Valley from the south. It's knocking at our door. Both are sucking insects and generally, the same pesticides are effective on both pests.

This author remembers the scope of the glassy-winged sharpshooter infestations in the late 1990s in the Edison and General Beale Road areas of Kern County. Large populations of this insect sucked voluminous quantities of fluid from the trees, which greatly increased summer heat-stress associated shoot-dieback in some citrus varieties such as Fisher navel and Midknight Valencia. Several large grape plantings, infested with Pierce's disease, had to be removed in this same area. Glassy-winged sharpshooter populations are on the rise in some areas in Kern County, largely as a result of wet weather last year which interfered with pesticide treatments. This year, our warm and sunny winter days promote survival of the adults.

Hopefully, this decade-long cooperative spirit will not fade away, and area-wide control measures will continue as needed. The USDA-APHIS glassy-winged sharpshooter director, Beth Stone-Smith, will provide a program update at the Kern Spring Citrus Meeting, described above, on April 19, 2012.

Wind, Rain and *Colletotrichum* – a Formula for Citrus Tree Defoliation

Almost every year I make at least one visit to an orchard in the Arvin-Edison-Maricopa citrus-growing area in late fall or winter to see defoliating trees. This area of Kern County is in what I call the 'wind belt' and fall and winter dirt storms can roar off the surrounding foothills with a vengeance. Higher elevation orchards are most at risk. The winds themselves have sufficient force to rip the leaves from trees bordering the orchard and from the tops of all of the trees within the orchard. Worse, if the storms are associated with moisture, that damage is just the beginning. We think that the blowing dirt and sand damages the leaves, and in combination with rain or high humidity, results in infection of these small wounds by spores of *Colletotrichum* spp. such as *C. acutatum* or *C. gloeosporioides*. These infections start in the leaves and usually continue into the twigs. In the old days, apparently, this disease symptom was referred to as 'whither tip'. The problem is also referred to as anthracnose. Affected leaves, especially those attached to infected twigs, become necrotic, usually beginning at the leaf tip, roll up and fall from the tree. Commonly, leaves at the tops of the trees fall first. The defoliation can continue until the whole tree has very few leaves. If the defoliation is severe enough, the fruit will also drop. Branches can die back a foot or more. Environmental conditions within an orchard can play a large role. It is not uncommon to see very different effects in neighboring orchards. This disease can also be a problem in the spring, but in our area, fall and winter damage is usually the worst.

The problem is usually most severe on trees producing fruit destined for the early market since growers, often; do not treat these trees with copper-containing sprays. Typically, for mid-season fruit, copper sprays are aimed at protecting the tree from brown rot or, if headed for Korea, Septoria spot. Normally, early fruit is harvested before rain, and before these diseases become an issue. In areas prone to blowing dirt, growers producing early-maturing fruit should consider copper sprays. Copper-containing sprays are effective in preventing or reducing *Colletotrichum* infections if sprayed before storms, and can also be effective in reducing the problem once it has begun. Colletotrichum spores (conidia) are produced from fungal structures on dead tissue, such as twigs, in the tree canopy. The spores are present throughout the year, just waiting for the right conditions to germinate.

Copper deficiency can also be a problem on calcareous soils, and these same copper treatments can supply necessary copper to the trees. As with any spray, copper can also cause phytotoxicity problems, so applications should be made with copper at recommended rates and in association with lime (see www.ipm.ucdavis.edu, click on 'agricultural pests', then 'citrus', then 'Septoria Spot' under diseases, for suggested copper sprays that should be effective in controlling *Colletotrichum* spp.).

Of course, leaves can drop in the fall and winter for other reasons. The two most common reasons that come to mind for this area are Texas mite feeding on the leaves, and forgetting to watch soil-moisture levels when the irrigation system is shut off for too long in anticipation of an early harvest that does not materialize on schedule.

Most of Kern County is not in the Citrus Belt

All localized freeze events are serious to the affected grower, of course, but the last serious county-wide frost event was probably the freeze in January of 2007. Five years has passed since then. New people have entered the industry, and new citrus orchards are again springing up in areas that are not only cold, but very cold. Wisely, many of these cold orchards were planted to early maturing citrus cultivars, which will usually be harvested by the time the worst of the winter temperatures arrive. An early harvest means that there will be no need to start wind machines on Christmas or New Year's Eve, which is just as well since it is a long way up to the inversion layer from the valley floor. Wind machines aren't much help if the warm air is too far aloft. The fruit should be safely in the marketplace before it gets cold enough to freeze.

If the fruit is safe, there still remains a cold-related risk to the trees – fruit or no fruit – from that cold front from Alaska which will eventually roar out of the north, dropping temperatures on the valley floor to 10˚F or below. Extended temperatures of 20˚F are sufficient to start freezing citrus wood. The water conducting tissues (i.e. sapwood) are the most sensitive to frost. We had serious frost events from the north in winter 1990-91, 1998-99 and in January 2007, which places them about eight years apart. I am not aware of any way to predict the next one, but the easiest and least expensive trees to defend against frost in very cold areas are those that were never planted.

Caution on the Use of Macrophylla Rootstock in Kern County

Recently, I have been asked about the suitability of Macrophylla lemon (*C. macrophylla* Wester, aka, Alemow) as a rootstock for Kern County citrus. I am not sure where the interest in this rootstock is being generated. Macrophylla rootstock has been a common rootstock for lemons in Ventura County, which has a mild, coastal Mediterranean climate. Macrophylla rootstock produces a precocious tree, that is, a tree that is vigorous, and produces fruit earlier in its life cycle than other rootstocks. We were well on our way to proving that in a rootstock trial, topped by a Washington navel scion, that we planted southeast of Bakersfield, in cooperation with Dr. Roose (U.C. Riverside) in April of 1997. Only the trees on Macrophylla rootstock had fruit in 1998, and while it was not a lot of fruit per tree, it was impressive to see a few large navels hanging from almost every tree on Macrophylla rootstock in this replicated and randomized trial composed of 29 different rootstocks.

In Kern County, upon occasion, it becomes all-to-obvious that our citrus belt has a climate that is more prone to severe freeze events than is the coastal area of Ventura County. While the fruit on the trees on the Macrophylla rootstock looked great during the summer and fall of 1998, things quickly changed after the severe 1998-1999 winter freeze. Most of the 2nd-year Washington navels on all of the rootstocks came through this freeze in fine shape, except for those on Macrophylla. In the accompanying picture, the two deadest looking trees, including the only tree in the picture with fruit, are on Macrophylla rootstock.

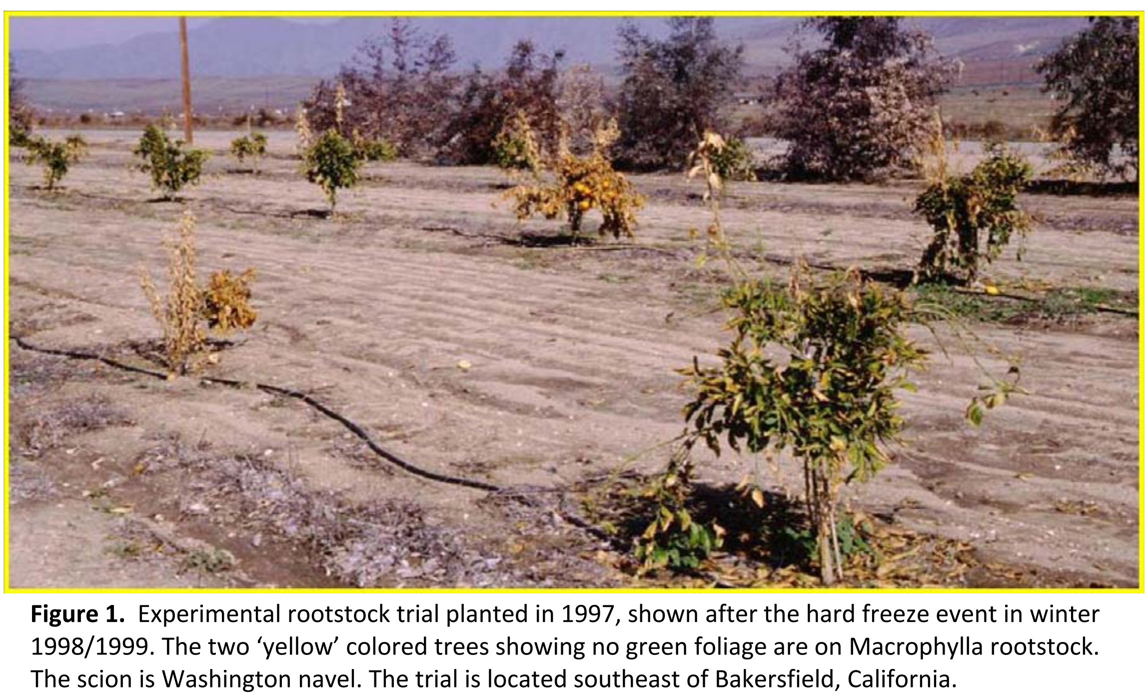

Figure 1. Experimental rootstock trial planted in 1997, shown after the hard freeze event in winter 1998/1999. The two 'yellow' colored trees showing no green foliage are on Macrophylla rootstock. The scion is Washington navel. The trial is located southeast of Bakersfield, California.

All of the Washington scions on the Macrophylla rootstocks were severely affected by the freeze. Most of the scions died on this rootstock, and the entire tree was killed on over a third of the Macrophylla. Regardless of the variety, the graft union of a young tree is a sensitive area to freeze damage in that it is an area of cell proliferation and bark disruption as the two different plant species meld together.

We don't have many trees on Macrophylla rootstock in the southern San Joaquin Valley, and I have noticed that freeze hardiness appears to improve somewhat as the trees grow older. However, trees, in general, on the vigorously-growing Macrophylla rootstock often show graft incompatibility symptoms at a younger age than many other rootstocks. This is especially true of blood orange scions on this rootstock and even on the coast of California, Eureka lemon on Macrophylla tends to be a relatively short-lived tree. Probably the best location for a Macrophylla orchard for a Kern County grower is one located near the coast of southern or central California.

Sooner or Later, Scion-Rootstock Problems Will Show Up

Generally, tried and true citrus varieties in Kern County, such as Washington navel, seem very compatible with trifoliate rootstocks and sweet-orange x trifoliate rootstocks (aka citrange) like Troyer and Carrizo. However, given enough time, say 50 years, some incompatibility will probably show up in an orchard. Over the past few years I have visited several orchards that were developed in the burst of citrus-planting exuberance that occurred in the late 1960s and early 1070s in Kern County. The varieties planted were navel varieties, such as Parent Washington, Frost Nucellar, and Atwood; and Minneola tangelo and Valencia orange. The rootstock of choice was Troyer although some are on trifoliate. Now in many orchards in 2008, a relatively small percentage of the trees, probably less than 10%, are showing signs of the pinching off of the scion at the bud union (see Figure 2). The rootstock grows much faster than the scion. The phloem, the vascular tissue that feeds the roots is affected first, which starves the roots. Starving roots cannot provide enough water and nutrients to the leaf canopy, and the tree declines. A sick tree is more susceptible to root disease, nematodes, and heat stress. The declining trees are obvious in an orchard and have a very thin leaf canopy, plenty of dead twigs, and a more stunted appearance. These trees can hang onto life for years and years and good irrigation and fertilization practices can delay the inevitable but only up to a point. Sometimes the primary cause for the decline is mistaken for a root rot disease, but no amount of Ridomil®, Alliette®, or phosphite will 'fix' these trees. The good news, for the future fate of an affected 60-year-old the orchard at least, is that many of these incompatible trees probably began to decline thirty years ago. Apparently, all Troyer rootstocks were not created equally or perhaps some buds take better than others. Whatever the reason, the observation that 10% of the trees are declining does not mean the rest of the orchard will follow suite in the near future. If so, the remaining trees would have begun to decline years ago. In most orchards, most of the trees inclined to early decline have already done so. The bad news is that even a relatively small percentage of sickly trees can make even the best orchards look bad, and can adversely affect the bottom line for the entire orchard since their production does not cover their culture. The declining trees are not going to get better. Replants will start producing fruit in three or four years and greatly add to the look, vitality and the resale value of the orchard with each passing year.

Figure 2. Cross section through a Valencia orange on Swingle rootstock showing pinching off of the vascular tissue at the graft union.

Does applying all of the Season's Nitrogen Early in the Season Promote Earlier Fruit Maturity?

The production of early navels is a competitive endeavor because orange growers receive a price premium in the market place for producing the first legally marketable orange of the season. How nitrogen (N) might be managed to encourage earlier development of color and an earlier acceptable solid/acid ratio is a question of interest to the grower.

Previous research by Dr. Embleton and others has shown that N may influence fruit quality characteristics of navel oranges and that leaf-N is indicative of the N-status of mature citrus trees. Total leaf -N in the range of 2.4 to 2.6 percent by weight on a dry matter basis is generally considered optimum and in this range should provide adequate yield, fruit size and quality. Generally, higher concentrations of leaf N are associated with higher yields, higher fruit numbers, a longer time to color break, lower solids/acid ratios and smaller fruit size. Thus the grower must balance applying enough N to the tree for adequate yield, tree health and vigor, with the adverse quality effects and smaller average fruit size associated with higher N application rates.

An experiment was established near Arvin in Kern County in March of 1996, and continued through the 1997 fall harvest (for more details see: Kallsen, C. 1999. The Effect of timing of the final seasonal nitrogen fertigation on early fruit maturity, fruit diameter, and leaf nitrogen on navel oranges. HortTechnology. 9:51-53). The soil of the site is a deep and gently sloping sandy loam which was planted to 'Fisher' navel oranges on Carrizo rootstock in 1985. The trees were on a 22 ft. between row and 19 ft. between tree spacing. Each tree was irrigated by five one gallon-per-hour drip emitters spaced at intervals along a single hose.

The objective of the experiment was to determine if the timing of the last seasonal N fertigation promoted early fruit maturity or affected fruit size. The total quantity of N applied was the same, the only thing that varied was the date at which all this N was applied. Nitrogen fertilization began each year in early March. The study consisted of four treatments, each consisting of one of four end dates for final N application. The end dates of the treatments were, approximately, May 1, June 1, July 1, and August 1, by which time the total and equal seasonal allocation of N fertilizer had been applied to randomly selected and replicated (six times) plots in a commercial orchard. The number of fertigations used to apply the N was as follows: two for the May 1 termination date, three for June 1, four for July 1 and five for August 1. Again, however, the total seasonal application of N was the same for all treatments but the N applied during each fertigation was reduced accordingly as the number of fertigations increased.

The source of N was a liquid calcium ammonium nitrate (CAN-17) injected through the irrigation system. A total of 119 lbs/acre of actual N was applied in 1996 and 85 lbs/acre in 1997.

The percent total N in the leaf was approximately 2.6 in September of 1996 and 1997, and not significantly different among treatments. No differences were found among the four N-application termination dates and the following fruit characteristics sampled in October: soluble solids concentration, titratable acidity, the ratio of soluble solids concentration to titratable acidity, percent juice, fruit color (as measured with a Minolta colorimeter) or fruit diameter (see Table 1).

Table 1. Fruit quality characteristics at harvest, and leaf nitrogen in the fall as affected by the month of the last nitrogen fertigation. Kern County, CA 1996-97

Treatment			fruit quality characteristics, (n = 10)											
Last N Fertigation	SSC[z] %		TA[y] %		SSC/TA		Color[v]			Juice %	Average Fruit Diameter[w] mm		Leaf N %	
							L*	C*	H°					
	1996	1997	1996	1997	1996	1997	1997	1997	1997	1997	1996	1997	1996	1997
May	10.1a[x]	9.2a	0.90a	1.15a	11.2a	8.1a	57.9a	45.2a	116.7a	47.4a	68a	73a	2.5a	2.6a
June	10.0a	9.2a	0.90a	1.21a	11.0a	7.7a	57.0a	44.4a	117.3a	47.7a	67a	72a	2.6a	2.6a
July	10.0a	9.2a	0.91a	1.19a	11.0a	7.8a	57.3a	44.1a	117.0a	47.1a	68°	72a	2.6a	2.6a
August	10.0a	9.0a	0.93a	1.15a	10.6a	7.9a	57.8a	44.4a	116.8a	47.3a	67a	72a	2.5a	2.7a

[z] Soluble solids concentration

[y] Titratable acidity in citric acid equivalents

[x] Data analyzed using ANOVA. Mean separation within columns by Fisher's protected LSD test at P≤ 0.05.

[w] n = 32 in 1996 and 75 in 1997

[v] L* = intensity , C* = chroma, H˚ = hue angle in degrees; (CIE units)

While a very weak trend toward higher sugar-acid ratios (SSC/TA ratios) in the fruit where most of the N was applied early, but no significant differences were observed. Growers that apply the total seasonal N application early in the season should not expect earlier fruit maturity, at least with leaf N concentrations in the optimum range. However, research has demonstrated that N utilization and metabolism increases during bloom and fruit set and applying most of the N during this period from March through June will continue to be a recommended practice in the San Joaquin Valley.

Craig Kallsen, Farm Advisor
Citrus, Pistachios/Subtropical Horticulture
661-868-6221 • cekallsen@ucdavis.edu