

The Science (and Art) of Ethephon Use on Walnut*Robert Beede, UC Farm Advisor, Kings County*

Note: Spring temperatures were cold enough to delay walnut maturity similar to last season. Processors are therefore anxious to receive as much product as soon as possible to refill inventory and meet European export scheduling deadlines. Many are offering financial incentives to obtain new crop at the earliest date. These conditions cause growers to consider using ethephon to accelerate harvest. The following newsletter outlines the pros and cons.

What is Ethephon? Ethephon, also known as Ethrel®, is an ethylene-based plant growth regulator applied at walnut maturity, or shortly thereafter, which accelerates hull cracking and separation from the shell. This advances walnut harvest by four to seven days, depending on the season and variety, and nut value is increased by lighter kernel color and possibly less insect damage. The performance of ethephon improves with experience. Proper application and timing are essential for a successful response.

When are walnuts mature? Walnut kernels are physiologically mature well ahead of their natural drop from the tree. Kernels achieve maximum oil accumulation when the packing tissue surrounding the kernel has changed from a bright white to the color of oak. This is commonly referred to as Packing Tissue Brown (PTB). The nuts in figure 1 are **NOT** at PTB, including the top nut, which still has flecks of white dispersed among the packing tissue. It is two to three days away from being uniformly oak colored. The nuts in figure 2 **ARE** at PTB. **Do Not Treat Until All The Nuts You Cut Are At This Stage!!** The packing tissue continues to darken to a mahogany color as the nut ages. Kernel maturity often occurs 21 or more days ahead of unaided commercial harvest (at least 80% removal with 10% or less sticktights). During this period, the green hull tissue surrounding the nut undergoes separation of its vascular tissue from the nut, and the hull also cracks from tissue breakdown and moisture absorption. Unfortunately, the kernel also ages, resulting in darker, less valuable nuts. The risk of insect damage, principally from navel orangeworm, also increases due to longer exposure to the last generations of the season.

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Figure 1. Immature walnuts



Figure 2. Mature and ready for treatment



Is Ethephon right for me? Perhaps not. Users must commit to monitoring the orchard once or twice weekly for PTB, applying the product at night or early morning to avoid temperatures approaching 90⁰ F, and then have control over harvest timing to take advantage of the accelerated maturity. Your dehydrator must also be open and prepared to process your nuts promptly to further minimize quality losses.

How do I time treatment? Three years research in Kings County shows **PTB occurs last in the bottom of the canopy**, and that fully shaded walnut canopies have greater maturity variability than those with full sunlight. **Orchards deficit irrigated or stressed from low water infiltration also develop PTB sooner than well watered orchards.** Early walnut varieties such as Serr develop PTB sooner (mid-August) than late varieties such as Chandler (mid-September). Begin sampling at least two weeks ahead of when PTB is expected. **Walk diagonally across the orchard and collect at least 100 nuts. Do not include nuts obviously advanced in maturity, since they are often oil-less and atypical. Cut each collected nut in half.** This is often done by insertion of a knife blade into the stem end of the nut, followed by a twisting of the blade to split the nut down its suture. Care must be taken to prevent the sudden loss of resistance to the knife blade, with subsequent puncture of your hand palm! Wear leather gloves over latex ones to reduce the risk of injury and severe hand staining from the hull tissue. Place one half of each nut into either a “yes” or “no” group for PTB. **Only nuts with complete browning of the packing tissue, including the area near the stem end, qualify for the “yes” group. It is better to be two days late in application than two days early, since losses in weight, nut quality, and hullability result from early ethephon application!** Application delayed five to seven days after PTB improves percent nut removal and the chances of having to only harvest once. Consider crop load, weather, and variety susceptibility to darkening in electing this option.

Do all walnut varieties respond similarly? No, research in Kings County suggests walnut cultivars differ in their sensitivity to ethephon. Laboratory testing of Serr, Payne, Tulare, and Chandler suggests that Serr produces the least amount of ethylene after treatment of these four varieties, and Tulare the most. This agrees with field experience in the Southern San Joaquin Valley, where Serr is often marginal in response, and Tulare falls off the tree shortly after treatment. Growers report Howard is also very

responsive to ethephon in Northern California, resulting in greatly enhanced quality and value. The responsiveness of Tulare in the South has now made it a standard cultural practice. Collaborative research with the UC Davis Plant Sciences Department suggests that the lower ethylene production from treated Serr walnuts is possibly due to less absorption into the hull, which has smaller pore spaces than the highly responsive Payne variety. We are experimenting with adjuvants to test the absorption/improved performance hypothesis. **Thus far, the organosilicones did NOT improve ethephon activity!**

What about treating stressed orchards? Growers treat stressed orchards at their own risk. Walnut stress typically arises from under or over irrigation and heavy mite infestation. Stressed orchards can experience more leaf drop prior to and after harvest. Excessive leaf drop can vastly complicate harvest, especially in the event of rain. Remember, quality does not begin at harvest, and ethephon is an aid, not a panacea for all the quality related problems experienced during the season.

How do I apply it? Only ground application with large self-propelled speed sprayers is recommended in the South. Four to five pints of product are added to 150-200 gpa, with ground speeds between 1.5 and 2 mph, depending upon canopy size. **Ethephon does not translocate! It MUST hit the nut to create the desired response! Experience shows greater response under higher humidity and lower temperatures. Never exceed 90° F. Do not apply when drying winds, typical in the North, prevail. Ethephon is rainfast within six hours of treatment. Like all plant growth regulators, application conditions which improve absorption time increase product performance.** Reports from northern California growers suggest weather conditions are favorable for effective aerial applications on responsive varieties such as Howard, Hartley and Vina. Growers and northern California county Ag Commissioners report aerial use rates of two to four pints in 40 gpa. Aerial application and ethephon concentrations greater than those recommended for ground treatment (900 ppm) are allowed by the label, **BUT** they are not supported by the manufacturers. **Rates higher than recommended may result in tree injury, such as excessive defoliation, reduced catkin formation and twig dieback. All risks for air application with higher concentrations are assumed by the grower. Check with your crop consultant for a local recommendation.**

Does Ethephon pay? Research documents improved nut value of five cents per pound, principally due to lighter kernel color. However, greater value increases may be experienced commercially under heavy navel orangeworm pressure, or with varieties prone to rapid kernel darkening. Growers in the North report improved Howard value of nine to 12 cents. Control over harvest timing is also an advantage to which a price cannot be assigned.



Additional Ethephon Use Considerations in the Sacramento Valley

Janine Hasey, UC Farm Advisor, Sutter and Yuba Counties

By the time you receive this newsletter, the time to apply ethephon to early season varieties will have passed. However, the timing for late season varieties like Chandler should be very close to packing tissue brown (PTB). Sampling nuts as stated in the previous article will give you the information you need to either apply ethephon to advance harvest or try for one shake harvest once you determine the date of PTB. Chandler has been responsive to ethephon application and many local growers have found treating certain

blocks a good way to spread the harvest timing and drying into more manageable allotments of this widely planted variety.

Other considerations:

- Although Howard is responsive to ethephon, avoid using it in orchards with the “yellow Howard problem” since these trees are stressed. We do not know the cause of this malady yet but are working on it.
- The benefits of ethephon application are usually seen 14 to 23 days after application. Test shake a tree and evaluate hull adhesion before committing to the harvest.
- In addition to earlier harvest reducing navel orangeworm damage by avoiding the last flight, mold damage can also be decreased by avoiding early rains.
- Nuts delivered to the huller/dryer without hulls dry quicker than nuts delivered in hull. Less drying time should be needed the earlier the hull cracks and separates from the shell.



Considerations When Replanting Individual Trees in a Walnut Orchard

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It happens often that a tree will die within a healthy orchard. The question is do you replant or do you leave that tree spot empty? If you decide to replant, what is the best way to grow the young tree while still maintaining the surrounding orchard. This article will take a look at considerations when making replant decisions and some practices that will help the interplant survive.

Sunlight availability:

When making the decision to replant or not the most important question to ask is; “Is there enough sunlight to grow the replant to production size?” In many cases the interplants are planted into a shaded orchard and they struggle to reach full size and many never do. If the tree can’t reach full size then it may not be worth the expense in time and money to replant.

- **Age of the orchard and canopy cover:** The age of the orchard is the first consideration when deciding if to replant. If it is a young orchard and sunlight at the tree location is available throughout the day replanting is a very good option. If the orchard is older and the tree canopy is at 75%-95% coverage the likelihood of the replant growing well is slim. The yield loss may be somewhat regained when the surrounding trees increase their fruiting area because of the increased light caused by the open space left by the missing tree. If this is the case it may not be worth the trouble to replant.
- **Orchard planting space:** In wide-spaced or standard spaced orchards there may be more sunlight for the replant. Trees in hedgerow orchards are so close together that the surrounding trees will quickly fill in the space left by the missing tree. It is not often recommended to replant within a hedgerow.

Why did the tree die?

It is important to understand why the tree died because it relates to the success of the replant and steps you should take when replanting. As the tree's health declines try to evaluate the reasons it is sick by looking for symptoms of disease or pests. Take tissue samples to a plant pathology lab or request help from your PCA or Farm Advisor to identify the cause. It may be that the orchard practices can be improved or preventative measures can be taken to moderate the chance of other trees becoming sick.

- **Soil borne pathogens:** Often a tree will succumb to root and crown disease while the rest of the orchard seems unaffected. In the case of Phytophthora or Oak Root Fungus, the fungus will remain in the soil and the interplant may become infected soon after planting. Opening the planting hole and letting the soil dry throughout the summer may reduce the fungi's efficacy. Future irrigation should be applied carefully to avoid water logging the soil which encourages the fungi while reducing tree growth. Nematodes can also be a reason for slow tree decline and a soil sample, with roots included, should be sent to a lab to test for them. Any soil borne pathogen may be reason enough to decide not to replant if surrounding older trees are still yielding well.
- **Saturated soil problems:** If the tree succumbs to overly wet soil conditions either with over irrigating, heavy spring rains, or high water table, consider not replanting until the problem has been resolved.
- **General decline:** General decline often happens in older orchards when there are many pests or diseases that can be found on a single dying tree. The tree may have dieback caused by sunburn, lack of vigor, branch wilt, Botryosphaeria, or Phomopsis. Trunk cankers from shallow or deep bark canker are often found in declining orchards. Crown gall can by itself reduce the health of the tree and shorten its life. If the orchard has many trees in some state of general decline it may be better to farm the orchard until it is no longer economical, after which the whole orchard should be removed and replanted. It would not be recommended to replant individual missing trees in an orchard that is in general decline.

Time and Inputs Considerations:

Your time and money are worth something so consider the effort and time needed to grow an interplanted tree. Each tree will need to be hand fertilized, staked and tied, pruned, and the irrigation modified. The cost of the tree and labor may be greater than the loss of the yield in your orchard. If the replanted trees are not well taken care of or they do not receive enough sunlight then it is doubtful that they will ever yield enough for the return in your investment.

Tips on successfully replanting individual trees

After careful consideration, you have decided to replant the missing trees. The best way to have success is to follow the good planting practices that are well known for planting a new orchard. The following are the highlights but previous newsletter articles have covered these subjects more in-depth.

- **Root removal:** When removing the dead tree excavate a large area and try to remove all the roots. The excavation area should be about 8-10 foot square. Using a backhoe will help loosen compaction, dry out and mix the soil, preparing for spot fumigation and reducing compaction.
- **Fumigation:** Spot fumigation increases the chance of replant success. There are individual tree site label rates for Chloropicrin, Telone C-35®, and Methyl Bromide. Drying out the soil and getting a good seal is important for fumigation success. Check with your county Ag Commissioner for current restrictions and regulations before applying any fumigant. For more information reread the article

“Best Management of Replant Alternative Fumigants”

<http://cesolano.ucdavis.edu/newsletters/Fruit - Nut Notes Issue 1427391.pdf>

- **Rootstock choice:** In a replant situation you want a vigorous tree and if possible you want a rootstock that can handle the soil pests and diseases that may be there already. Paradox seedling is more vigorous than California Black and is typically a better choice in a replant situation. Clonal Paradox Vlach and VX211 are also very vigorous. VX211 has shown tolerance to nematodes and Vlach moderate resistance to crown gall. In orchards where Phytophthora is present, clonal Paradox RX1 may be a good choice. Clonal rootstocks are commercially available. For more information reread the article “Clonal Paradox Update”
<http://cesolano.ucdavis.edu/newsletters/Fruit and Nut Notes31613.pdf>
- **Plant correctly:** Good planting practices need to be followed when planting interplants. It is important to rebuild the berm and make sure the tree is planted high. It is a common mistake to replant the tree too low with a sunken area around it creating a wet situation around the crown of the tree and lowering the tree’s chance of survival. For more information reread the article “Guidelines for Planting Walnut” <http://cesolano.ucdavis.edu/newsletters/December 2008 Issue 927399.pdf>
- **Irrigation:** Irrigation is very difficult for replants. The young tree needs less water than the older trees in the orchard but the water has to be accurately placed into their root zone. Relying on the mature orchards irrigation system can leave the little trees too wet or too dry. The best set up is a modified drip or micro sprinkler for the each tree with care to adjust it throughout the season as needed. If there are a number of replants in the orchard it may also be possible to shorten the intervals between irrigations and reduce the time or amount of application without significantly changing the total application to better meet the needs of the replant while adequately irrigating the mature trees. This would only be necessary until the replants become established.
- **Fertilization:** This is one of the most important points to remember when interplanting in a mature orchard. The young tree is being planted in the same location that the removed tree mined for nutrients in the previous years. For success it will need to be fertilized much more regularly with small amounts each time. In many cases a full fertilizer with nitrogen, phosphorous, potassium and zinc has shown positive results in the first year of growth. Hand application is the easiest way to manage this.
- **Light management:** If the decision is made to replant but shading is a concern it may be necessary to prune back the surrounding trees just enough to allow for good light penetration for the developing replant.



How Traps Are Used to Monitor Walnut Husk Fly

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Placement – Trap placement is very important and influences how well walnut husk fly (WHF) traps work. If possible, place traps in “hot spots” where nuts were damaged the previous season. After feeding in the husk, mature larvae drop to the ground and burrow several inches into the ground to pupate. So areas infested last year are more likely to have flies this year. Traps should be hung on the north side of trees,

high in the upper one third of the canopy in areas where husk flies are most likely to appear. They prefer cool, damp, shaded areas. A black walnut tree is also a good trap location. Good trap placement is particularly important when monitoring low WHF populations.

Trap Selection – “Supercharged” AM NB (apple maggot no bait in the stickem) traps are recommended to determine when WHF appear and to detect female flies with eggs. Traps are yellow sticky cards with a vial or packet containing ammonium carbonate. Ammonium carbonate makes the trap 4 to 10 times more attractive. Walnut husk fly traps are commercially available and differ in catch efficiency.

Trap Numbers – If “hot spots” are unknown, additional trap density is necessary. Even the smallest orchards should have at least three traps. For orchards between 30 and 100 acres, one trap for every ten acres is suggested. For orchards over 100 acres, one trap for every 20 acres should be adequate.

Supercharger attractant – The condition of the ammonium carbonate is crucial for trap performance. Check the effectiveness of the ammonium carbonate by smelling for ammonia. Each time you check the trap, stir or shake the container and carefully smell check for ammonia by waving your hand over the container. If you can’t smell ammonia the supercharger is not working and the ammonium carbonate needs to be replaced.

Orchard Location – Walnut husk fly development is related to the availability of food. Food availability varies from orchard to orchard causing fly development to vary as well. As a result, each orchard must be monitored and treated separately. WHF decisions based upon adjacent orchards are usually faulty.

Timing – In the Sacramento Valley WHF emerge as adults from June until early September. It is critical to get traps up before the first fly emergence and check traps frequently throughout the season. Check traps two or three times per week until three weeks before harvest.

Trap Limitations – You can determine when flies are emerging and if females contain eggs from supercharged yellow sticky panels. However, traps are not particularly good at predicting population size or damage potential. No numerical treatment thresholds are available for WHF and damage can occur with low trap catches. For the most accurate spray timing, check females for eggs and apply treatment to prevent egg laying. Figure 1 shows WHF monitoring and the associated treatment strategy.

Additional Information – Check with your extension office to buy or view the “Walnut Husk Fly: Biology, Monitoring and Control Strategies” CD.

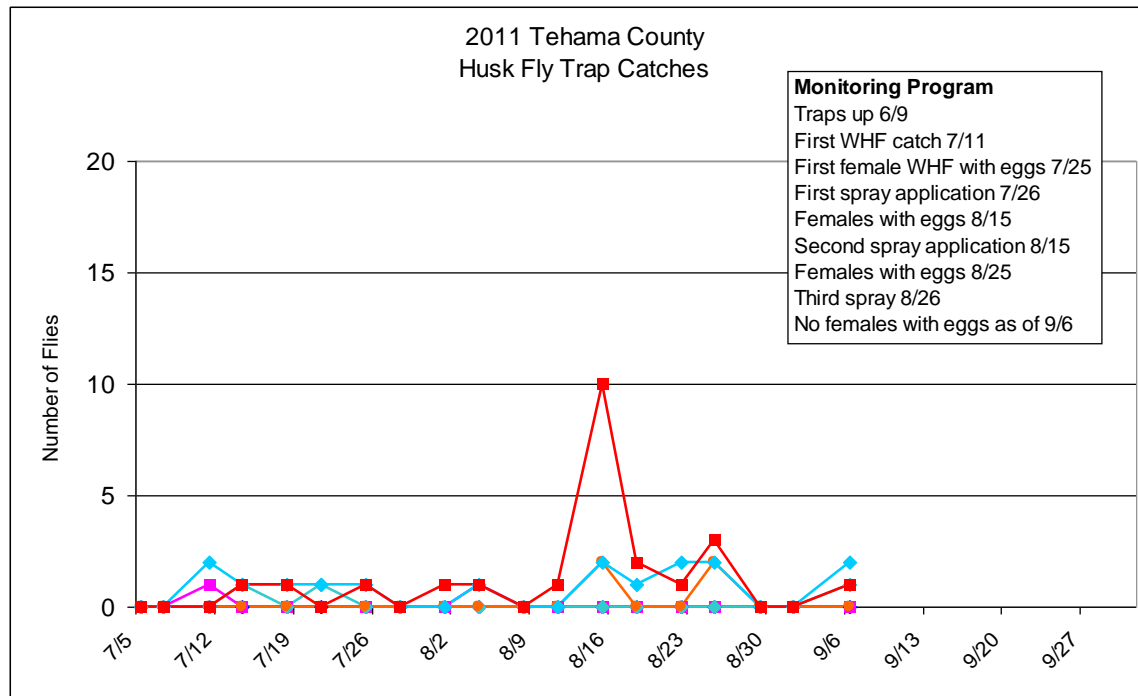


Figure 1. 2011 Walnut husk fly activity for a Tehama County Hartley orchard. Multiple lines represent different traps and locations within the same orchard.



Walnut Huller and Dehydrator Food Safety Good Manufacturing Practices (GMP) Checklist

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A huller and dehydrator good manufacturing practices (GMP) handout has been developed by the Grades and Standards Committee of the California Walnut Board. The checklist describes the actions you can take to help prepare your operation for an FDA inspection. Although these standards are voluntary only, they are well-accepted and reflect the best practices available today. Contact Carl Eidsath (CEidsath@Walnuts.org) at the California Walnut Board if you would like a copy of the handout.



Useful Websites Related to Walnut Production

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The internet is one of the greatest developments of recent history. It allows us to have a great source of information at our fingertips. Following are some links to websites that I have found useful for information related to walnut production and related topics. This is by no means an exhaustive list and is in no particular order.

UC Fruit and Nut Research and Information Center –Information related to the production of fruit and nut crops: <http://fruitsandnuts.ucdavis.edu/>

For the Walnut page- Click on “Fruit and Nut information” then choose “walnut”

Walnut Research Reports – contains all of the walnut research reports from projects funded by the California Walnut Board from 1971 through 2010 and is searchable by subject and author:
<http://walnutresearch.ucdavis.edu/> -

UC IPM – Integrated Pest Management of a wide variety of pests including Pest Management Guidelines (PMG) for a wide variety of crops: <http://www.ipm.ucdavis.edu/>.

For the walnut PMG add /PMG/selectnewpest.walnuts.html to the address or choose “Agriculture and floriculture” then click on “walnut”.

UC Cost Studies – Establishment and production cost studies for a wide variety of California crops. <http://coststudies.ucdavis.edu/> for walnuts in the Sacramento valley add /files/walnutsv2007r.pdf to the address.

UC Cooperative Extension County websites – Individual websites for the counties are written all the same except differing only in the county name: cecountyname.ucdavis.edu. Put your county name in the place of countyname in the address which will take you to that counties website. An example would be: ceglenn.ucdavis.edu. In addition to other information, you can find back issues of this newsletter.

Kearney Agricultural Research and Extension Center - <http://www.uckac.edu/>

For the latest information on managing nematodes in perennial crops add /programs/Nematodes to the address.

For the latest on fungicide and bactericide efficacy and timing of tree fruit, nut, strawberry, and vine crops add /files/106962.pdf to the Kearney website address. This can also be found at the UC IPM website at the bottom of the walnut page.

Natural Resources Conservation Services (NRCS) web soil survey- for soil maps for your area of interest, <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>

Weed Research and Information Center- <http://wric.ucdavis.edu/index.htm>

Ground Squirrel management – http://ucanr.org/sites/Ground_Squirrel_BMP/