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Olive Notes
Tulare County

Vol. 11, Issue 1, June 2014

Olive Grower's Council/ UCCE Pre-harvest Olive Day Meeting

July 30, 2014
Exeter Memorial Building
324 N. Kaweah Ave., Exeter, CA 93221

7:30 AM	**Registration**
8:00 – 8:15	Highlights from visit to the Olive Tree Institute, Tunisia – *Elizabeth Fichtner, UCCE Farm Advisor, Tulare County*
8:15 – 8:30	State of Table Olive Industry – *Adin Hester, President, Olive Grower's Council*
8:30 – 8:50	COC: Review and Strategic Focuses for the Table Olive Industry – *Alexander Ott, Executive Director, California Olive Committee*
8:50 – 9:20	Evaluation of Pathogenicity and Insect Transmission of *Xylella fastidiosa* Strains to Olive Plants – *Rodrigo Krugner, Research Entomologist, USDA ARS, San Joaquin Valley Agricultural Sciences Center*
9:20 – 9:35	Olive Fly and Brown Marmorated Stink Bug Identification – *Dani Lightle, UCCE Farm Advisor, Glenn, Butte & Tehama Cos.*
9:35 – 9:50	Olive Fruit Fly Population Trends in the Southern San Joaquin Valley – *Jim Stewart, Ag IPM Consultants, Inc.*
9:50 – 10:20	**Coffee Break and Visit with Sponsors**
10:20 – 10:50	Olive Oil Market and Future Market Potential – *Paul Vossen, UCCE Farm Advisor, Sonoma County*
10:50 – 11:20	Overview of Olive Oil Production – *Eli Cohen, Global Expert on Olive Oil Production, Natar Olive Technology, Israel*
11:20 – 11:45	Olive Harvest Labor: Now and in the future- *Manuel Cunha, President, Nisei Farmers League, Fresno*
11:45 – 12:00 PM	Meeting Overview and Recognition of Sponsors – *Rod Burkett, Board Chairman, Olive Grower's Council*
12:00 – 1:00	**Lamb BBQ Courtesy of Our Sponsors**

Meeting Sponsors:
West Coast Olive Guide, Olive Grower's Council, UCCE Tulare County, California Olive Committee, Musco Family Olive Co., Bell Carter Olive Co., AgriLogic Insurance

Continuing Education Requested: PCA 1 Hour, Other & CCA 1 Hour PM, .5 Hour PD

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U.S. Department of Agriculture, University of California, and Tulare County Cooperating

Preemergence herbicides for olive orchard weed control

Brad Hanson, Cooperative Extension Weed Specialist,
Plant Sciences, UC Davis - Plant Sciences

Weed control is always important in table and oil olives and is critical during the first few years after planting when the trees are more vulnerable to weed competition. Olive producers often rely on a combination of tillage and chemical control strategies to manage weeds. Herbicides are primarily used as "strip" or "berm" treatments within the tree rows and are becoming increasingly important as some olive systems shift to moderate- or high-density production systems which limits within-row cultivation. In addition, the shift to low-volume irrigation systems in olive and other tree crops has affected weed emergence and growth, herbicide persistence, and further limits mechanical weed control within the tree row in these orchards.

In terms of herbicides used in olive orchards, there is a heavy reliance on just two active ingredients; glyphosate (Roundup and similar products) and oxyfluorfen (Goal, GoalTender and similar materials) (Table 1). Glyphosate has postemergence activity on many weeds and oxyfluorfen has both postemergence and preemergence control of many broadleaf weeds. However, the increasing prevalence of glyphosate-resistant broadleaf and grass weeds in orchards and vineyards has led to increasing interest in other herbicide options, especially preemergence materials.

Table 1. Top ten herbicides used in California olive orchards (CDPR data).

	active ingredient	2011 treated acreage
1	glyphosate (eg. Roundup)	64051
2	oxyfluorfen (Goal, GoalTender)	23209
3	diuron (Karmex, Diurex)	7910
4	simazine (Princep, others)	7457
5	carfentrazone (Shark)	7297
6	pendimethalin (Prowl H2O)	4513
7	oryzalin (Surflan, others)	4255
8	paraquat (Gramoxone)	3541
9	flumioxazin (Chateau)	752
10	pyraflufen (Venue)	331

Compared to some other tree crops, California olives have relatively few registered preemergence herbicide options (chart below); however, a few new materials are being tested and will hopefully also be available for olives in the next few years. Briefly, here is a rundown of the preemergence herbicides registered in California olives:

Diuron (Karmex, Diurex, others). Diuron provides preemergence and some postemergence control of many broadleaf and grass weeds including suppression of some perennial weeds. This herbicide works by blocking photosynthesis at photosystem II (Group 7 herbicide). This older chemistry typically is used at 1-2 lbs/A once or twice during winter and early spring and requires water for incorporation. Because diuron is quite water-mobile, it can be a leaching hazard in coarse soils and is subject to additional use restrictions in some areas.

Flumioxazin (Chateau, others). Flumioxazin is currently registered only on <u>nonbearing olives.</u> It is a Group 14 herbicide that has good residual weed control activity and also helps with

postemergence control of emerged broadleaf weeds when tankmixed. Flumioxazin usually is applied at 6-12 oz/acre with longer residual control resulting from the higher rates.

Indaziflam (Alion). Indaziflam is the newest preemergence herbicide to be registered in olive. It is a long lasting, Group 29 herbicide that controls many grass and broadleaf weeds preemergence but has no postemergence activity. In olive, indaziflam can be used at 5-6.5 fl oz/A and trees should be at least three years old before this herbicide is used.

Isoxaben (Trellis, Gallery). Isoxaben can currently only be used in nonbearing olive orchards. When applied in the winter at 1 to 1.33 lb/A and properly incorporated, it can provide 4-5 months of control of many winter and summer broadleaf weeds. However, isoxaben has little or no activity on grass weeds and will not provide acceptable control of emerged or germinated grass weeds. Isoxaben is cellulose synthesis inhibitor (Group 21 herbicide).

Oryzalin (Surflan, others). Oryzalin is a Group 3 herbicide that provides preemergence control of annual grasses and small-seeded broadleaf weeds but has no postemergence activity. It is typically applied at 2-4 qt/A and must be incorporated by water or tillage for effective weed control. This herbicide is similar to pendimethalin in its weed control spectrum and residual activity.

Pendimethalin (Prowl H2O). Pendimethalin is a Group 3 herbicide that provides preemergence control of annual grasses and small-seeded broadleaf weeds but has no postemergence activity. It is typically applied at 2-4 qt/A and must be incorporated by water or tillage for effective weed control. This herbicide is similar to oryzalin in its weed control spectrum and residual activity.

Simazine (Princep, others). Simazine is a photosynthesis inhibitor (Group 5 herbicide) that controls many broadleaf and some grass weeds preemergence but has little postemergence activity. In olive, it is typically applied once or twice in the winter at 1-2 lb/acre. Because simazine is water-mobile, it can be a leaching hazard in coarse soils and is subject to additional use restrictions in some areas of the state.

Recent research:

Several new herbicides have been registered in other tree and vine, and UC weed scientists have conducted several experiments with the support of the California Olive Commission and the crop protection industry to evaluate their crop safety in olives. Although these herbicides are not currently registered in olive, early crop safety results have been mostly promising with penoxsulam (PindarGT), rimsulfuron (Matrix), mesotrione (Callisto), flazasulfuron (Mision), and saflufenacil (Treevix) – hopefully some of these will eventually be registered in this crop.

Two demonstration trials were conducted in commercial table olive orchards in 2012-13 to evaluate registered preemergence herbicides. At the Corning site (Table 2), the overall weed control ratings were quite good into early summer following a March application. Note: the Corning orchard was previously treated with glyphosate; thus the untreated plots should really be considered a “glyphosate-only” program. At the Porterville site, weed control was excellent up to 6 months after a November application with Princep, Goal/Prowl, Goal/Surflan, and both Chateau (10 oz or 6 + 6 oz) treatments.

Table 2. Effects of preemergence herbicides on weed control in a young table olive orchard near Corning in 2013.

		Rate	Timing*	Overall weed control (%)**					
		lb ai/a		35 DAT		63 DAT		94 DAT	
1	untreated			45	a	42.5	a	15	b
2	simazine (Princep)	3	A	81.5	a	76.8	a	67.5	ab
3	oxyfluorfen (Goal 2XL)	1.5	A	83.8	a	62.5	a	25	b
	pendimethalin (Prowl H2O)	3.8	A						
4	oxyfluorfen (Goal 2XL)	1.5	A	88.3	a	67.5	a	35	ab
	oryzalin (Surflan)	4	A						
5	isoxaben (Trellis)	1	A	62.5	a	60	a	57.5	ab
6	flumioxazin (Chateau)	0.38	A	83.8	a	77.5	a	27.5	b
7	flumioxazin (Chateau)	0.191 fb 0.191	A fb B	88.3	a	78.8	a	80	a
	LSD (P=.05)			29.95		35.43		35.91	

*The "A" timing was applied March 19, 2013 and the "B" timing on May 21, 2013.
DAT = days after treatment.
**Prior to treatment the site had been treated with glyphosate; thus the weed control data are not solely the residual treatment.
***No treatment resulted in visible injury to the olive trees at any rating date.

In general, integrated weed management programs that include: preemergence herbicide, postemergence herbicides, and tillage are recommended for conventional olive production systems. Including several herbicide modes of action in a tankmix or in rotation will help reduce the selection pressure for herbicide-resistant weeds. This is particularly important as glyphosate-resistant weeds become more widespread in California orchard and vineyard cropping systems.

For the most recent Pest Management Guideline for olive (and dozens of other crops) check out UC IPM Online at http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html. Additional weed control information can be found at the UC Weed Research and Information Center (http://wric.ucdavis.edu/) and at the UC Weed Science blog (http://ucanr.org/blogs/UCDWeedScience/).

Advances in mitigation of alternate bearing of olive: Vegetative growth response to plant growth regulators

Elizabeth Fichtner, UCCE Farm Advisor, Tulare County, and Carol Lovatt, Professor of Plant Physiology, Botany and Plant Sciences, UC-Riverside.

Alternate bearing (AB) is a phenomenon in olive 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. The large swings in biennial olive production impact the overall industry, from growers to harvesters, to processors. In olive, the vegetative growth in one year produces the nodes bearing potential floral buds in the spring of the second year. Fruit suppress vegetative shoot growth resulting nvbvv in fewer nodes available to bear fruit the following year. Our phenological studies have helped

characterize the relationship between fruit load and vegetative growth on 'Manzanillo' olives in Tulare County, California.

Investigation of vegetative growth response to plant growth regulators

One strategy proposed to mitigate AB is to stimulate summer vegetative shoot growth to increase the number of nodes with the potential to produce floral buds. To address this strategy, our research team designed and implemented a proof-of-concept study in which plant growth regulator (PGR) treatments were injected into individual scaffold branches on opposing sides of 'ON' and 'OFF' trees. Plant growth regulators utilized in the study included two cytokinins, 6-benzyladenine (6BA) and a proprietary cytokinin (PCK), as well as two auxin-transport inhibitors, tri-iodobenzoic acid (TIBA) and a natural auxin transport inhibitor (NATI). Eight PGR treatments were included, with each PGR tested alone, and each cytokinin tested in combination with each auxin-transport inhibitor. PGR treatments were implemented in Summer (July 2012), and Summer + Spring (July 2012 and February 2013). Vegetative shoot growth was recorded monthly throughout the year to determine the influence of PGR treatments and timings on node production. The study was completed at the Lindcove Research and Extension Center (Exeter, CA).

Node production in response to plant growth regulator treatments

Scaffold injection with numerous PGR treatments resulted in significant increase in vegetative shoot growth. For example, nonbearing shoots on 'ON' control trees, produced an average of one node between July 2012 and February 2013, whereas nonbearing shoots on PGR-treated scaffold branches exhibited almost 4 times the new growth of the control trees (Table 1, shaded). Importantly, the new growth in some cases was statistically equal to and numerically greater than the new vegetative shoot growth of nonbearing shoots on 'OFF' control trees. The PGR treatments also had a positive effect in increasing vegetative shoot growth on bearing shoots of 'ON' crop trees. Bearing shoots on 'ON' control trees produced an average of 0.8 nodes between July 2012 and February 2013, whereas bearing shoots on PGR-treated scaffold branches of 'ON' trees produced over three-fold more nodes during this period. Some PGR treatments increased the number of new nodes on bearing shoots on 'ON" trees to values equal to those of nonbearing shoots of 'OFF' crop control trees (Table 1, asterisk). Identify the better treatments. On average two additional nodes of growth were added to shoots in all treatments from February through April. Thus, in April shoots treated with some PGRS (Table 1, shaded) remained longer than bearing or nonbearing shoots on 'ON' crop control trees and equal to nonbearing shoots on 'OFF' crop control trees. This result suggests that with regard to increasing vegetative shoot growth there was no advantage derived from supplementing the Summer PGR treatment with the second Spring PGR treatment. However, the effect of the Spring PGR treatments on floral bud break, return bloom and fruit set remains to be determined.

Table 1. The effect of scaffold branch injected plant growth regulator treatments on vegetative shoot growth, as number of new nodes produced.

		New Nodes	
Treatment	**Branch Status**	**July-February**	**July-April**
ON Control	**Fruit**	0.8 l	3.3 jkl
TIBA+6BA SUMMER	Fruit	2.3 hijk*	4.6 cdefghij
TIBA+PCK SUMMER	Fruit	2.5 ghij*	4.9 bcdefghij
NATI+6BA SUMMER	Fruit	2.7 fghij*	4.2 fghijkl
NATI+PCK SUMMER	Fruit	2.2 hijk*	3.9 hijkl
TIBA SUMMER	Fruit	2.4 hij*	4.9 bcdefghij
NATI SUMMER	Fruit	2.5 fghij*	4.3 efghijkl
6BA SUMMER	Fruit	2.2 ijkl	4.2 fghijkl
PCK SUMMER	Fruit	2.6 fghij*	4.7 cdefghij
TIBA+6BA SUMMER+SPRING	Fruit	2.4 hij*	4.5 defghijk
TIBA+PCK SUMMER+SPRING	Fruit	3.0 efghi*	4.5 defghij

NATI+6BA SUMMER+SPRING	Fruit	2.6 fghij*	5.0 abcdefghij
NATI+PCK SUMMER+SPRING	Fruit	2.2 ijk*	3.7 ijkl
TIBA SUMMER+SPRING	Fruit	2.0 ijkl	4.1 ghijkl
NATI SUMMER+SPRING	Fruit	3.1 defghi*	5.5 abcdefghi
6BA SUMMER+SPRING	Fruit	2.7 fghi*	4.9 bcdefghij
PCK SUMMER+SPRING	Fruit	1.3 jkl	2.5 l
OFF Control	No Fruit	3.6 abcdefgh	5.0 bcdefghij
ON Control	No Fruit	1.0 kl	2.7 kl
TIBA+6BA SUMMER	No Fruit	3.8 abcdefg	4.7 cdefghij
TIBA+PCK SUMMER	No Fruit	4.7 ab	5.9 abcdefg
NATI+6BA SUMMER	No Fruit	4.8 a	6.3 abcd
NATI+PCK SUMMER	No Fruit	4.5 abc	6.0 abcde
TIBA SUMMER	No Fruit	4.4 abcd	6.0 abcdef
NATI SUMMER	No Fruit	4.2 abcde	4.9 bcdefghij
6BA SUMMER	No Fruit	3.4 bcdefghi	4.0 hijkl
PCK SUMMER	No Fruit	4.3 abcde	5.5 abcdefghi
TIBA+6BA SUMMER+SPRING	No Fruit	4.2 abcde	5.2 abcdefghi
TIBA+PCK SUMMER+SPRING	No Fruit	4.8 a	5.7 abcdefgh
NATI+6BA SUMMER+SPRING	No Fruit	3.9 abcdef	5.1 abcdefghi
NATI+PCK SUMMER+SPRING	No Fruit	3.2 cdefghi	4.2 efghijkl
TIBA SUMMER+SPRING	No Fruit	4.8 a	6.5 ab
NATI SUMMER+SPRING	No Fruit	4.5 abc	6.8 a*
6BA SUMMER+SPRING	No Fruit	4.8 a	6.4 abc
PCK SUMMER+SPRING	No Fruit	3.6 abcdefgh	4.7 cdefghij
***P*-value**		**<0.0001**	**<0.0003**
Note: Shading denotes treatments significantly different than ON Control + Fruit treatment. Asterisk denotes treatments significantly different than OFF Control (- Fruit).			

Summary

These preliminary data demonstrate that PGRs increase shoot growth, which might result in more nodes with the potential to produce inflorescences the following spring. Future studies are anticipated to address the use of promising treatments in foliar applications. Naturally-occurring compounds, such as PCK and NATI, may be easier and less costly to register than PGRs, which are classified as pesticides. Therefore, significant growth response to the natural compounds tested may have commercial benefit even if proven less efficacious than the synthetic PGRs.

Acknowledgements: The financial support of the California Olive Committee and the technical support of the Lindcove Research and Extension Center were integral to the success of this project.

Olive "Quick Decline" in southern Italy may be associated with pathogen common in California

Elizabeth Fichtner and Dani Lightle, Farm Advisors, UCCE Cooperative Extension

The report of a new disease on olive in Italy, called "quick decline," marks the first report of the bacterial pathogen, *Xylella fastidiosa*, in Europe. This pathogen is not new to the Americas and has been in California

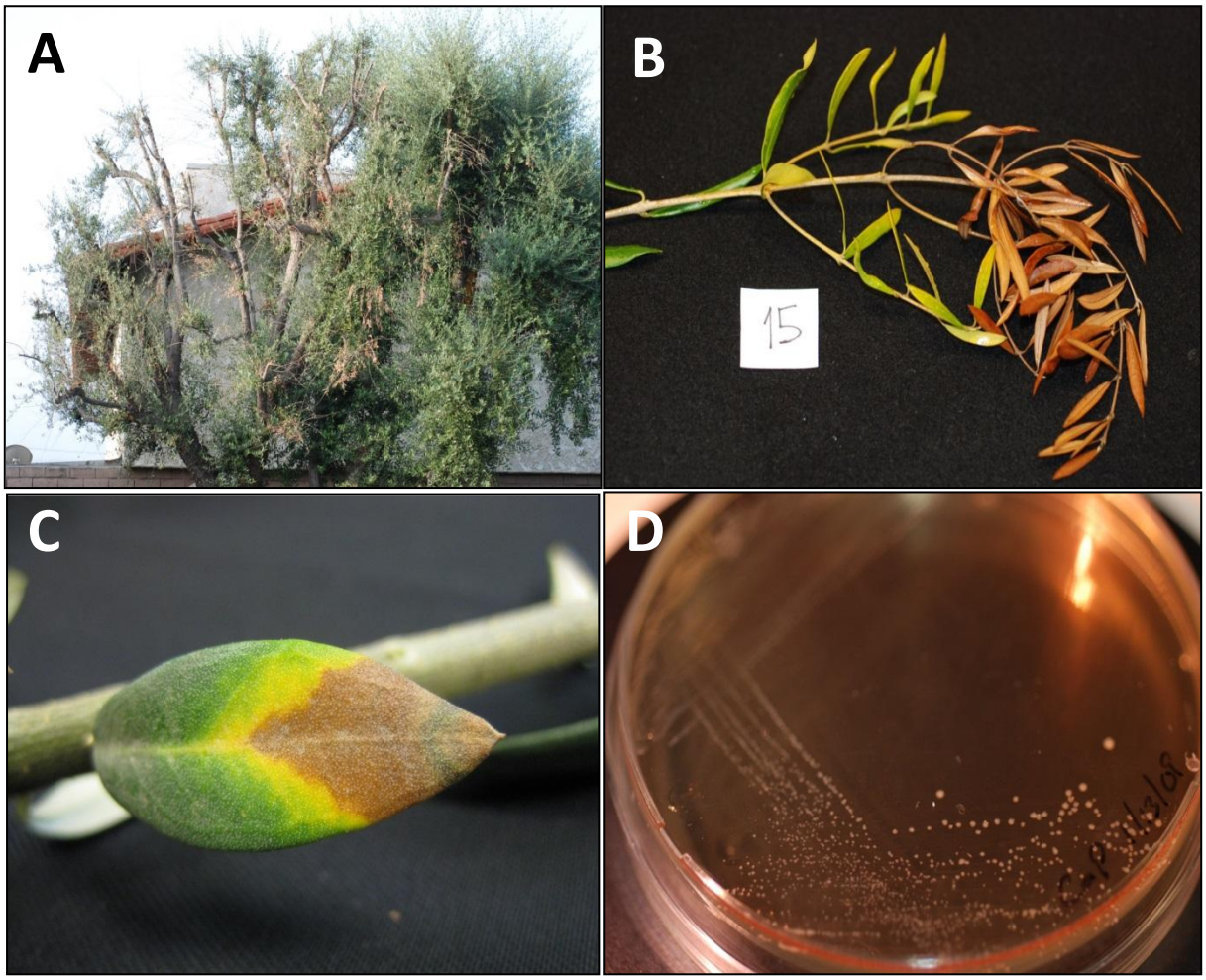

Figure 1. In southern California landscapes, olives exhibited dieback (A and B) and leaf scorch (C). Six strains of *Xylella fastidiosa* subspecies *multiplex* were isolated into pure culture (D) from symptomatic olives trees in southern California. Photos: R. Krugner

for over 100 years. It is perhaps best known as the cause of Pierce's Disease on grape, but also causes citrus variegated chlorosis, peach phony disease, alfalfa dwarf, and scorch on almond, oleander, and pecan. In response to scorch and dieback symptoms (Figure 1 A-C) on landscape and orchard plantings of olives in California, Dr. Rodrigo Krugner, an entomologist with the USDA ARS in Parlier, CA, established a research program to investigate the epidemiology of *X. fastidiosa* on California olives.

The Pathogen

X. fastidiosa is a gram-negative, xylem-limited bacterium affecting over 100 known plant hosts. The pathogen multiplies within the xylem and is thought to cause disease by interfering with water and nutrient transport. It is spread naturally from plant to plant by xylem-fluid feeding insects. The pathogen is difficult to culture (Figure 1D); consequently, prompt identification often relies on use of PCR techniques that detect pathogen DNA in plant tissues.

The pathogen may be grouped into subspecies based on host specificity. For example, *X. fastidiosa* subsp. *fastidiosa* causes Pierce's disease on grapevine as well as scorch on almond; however, the *X. fastidiosa* subsp. *multiplex*, causes disease on almond but not on grapevine.

Vectors associated with *X. fastidiosa* in California

X. fastidiosa is transmitted by xylem-fluid feeding insects, such as spittlebugs, froghoppers, and sharpshooters. While many of these insects may have the potential to transmit *X. fastidiosa*, there are four sharpshooter species in California that are recognized to have the greatest role in *X. fastidiosa* spread. Three of these sharpshooters are native to California and present throughout the state: red-headed sharpshooter, blue-green sharpshooter, and green sharpshooter. The last vector is the invasive glassy-winged sharpshooter (Figure 2A), which became established in southern California in 1990 and is responsible for the rapid spread of *X. fastidiosa* on grapevine. Sharpshooters acquire *X. fastidiosa* when feeding on infected plant material. Once inside the vector's mouthparts, the bacterium multiplies rapidly and the insect is then capable of transmitting the bacterium for the remainder of its life (if it is an adult) or until it molts (if it is immature). Because sharpshooters are strong fliers and typically feed on multiple host plant species, *X. fastidiosa* may be spread to multiple hosts over the insects' lifetime.

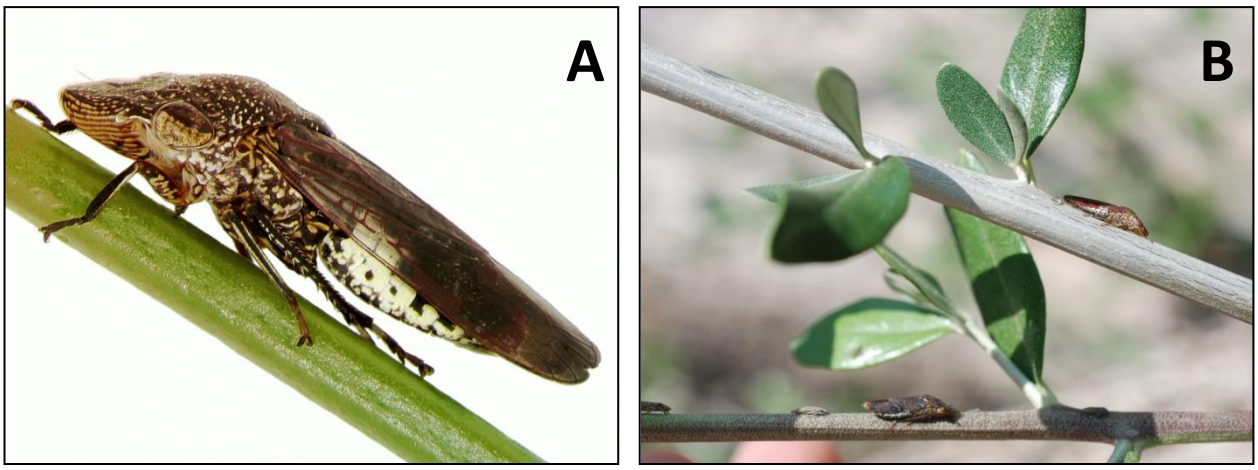

Figure 2. The glassy-winged sharpshooter (A), *Homalodisca vitripennis*, is a known vector of *Xylella fastidiosa* and contributes to the spread of Pierce's Disease on grapevine in California. The glassy-winged sharpshooter can reproduce and overwinter on California olives (B). Photos: R. Krugner.

'Quick Decline' in Italy

In October 2013, *X. fastidiosa* was reported in the Puglia region of southern Italy, marking the first report of the pathogen in Europe. Characteristic symptoms included extensive leaf scorch and branch dieback, as well as discoloration of vasculature. Along with isolation of several putative fungal pathogens, presence of *X. fastidiosa* was confirmed by serological and PCR tests. Almond and oleander plants near the infected olives also tested positive for the pathogen. Scientists in Italy are currently surveying the area surrounding the outbreak and regulatory agencies have prohibited the movement of propagation materials from susceptible hosts out of the infected area. Additionally, researchers are working to determine the subspecies of *X. fastidiosa* associated with symptomatic olives and to obtain pure cultures of the pathogen for pathogenicity tests. Currently, the origin and strain(s) of *X. fastidiosa* introduced to Europe, as well as the insect species responsible for transmission, are unknown.

Association of *X. fastidiosa* with California olives

Leaf scorch and dieback symptoms have been observed in commercial olive orchards and landscape plantings (Figure 1 A and B) in California. Krugner's laboratory found that only 17% of the trees sampled tested positive for *X. fastidiosa* by PCR, with rates of pathogen detection higher in southern CA (39%) than in the Central Valley (2.5%). The pathogen was only successfully cultured from samples collected in southern California, suggesting that the pathogen population on olive is limited in the Central Valley. Reintroduction of the pathogen into multiple varieties of olive resulted in low levels of infection, and asymptomatic infections were common. Dr. Krugner's work also demonstrated that California strains of *X. fastidiosa* belong to the *multiplex* subspecies, which is pathogenic on almond, but not grapevine. Consequently, California olives are not

considered a source of inoculum for Pierce's Disease on grapevine; however, olives may harbor insect vectors (Figure 2B) responsible for transmission of the bacterium to grapes or other crops.

What does the "'Quick Decline" in Italy mean for California olive growers?

Dr. Krugner's work demonstrated low levels of pathogen recovery from olives in the Central Valley and minimal association of the pathogen with disease upon reintroduction to healthy plants. Further studies, however, are necessary to determine a) the subspecies responsible for the 'quick decline' in Italy, and b) the pathogenicity of isolates recovered from symptomatic plants in Italy. It is possible that pathogen strains recovered in Italy may be different, and more aggressive on olive, than strains endemic in California. California olive growers and landscape managers should report new incidences of extensive dieback or scorch on olives to farm advisors.

Acknowledgements

The authors thank Dr. Rodrigo Krugner for his critical review of this article and for providing photographs. Dr. Krugner's research was supported by the California Olive Committee and the USDA Agricultural Research Service.

Select References

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The UC Davis Olive Center and UC Cooperative Extension offer additional resources for olive industry

The UC Davis Olive Center and UC Cooperative Extension in Sonoma County offer courses for olive growers as well as members of allied industries.

Upcoming Events

● June 16-20, 2014: Olive Oil Quality Assurance Certificate Course with the International Olive Oil School. Course targeted to educate retail, foodservice, restaurant, importing and distribution professionals on state-of-the-art practices for the quality assurance of olive oil.

Register at: www.olivecenter.ucdavis.edu

● July 21, 2014: The Intricacies of Olive Oil: An Olive Oil Short Course. Course includes tasting, cooking and frying demonstrations, and marketing information.

Register at: http://cesonoma.ucanr.edu/SpecialtyCrops/OLIVES/

● September 16-18, 2014: Advanced Sensory Evaluation of Olive Oil Certificate Course. For buyers, importers, category managers, and producers, this advanced course will address official methods of the International Olive Council as well as protocols used by major food and beverage companies.

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Olive Notes
June 2014

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