Topics in Subtropics Newsletter

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News from the Subtropical Tree Crop Farm Advisors in California

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Farm Advisors

Gary Bender – Subtropical Horticulture, San Diego
Phone: (760) 752-4711
Email: gsbender@ucdavis.edu
Website: http://cesandiego.ucdavis.edu

Mary Bianchi – Horticulture/Water Management, San Luis Obispo
Phone: (805) 781-5949
Email: mlbianchi@ucdavis.edu
Website: http://cesanluisobispo.ucdavis.edu

Ben Faber – Subtropical Horticulture, Ventura/ Santa Barbara
Phone: (805) 645-1462
Email: bafaber@ucanr.edu
Website: http://ceventura.ucdavis.edu

Neil O'Connell – Citrus/Avocado, Tulare
Phone: (559) 684-3312
Email : nvoconnell@ucanr.edu
Website: http://cetulare.ucdavis.edu

Craig Kallsen – Subtropical Horticulture & Pistachios, Kern
Phone: (661) 868-6221
Email : cekallsen@ucdavis.edu
Website: http://cekern.ucdavis.edu

Eta Takele – Area Ag Economics Advisor
Phone: (951) 683-6491, ext 243
Email: ettakele@ucanr.edu
Website: http://ceriverside.ucdavis.edu

Elizabeth Fichtner - Orchard Systems, Tulare
Phone: (559) 684-3310
Email to: ejfichtner@ucanr.edu
Website: http://cetulare.ucdavis.edu

Stephen Vasquez – Citrus & Nut Crops, Fresno/Madera
Phone: (559) 600-7285
Email : skvasquez@ucanr.edu
Website: http://ucanr.org/sites/Citrus/

In This Issue

Editor's Note:

Topics in Subtropics is also available as an online blog. Visit our blog for up-to-date information that may be available prior to receipt of this newsletter: **http://ucanr.org/blogs/Topics/**

Has your mailing address changed? Would you like to add someone to our mailing list? Simply call or e-mail the farm advisor in your county to make additions or changes to our mailing list.

We strive to extend to you the most recent information pertaining to topics in subtropics. We enourage you to contact your local farm advisor to suggest topics of import to your commodity or industry for inclusion in future editions of this newsletter.

Elizabeth Fichtner
Craig Kallsen
Co-Editors

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UCCE 4437B S Laspina St, Tulare, CA 93274 • Phone (559) 684-3300 • Fax (559) 685-3319 • Web Site cetulare.ucdavis.edu
U.S. Department of Agriculture, University of California, and Tulare County Cooperating

Asian Citrus Psyllid Quarantines Impact Central Valley Citrus

David Haviland, UCCE, Kern Co.

For the last few years citrus growers in the San Joaquin Valley have been nervously watching the establishment of Asian citrus psyllid in southern California and bracing themselves for the day of northward movement. That day arrived in November 2012 when two psyllids (Strathmore 16 Nov. and Terra Bella 21 Nov.) were caught on yellow sticky card traps, in addition to a third capture back in January 2012. These captures have now resulted in restrictions on the movement of citrus in the heart of California's principal citrus production region.

Asian citrus psyllid is a small insect the size of an aphid that feeds on citrus leaves and stems. It is the vector of a deadly bacterial disease of citrus called huanglongbing, often referred to as HLB or citrus greening. This pest and disease combo has resulted in devastating losses to the citrus industry in Florida, and has the potential to have a similar effect in California.

Prior to November 2012 Asian citrus psyllid had been reported in eight California Counties, mostly in the southern part of the state, with a combined total of approximately 26,000 square miles under quarantine. However, the two finds in Tulare County mark the first time the psyllid has been found in the heart of California's principal citrus production region of the lower San Joaquin Valley: citrus production in Kern, Tulare and Fresno counties totals more than 200,000 acres at an annual value of approximately $1.7 billion.

The capture of individual psyllids on sticky traps in Strathmore and Terra Bella gives CDFA the authority to establish a quarantine of citrus within a 20-mile radius of the find in Strathmore. As an interim step, CDFA has opted to only regulate citrus in a 5-mile radius around each find. Further trapping and delineation can determine if psyllids are truly established in the region, or if the psyllids caught were just non-breeding hitchhikers brought to the corridor along State Highway 65 from infested counties in Southern California. Within the five-mile regulated area is an eight-hundred meter eradication zone requiring mandatory treatment of all host plants. If further delineation detects an established population it is anticipated that quarantines would be established. If established, a quarantine for Asian citrus psyllid would last a period of 2 years from the most recent capture. If additional psyllids were captured during the two-year quarantine the clock would reset itself for another two years.

Due to the fact that the psyllid only feeds on leaves and stems (and not fruit), citrus growers within quarantine zones in California have several options for harvesting and shipping fruit. Fruit harvested within quarantine zones can be picked, transported and packed within the quarantine zone without restrictions. Once clean fruit is packed (no leaves or stems) it can be shipped to locations outside of the quarantine.

Packing fruit from within the quarantine at packing houses outside of the quarantine is also possible under a CDFA compliance agreement that can be accessed through the County Agricultural Commissioner. These agreements state that the grower is willing to comply with CDFA and USDA regulations regarding the movement of bulk citrus, the most important of which is that bulk citrus must be processed through trash-removal equipment (to remove all leaves and stems) before it is shipped in bulk to a packer outside of the quarantine.

The Asian citrus psyllid quarantine also affects retail nursery stock. Currently there are compliance agreements and protocols available that allow retail nursery stock to be moved within the quarantine zone. However, no provisions are currently available to move nursery stock from the quarantine zone to regions outside of the quarantine zone unless the plants were budded and produced within a federally-approved screenhouse facility.

Regulations regarding Asian citrus psyllid can change quickly. For that reason citrus growers are encouraged to maintain good contact with their local Agricultural Commissioner. Additional information on the status of quarantines and other restrictions can be found online at http://www.cdfa.ca.gov/plant/acp/.

Decline of Oranges and Mandarins with Trifoliate and Citrange Rootstocks in the San Joaquin Valley of California

Craig Kallsen, UCCE Kern County & Neil O'Connell, UCCE Tulare County

In 1985, H. Schneider and J. Pehrson published an article documenting a decline of Frost Nucellar navel oranges on a number of trifoliate rootstocks (H. Schneider and J.E. Pehrson, Jr. 1985. Decline of navel orange trees with trifoliate rootstocks. California Agriculture. Sept. – Oct. 1985 p. 13-16) http://ucce.ucdavis.edu/files/repositoryfiles/ca3909p13-62889.pdf

In this decline, which began in the 1970s, trees began demonstrating symptoms when they were 15 to 20 years-old. Affected trees showed leaf discoloration, some defoliation, twig dieback and subnormal growth. They describe how some declining orchards were removed and, in others, individual trees were removed and replanted. Schneider and Pehrson concluded the following: "disorganized phloem and cambial tissues at the budunion proliferate into a tongue like wedge that protrudes from the inner side of the bark. Affected tissue acts as a girdle and is presumed to be responsible for the decline of the trees." In this article, Schneider and Pehrson provide excellent micrographs illustrating what was occurring at the budunion. However, the actual cause of this aberrant growth pattern was not described.

If we fast-forward to 2012, citrus growers in Kern and Tulare County, and presumably in other counties of the San Joaquin Valley, are experiencing similar tree symptoms to those described and pictured by Schneider and Pearson. The problem has been observed with blood oranges; navel oranges, including Fukumoto, Earli-Beck, Newhall, Atwood, and Powell; and on Satsuma and Page mandarins; on trifoliate and citrange rootstocks such as C-35 and Carrizo. This decline has not been reported, to our knowledge, in California outside of the Central Valley. There are similar reports of graft union disorders in Florida. We are observing symptoms much earlier in orchards than did Schneider and Pehrson. Decline is present in one two-year old blood orange orchard and in several navel orange orchards that are 7 years-old or less. This decline is not common, but can be devastating in a particular orchard, with most trees within an affected orchard showing decline or evidence of the disorder of the graft union. In some orchards only a few trees may initially demonstrate symptoms.

Normally, the scion of a navel orange tree grafted onto trifoliate or citrange rootstock will grow more slowly than the rootstock and a 'bench' will form at the graft union. This bench begins to form when a tree is six or seven years old. A typical graft union of a healthy tree is shown in Figure 1. Conversely, the growth of the scion and rootstock are more similar in affected trees when young and the scion will usually show a slight overgrowth of the rootstock (See Figure 2). In Fukumoto, the graft union is an area of intense suckering, and the graft union can become much distorted. As described by Schneider and Pehrson, a groove containing a light brown gum is apparent at the graft union of affected trees. In young trees only staining may be present at the union (see Figures 3 and 4). The groove does not always traverse the entire circumference, especially in the early stages. This groove is associated with the decline (see Figure 5 and 6) and death (see Figure 7) of trees.

The cause of the decline is not known. No pathogen has been identified, consistently, in affected trees. If the decline is a result of incompatibility between the scion and rootstock, there must be an additional stimulus, as the decline is not common and trifoliate and citrange rootstocks are the preferred rootstocks in this citrus growing area. In some young affected orchards, most trees show the groove at the graft union, and it seems unlikely that this uniformity was the result of tree-to-tree transmission of a pathogen. Currently, we have no suggestions on how to prevent this problem or alleviate the symptoms once found. Causes of the problem are being investigated.

Figure 1. Typical graft union of a healthy 7-year-old Newhall navel orange scion on Carrizo rootstock. (Photo: C. Kallsen)

Figure 2. Problematic graft union of a declining 7-year-old Newhall navel orange scion grafted on Carrizo rootstock. Note 'groove' marking the graft union. (Photo: C. Kallsen)

Figure 3. Graft union of an affected Newhall navel tree with a portion of the bark removed, showing the light brown discoloration within the 'groove'. (Photo: C. Kallsen)

Figure 4. Four-year old Blood orange scion on trifoliate rootstock showing staining at the graft union. (Photo: N.V. O'Connell)

Figure 5. An affected Newhall navel orchard showing declining trees. Many of the healthy-appearing trees show a developing groove, while all of the affected trees display this symptom.

Figure 6. A symptomatic four-year old Blood orange tree in severe decline. (Photo: N.V. O'Connell)

Figure 7. A symptomatic dead Newhall navel orange tree. (Photo: C. Kallsen)

Research Advances on Mitigation of Alternate Bearing in Olive

Elizabeth Fichtner, UCCE Tulare County & Carol Lovatt, UC Riverside

Alternate or biennial bearing is a phenomenon where fruit production alternates between large crops consisting of smaller, lower value fruit during an "ON" year and smaller crops consisting of larger, higher value fruit during an "OFF" year. Alternate bearing is not unique to olive, but also affects other perennial California crops including (but not limited to) pecan, pistachio, apple, avocado and citrus, especially mandarins. The large swings in biennial fruit production impact the overall industry, from growers to harvesters, to processors. The 2009-2011 seasons exemplify the magnitude of the affect of alternate bearing on olive production and crop value in Tulare County (Table 1).

Table 1. Tulare County Olive Production

	Yield (Tons/Acre)	Value (Dollars)
2009 OFF	0.40	5,750,000
2010 ON	7.23	74,128,000
2011 OFF	1.82	23,278,000

Causes of alternate bearing in olive

In olive, the current year's fruit is borne on the prior year's vegetative growth. The current year's fruit, and specifically the pit, inhibits the vegetative growth that supports flower buds for the following year (Sibbett 2000). Consequently, during an ON year, fruit production directly inhibits vegetative growth. A recent Israeli study (Dag et al. 2010) demonstrated the inhibitory effect of fruit on vegetative shoot growth and return bloom in the oil cultivar 'Coratina'. Similarly, in 2011 and 2012 we investigated the relationship between fruit load and vegetative growth on 'Manzanillo' olives in Tulare County. In our study, we assessed the influence of fruit on vegetative growth on ON trees in comparison to OFF trees. Additionally, within ON trees, we assessed vegetative growth on branches bearing fruit and branches not bearing fruit. Our study demonstrated the inhibitory effect of fruit number (crop load) on vegetative growth (Table 2). Vegetative shoot growth was lower for shoots that did not set fruit (-fruit) on ON trees than shoots without fruit on OFF trees indicating a whole-tree effect of crop load in alternate bearing. Additionally, our data demonstrate that fruit-bearing branches exhibit even less vegetative growth than non-fruit-bearing branches on ON trees, providing evidence of a strong localized effect of fruit on shoot growth (Table 2).

Our studies also demonstrated that the bearing status of a shoot influences the following year's percent bud break of floral buds. For example, shoots bearing fruit in 2011 exhibited over 90% fewer inflorescences than did shoots without fruit, regardless of whether non-bearing shoots were on an ON- or OFF-crop tree.

Alternate bearing is typically initiated by adverse climate. Once initiated, in the absence of additional environmental constraints affecting crop load, the bearing status of an orchard alternates between ON and OFF years, with ON years exhibiting less vegetative growth than OFF years. This biennial cycle, however, can be reset by adverse environmental conditions affecting bloom and fruit set. Adverse conditions 8-10 weeks prior to bloom may cause abortion of female flower parts, resulting in a high proportion of staminate (male) flowers that do not give rise to fruit. Additionally, adverse weather conditions at bloom may impact pollination and subsequent fruit set. Any conditions resulting in loss of crop during an anticipated ON year may render the season an OFF year.

Table 2. Effect of ON- and OFF-crop tree status and the presence (+fruit) or absence (-fruit) of fruit set on a shoot on shoot extension growth. (Orchard 2, Exeter, CA, 2011).

Tree status	No. fruit per shoot	Net shoot growth (mm) and no. of nodes per shoot			
		15 July - 17 Aug		18 Aug - 4 Oct	
ON-crop tree		-- mm --	-- no. --	-- mm --	-- no. --
shoot +fruit	22.8 a[z]	0.0 c	0.1 c	0.0 a	0.1 a
shoot -fruit	0.0 b	9.0 b	0.6 b	1.0 a	0.1 a
OFF-crop tree					
shoot -fruit	0.0 b	24.0 a	1.3 a	1.0 a	0.1 a
P-value	<0.0001	<0.0001	<0.0001	0.4004	0.6024

[z] Values in a vertical column followed by different letters are significantly different at specified *P* levels by Fisher's LSD Test.

Mitigation of Alternate Bearing

Reduction of fruit load prior to the major period of vegetative shoot growth during an ON year may mitigate alternate bearing. Chemical thinning with NAA at bloom may result in a smaller crop with larger sized fruit during an ON year, and allow for more vegetative growth to support the following year's crop.

Current Research on Mitigation of Alternate Bearing using Plant Growth Regulators (PGRs)

During the 2012 growing season, we investigated the potential for applications of PGR treatments to mitigate alternate bearing in olive. The specific goal of PGR treatments was to enhance spring bud break, summer vegetative shoot growth, and return bloom. In the first phase of this project, individual scaffolds of mature 'Manzanillo' olives were injected with a suite of PGR treatments. PGR treatments were injected at two times during the growing season, with winter/spring (pre-bloom) treatments targeting floral bud break, and summer treatments targeting vegetative shoot growth. Additionally, the winter/spring injections were made over a four-month timeframe (January-April) to assess the optimal timing of injections for enhanced floral bud break. Scaffold injection treatments resulting in desired growth responses will be carried forward in future studies focused on determining the efficacy of foliar applications. Treatments included either of two auxin transport inhibitors (tri-iodobenzoic acid and a proprietary auxin-transport inhibitor) injected alone, or in combination with two cytokinins (6-benzyladenine, and a proprietary cytokinin).

In the 2012 growing season, PGR treatments had encouraging results. Cytokinin treatments injected in February resulted in over 60% more floral bud break on non-bearing shoots of ON- trees, as compared to the untreated control. Similar treatments also increased floral bud break over 6 fold on bearing shoots on ON-trees; however, due to the variability in floral bud break, there was no significant difference between treated trees and controls on bearing shoots on ON-trees. All summer PGR treatments (either auxin transport inhibitors or cytokinins, alone or in combination) increased vegetative shoot growth on both bearing and non-bearing branches by over four fold; however, the influence of PGR-induced enhancement of summer vegetative growth on return bloom is not yet known. Return bloom and fruit set will be quantified during the 2013 season to determine the efficacy of PGR treatments on mitigation of alternate bearing on olive.

Selected Literature

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Alternate Bearing in Mandarin – The basics

Carol J. Lovatt, Professor of Plant Physiology Department of Botany and Plant Sciences, University of California-Riverside

Fruit influence mandarin tree phenology and return bloom and yield.

Effects of the OFF crop, ON crop and removing the entire ON crop on 'Pixie' mandarin tree phenology, vegetative shoot growth, floral development and the next year's yield under California growing conditions have been quantified (Verreynne and Lovatt 2009). Results of this research provide insight into solutions to alternate bearing that can be used now. In addition, the results identified the best time for taking action and established the consequences of delaying action or doing nothing.

For the sake of this discussion, Year 1 starts with bloom. The ON crop (ON year) is initiated with an intense ON bloom, followed by the setting of the ON crop of fruit. We will follow the Year 1 ON crop from fruit set through development to harvest to discuss how and when the ON crop of fruit at each stage of development impacts mandarin tree phenology and return bloom and yield the following year (Year 2). To facilitate comparison of the effects of ON and OFF mandarin crops, we will similarly discuss the effects of the OFF crop of fruit on mandarin tree phenology starting with the Year 1 light OFF bloom, which sets the OFF crop. The phenology models included herein are for 'Pixie' mandarin but apply to other mandarins and sweet oranges, with the exception, in some cases, of the late harvest varieties.

Summer vegetative shoot growth is key to a good return bloom and yield.

OFF-bloom/OFF-crop Year. When the mandarin tree sets and develops an OFF crop, a significant number of vegetative shoots develop during the summer and to a lesser degree during the fall of Year 1 (Fig. 1). The following spring, in addition to the contribution of Year 1 spring shoots to return bloom, the Year 1 summer shoots contribute inflorescences to bloom, resulting in the ON bloom and ON crop in Year 2. For OFF-crop 'Pixie' mandarin trees in California, ~60% of the Year 2 floral shoots are produced by the Year 1 spring vegetative shoots, ~32% by the Year 1 summer vegetative shoots and ~8% by Year 1 fall vegetative shoots (Verreynne and Lovatt 2009). Thus, 40% of the return bloom is contributed by summer + fall shoots. Summer vegetative shoot growth is key to a good return bloom; the more summer vegetative shoots, the greater the return bloom and yield.

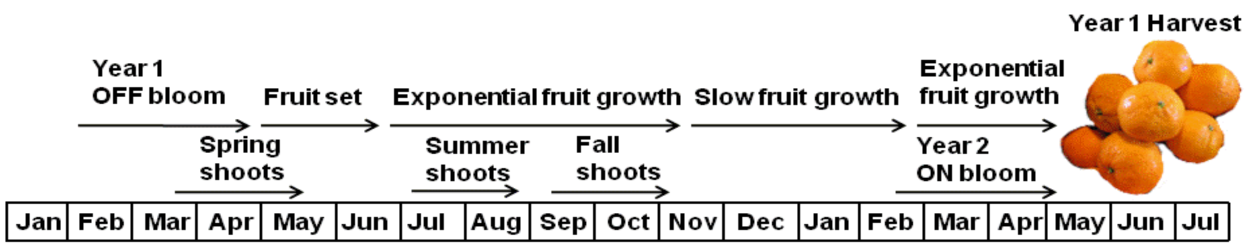

Fig. 1. An OFF-crop year starts with an OFF bloom that sets an OFF crop or is initiated by a climatic or culture event that reduces flower or fruit number during the bloom or fruit set periods. The low number of young developing fruit in Year 1 results in a significant amount of summer and fall vegetative shoot growth that contributes inflorescences to the ON bloom in Year 2, ~32% and ~8% by summer and fall shoots, respectively. Summer vegetative shoots also contribute the majority of leafless inflorescences, which are present in large numbers in an ON bloom. Note that the mature fruit of the OFF crop are fewer in number but large in size.

The setting ON crop of fruit inhibits summer vegetative shoot growth.

ON-bloom/ON-crop Year. During Year 1, the ON crop of young developing fruit inhibits summer and fall vegetative shoot growth, thereby reducing the number of buds available to produce inflorescences (and vegetative shoots) the next spring, resulting in an OFF bloom (Year 2) (Fig. 2). Note that due to the inhibition of summer and fall vegetative shoot growth during the ON-crop year, only Year 1 spring shoots contribute inflorescences at return bloom.

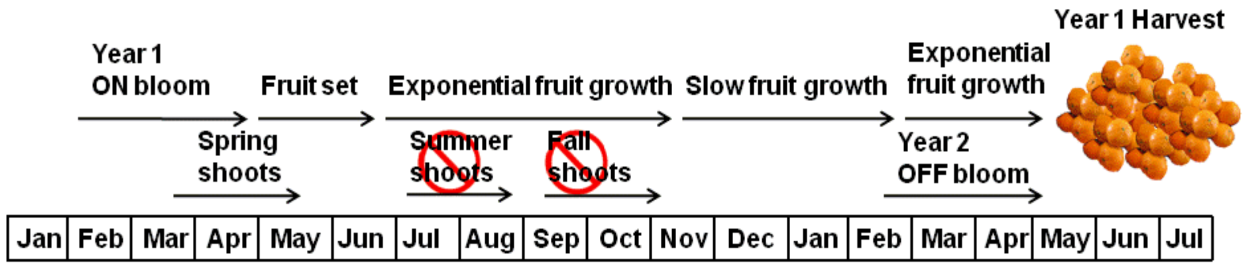

Fig. 2. An ON-crop year starts with an ON bloom that sets an ON crop or is initiated by climatic or culture events that are optimal for flowering and fruit set such that natural fruit thinning fails to take place. The large number of young developing fruit inhibits summer and fall vegetative shoot growth. The loss of summer and fall shoots means there are fewer sites that can bear inflorescences in spring of Year 2, especially leafless inflorescences, which develop predominantly on summer shoots. The result is an OFF bloom in Year 2 that is produced predominantly by the Year 1 spring shoots. Note that there are many small size mature fruit in the ON crop.

The setting ON crop of fruit has a localized and a whole tree effect on return bloom.

On both ON- and OFF-crop mandarin trees, some Year 1 spring shoots set fruit (with fruit) and others fail to set fruit (without fruit). Clearly ON-crop trees have more shoots that set fruit than OFF-crop trees. In Year 1, shoots with and without fruit were tagged on ON- and OFF-crop 'Pixie' mandarin trees. At bloom the following year, the number of inflorescences produced by the spring shoots and summer + fall shoots for each original tagged shoot was counted. Year 1 shoots without fruit on OFF trees produced the most inflorescences on both spring and summer + fall shoots at return bloom (Verreynne and Lovatt 2009). In contrast, Year 1 shoots that set fruit (with fruit) on ON-crop trees produced the least inflorescences. Year 1 spring shoots without fruit on ON trees and Year 1 shoots with fruit on OFF trees produced intermediate numbers of inflorescences.

Fruit exert a localized effect and a whole tree effect on the contribution of spring, summer and fall shoots to return bloom of mandarin trees.

	Year 1 Spring shoots Bud Break (%)	Year 1 Spring shoots Inflores. (no.)	Year 1 S + F shoots Nodes (no.)	Year 1 S + F shoots Bud Break (%)	Year 1 S + F shoots Inflores. (no.)
Shoots without Fruit					
OFF	31.4 a	9.8 a	10.0 a	33.0 a	7.0 a
ON	15.5 b	2.5 b	2.7 bc	5.0 c	0.8 c
Shoots with Fruit					
OFF	10.8 bc	5.8 bc	4.2 bc	8.4 b	2.1 bc
ON	2.1 d[z]	0.2 c	1.1 c	1.0 c	0.1 c
P-value	0.0001	0.0001	0.0001	0.0001	0.0001

[z] Values in a vertical column followed by different letters are significantly different at the *P*-value specified by Duncan's multiple range test.

The number of shoots that do not set fruit during the ON-crop year is important.

The data above illustrate the interaction between the localized effect of fruit present on a shoot and the effect of crop load. The interactions are strongest for buds on Year 1 spring shoots without fruit on OFF trees and Year 1 spring shoots with fruit on ON-crop trees. The full negative effect of fruit on return bloom in alternate bearing is expressed on spring shoots that set fruit (with fruit) on ON-crop trees. Thus, for ON- or OFF-crop trees, the intensity of the return bloom and yield in Year 2 is proportional to the number of shoots that do not set fruit (without fruit) in Year 1. This is an important concept for managing alternate bearing. ***Example:*** Both Growers A and B have 1,500 fruit per tree. Grower A's crop will be followed by an OFF bloom and OFF crop but Grower B's crop will be followed by another crop of 1,500 or more fruit per tree. *Why?* ***<u>Answer:</u>*** Grower A has very few shoots without fruit that can produce vegetative shoots in summer and inflorescences the next spring, whereas Grower B has more than 1,500 shoots without fruit that will produce summer and fall vegetative shoots and a strong return bloom.

The effect of the ON crop on return bloom is cumulative.
A fruit removal experiment was conducted to determine when the ON crop is exerting its effect on the return bloom (Verreynne and Lovatt 2009). The results demonstrated that the effect of the ON crop on return bloom is cumulative. This basic information is necessary for timing treatments to mitigate alternate bearing. In this experiment, all fruit were removed from sets of ON-crop trees in progressively later months and the intensity of the return bloom on these trees was compared to OFF- and ON-crop control trees. Removing all Year 1 young fruit from ON-crop trees in June, July or August significantly increased the number of summer and fall vegetative shoots that developed and the intensity of the Year 2 bloom and yield to values greater than or equal to the return bloom and yield of Year 1 OFF-crop control trees, which were ON-crop trees in Year 2. Removing fruit progressively later (Sept through Dec), reduced the number of summer and fall vegetative shoots that developed and their contribution to return bloom and yield compared to OFF-crop control trees or ON-crop trees with all fruit removed in June, July or August. Removing fruit as late as December increased the number of inflorescences contributed by the Year 1 spring shoots during bloom in Year 2 compared to ON-crop control trees with no fruit removed, demonstrating that Year 1 spring shoots had viable floral buds through December. However, the number of floral shoots that developed on ON-crop trees with the fruit removed in December was significantly less than OFF-crop control trees and ON-crop trees with their fruit removed earlier in the year, because these trees produced summer and/or fall vegetative shoots that contributed to return bloom. Subsequent research by Arbona and Lovatt demonstrated that the number of inflorescences produced by Year 1 spring shoots decreased incrementally for each month the ON crop remained on the trees past December compared to OFF-crop control trees and ON-crop trees with all fruit removed in December or earlier.

Reducing crop load (i.e., creating more shoots without fruit) mitigates alternate bearing.
The incremental decrease in inflorescence number due to the presence of the ON-crop past December is a problem for 'Pixie' mandarin, 'Valencia' and other late-maturing cultivars. For these cultivars, it is important that ON-crop trees be harvested as soon as possible after the fruit reach legal maturity. In addition, having two crops on the trees into early summer should be avoided to reduce the risk of inhibiting summer vegetative shoot growth and creating a second OFF-crop year in Year 3 (Verreynne and Lovatt 2009). Similarly, alternate bearing is exacerbated by the cultural practice of holding the ON-crop on the tree to extend the commercial harvest period.

Thinning (fruit removal by hand, by chemical or by pruning) the ON crop prior to summer vegetative shoot growth is the most effective time for increasing return bloom and yield (Fig.3A). Summer fruit thinning is also optimal for increasing size of the young, developing fruit. Thinning the ON crop prior to fall shoot growth will increase return bloom and yield to a lesser degree than summer thinning (Fig. 3B). Note that December of Year 1 is the latest time to thin and still obtain a positive effect on Year 2 bloom and yield (Fig. 3C). The goal is to reduce the number of fruit in the ON crop uniformly over the tree sufficiently early to promote summer vegetative shoot growth. Research in a commercial 'Nules' Clementine mandarin orchard in Grapevine provided evidence that fruit drop of the young fruit is minimal by the third week of August in both ON- and OFF-crop years (Chao and Lovatt 2012). It is possible to wait until this time to thin the crop, which will reduce the risk associated with high temperatures that can occur during the June drop period (mid-June through the end of July) but still increase return bloom to a greater degree than fall fruit thinning would accomplish. If the crop is to be thinned by pruning, prune with caution. The goal is a light pruning to promote summer vegetative shoot growth. It must be done sufficiently early (spring or early summer) so the new vegetative shoots have time to mature and develop floral buds. Shoots that develop in response to fall pruning will contribute marginally to return bloom in spring of Year 2, but will provide shoots that will flower in Year 3. Removing summer shoots from spring shoots that did not set fruit (shoots without fruit) defeats the purpose. Avoid over-pruning, which will interfere with floral bud development. When deciding how many fruit to remove or how much to prune from ON-crop trees, keep in mind that next year's crop will be produced predominantly on Year 1 (current season) spring and summer shoots that did not set fruit (without fruit) or from which fruit have been removed by hand or pruning early in the season. In addition to pruning to reduce crop load, pruning should be done at other times of the year to increase shoot number (fruiting wood) and branching (tree complexity), which contribute to increased floral shoot number and yield the following year and the next.

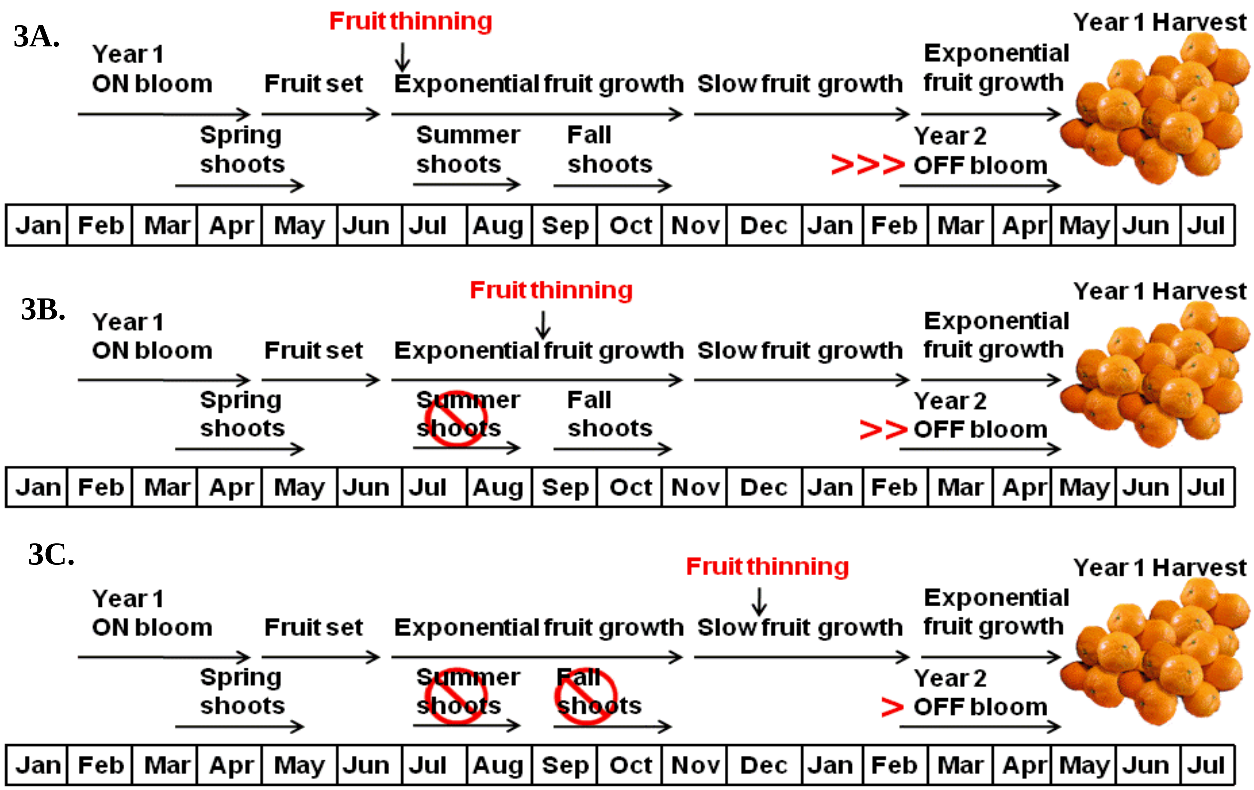

Fig. 3. A, B and C. A. Thinning (fruit removal by hand or chemical) the ON crop in early summer has the greatest potential to increase the number of summer and fall vegetative shoots that develop and thus, the greatest potential to significantly increase floral intensity and yield above that of the expected Year 2 OFF bloom and OFF crop. Early fruit removal also increases the contribution of the Year 1 spring shoots to return bloom. Summer fruit thinning is also the optimal time for increasing the size of the young developing fruit. B. Thinning the ON crop in fall will reduce the number of summer vegetative shoots that develop and their contribution to return bloom and yield, but will increase the growth of fall vegetative shoots and their contribution to increasing Year 2 bloom and yield above the anticipated OFF bloom. Removing fruit at this time will also increase the contribution of the Year 1 spring shoots to return bloom. C. Waiting until December to thin the ON crop will eliminate the contribution that summer and fall vegetative shoots could make to the Year 2 bloom, but will increase the contribution made by the Year 1 spring vegetative shoots so that bloom and yield in Year 2 will be slightly greater than the putative OFF bloom and OFF crop. There is an incremental decrease in return bloom for each month the ON crop of fruit remains on the tree past December.

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Cooperative Extension
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Topics in Subtropics

Elizabeth Fichtner
Farm Advisor

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