Topics in Subtropics Newsletter

University of California Cooperative Extension

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News from the Subtropical Tree Crop Farm Advisors in California

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Why has California red scale been so difficult to control?

Beth Grafton-Cardwell
IPM Specialist and Research Entomologist, UCR and Director of Lindcove Research and Extension Center

California red scale has been wildly out of control for several years now and growers often ask me what is going on. My answer is that heat and drought have been major contributors to the situation and so hopefully with the cold winter and rain we had this spring the problem will subside. But there are other issues involved, such as grower treatment practices. Let me explain further.

California red scale completes 3-4 generations per year in the San Joaquin Valley. In this region, the harsh winters eliminate many of the younger stages of scales, so that the population consists primarily of late stage males and females at the end of winter. The first male flight occurs in March during which mating occurs. Approximately 550 degree-days later, the 1st generation of crawlers emerge from the female scale bodies (Fig. 1). The exact date of this first crawler emergence depends on temperature and the accumulation of what we call degree days. Degree days for California red scale are defined as the accumulation of the average daily temperatures (maximum temperature – minimum temperature divided by 2) above the scale's lower developmental threshold of 53ºF. At 1100 degree-days after the first male flight another male flight occurs, and at 1650 DD the second crawler emergence occurs and so on through about 4 crawler generations (Fig. 1). When temperatures are cool in the spring, it takes about 8 weeks to accumulate 550 degree-days (male flight to crawler emergence). When temperatures are hot in the summer it only takes 2-3 weeks to accumulate 550 degree-days and events happen quickly.

Fig. 2 shows that during 2010-2011, degree days accumulated more slowly than the 30 year average. In contrast, during the hot dry years of 2012-2016 (2015 and 2016 shown), degree days accumulated more rapidly than the 30 year average. More heat has a number of consequences. It means that the scale is developing very rapidly and it makes it harder for the parasitoids to find and parasitize their preferred 3rd instar scale stages. The high heat and dust created by the drought work against the survival and effectiveness of the parasites. Finally, the extra degree days support an extra partial or full generation of scale at the end of the season on the fruit. To make things worse, we had such a warm winter in 2015-2016, that for the first time in my 27 years of monitoring, California red scale did not diapause during the winter – scales kept reproducing all winter long!

In addition to weather effects, there are insecticide efficacy issues. The insecticides work best if the scale population is synchronous – mostly in the crawler to white cap stage. That is why insecticides are recommended during the 1st and 2nd crawler generation (Fig. 1). After that, the stages become mixed and the scale is on the fruit, making insecticide control more difficult. With warm winters allowing young instars to survive, the scale populations have been mixed stages year round, reducing the effectiveness of insecticide treatments. In addition, insecticides are effective for only about 30 days, which is one scale generation. If extra generations are tagged on at the end of the season, and scale are moving to fruit early in the season, then a single insecticide application simply can't do the job. Another factor reducing insecticide efficacy is the practice of growers routinely applying systemic imidacloprid (Admire Pro and generics) to their acreage for various reasons including leafminers, psyllids, and soft scales. This product does not kill California red scale on wood. Year in and year out use of this product gradually builds scale on the wood that eventually spills out onto leaves and fruit, especially in a hot, dry year. As a consequence of these combined issues of drought, heat, and insecticides, quite a bit of the acreage was treated 2-3 times for California red scale during 2016.

So what are we going to do about California red scale? The degree days for 2017 have accumulated at about the rate of the 30 year average so far because the spring has been cooler than the past five years. That is helpful for slowing the growth of red scale, synchronizing the scale stages and improving both chemical and biological control. So there will likely be fewer treatments needed this year. A newly available scale control option is to utilize pheromone disruption alone or in combination with an insecticide treatment. Suterra has just begun marketing a slow-release mesoporous lure for California red scale –180 lures per acre hung in the trees just prior to the 2nd male flight provides season-long suppression of scales. My team has experimented with this product and found that it reduces scale on leaves, twigs and fruit by about 50% for low to moderate scale populations. At high population densities, the pheromone product is not effective enough to reduce scales. This makes sense, as male scales at high densities don't have to crawl very far to find a female.

Whatever methods you use to control scale, be sure to monitor live scale on leaves, twigs and fruit this year. Don't just depend on pheromone trap counts to make decisions because some insecticides and pheromone disruption can create artificially high or low male scale counts. Be sure to drive slowly to achieve excellent spray coverage.

Figure 1.

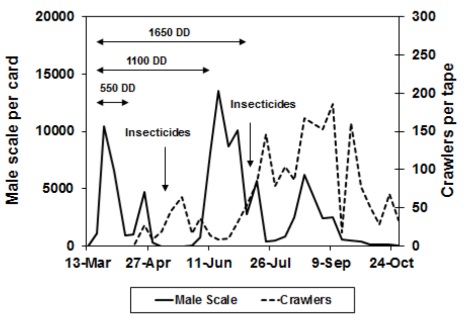
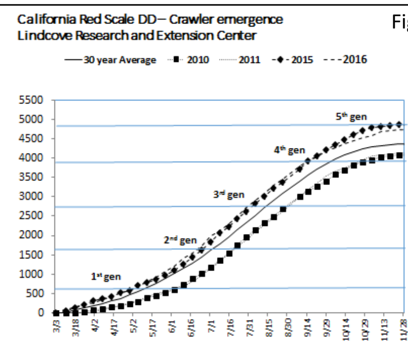


Figure 2



Navel Orange Nitrogen Fertilization

Craig Kallsen
Farm Advisor, UCCE Kern County

Spring is the best time to apply nitrogen (N) to navel oranges. Research has shown that the demand for N in citrus is highest from bloom through June and most of the supplemental nitrogen fertilizer should be applied during this time period. Citrus growers commonly apply about 1/10 to 1/4 of the annual N requirement foliarly in pre-bloom and post-bloom low-biuret urea sprays. Additional N is applied through the irrigation system at intervals through the growing season beginning in March and usually ending sometime in July or early August. Late summer and fall applications of N in the San Joaquin Valley tend to retard winter dormancy and promote vegetative growth susceptible to freeze damage. Fall or winter applied N, especially on light sandy or sandy-loam soils is subject to loss through the soil profile as a result of winter rains and irrigation water run during frost protection.

Navel orange responds readily to N nutrition. Current and past research shows that if orange fall leaf-tissue analysis is maintained in fall-sampled citrus leaves between 2.4 and 2.6 % nitrogen on a dry-weight basis for oranges, and between 2.2 and 2.4 % for lemons, a good balance is struck between yield, size and fruit quality. The evidence linking excess N to puff, crease, smaller fruit size and staining does exist, but these negative effects are most significant at N levels greater than 2.6 % nitrogen. In the past, some growers have decreased N applications for several years in a row with the hope of improving fruit size and quality, which resulted, eventually, in leaf-tissue analysis below 2.0 %. Nitrogen deficiencies this severe in oranges will result in considerable yield losses.

Nitrogen can certainly be applied in excessive quantities. Excessive N is not only associated with fruit size and quality problems, but also with water contamination. How much N a mature navel orange grove requires is a function of variety, irrigation scheduling and system efficiency, productivity, vigor, tree health and how the fertilizer is applied. For mature trees, at tree densities normally encountered in commercial groves, N requirement is most accurately calculated on a 'per acre' and not a 'per tree' basis. As a result of crowding and mutual shading, a closely spaced tree will use less N than one in a more open planting, but since there are more trees per acre the closely spaced trees will use a similar quantity per acre as the more open planting.

What would be the N requirement per acre of a grove of 25-year-old drip–irrigated Washington navel orange trees on Carrizo rootstocks that yield 650 cartons/acre of fruit? If we assume good irrigation efficiency and scheduling, growers who apply the bulk of the N through frequent but small injections of fertilizer through the irrigation system (six or more times through the season) with the rest applied foliarly, may maintain tree health, high fruit yield and quality of mature navels with less than 100 pounds of actual N per acre. For light, sandy soils, small, frequent applications can reduce deep leaching losses of N and improve tree health and productivity. Those who apply nitrogen foliarly and then split the remaining nitrogen application among two or three fertigations will probably require a total of 100 - 125 pounds of actual nitrogen per acre for mid-season and late navels and only 80 to 100 pounds for the relatively non-vigorous early navels. The use of significantly more N than this to maintain leaf levels in the 2.4 to 2.6 % range would suggest deep leaching of N through excessive irrigation may be occurring either through poor water scheduling or poor water distribution uniformity within the orchard. Past research by University of California scientists, Drs. Lund and Arpaia, have shown that relying totally on foliar application of nitrogen will produce a tree with a thin leaf canopy. Application of N in furrow irrigated citrus is usually less efficient than with low-volume systems and annual N application rates may climb to 200 or more pounds per acre.

Large amounts of N can be stored in the tree, especially the leaves. Correctly sampled in the fall, spring flush leaves can be used as a guide for adjusting N fertilizer applications for the following year. In spring flush leaves, some empirical data suggests that each tenth of a percent of leaf N by dry-weight over and above 2.5 percent N is equivalent to the storage of approximately 10-15 pounds per acre of N in the trees. Trees in an efficiently irrigated high-yielding orchard in which leaves produced in the spring are analyzed and test 2.5 % N in the fall (late September to early October) will probably require about 120 lbs. of N per acre the following season to produce a good yield and maintain 2.5 % N on a leaf dry-weight basis the following fall when retested. Trees in an orchard in which spring flush leaves test 3.0 % in September, will probably require a total seasonal N application of only 60 to 70 lbs. /acre the following season to produce a good yield of fruit and maintain leaf-nitrogen content of 2.4 - 2.6 % when sampled that fall. Conversely, trees whose leaf tissue contains only 2.0 % leaf N in the fall will probably require approximately 180 lbs. of N per acre to bring leaf levels to 2.4 - 2.6 % the following year.

In some areas, well water can supply a significant amount of the N requirement, and growers should know the N content of their irrigation water. Nitrogen stored in the soil or present in organic amendments can substitute for chemical sources. However, some raw organic amendments can be sufficiently low in N (as those derived from yard waste) that their microbial degradation can actually induce a temporary N deficiency in a grove that would otherwise have sufficient N. Well composted organic materials can furnish N to the trees. One of the biggest problems encountered by growers producing certified organic citrus is maintaining N nutrition. Fish fertilizer, compost, and organic liquids that meet certification requirements, and that have high nitrogen to carbon ratios, are some of the products used by organic growers to meet tree N needs.

Critical levels for leaf-nitrogen for some varieties of citrus, like the grapefruits, pummelos, pummelo x grapefruit hybrids and the mandarins are not well established. The high-yielding grapefruits and their pummelo cousins and crosses, appear to have slightly higher nitrogen requirements than oranges, probably as a result of their vigorous vegetative growth habits and prolific yielding characteristics. Trees of equivalent age will generally have a higher nitrogen requirement if grown on a vigorous rough lemon rootstock, for example, than if grown on trifoliate rootstock. Likewise anything that reduces tree growth and yield, such as water stress, severe pruning, late-stage rootstock/scion incompatibility, shallow soils, disease, or severe insect infestations, will reduce N requirements.

By keeping N as a nutrient and not a pollutant, the tree, the grower's bottom line, and the environment, will all come out looking better in 2017.

Recent advances in understanding the history of olive domestication

Elizabeth Fichtner, Farm Advisor, UCCE Tulare and Kings Counties

With the emergence of the California olive oil industry, the state has witnessed a dramatic diversification in the olive cultivars grown commercially. Our mainstay black ripe olive industry, dominated by the 'Manzanillo' olive, is now combined with increasing acreage of Spanish, Greek, and Italian cultivars used to create high quality, extra virgin oil. The historic table olive industry of California still represents around 18,000 acres of olives in the state, while approximately 40,000 acres are currently devoted to oil production.

Although olive cultivation in California is relatively new (dating back to the historic Spanish Missions established by Franciscan priests), olives are of key importance in the history and culture of the Mediterranean basin. A recent publication by a group of European, American, and North African scientists has re-evaluated the location of the domestication of the olive, providing genetic evidence that domestication occurred in the northeastern Levant, close to the present-day border of Syria and Turkey.

Figure 1. Olives are thought to have first been domesticated in the northeastern Levant, an area near the border of present-day Turkey and Syria. Map captured from Google Maps.

To complete the study, researchers collected plant material from nearly 2000 trees, sampling both wild oleaster populations (Figure 2) and domesticated cultivars of olive. World Olive Germplasm Banks in Córdoba (Spain) and Marrakech (Morocco) served as sources of the majority of cultivars included in the study. Researchers utilized the genetic sequences of plastids (i.e. chloroplasts) to discern differences between cultivars and wild oleaster populations. Plastids are organelles (structures inside cells) that contain their own DNA. Since plastids are generally inherited from one parent (similar to mitochondria), their genetic sequences are more conserved then that of nuclear DNA, which is contributed by both parents. Since olive is a wind-pollinated crop, nuclear DNA may be disseminated over large distances.

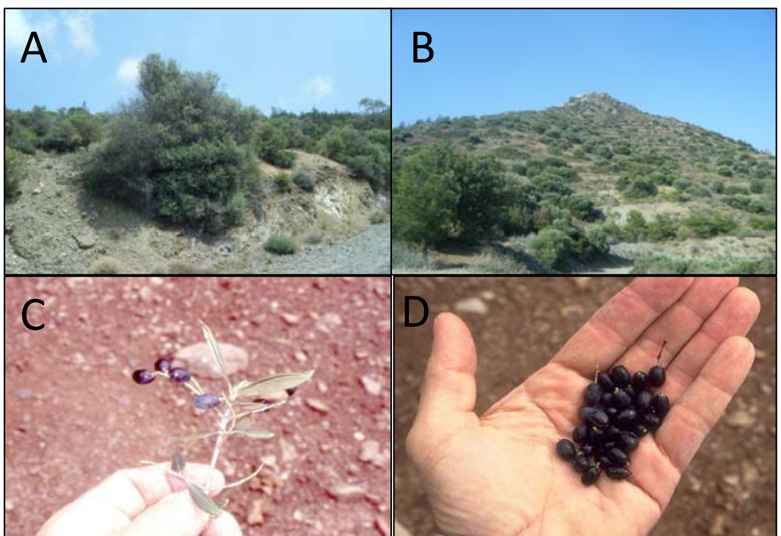


Figure 2. Wild oleaster trees (A) were sampled from populations such as those at the Stavrovouni Monastery in Cyprus (B). Plastid DNA in oleaster seedlings and fruit (C and D) is inherited from only one parent and is therefore relatively conserved. Photos A and B: Dr. G. Besnard. Photos C and D: P. Vossen.

The genetic analysis of wild populations indicates three distinct lineages of olive: the Near East (including Cyprus), the Aegean area, and the Straight of Gibraltar. These three wild populations are likely linked to refuge areas where populations persisted through historic glaciation events. Interestingly, the geographic distribution of these three populations also corresponds to the subdivisions of the olive fruit fly, suggesting that these regions offered shared refuge habitat for both the host and the pest. The wild oleaster population in the eastern Mediterranean was found to be more diverse than previously thought and ninety percent of the present-day cultivars analyzed in the study matched this group. Common olive cultivars grown in California, including, Sevillano, Manzanillo, Arbosana, Arbequina, and Koroneiki, all belong to this group originating in the eastern Mediterranean. As a result of this study, it is proposed that the initial domestication of olive took place in the northeastern Levant; subsequently, plant material was disseminated to the whole Levant and Cyprus before being spread to the western Mediterranean.

Figure 3. The olive grove near Smuggler's Cove on the east coast of Santa Cruz Island, approximately 25 miles off the coast of Santa Barbara, CA were planted in 1886-1887.

After these initial domesticated trees spread throughout the Mediterranean basin, they likely underwent subsequent domestication events by crossing with wild oleasters, thus introducing genetic material from the other two ancient western Mediterranean lineages. Such studies may appear purely academic; however, they can also address more timely questions and assist in characterizing cultivars. For example, a 2010 study in California made genotypic comparisons between historic olive plantings in Santa Barbara, CA and at Santa Cruz Island, CA. The study elucidated that the olives on Santa Cruz Island, planted in the late 19th century are different than other historic olive plantings in Santa Barbara, CA. Olives planted at the Santa Barbara Mission in the late 18th century are the 'Mission' cultivar, whereas those on Santa Cruz Island (Figure 3) are generally 'Redding Picholine.' Interestingly, the olives on Santa Cruz Island are thought to have been planted for oil production, but there are no historic reports of harvest or sale of a crop. Additionally, the Santa Cruz Island olives have become somewhat invasive on the island due to their propensity to establish from seed. As a result of genotypic analysis of these populations and the fact that 'Picholine' makes an excellent rootstock due to its ease of propagation from seed, it is hypothesized that the 'Picholine' variety was intended as a rootstock, but the grafts never took. Consequently, maturation of a 'Picholine' orchard may have just been an accident, a mistake, or simply bad luck.

The completion of this local population genetics study may have helped explain the unsolved mystery of the historically unharvested trees on Santa Cruz Island.

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UC DAVIS OLIVE CENTER at the Robert Mondavi Institute

Upcoming UC Olive Center Events

Sensory Evaluation of Olive Oil Part I
June 26/27, 2017

The essential sensory course for the professional buyer, importer, category manager, producer, or anyone who wants to gain expertise in evaluating olive oil. Sensory, culinary, chemistry and policy experts guide you through a unique tasting and educational odyssey. The lessons are useful for tasters at any level of experience.

Sensory Evaluation of Olive Oil Part II
June 28/29, 2017

Pre-requisite: Sensory Evaluation of Olive Oil I or similar course. Attendees receive the Olive Oil Defects Wheel, a booklet with presentations, and a flash drive with presentations and supplemental materials.

For course registration information, visit: www.olivecenter.ucdavis.edu

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Topics in Subtropics

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