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THE SCOOP

on fruits and nuts in Stanislaus County

Walnut Updates

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Here is a brief overview of important walnut planning topics/tasks. You can contact your local UCCE farm advisor for more locally based information. Your pest control adviser (PCA) will help you make specific pest-control application decisions. More information is available on the UC Integrated Pest Management (http://ipm.ucanr.edu/) and UC Fruit and Nut Research and Information Center (http://fruitsandnuts.ucdavis.edu/).

Special consideration: Prepare and protect trees from future freeze damage

Background

Freeze damage in walnuts is caused by freezing temperatures in the fall. Over the last three years, UCCE Walnut Advisors observed damage in older orchards in Sacramento and northern San Joaquin Valleys where material should be dormant. Often this occurs in young orchards where new growth is still being formed during periods of freezing night temperatures. Freeze damage is brown, necrotic tissue, which can appear to be related to pathogens, but no signs of fungal infection are present. Please see Fig. 1 for photos associated with freeze damage.

While green tissue is highly susceptible to freeze damage, dormant walnut tissue is believed to withstand temperatures in the low 20s (°F). Yet bud and wood temperature may fall lower than the ambient air temperature, and walnut tissue requires a slow decline of ambient temperature to convert complex carbohydrates to simple sugars during the fall period. In the last two autumn seasons, we experienced rapid declines in temperature, sometimes shifting from 60 °F to 28 °F within 12 to 24 hours. We believe this is why we see the erratic patterns of damage in older orchards as well as the typical damage sometimes seen in young orchards.

Walnut growers are concerned about threats from a possible November-December freeze and increased drought across the state. Such a situation requires growers to be more vigilant in preparing for these unprecedented freeze events. We are hoping for rainfall in early November, which could provide a much needed relief, especially for growers who only use surface water.

What can be done?

Although there is limited field-based research on the topic, institutional knowledge and field observations may be able to help. Suggestions for freeze damage mitigation include the following:

- Promote healthy trees throughout the season but reduce growth in fall. Cutting back on irrigation in September and no longer applying nitrogen after August helps slow growth and may promote the hardening off process needed before a sudden freeze event comes along.

In this issue…

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The Scoop on Fruits and Nuts in Stanislaus County is a combined effort of UC Cooperative Extension Farm Advisors Roger Duncan—raduncan@ucanr.edu, Kari Arnold—klarnold@ucanr.edu, and Jhalendra Rijal—jrijal@ucanr.edu, and covers topics on all tree and vine crops and associated pest management.

You may reach us at 209-525-6800 or by email.

- For young trees, stop irrigating in September to set the terminal bud (Fig. 2) and harden off the trees, later resume irrigation if needed to avoid tree stress.
- If there is no rain after harvest, apply regular irrigation before a freeze event, so the soil is moist in November. This should keep the orchard slightly warmer and store heat during warm, sunny days. Hydrated trees are expected to be less susceptible to freeze damage.

Got freeze damage?

UCCE Walnut Advisors are interested in learning more about freeze damage. If you experienced freeze damage over the past few years and can provide us feedback on your situation, please follow this link:

http://ucanr.edu/walnutfreezesurvey2021

More questions? Please don't hesitate to call Kari Arnold at: (209) 525-6800 or Mohamed Nouri at: (209) 953-6100.

Managing Walnut Mold

Something has been plaguing walnut orchards for many years without a known cause. Often referred to as Brown Apical Necrosis, or BAN (Fig. 3), growers and PCAs have scratched their heads for years when walnut grades come back dinged due to moldy, off-color nuts. Dr. Themis Michailides, a UC Davis Plant Pathologist, recently decided to take a stab at this issue and can now offer a solution. Here is what he and his lab have found. After collecting samples and isolating various types of fungi from nuts, hulls, and BAN tissues, the Michailides lab at the Kearney Agricultural Research and Extension Center in Parlier, CA consistently found *Alternaria, Fusarium, Aspergillus niger, Botryosphaeria,* and *Phomopsis* present (Fig. 4.). *Botryosphaeria* and *Phomopsis,* we know from previous work, can be managed by pruning dead/ diseased wood/spurs, pruning after harvest in the fall, reducing sprinkler angles to avoid wetting tree limbs, and depending on severity, fungicide sprays applied in mid-May, mid-June, and mid-July (further product information can be found at http://ipm.ucanr.edu/). Yet the other three fungi, *Alternaria, Fusarium,* and *Aspergillus niger* were not considered pathogens on walnut. By performing a variety of tests both in the lab and in the field, the Michailides lab discovered these fungi are responsible for walnut mold. Additionally, walnut blight, caused by *Xanthomonas arboricola* pv. *juglandis* may exacerbate the problem, leading to larger lesions on the hull and the potential for greater damage to the hull and nut.

What can be done?

Applying Merivon at three weeks prior to hull split reduces mold related to *Botryosphaeria, Phomopsis,* and *Alternaria*. Adding Tebuconizole to the tank mix will increase efficacy against *Phomopsis*. To further increase efficacy, apply Rhyme at 20-30% hull split. If this high level of control is not needed, only apply Rhyme at 20-30% hull split.

**Note: Please refer to current label recommendations and restrictions when applying pesticides.*

Updates on Botryosphaeria-Phomopsis Diseases of Walnut in San Joaquin and Stanislaus Counties

For the past several years, Botryosphaeria and Phomopsis canker and blight diseases have been increasingly observed in walnut orchards in almost all walnut-growing regions in California. Main symptoms include cankers in branches and dieback of spurs resulting from infections moving from affected fruits (fruit blight) via the peduncle or shoots through leaf and peduncle scars. The infected branch turns black, cankers enlarge, and the pith of the branch is black or dark brown (Fig. 5). Growth in the pith, at least for Botryosphaeriaceae spp, moves beyond the killed woody tissues (external margin of canker) for 1 to 2 inches, which is obvious when one splits a shoot along the long axis.

Serial inoculation experiments indicated that pruning wounds are susceptible for at least four months. The wounds of 3- to 4-year-old shoots are more likely to develop larger cankers than those of 1- to 2-year-old shoots. This long-lasting susceptibility may be due to the hollow pith inside the walnut branches, which can provide a favorable condition for the fungal spores to germinate and continue to cause infection. As the infection or the pith cankers on spurs or branches continue growing during fall, the dead part of the branch may become covered with a dense layer of pycnidia (Fig. 5D).

You may find dead branches in the lower canopy of orchards, which may be caused by abiotic problems that may include shade/low sunlight or freeze. In the latter case, dead branches will not show any vascular discoloration (Fig. 6). However, the surface of these branches eventually will be covered with scale, Botryosphaeriaceae, and Diaporthaceae fungi.

New findings in 2020:

Despite several management practices implemented to prevent major yield and economic losses caused by Bot/ Phomopsis diseases, recent field survey results showed Diaporthaceae fungi to be the most prevalent fungal pathogen isolated from diseased walnut samples in the San Joaquin and Stanislaus Counties. Botryosphaeriaceae fungi were found occasionally in these orchards. Although growers are making several fungicide applications per season to control these diseases with emphasis in controlling the Botryosphaeriaceae, the persistence of Diaporthaceae spp. in walnut orchards has raised the question of whether the *Phomopsis* fungi have emerged as the main blight/ canker/dieback disease of walnut in San Joaquin County.

A spore-trapping study was undertaken to determine when and under what environmental conditions spores of these fungi are released. Based on colony counts, the population of Botryosphaeriaceae fungi was significantly lower than that of the Diaporthaceae fungi – which corresponds to the results of the field surveys. Molecular work revealed the occurrence of three new species of *Diaporthe* recovered from both spore trapping and diseased tissues. The occurrence of these new species in walnut orchards represents new reports in California. In this spore-trapping study, we analyzed the correlation between precipitation events, irrigation, and grinding of infected branches between tree rows (following maintenance/cleaning pruning) and Bot/Phomopsis spore release. Among these variables, we found a strong correlation between spore release and precipitation: as precipitation increased, spore release also increased, and spores were mainly captured from March to May, a period that coincided with late-season rainfalls.

We also detected high aerial dissemination of *Phomopsis* spores after grinding of the prunings (among which were also infected branches), which were placed between tree rows in a mature orchard with a high incidence of Phomopsis disease (Fig. 7). This information is of great importance as it helps to identify production practices responsible for the spread of these fungal pathogens within walnut orchards.

In orchards with sprinkler irrigation systems, low number of spores were captured during and following the first irrigation of the season. In addition, our results showed no correlation between further in-season irrigation events and the release of fungal spores of Diaporthaceae and Botryosphaeriaceae fungi. However, the wetness/ humidity in the orchard resulting from the first irrigation may cause spores to ooze and be released from pycnidia in diseased tissues within the orchard.

Fig. 1. Freeze damage in a 9th leaf Solano orchard. Severity of symptoms is variable across and within orchard blocks (damage beneath the bark appears as brown discoloration). @Figure provided by Mohamed Nouri.

Ongoing research:

Based on the spore-trapping study, a new fungicide program was initiated this year to investigate whether an early spray timing would be effective to reduce the disease incidence. Pruning wound protection trials were also initiated this year to evaluate the efficacy of some old and new chemical and biological compounds to protect pruning wounds from infections by canker pathogens.

Disease management practices:

Cultural control:

- When pruning dead branches, pruning cuts should be made into healthy green wood during the summer or immediately following harvest allowing enough time before rains occur and spread inoculum to susceptible fresh cuts.
- For young orchards not infected with Bot/Phomopsis pathogens, after pruning (pruning for training), you can shred prunings and leave wood chips in the orchard. No sprays are needed.
- For heavily infected orchards, it is advisable to remove infected prunings from the orchard and shred or burn them if permitted.
- For orchards/trees affected by the November 2020 freeze damage, remove dead limbs and prunings from the orchard as they may eventually become infected with *Bot/Phomopsis* pathogens.

Chemical control:

- Timely application of effective fungicides adjusted for weather and Bot/Phomopsis inoculum level in the orchard.
- In orchards with a high incidence of *Phomopsis*, emphasis should include a triazole fungicide in the spray program.
- It may be good to consider applying a Bot/Phomopsis spray before the first irrigation of the season. Irrigation may create a microclimate that encourages potential infection and sporulation of these fungal pathogens.

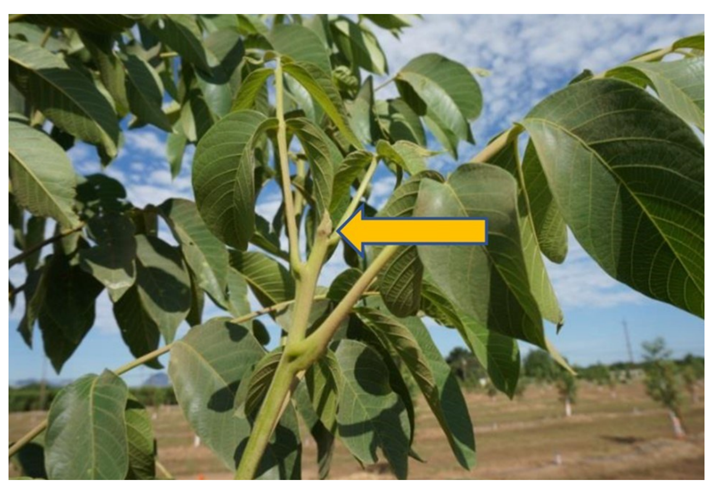

Fig. 2. Example of a set terminal bud. Photo provided by Janine Hasey.

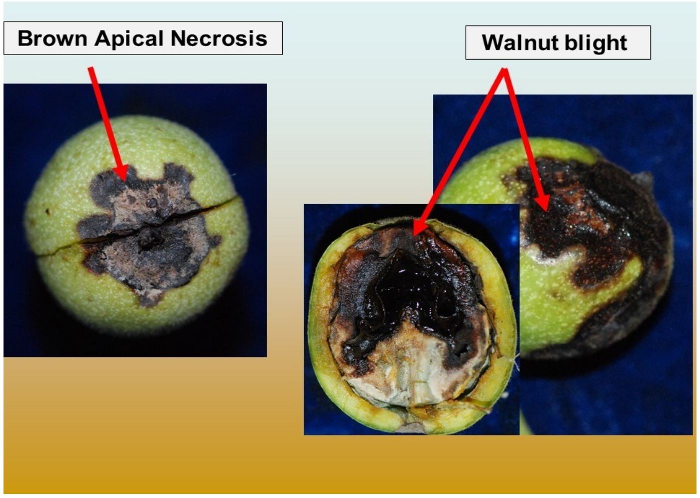

Fig. 3. Brown Apical Necrosis is shown on the left, not to be confused with Walnut Blight, shown on the right, and caused by the bacterial pathogen, *Xanthomonas arboricola* pv. *juglandis.* Internal tissues in nuts with BAN at this stage do not show any decay and/or black discoloration as do nuts with walnut blight. Figure provided by Themis Michailides.

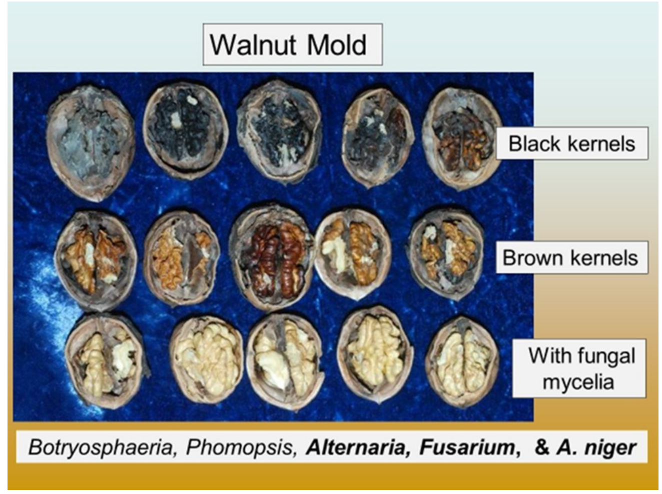

Fig. 4. Moldy, off-color nuts which lead to economic loss due to downgrading. Figure provided by Themis Michailides.

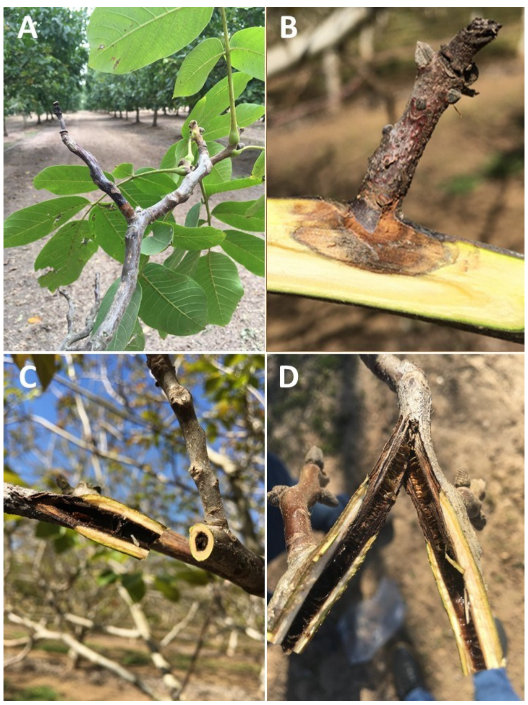

Fig. 5. Symptoms in walnut trees associated with *Botryosphaeria* and *Phomopsis* fungi; (D, shows the growth of the fungi within the pith beyond the margin of the canker - dead tissues).

Fig. 6. Symptoms in walnut trees associated with abiotic problems that may include shade/ low sunlight or freeze

Fig. 7. High aerial dissemination of *Phomopsis* spores when grinding of infected branches that are placed between tree rows in a mature walnut orchard.

Insecticide Options for Navel Orangeworm IPM in Almonds—A Recent Trial Summary

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Navel Orangeworm Integrated Pest Management

Navel orangeworm (NOW) is one of the important pests that draws nut crop grower's attention throughout the season. Although the economic damage may not be significant every year, the unpredictability associated with this pest makes it difficult for growers and PCAs to relax some of their pest management practices. The current NOW integrated pest management (IPM) practices include: (1) winter sanitation to remove and destroy 'mummy nuts' before mid-March, (2) mating disruption product application at the beginning of the season to gradually reduce the NOW population, (3) timely harvest to minimize late-season infestations, and (4) one to two insecticide spray applications during hullsplit. All of these methods are commonly used IPM practices and should be combined to achieve the best results. As insecticide is a part of the NOW IPM strategy, in the 2020/2021 seasons, we evaluated the efficacies of multiple insecticides against NOW using the previous season nut (i.e., mummy nut) strands as substrate. We used mummy strands to compare insecticide efficacy as conducting large field trials is not always feasible, especially when several treatments with multiple replications are needed. Almond mummy nut strands have been used to evaluate insecticide performance in several other NOW studies.

Insecticide Efficacy Trials – 2020/2021

The insecticide study was conducted using mummy nut strands that consisted of 20 mummy nuts glued to a strand cut from window screen material (Photo 1A). 15 to 20 mummy strands (20 replicates in 2020; 15 replicates in 2021) were used for each of the 11 insecticides and a water-treated control (Table 1). All insecticide concentrations were prepared in water using the 100-gallon per acre rate. The strands were thoroughly dipped in two quarts (1.89 L) of the prepared insecticide solutions for 10 seconds, allowed to air dry for about 30 minutes, and deployed to the selected trees in an almond orchard (Photo 1B). Two rows of a pollinizer variety (in 2020) or three rows of Nonpareil variety (in 2021) were selected in the orchard, and one strand of each treatment (Table 1) was hung in a total of 15 to 20 trees. Experiments were set up in mid-August of 2020 (targeting the 3rd NOW generation) and late April of 2021 (targeting the 1st NOW generation). The nut strands were left in the field for two weeks to provide enough time for female NOW to lay eggs. Once collected from the field, we carefully looked at the NOW larvae under a microscope, and the percent nut infestation for each strand was calculated and used for statistical analysis. One-way analysis of variance (ANOVA) was used to determine whether or not percent nut infestation was affected by the treatments, and the Tukey-Kramer honestly significant difference (HSD) was used to compare treatments.


Photo 1A


Photo 1B

Table 1. Insecticides with rates used for navel orangeworm trial in 2020 & 2021 seasons

Insecticide	Active ingredient	Rate (per acre)	IRAC MoA*
Altacor	Chlorantraniliprole	4.5 oz.	28
Besiege	Chlortraniliprole + Lambda cyahalothrin	12.5 fl. oz	28, 3
Intrepid	Methoxyfenozide	24 fl. oz.	18
Intrepid Edge	Methoxyfenozide + Spinetoram	18 fl. oz.	18, 5
Success	Spinosad	10 fl. oz.	5
BT NOW	*Bacillus thuringiensis* subsp. *kurstaki,* strain EVB-113-19	3.5 pt.	6
Dipel	*Bacillus thuringiensis*, subsp. *kurstaki*, strain ABTS-351	1 lb.	6
Proclaim	Emamectin benzoate	4.8 fl. oz.	11
Venerate	Heat-killed bacterial (*Burkholderia* spp. strain A396) toxin	4 qt.	Unknown or undefined
Rango	Azadirachtin	160 fl. oz.	Unknown or undefined
SpearLep + Leprotec (Btk)	Peptide-based (GS-OMEGA/ KAPPA-HXTX-HV1A)	SpearLep (2pt.), Leprotec (1pt.)	32, 11

Note: Venerate was used only in 2020; BT NOW and SpearLep+Leprotec were used only in 2021.

** IRAC (Insecticide Resistance Action Committee) assigns different numbers for insecticide active ingredients with varying modes of action (MoA). In general, avoiding the repeated spray of the insecticide(s) from the same IRAC group help to reduce the risk of insecticide resistance.*

Insecticidal Reduction of NOW Infestation

The results of this insecticide efficacy study were similar in 2020 and 2021. The NOW infestation of the control treatment exceeded 15% (approximately 16% in 2020; 18% in 2021), but this was not surprising because we anticipated a high infestation rate due to the limited number and spatial proximity of mummy nuts in each nut strand, and multiple strands in individual trees. The likelihood of egg laying by female moths in that scenario is higher relative to a scenario where mummy nuts are fewer in number and randomly distributed on the tree.

In 2020, all insecticides except Venerate performed statistically better than the control (Figure 1). However, Venerate was not significantly different than Altacor, Intrepid, Proclaim, Dipel, and Rango. The insecticides Besiege, Intrepid Edge, and Success showed the best efficacy with a low NOW infestation percentage of less than 6%. However, the infestation percentages were not statistically different than Altacor, Intrepid, Proclaim, Dipel, and Rango.

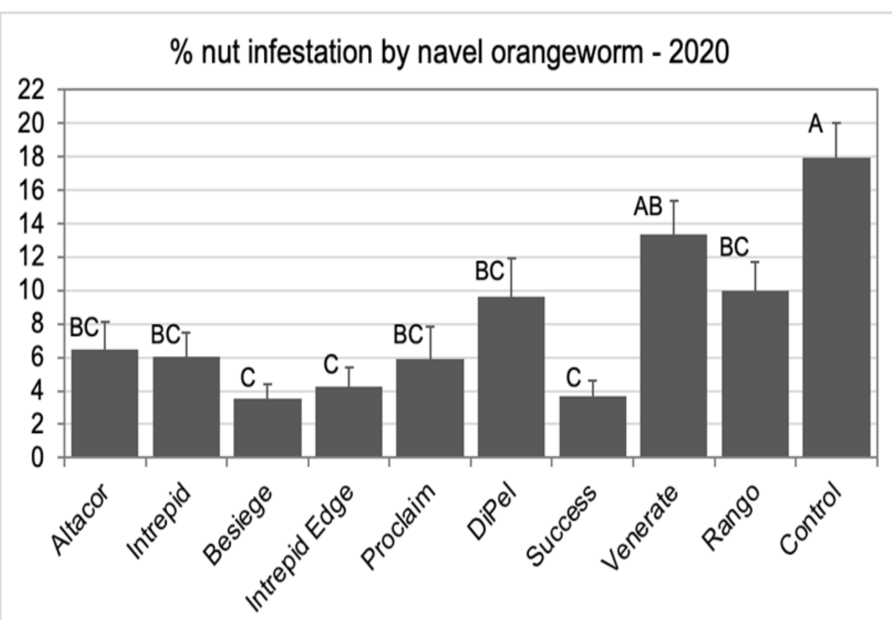

Figure 1. Effect of insecticides on NOW infestation, 2020

Treatments with a common letter had a similar NOW % nut infestation and were not significantly different based on the Tukey HSD (5% level of significance).

In 2021, all insecticides except SpearLep + *Btk* performed significantly better in reducing NOW infestation compared to the control (Figure 2). Although not statistically different, the average percent infestation among insecticides ranged from 1.2% (Besiege) to 9.9 % (SpearLep + Btk).

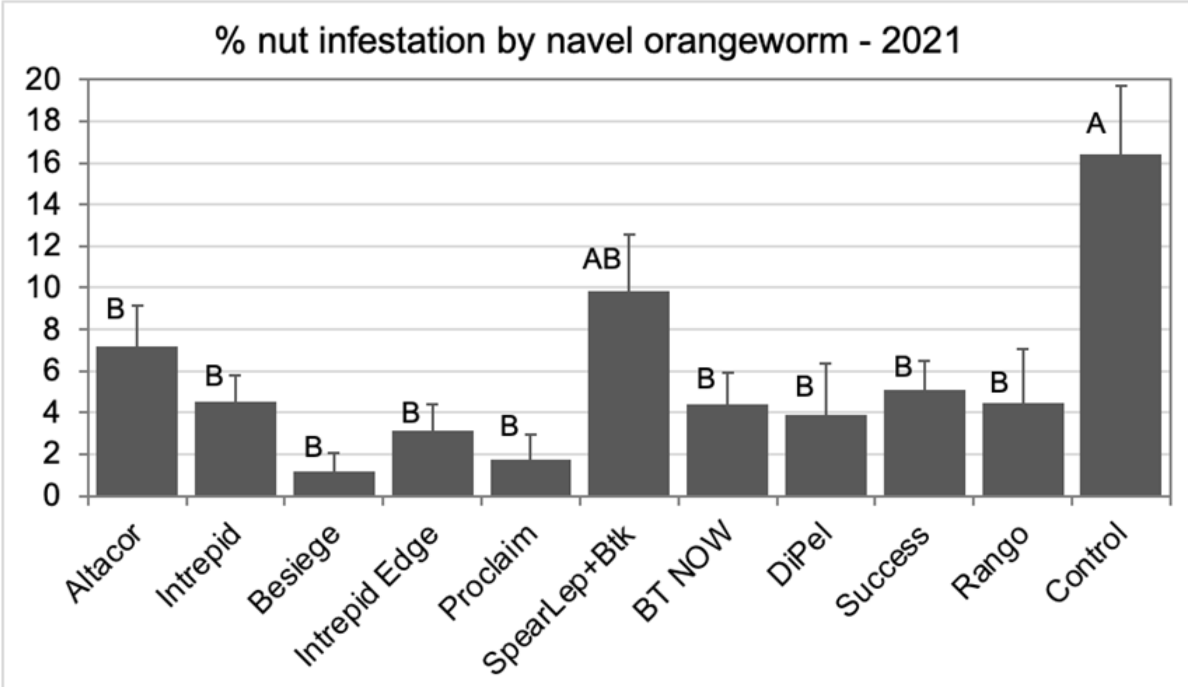

Figure 2. Effect of insecticides on NOW infestation, 2021

Treatments with a common letter had a similar NOW % nut infestation and were not significantly different based on the Tukey HSD (5% level of significance).

Insecticide Selection with NOW IPM

It is no secret that insecticides cannot reduce NOW infestation to zero. Navel orangeworm insecticide efficacy trial results depend on the season, treatment methods, population levels, etc. This makes it challenging to identify which product provides the best and most consistent protection against orchard infestation. Additionally, NOW damage in almond orchards varies tremendously, even within the same block, and as a result, there can be limited efficacy of even the established insecticides such as Altacor and Intrepid evaluated in this study. Four main groups of insecticides were used in this study and, in general terms, these were: (1) broad-spectrum – pyrethroids or other combo products (e.g., Besiege, Intrepid Edge; Mitecto Pro – not included in our trial), (2) reduced risks - larvicidal (e.g., Altacor and Intrepid), (3) biological-based (e.g., DiPel, BT NOW, Rango, SpearLep, Venerate, and Success), and (4) all but the SpearLep can also be used in the organic production system. It is not recommended to use pyrethroid-based or other combo insecticides because of their potential negative impacts on mite predator - sixspotted thrips, especially when applied during the early part of the season. There is also the high risk of NOW developing resistance to pyrethroids, something that has already been documented in the southern San Joaquin Valley. The larvicidal insecticides (e.g., Altacor and Intrepid) have been shown to do a good job in reducing NOW infestation, as indicated by several experiments, including ours. However, even though there is currently no evidence of NOW resistance to these ingredients, as an industry, we need to explore additional active ingredients to reduce the burden on a select number of these products. Studies show that biological-based insecticides can be used to reduce NOW infestation. Biological-based products may also be able to substitute for synthetic insecticides under a time crunch when time is running out, to use other insecticides due to higher pre-harvest interval, and the biological-based products may be the only viable option. Not all biological-based insecticides are created equal in terms of efficacy and impact to the natural enemies, so more research is needed to explore more options. Besides the insecticide active ingredient, other factors can play roles in spray coverage to get the insecticide to the target, thereby reducing NOW damage. For example, application parameters such as tractor speed of 1.5-2 miles per hour, routinely-calibrated sprayer, well-timed sprays based on the NOW activity, and hullsplit timing contribute to a better spray coverage. Although insecticide is a part of the navel orangeworm IPM, it is critical to prioritize and utilize non-insecticidal interventions such as winter sanitation, mating disruption, and timely crop harvest before applying insecticides.

Acknowledgments

The California Department of Food and Agriculture (CDFA) partially funded these studies. We give thanks to Chang Vue, Tania Herrera, and Daniel Green for their help in this project.

Cover Crop Best Management Practices

Announcing the new Cover Crop Best Management Practices guide, coauthored by UC advisors and specialists and sponsored by the Almond Board of California.

This 12-page document will guide you in selecting the best cover crops to achieve your orchard management goals and provides information on planning, planting, seeding rates, and crop management strategies for your particular orchard conditions.

Cover Crops Best Management Practices BMPs.pdf (live-almonds-next.pantheonsite.io)

Regional Testing of Almond Varieties Ongoing

Roger Duncan, UCCE Pomology Farm Advisor, Stanislaus County

In 2014, UC Cooperative Extension planted identical almond variety trials in three major growing areas of the Central Valley. The Butte, Stanislaus, and Madera County trials were planted on Krymsk 86, Nemaguard, and Hansen 536 rootstocks, respectively, at tree densities of 110, 130, and 173 trees per acre. These trials feature 30 selections from the UC Davis and USDA breeding programs and several commercial varieties from California nurseries. Twelve of the varieties are self-fertile, meaning they can be planted in a solid block, require fewer bees, and have one harvest. Varieties are being compared side by side in one field under commercial farming conditions. Experimental varieties are planted like pollinizers, every other row with Nonpareil rows in between. Information including bloom time, hull split, harvest time, yield, kernel quality, and insect & disease susceptibility are recorded for each variety.

After several years of intensive data collection, a few new varieties and selections are showing promise. An experimental pollinizer variety from UC Davis, currently called UCD 18-20, and the pollinizer variety Booth from Burchell Nursery, are top-yielding varieties across all three locations to date. UCD 18-20 blooms with Nonpareil, shakes well and harvests about a month after Nonpareil. Booth also shakes well and harvests 10-20 days after Nonpareil, depending on soil and rootstock. USDA varieties Yorizane and Y117-91-03 are self-fertile and are also high yielding, with Y117-91-03 being the highest yielding variety in the Stanislaus trial. We expect this experimental variety to be released by the USDA soon. Yorizane, a small tree with high kernel quality, was released in 2020 and is becoming available from many commercial nurseries. A few other varieties in the trials have excellent kernel quality but only moderate yields so far.

Cumulative yields for the first five years of harvest are shown in the table below, as well as tree canopy size (measured as PAR – the higher the PAR, the larger the canopy). We assume small canopied varieties with high yield efficiency could be planted closer for higher yields per acre. For instance, experimental variety UCD 8-160 is a very small tree but yields better than all other varieties in the trial for its size. It is important to realize that juvenile yields may not reflect long-term yields as canopies continue to develop. Some varieties, including UCD 18-20, have a high percentage of doubles or other problems which may limit their adoption. Although some varieties are performing well so far, we suggest longer-term study is prudent before risk-averse growers choose to plant any new variety.

A more complete report of this study can be found at our website cestanislaus.ucdavis.edu or in the Almond Board's database at almondboard.com. We are currently planning a new set of regional variety trials to be planted in 2023. It will include many more self-fertile varieties from California and overseas. If you are interested in hosting a variety trial in Stanislaus County, contact Roger Duncan at raduncan@ucdavis.edu or 209-525-6800.

Average Cumulative Yield for First Five Harvests, Canopy Size as Measured by Photosynthetically Active Radiation (PAR) and Yield per PAR. UC Regional Almond Variety Trials Through 2020.							
		Cumulative Yield 3rd – 7th leaf				Average PAR	Cumulative Yield / PAR
	Self-fertile?	*Average of 3 Trials*	Butte County	Stanislaus County	Madera County		
Nonpareil		*11,638*	12,949	8,520	13,446	69	169
UCD 18-20		*10,940*	11,412	9,290	12,118	64	171
Booth		*10,197*	11,312	8,103	11,176	72	142
Y117-91-03	Yes	*10,140*	10,103	9,412	12,142	67	151
Yorizane	Yes	*9,742*	9,061	7,965	13,021	56	174
Capitola		*9,701*	9,727	8,069	11,307	74	131
Aldrich		*9,668*	10,989	8,162	9,855	63	154
Y117-86-03	Yes	*9,392*	8,256	7,778	10,764	58	162
Bennett-Hickman		*9,331*	8,660	8,950	10,324	63	148
Durango		*9,316*	9,944	7,969	9,699	64	146
Kester		*9,304*	8,660	7,993	11,260	67	139
Winters		*9,195*	9,923	7,887	9,777	61	151
Jenette		*9,161*	10,222	6,185	11,078	57	161
UCD 8-201	Yes	*8,910*	8,979	7,167	10,148	56	159
UCD 8-160	Yes	*8,821*	8,694	8,353	9,416	49	180
Sterling		*8,570*	7,888	7,490	10,061	69	124
Eddie		*8,422*	7,908	7,255	10,102	67	126
Folsom		*8,245*	8,693	6,684	9,368	71	116
UCD 1-16		*8,106*	8,171	6,496	9,650	60	135
Sweetheart		*8,005*	7,429	6,806	10,372	72	111
UCD 7-159	Yes	*7,966*	7,960	8,129	7,756	59	135
Supareil		*7,723*	6,964	6,644	9,292	76	102
UCD 1-232	Yes	*7,396*	8,181	6,881	7,034	58	128
UCD 8-27	Yes	*7,049*	7,438	5,151	8,349	64	110
Y121-42-99	Yes	*6,208*	--	6,208	--		
UCD 3-40		*5,731*	6,940	5,867	3,940	68	84
UCD 1-271	Yes	*5,473*	4,887	6,537	4,836	61	90