

**2016 Advances in Almond Production Short Course,  
November 8-10, Modesto, California**

**Registration will be open on July 1** for this integrated orchard management short course featuring UC faculty, Cooperative Extension specialists and farm advisors, and USDA researchers who will provide an in-depth, comprehensive study of all phases of almond culture and production.

This course is designed for new and experienced growers as well as other industry members interested in commercial almond production. For more information, go to <http://ucanr.edu/almondshortcourse>

**Symptoms of Foliar Chlorosis on Tulare County Walnuts  
Indicative of Over-irrigation**

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*Bruce Lampinen, UC Extension Specialist, UC Davis*

Although over-irrigation may seem like an unlikely diagnosis after an extended drought, the foliar chlorosis observed in Tulare County walnut blocks in late May and early June are identical to symptomology in research blocks maintained wetter than baseline (Figure 1). In research plots, foliar chlorosis occurs within just days of an excessive irrigation event. Note that the yellowing associated with overwatering affects all of the leaves on a shoot down to the nuts (i.e. neoformed leaves that were formed in the current season). In contrast, newly

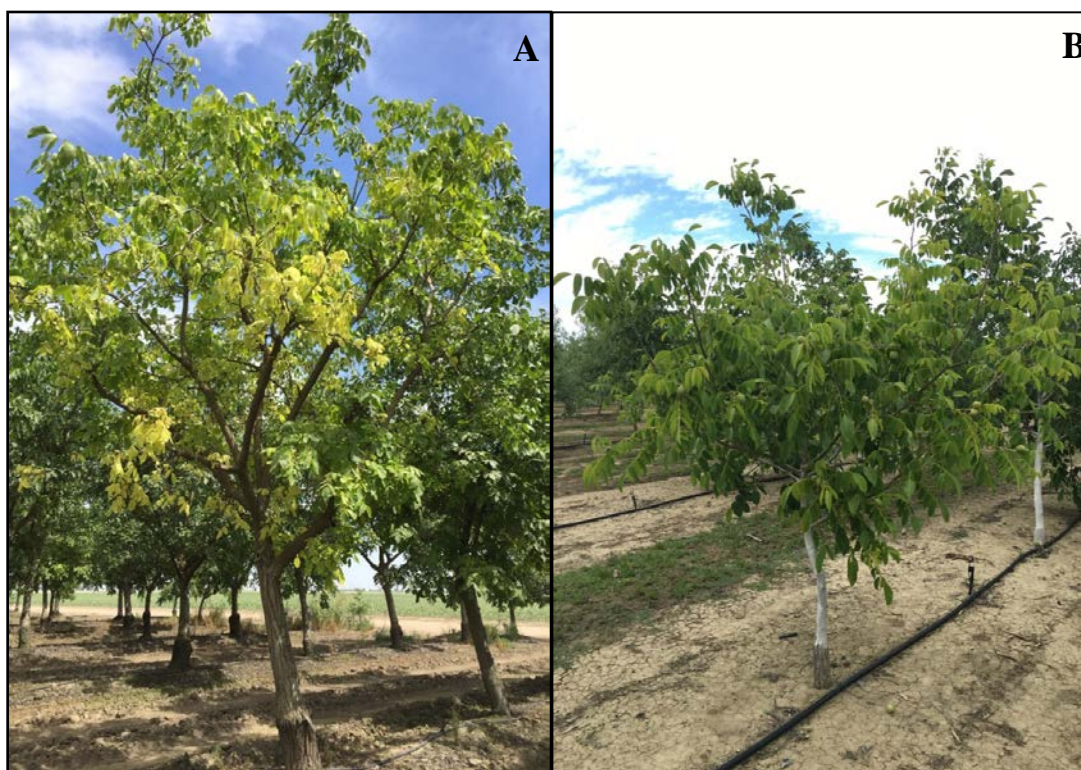


Figure 1. Chlorosis observed in Tulare County walnuts on May 27, 2016 (A). Chlorosis in irrigation trial maintained at 1 bar wetter than baseline (B). Photo A: E. Fichtner; Photo B: B. Lampinen

emerging leaves may initially appear yellow; however, they gradually turn to green three or four leaves back from the growing tip. Over-irrigated walnut trees in research plots also have a tendency to drop one of two nut doubles, resulting in lower overall nut retention in the canopy. When this situation is occurring, you can grasp a number of pairs of double nuts on the tree and one of each pair will often come loose with almost no force. These nuts will exhibit blackening while still on the tree (Figure 2) and squirt water vigorously when cut. Anaerobic conditions in the root zone may cause root rot which may lead to overall tree decline and mortality.



Figure 2. Walnuts maintained wetter than baseline develop blackened nuts. Photo: J. Grant.

Over-irrigation of walnuts is common in young blocks where growers cultivate an annual crop in the middles of tree rows to maintain an economic return on the land in advance of tree maturation and productivity (Figure 3). The challenge to meet the irrigation demands of an annual crop may result in damage to the trees, thus affecting the future economic productivity of the orchard. Similarly, replants are often subject to over-irrigation because irrigation events are designed to meet the needs of the more mature trees. The root rot and tree decline resulting from over-watering is similar to the symptoms of root rot caused by *Phytophthora* spp.; however, isolation of these pathogens from the roots of overwatered trees is rare, suggesting that over-watering is the primary cause of decline.

Because orchards are dynamic ecosystems managed for economic return, irrigation events may be timed around factors other than tree physiology. For example, many growers in Tulare County were irrigating walnut orchards

approximately a week in advance of the anticipated codling moth flight around May 30, 2016. These irrigations were timed to allow enough time for the orchard floor to dry in advance of pest management operations. In some orchards, irrigation events timed around pest management operations may be ill-timed with respect to tree water needs. Additionally, some irrigation districts in Tulare County had a release of Class 1 surface water in mid-May 2016. The timing of surface water availability and anticipated codling moth flight activity might have contributed to the over-irrigation and subsequent chlorosis in several Tulare County walnut blocks. Finally, over irrigation symptoms can occur when there is a period of hot weather with high rates of irrigation followed by a cool cloudy period.

Use of a pressure chamber (aka ‘pressure bomb’) to measure stem water potential (SWP) will allow for direct measurement of tree water stress and thus assist with irrigation management. Most irrigation managers measure SWP prior to an irrigation and one to two days after an irrigation event. To reduce variability and achieve consistency in readings, SWP measurements should be made on bagged interior branches in the lower canopy during the afternoon. To maximize shoot growth and allow for sizing of nuts, SWP should be maintained from 4.0- 6.0 bars (low to mild stress) from leafout until mid-June. To control vigor without adverse effect on kernel development or fruitfulness in the successive season, trees may be maintained at 6.0- 8.0 bars (mild to moderate stress). For a comprehensive understanding of the use of the pressure chamber for measuring SWP in walnut, download the UC ANR article entitled “Using the Pressure Chamber for Irrigation Management in Walnut, Almond, and Prune” from the following URL: <http://anrcatalog.ucanr.edu/pdf/8503.pdf>. The article was composed by Allan Fulton, Joe Grant, Richard Buchner, and Joe Connell, UC farm advisors, and provides background on the use of the pressure chamber and interpretation of SWP data.



Figure 3. Some growers may grow an annual crop between the rows of new orchards. Meeting the irrigation demands of the annual crop without adversely affecting the trees poses a challenge. Photo: E. Fichtner

# Field Treatment of Crown Gall on Walnut

## *Different Options' Effects on Growth and Productivity*

*By Bill Olson & Richard Buchner*

Due to superior resistance to *Phytophthora* crown and root rot, increased vigor and more adaptability to marginal walnut soils walnut trees on Paradox rootstock are the preference of most California walnut growers even though the paradox rootstock is highly susceptible to the bacteria disease crown gall (*Agrobacterium tumefaciens*).

The California Walnut Board is supporting research on the epidemiology and prevention of this disease while growers that already have the disease on their walnuts are treating it with surgery and chemicals or with a heat treatment.

The surgery and chemical treatment generally consist of:

1. Removing the entire gall as thoroughly as possible with hatchets, chisels, etc.
2. Removing 1-2 inches of bark around the gall margin.
3. Often treating the entire area with a chemical.
4. Sterilizing all tools between each tree with a disinfectant material.
5. Watching for gall regrowth for one year and retreating with surgery and chemical as needed.

With the heat treatment it is advised to:

1. Grossly remove large galls with a hatchet in order to see where to apply the heat and to be able to observe any gall regrowth.
2. Apply heat using a torch fueled by propane (or other gas) to a 1-2 inch margin around the gall area.
3. Watch for gall regrowth for one year and retreat with heat as needed.



*Surgical/chemical treatment must be thorough to be effective.*

### ***Is Crown Gall Present in the Orchard?***

Knowing if crown gall is present in the orchard on young trees can be a difficult determination before the presence of galls become noticed above ground. Early signs that crown gall may be present on young trees includes:

- tree not growing vigorously

- stunted tree
- excessive ground cracking around the trunk of the tree
- ground “heaving” around the trunk of the tree
- poor leaf color
- early appearance of fall coloration

If any of these signs appear it is recommended that the crown of the tree

*Burning the margin is the key to success with the heat treatment.*



be exposed and examined for the presence of crown gall.

**To Treat or Not to Treat?**

Treating for crown gall is expensive. It can easily take one hour and often two hours to remove the soil and treat a single tree. The preferred time to treat is during the growing season when tissue can callus (heal) rapidly. This timing interferes with many other important farming operations. Also the surgery performed to clean up the gall on small trees is often extensive enough to girdle part of the cambium causing restricted flow of nutrients. For these reasons paradox rootstock trees that do not make good growth the first year due to the presence of crown gall are better off being replaced than treating for crown gall.



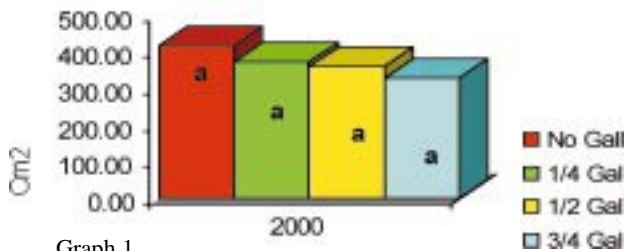
*Retreating gall regrowth is simplified with the heat treatment*

On second leaf trees it may be advisable to treat the gall depending on its size and any effect it has had on the trees performance. With small galls (less than one-fourth the way around the trunk) it may be economic to treat the gall. While second leaf trees with larger galls it is more economic to replace the tree. Any stunted tree caused by crown gall should be replaced, not treated.

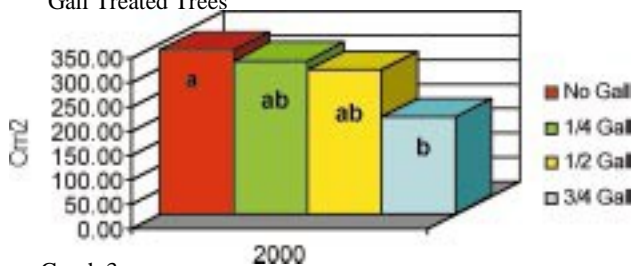
On third through about sixth or seventh leaf trees it is economic and generally a good idea to treat trees with galls of nearly any size except those that have completely girdled the tree. These trees should be replaced, as should any stunted trees.

After the sixth or seventh leaf, or when the trees are nearly full size, gall treatment can end. Trees of this age, that are not stunted, are rarely an economic problem even if crown gall exists.

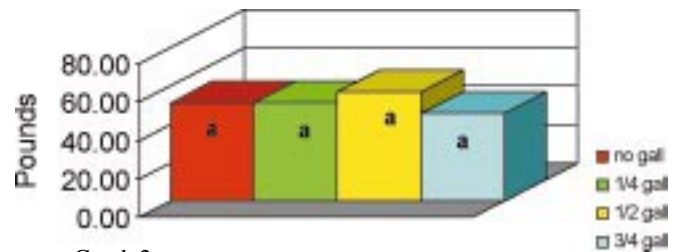
Early research data through the sixth leaf shows that treating galls on third leaf trees, and continuing to retreat any gall regrowth as needed produces a tree comparable in size



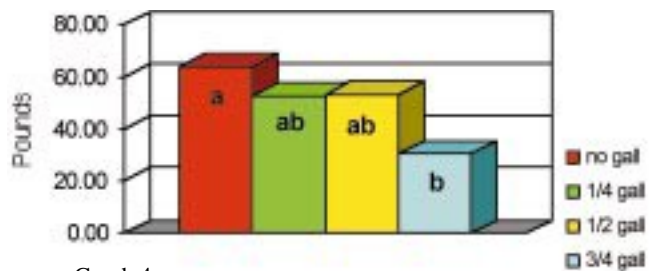
Graph 1.  
Mean Trunk Area 10 cm Below the Union on Gall Treated Trees



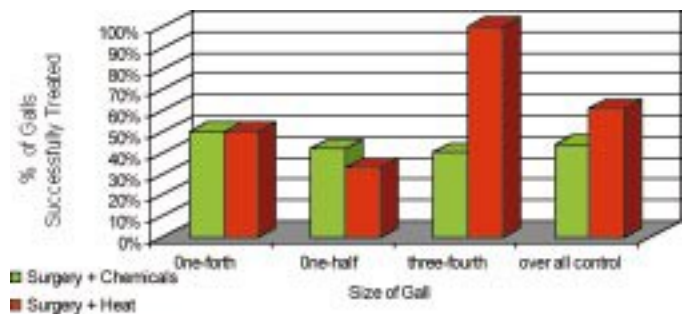
Graph 3.  
Mean Trunk Area 10 cm Below the Union on Untreated Trees with Galls



Graph 2.  
Mean Accumulated Yield (lbs/tree) on Gall Treated Trees (1999 - 2000)



Graph 4.  
Mean Accumulated Yield (lbs/tree) on Untreated Trees with Galls (1999 - 2000)



Graph 5.

and with comparable yields of trees that never had a gall (Graphs 1 and 2). This is true of galls one-fourth, one-half, and three-fourths the way around the tree trunk. Comparable trees that were left untreated have decreased tree size and yield where galls were three-fourths the way around the trunk as compared to trees that never had a gall (Graphs 3 and 4.). Additional data collected over the next two years will provide conclusive evidence of the economic impact crown gall has and whether treating galls is economically worthwhile or not.

#### What Method of Treatment is Best?

Under actual field conditions research efforts have shown little preference in method of treating galls. All methods can work well and no method provided 100 percent control without retreatment. Surgery alone can work as well as any other method but this method is very time consuming and requires considerable precision. With the heat treatment the amount of heat needed to kill cells and the bacteria is unknown. Early trials have applied heat until the bark is "red hot".

Field research on below ground galls on third leaf trees comparing the surgery/chemical treatment to the heat treatment showed no clear preference in terms of gall control on galls one-fourth or one-half the way around the trunk (Graph 5). Surprisingly, the heat treatment gave

nearly complete control of galls that were three-fourths the way around the trunk while the surgery/chemical treatment resulted in less than 40 percent control. Overall the heat treatment resulted in 16 percent better control of galls than the surgery/chemical treatment (Graph 5).

#### *Success in Treating Galls*

Although the heat treatment is still being researched and is not recommended as a general treatment, because the long term effects of applying heat to the cambium of walnut trees are not known, growers are quick to point out the following disadvantages and advantages of the two crown gall treatment procedures.

#### *Treatment Disadvantages*

Surgery + Chemicals

- More expensive
- Complete surgery required
- More equipment required
- Slower process
- Treating gall more complex
- **Tool sterilization is more detailed**

Surgery + Heat

- Long term effects are unknown

#### *Treatment Advantages*

Surgery + Chemical

- Long standing proven technique

Surgery + Heat

- Less equipment needed
- Slightly faster

- Control is at least as good if not better
- Ease of treating gall regrowth
- "Gross" surgery or no surgery required
- **Simplified sterilization of tools**

Even with crown gall the fact remains that paradox is and will continue to be the most popular walnut rootstock for many years to come. Research on crown gall epidemiology and prevention will hopefully reduce the incidence of crown gall in the future. For now the best course of action, once a gall is present on a second or older leaf tree is to treat it and continue treating it until no more galls appear. Treatment can be discontinued once the tree is near full size. Early data suggest that this procedure can be economic and can result in a tree as large and productive as a tree that never had a gall.

*Bill Olson is a University of California Cooperative Extension Farm Advisor in Butte County, and Richard Buchner is a University of California Cooperative Extension Farm Advisor in Tehama County.*

*This article is as published in Pacific Nut Producer, July/August, 2001*



*Kings and Tulare Counties*  
**NUT HARVEST SAFETY TRAINING CLASS**

Wednesday, July 20, 2016  
8:00 a.m. to 12:00 p.m. (includes lunch)



**KINGS COUNTY FAIRGROUNDS**

801 S.10th Ave  
Hanford, CA 93230

**Registration from 7:30 – 8:00 a.m.**

**Hosted by:** Kings County Farm Bureau, Tulare County Farm Bureau, State Compensation Insurance Fund and University of California Cooperative Extension.

This annual safety training program is directed towards nut commodity harvest equipment operators, crews and farm employees in conjunction with farm managers/supervisors, and growers. Harvest equipment for walnuts, almonds and pistachios will be included. The training will be held in English and Spanish. Be sure that you indicate on your registration form which training the employee will be attending and whether they will be staying for lunch.

Staff from the Family Healthcare Network will be on hand from 7:30 to 8:00 a.m. to provide free health screenings for participants.

**Mail or fax by July 15th, to the following:**

Tulare County Farm Bureau  
P.O. Box 748  
Visalia, CA 93279  
Phone: 559-732-8301  
Fax: 559-732-7029

**It is IMPORTANT to make your reservations prior to July 15th, to give us time to complete certificates of participation with proper name and organization and to make lunch arrangements.**

Company Name _____				
Contact _____				
Address _____				
Phone _____ Email _____				
	Language		Lunch	
Name of person(s) attending	English	Spanish	Yes	No



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# *In-A-Nutshell*

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June 2016

Elizabeth Fichtner  
Farm Advisor

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