University of California
Agriculture and Natural Resources
Cooperative Extension
July 2020, Vol. 25.3

THE SCOOP

on fruits and nuts in Stanislaus County

IPM Task at Harvest: Identifying Insect Pest Damage Through Harvest Sampling

Jhalendra Rijal, PhD, UCCE IPM Advisor, Stanislaus, Merced and San Joaquin Counties

Since we are a few weeks away from almond and walnut harvests, it is a good time to review harvest nut sampling strategy and protocols for the best estimation of field loss by common pests. It is a general understanding that the grade sheet from your processers only represents about half of what is going on in the field. Also, the whole sum percent damage from the grade sheet does not identify which pest is causing the most economic loss. Insect population in orchards builds over time; therefore, knowing the history of damage helps to address potential risks and strategies to next year's pest management program.

1. Harvest Sampling in Almonds

Taking a minimum of 500-1000 sample nuts from an average-sized orchard, anytime between shaking and sweeping, is recommended. Infestation can vary among different sides of the tree, and between edges and interiors of the orchard. This is especially true for navel orangeworm damage. Use paper bags to collect samples from multiple spots (>10 sampling spots, if possible) within the orchard. Store the sample bags in a cold room or freezer until you have time to do crack out. Look for damage signs associated with insect species described in the following paragraphs. Major insect pests for the damage evaluation are navel orangeworm (NOW), peach twig borer (PTB), oriental fruit moth (OFM), ants, leaffooted bugs (LFB), and brown marmorated stink bug (BMSB). BMSB is an invasive stink bug species, which is established and causing damage in almond orchards in the northern San Joaquin Valley.

1.1. Worm Damage (NOW, PTB, OFM). NOW feed in the kernel (nutmeat) and create deep feeding tunnels. Feeding by NOW results in a significant amount of white frass, and webbings on the kernel (Fig. 1a). Since NOW and PTB often infest the same nut, NOW feeding damage often masks the PTB damage. Feeding damage signs by PTB and OFM on the nutmeat are similar (i.e., the presence of the shallow tunnels and surface grooves on the kernels, and no webbings) (Fig 1b & 1c), except OFM leaves a small amount of reddish frass on the hull, which is absent in PTB damaged nuts.

1.2. Ant Damage. The percentage of almond damage by ants at harvest depends on the duration the nuts are on the ground after shaking. The longer almonds are left on the ground gives more time for ants to feed on them, results in more damage. Also, more damage is likely in orchards with drip or sprinkler irrigation compared to orchards with flood irrigation. Cover or vegetation in the orchards also favors ant activity. Nuts with tight shells or with narrower (<0.03-inch wide) hull split have less ant damage. Ants can completely hollow out the nutmeats and leave only thin skin (i.e., pellicle). Other signs of ant feeding damage include scraped or peeled pellicle and presence of "sawdust", with the absence of webbings and frass (Fig 2a).

1.3. Leaffooted Bug and Brown Marmorated Stink Bug Damage. Most nuts infested by the leaffooted bug or BMSB, early in the season (mid-March to mid-May), abort and drop. A small percentage of those infested nuts do not drop but end up becoming shriveled and gummy kernels at harvest (Fig 2b). Both LFB and BMSB feeding after the

Also in this issue…

Authors

Kari Arnold, PhD, klarnold@ucanr.edu

Jhalendra Rijal, PhD, jrijal@ucanr.edu

The Scoop on Fruits and Nuts in Stanislaus County is now a combined effort of UC Cooperative Extension Farm Advisors Roger Duncan, Kari Arnold, and Jhalendra Rijal and will cover topics on all tree and vine crops and associated pest management.

Due to continued corona virus concerns, our office is open to the public although many advisors are working remotely and staff is staggered to reduce potential spread. We can still be reached at 209-525-6800 or by email.

shell hardening can result in sunken dark spots on kernels (Fig. 2c), although the degree of damage tends to be higher with BMSB feeding than LFB. Late-season feeding (July-August) by BMSB, can cause dark stained kernels (Fig 2d). Varieties with soft shells such as Fritz, Sonora, Aldrich, Livingston, Monterey, and Peerless are more susceptible to bug damage and for a longer period during the season.

2. Harvest Sampling in Walnuts

It is recommended to take a minimum of 1000 nuts at the harvest and evaluate for the damage caused by navel orangeworm , codling moth, ants, husk fly, and sunburn. It is important to have representative samples (>10 samples with a minimum of 100 nuts/sample) from the orchard for better estimation of the infestation. The damage signs associated with these specific insect pests and sunburn are described as follows:

2.1. Worm Damage (NOW, CM). Navel Orangeworm damage can be identified by the presence of a large amount of frass and webbings (Fig 3a). NOW larvae are present in groups and can bore deeply into the kernel. Heavy infestation may give a nutshell an oily appearance. In contrast to NOW, a single codling moth larva infest the nut, and has a lot cleaner damaged area inside the nut. Frass is evident, but only at the entry point on the husk; very little webbings present (Fig. 3b). If larva is present, look for crescent-shaped marking just behind the head to confirm navel orangeworm.

2.2. Ant Damage. Similar to almonds, nut damage by ants increase as the duration of the harvested nuts on the ground increase. Ants enter the nuts from the soft tissues (i.e., stem end) and/ or through a codling moth injury. Ant damage on nuts is identified by the presence of deep chewing channels with clean kernels (i.e., no frass, no webbings, no deep boring) (Fig 4a).

2.3. Husk Fly Damage. Walnut husk fly larvae (technical term: maggots) feed in groups by boring into the husk. Early season damage results in shriveling and darkening of the kernels, with the increased potential for mold growth. Late-season infestation causes little kernel damage (Fig. 4b), although it may stain the shell and make the husk removal process difficult.

2.4. Sunburn Damage. Sunburn damage on nuts can be confused with husk fly damage. In the case of sunburn, nutmeat is shriveled and darkened on one side of the nut — no evidence of frass, webbings, or larval presence (Fig. 4c). Husks from sunburn damaged nuts can be removed from the shell during processing, which is not the case for the nuts damaged by husk fly.

Fig. 1. Almond kernels (nutmeat) damaged by: a) navel orangeworm, b) peach twig borer, c) Oriental fruit moth

Fig. 2. Almond kernels damaged by: a) ants, b-d) leaffooted bug and brown marmorated stink bug

Fig. 3. Walnut damaged by: a) navel orangeworm, b) codling moth

Fig. 4. Walnut damaged by: a) ants; b) walnut husk fly; c) sunburn

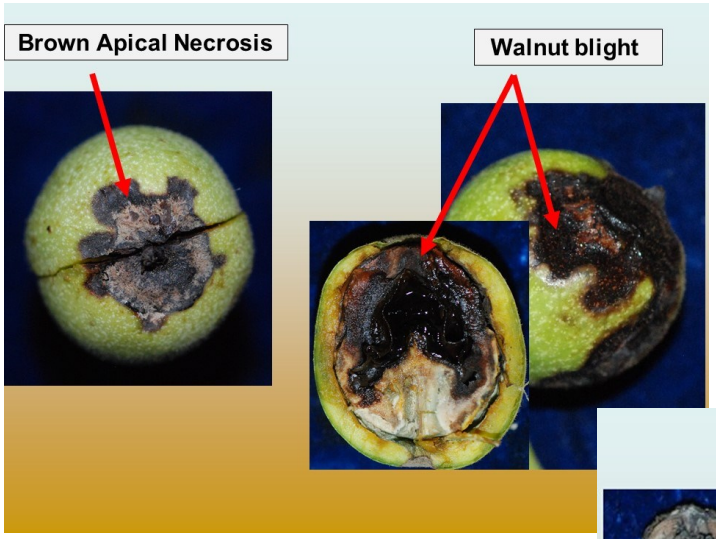

Fig. 5. (Left) Brown Apical Necrosis is shown on the left, not to be confused with Walnut Blight, shown on the right, and caused by the bacterial pathogen, *Xanthomonas arboricola* pv. *juglandis.*

Figure provided by Themis Michailides.

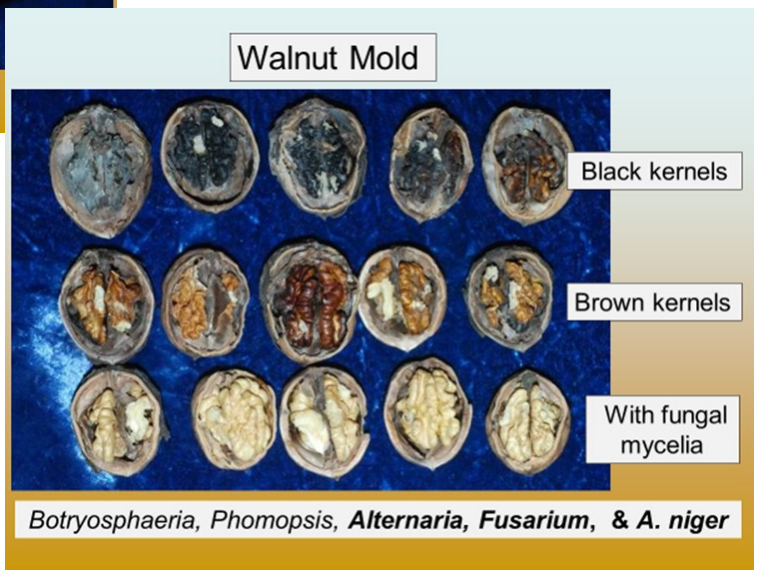

Fig. 6. (Right) Moldy, off color nuts which lead to economic loss due to downgrading.

Figure provided by Themis Michailides.

Managing Walnut Mold

Kari Arnold Ph.D. UCCE Area Orchard and Vineyard Systems Advisor, Stanislaus County
Themis Michailides Ph.D., UC ANR Plant Pathologist and Lecturer, Kearney Agricultural Research & Extension Center

Something has been plaguing walnut orchards for many years without a known cause. Often referred to as Brown Apical Necrosis, or BAN (Fig. 5), 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. The findings are:

After collecting samples and isolating various types of fungi from both nuts and hulls, the Michailides Lab at the Kearney Agricultural Research and Extension Center in Parlier, Calif. consistently found *Alternaria, Aspergillus niger, Fusarium, Botryosphaeria,* and *Phomopsis* present, please see Fig. 6. *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, Aspergillus niger* and *Fusarium* 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?

One year of field experiments in the southern San Joaquin Valley show that applications of Merivon at 6.5 fl. oz/ac (FRAC group 7 and 11, a.i. fluxapyroxad and pyraclostrobin, respectively) or Rhyme at 7.0 fl. oz./ac (FRAC group 3, a.i. flutriafol) at three weeks prior to hull split are most effective at controlling walnut mold. Applications made between hull split and three weeks prior to hull split are also effective. Unfortunately, applications made to control *Botryosphaeria* and *Phomopsis* are not effective in controlling walnut mold caused by *Alternaria, Fusarium,* and/or *Aspergillus niger*.

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

Walnut Rootstocks

Kari Arnold Ph.D. UCCE Area Orchard and Vineyard Systems Advisor, Stanislaus County

Walnut rootstock options were historically seedlings, either Northern California Black (*Juglans nigra*), or Paradox (a cross between English Walnut, *Juglans regia,* and Northern California Black). Those two options still exist, but as research and technology advances in walnut cloning, clonal rootstocks are becoming more available. With this new advancement, growers have questions. Hopefully, I can provide some answers.

What is the difference?

There is a large difference between clonal rootstocks and Paradox seedlings. This is due in part to the genetic variability, or genetic differences, in Paradox seeds. UC/UCCE/USDA Walnut researchers, specialists, and farm advisors studied the genetic background of Paradox seedlings and found high variability from one seed to the next. This means that each seed is different from the next one. One seed might be more vigorous, one seed might be more susceptible to phytophthora , one seed might encourage more seed production, while another encourages more leaf and branch growth. This leads to a highly variable stand of trees in an orchard. Clonal rootstocks, on the other hand, are cuttings of the same plant. Walnut varieties are a good example of this process, as every Chandler tree in California came from one single
mother tree which was originally produced by a seed. Much like how every Chandler tree tends to produce the same nut (some differences do develop depending on the growing conditions), every RX1 clonal rootstock will develop similar characteristics in the tree. Therefore, a Chandler orchard on a clonal rootstock tends to be more uniform in growth than an orchard on Paradox seedlings.

What is the RIGHT choice?

I honestly cannot think of a single “right choice” in agriculture, there’s just options. Options are

nice, but they can also be confusing. Here is some background information that might help the decision in the future.

RX1 and VX211 are both UC selections, chosen from acres of single seedling crosses based on their potential benefits. These were developed as a part of the Paradox diversity study done by UC/UCCE/USDA researchers, specialists and farm advisors. RX1 appears to show some tolerance to *Phytophtora*, a root infecting fungus like organism, but if disease pressure is high, the rootstock may still succumb to *Phytophthora.* VX211 was selected based on its potential tolerance to some nematode populations, but again, much like RX1 and *Phytophthora*, if nematode pressure is high, VX211 may still succumb. Both RX1 and VX211 were field tested against a handful of other selections as well as Paradox and Vlach. Vlach was developed by a private party which originated from a Paradox seedling tree in our very own county of Stanislaus. The tree was selected based on its high level of vigor.

Are any commercially available walnut rootstocks resistant to crown gall?

Short answer: no. Long answer: Paradox seedlings, RX1, VX211, and Vlach can all be infected with the causal agent of crown gall (*Agrobacterium tumefaciens*) and develop galls. YET the production of clonal material AVOIDS many opportunities for infection. Paradox seedlings are collected from the field as walnut seeds. Previous UC/UCCE/USDA research (funded in large part by nurseries) demonstrated that *Agrobacterium tumefaciens* is picked up from the ground in seed orchards. Nurseries funded this research to find ways to make their production better and have since developed ways to reduce crown gall in new Paradox seedling rootstocks by incorporating the use of tarps or catch frames. That said, Paradox seedlings are highly susceptible to *Agrobacterium tumefaciens* and clonal material skips this field collection step. Please be advised that orchards on RX1, VX211, and Vlach still require proper sanitation, ie, cleaning pruners/loppers with 10% bleach solution or 70% ethanol and avoid wounding the crown, trunk, and roots during planting and other practices.

Are these our only options?

When excluding Blackline (please see my summer 2019 issue for further information http://cestanislaus.ucanr.edu/newsletters/Walnut_News_-_Fruit_For_Thought80737.pdf), for now, yes, but not forever. The California Walnut Board in combination with the US Specialty Crop Research Initiative is currently funding ongoing research in the breeding and development of future rootstocks. We are looking at three to four selections for various reasons, one of which being resistance to crown gall. These rootstocks are being field tested now and will be made available in the future provided they prove themselves worthy, in other words capable of producing a good crop.

More questions?
Please don't hesitate to call. (209) 525-6800. Stay healthy!

To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products which are not mentioned.

Upcoming events:

Register today to learn about Establishing Nut Crop Orchards from experts with the University of California and USDA. Different topics will be presented during each session. $10 registration fee will allow you to attend any or all of the sessions from 3-5 PM on July 29, August 5, and August 12. CEUs have been obtained from CCA for all 3 sessions and have been applied for from CA DPR for Aug. 5 (1.0 Other). For more information on registration, contact anrprogramsupport@ucanr.edu, 530-750-1361 or for course content, contact Phoebe Gor-don, pegordon@ucanr.edu, Orchard Crops Farm Advisor, UCCE Madera (detailed agenda at ucanr.edu/sites/PSU/files/329744.pdf)

University of California
Agriculture and Natural Resources
Cooperative Extension
July 2020, Vol. 25.3

In This Issue:

CURRENT RESIDENT OR

UNIVERSITY OF CALIFORNIA
COOPERATIVE EXTENSION
3800 Cornucopia Way, Suite A
Modesto, CA 95358

NONPROFIT ORG.
US POSTAGE PAID
MODESTO, CA
PERMIT NO. 400