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ORCHARD FACTS

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Sacramento Valley Walnut Newsletter

This is the first issue of a new walnut newsletter which is written and compiled by UC Sacramento Valley Walnut Farm Advisors. It will be published periodically with the goal of providing timely information to area walnut growers.

New Walnut Rootstocks and Pest Interactions

Janine Hasey[1], Gale McGranahan[2], Michael McKenry[3], Greg Browne[4], Dan Kluepfel[4]

The standard walnut rootstocks are seedling Paradox and seedling black. Where tree death from walnut blackline disease is a concern, seedling English have been used. Paradox, which is a hybrid seedling between a black walnut species (usually northern California black) and English walnut, has been the rootstock of choice because of its vigor and greater tolerance of wet soil conditions. However, seedling Paradox is highly susceptible to crown gall infection caused by *Agrobacterium tumefaciens*.

To determine the diversity between different sources of Paradox, UC and the California walnut nursery industry initiated a Paradox Diversity Study in 1996. Seedlings were planted in long-term field trials and evaluated for vigor, resistance to nematodes, crown gall, and *Phytophthora.* Superior individuals were selected, micropropagated (cloned) and retested. From those studies, two clonal Paradox rootstocks, 'VX211' and 'RX1' were released in 2007 and will be available in 2008. The first Paradox clone to be micropropagated was 'Vlach' which came from a vigorous Paradox tree in Stanislaus County. 'Vlach' has been available since 1999 and was also tested in these studies.

Clonal Paradox rootstocks provide options in selecting a rootstock to manage problems or issues in a particular orchard. Although experiments are ongoing and data is tentative, the table below is a guide for selecting the most appropriate clonal Paradox rootstock for each situation.

Responses to Selected Nematode and Disease Pathogens by Clonal Paradox Walnut Rootstocks Available Based on UC and USDA-ARS Screening Tests to Date [1]

Category	'Vlach'	'VX211'	'RX1'
Inherent Rootstock Vigor	Vigorous[2]	Highly vigorous	Moderately vigorous
Phytophthora citricola	**LR**	**MR**	**MR**
P. cinnamomi	**LR**	**LR**	**MR**
Agrobacterium tumefaciens **(gall occurrence/development)**	**MR**	**LR**	**LR**
	LR = low resistance	**MR** = moderate resistance	
Root Knot Nematode	**S-?**	**S-ST**	
Root Lesion Nematode (*Pratylenchus vulnus*)	**HS-IT**	**HS-ST**	
	Nematode's ability to reproduce	**HS** = highly susceptible **S** = susceptible	
	Tree response to nematode	**ST** = some tree tolerance to nematode presence **IT** = tree intolerance to nematode presence	

[1]Data is tentative and trials are ongoing

[2] 'Vlach' ranked first in trunk circumference in 2006 in Paradox Diversity Study (PDS) across four sites and ranked 4th in production in 2007 in the San Joaquin County PDS trial.

In addition to clonal Paradox, own-rooted English walnut trees (English variety on its own roots with no graft union) have been available since 1999 and usually planted where walnut blackline is a severe problem. Own-rooted English trees have replaced seedling English in the nursery trade. Based on a statewide survey of grower orchards and experimental plots conducted in 2006-07, own-rooted English walnut trees averaged less than 1 percent crown gall infection compared to seedling Paradox with 21 percent crown gall. Own-rooted English walnut trees should only be considered for deep, well-drained loamy soils with no lesion nematodes.

For more information on walnuts in the nursery trade, how they are propagated and understanding the terminology, a handout is available at your local UC Cooperative Extension office or on the web at http://cesutter.ucdavis.edu or http://fruitsandnuts.ucdavis.edu . A list of nurseries licensed to sell clonal Paradox is also listed at http://cesutter.ucdavis.edu.

[1]UC Farm Advisor Sutter/Yuba Counties, [2] Pomologist, UC Davis, [3] UC Extension Nematologist, Kearney Ag Center, [4] USDA-ARS Plant Pathologists, UC Davis, respectively

Walnut Blight Control

Richard Buchner[1], Jim Adaskaveg[2] and Steve Lindow[3]

Depending upon weather conditions, pathogen population size and walnut variety, walnut blight caused by the bacterium *Xanthomonas campestris* can cause significant crop loss. During the 2007 season in Tehama County, untreated trees under simulated plus natural rainfall had 32% blighted walnuts in the mid-canopy and almost 70% damage on walnuts reachable from the ground.

Research funded by the California Walnut Board has resulted in a good understanding of the disease and how to protect walnuts from infection. Walnut blight bacteria over-winter on dormant buds primarily under the outer bud scales or cataphylls. Bud population evaluations have shown that the inner buds where the immature walnut flowers are located are relatively free of bacteria. When buds break in the spring, cataphylls open and young shoots extend past them. During favorable weather conditions, blight bacteria are splashed onto and can infect any green tissue. Early infections usually occur at the flower end of developing walnuts. Once inside the walnut, bacteria grow toward the center of the nut, destroying the developing kernel resulting in nut abortion. So-called "end blight" occurs early in the season compared to later infections that are randomly distributed over the hull and are referred to as "side blight." Side blight may or may not result in kernel damage depending upon when infection occurs. Successful blight control relies upon decreasing bacterial populations and preventing new infections.

We have tested almost all of the available spray materials and mix combinations and found that copper mixed with Manex is currently the most effective spray choice. Tests have repeatedly shown that any good-quality copper product mixed at the label rate with Manex will provide good protection. Pest Control Advisors (PCAs) can help select which copper product to use. The section 18 registration for Manex has been approved for the 2008 season for listed counties and a PCA recommendation is required for Manex use. We continue to seek full registration of Manex and other ethylene bis-dithiocarbamates (EBDCs) such as Manzate for the coming seasons. Additionally, we are evaluating new bacteriacides that could potentially be used in future rotation programs with copper/EBDC bactericides to avoid the over-use of any one single material.

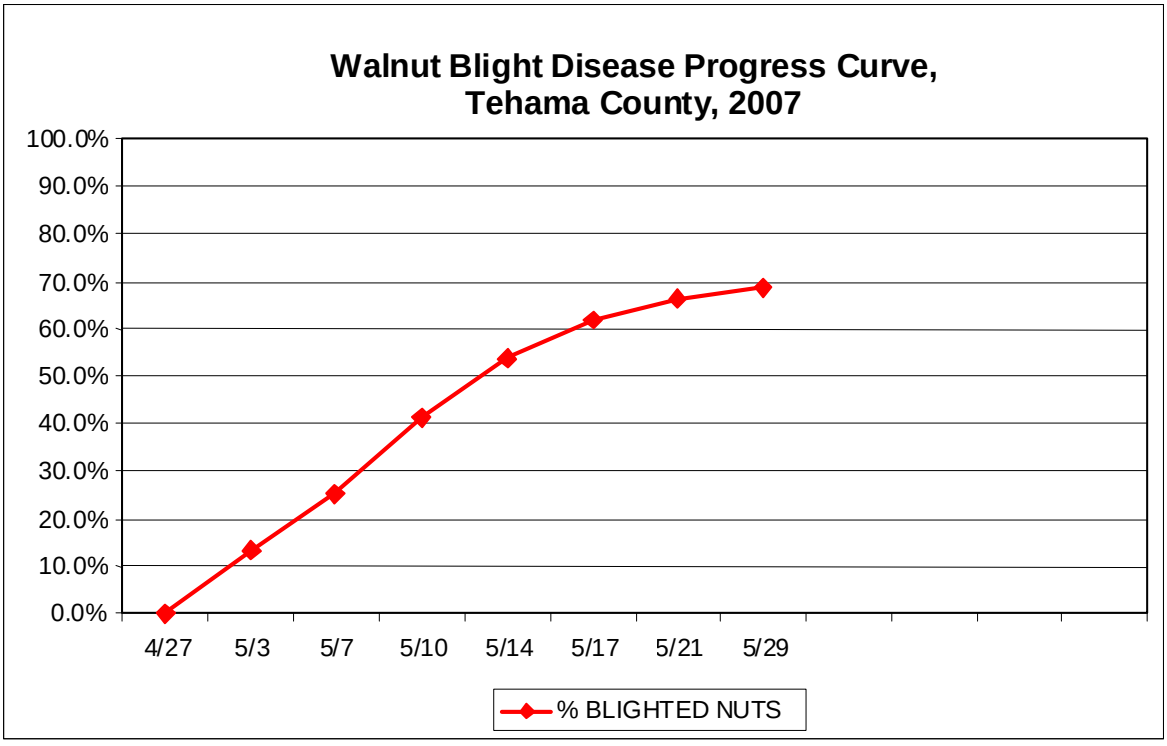
Once the material and rate have been selected, spray timing and coverage are the remaining two elements in a successful walnut blight control program. Timing the first spray when 40% of the buds are at the "prayer" stage has the greatest effect on reducing bacteria populations and protecting walnuts. A good-quality adjuvant will wet cataphylls and encourage the copper/Manex mix to penetrate between bud scales and kill over-wintering bacteria. Following the first application, decisions are made based upon weather conditions and damage history. Warm, wet (rainfall or leaf wetness from dew) weather favors disease epidemics and severe damage compared to relatively low infection risk if weather is dry. Under severe walnut blight pressure, a second application 7-10 days following the first spray will protect any remaining shoots that have emerged following the first application. Additional spray applications are based upon the weather and the risk of infection. Risk increases with warm wet weather. A disease prediction model, XanthoCast, developed by Jim Adaskaveg at UC Riverside is available in some areas. XanthoCast can be found at http://irrigate.net/index.php?action=xanthocast. If XanthoCast is not an option, watch weather forecasts and treat before rainfall. Blight treatments work by protecting walnuts from infection and will not control the disease if applied after infection has already occurred.

Copper/Manex treatments result in a protective barrier on the tissue surface. If coverage is poor or bacteria are exposed to a sub-lethal dose, sprays will not work well. In addition, spray failures increase the risk of developing copper/Manex resistant bacteria.

[1]Farm Advisor, Tehama County, [2]Plant Pathology Professor, UC Riverside, [3]Plant Pathology Professor, UC Berkeley

Additional walnut blight information is available at http://walnut.research.ucdavis.edu
Examples of walnut shoots at or close to prayer stage.

Blight incidence (percent infected walnuts) over time on untreated Chandler walnuts in Tehama County under environmental conditions with natural and simulated rainfall. Disease symptoms first occurred after April 27 and increase until May 21. The graph represents a disease progress curve over the spring season and demonstrates the disease potential under very favorable conditions for walnut blight.



Spring Fertilization for Walnuts

Carolyn DeBuse, UC Farm Advisor, Solano/Yolo Counties

Many factors affect tree growth and productivity. One of the more important factors is tree nutrient status determined by nutrients stored in tree tissue or available in the soil. A good spring fertilization program promotes healthy vigorous trees and a good cropping. The two most important spring nutrients are the macronutrient nitrogen (N) and the micronutrient zinc (Zn). With the rising cost of fertilizer, determining a nitrogen budget for your orchard and the correct timing of application may save you money while benefiting your orchard and yield.

Nitrogen

- Symptoms of deficiency- Nitrogen deficiency symptoms are rarely seen because growers apply large amounts of nitrogen annually. Symptoms include pale leaves, nonvigorous shoot growth, and early fall leaf yellowing and drop.

- Sources of nitrogen- The most common source of nitrogen are the synthetic fertilizers; urea (45%), urea-ammonium nitrate (32%N), ammonium nitrate (34% N), ammonium sulfate (21%N), calcium-ammonium nitrate (17%N), and calcium nitrate (15%N). Organic sources might include manures, cover crops and/or organic fertilizers. Nitrogen can be found in forms other than the applied sources and these sources should be considered when budgeting N application.

    - The first is the amount N stored in the tree itself. Tree nitrogen is estimated by taking leaf samples in July using analysis by an analytical lab. Leaf values below 2.3% are considered deficient requiring additional N. Leaf values above 3.0 % suggest additional N will give little tree growth improvement.

    - Secondly, irrigation water can contain a significant amount of N. One ppm nitrate from a water analysis equals 2.72 lbs. of N per acre-foot of water.

    - Thirdly, organic matter in the form of manures, compost, and animal meals will add N within the year applied and in future years at a slower release rate. First year N release estimates range from 10-65% depending on the type of organic matter used. If the organic matter is applied annually over many years then you can estimate that the full N content of the material is released yearly. Cover crops add nitrogen however the amount of N released is dependent on the biomass and the final N content of the cover crop. Leguminous cover crops that are incorporated into the soil have a 20% higher N recovery than if mowed.

- Nitrogen efficiency and losses- Not all of the applied nitrogen ends up in the orchard. Nitrogen fertilizers, organic and synthetic, are vulnerable to leaching, volatilization, and denitrification. Losses vary with the type of fertilizer, method of irrigation, and soil type. The highest recovery is in clay loam soil applied by fertigation through microsprinklers or drip. The lowest recovery occurs in sandy loam soil with broadcast application, no incorporation and flood irrigation.

- Budgeting - The best way to nitrogen budget is to follow the guidelines in the publication "*Guide to Efficient Nitrogen Fertilizer Use in Walnut Orchards*", by K. Anderson, J. Grant, S. Weinbaum, and S. Pettygrove (ANR #21623). Their budgeting methods take in to account the amount of N found in irrigation water, organic sources, and cover crops. Estimated available N together with N removed by the crop is used to calculate orchard nitrogen needs.

- Timing- Springtime is when N is taken up quickly and used readily as new growth occurs. Applying half to two-thirds of the annual N right before or during the first flush of growth is recommended. The remaining N should be applied by the end of August. Nitrogen applied in autumn and winter is discouraged because trees are not able to uptake nitrogen efficiently and most of the N is lost to leaching. The most efficient way to apply N is in small amounts throughout the growing season. Fertigation is a very efficient technique to accomplish that goal. This practice has been shown to be very beneficial to the health of the tree with reduced N losses.

Zinc

- Symptoms of deficiency- Zinc deficiency, depending upon severity, can delay spring bud growth and result in small discolored terminal leaves with intervenal chlorosis (little leaf). Mild deficiencies may not show leaf damage but may affect the size and quality of the nuts. Severe deficiencies can cause terminal dieback and limb death.

- Sources of zinc- Many zinc formulations are available for foliar application. Studies have shown that the two formulations most readily absorbed and used by the tree are zinc sulfate ($ZnSO_4$ 36%Zn) and organic chelated zinc (Zn-EDTA 15% Zn).

- Timing- The best timing is spring applications. The zinc should be applied just as the young shoots and leaves are turning from pink tinged to full green. At this time, the ability to absorb Zn is highest and the leaf has the maximum surface area available before it begins to harden and change to the mature leaf.

- Recommendations- Foliar applications of $ZnSO_4$, 36 % Zn, at 1-2 lbs. per 100 gallons of water buffered to a pH of 5.0, or zinc chelate (Zn- EDTA) at 2 pounds per 100 gallons of water with an addition of a surfactant have corrected zinc deficiencies.

- Severe deficiencies- If zinc deficiency is severe, a soil application of $ZnSO_4$ either by trenching or soil injection should be considered. Another option is to broadcast Zn chelate before an irrigation.

Annual nitrogen replacement and zinc fertilization, where deficiencies occur, should be an annual spring fertilization program to keep walnuts healthy and profitable. Check out the web site at UC Davis for additional information http://fruitsandnuts.ucdavis.edu/ .

Managing Pistillate Flower Abortion (PFA) in Walnut with the Use of ReTain®

Robert H. Beede[1], Joe Grant[2], Kathy Kelley Anderson[3], Janine Hasey[4]

What can we now tell growers about the use of ReTain® to manage pistillate flower abortion (PFA)? First, we know that PFA is the result of too much pollen landing on the pistillate, or female, walnut flowers. We also know that excess pollen triggers ethylene production, which causes flower abortion or PFA. ReTain® is a plant growth regulator that blocks ethylene production, thus preventing the occurrence of PFA **on flowers treated before they are exposed to excessive pollen.** Statewide research by farm advisors shows that **the economic value of ReTain® application is entirely dependent upon the level of PFA within the orchard and the number of flowers protected from PFA.** Receiving benefit from ReTain® is purely a numbers game! Every researcher having studied walnut pollination and PFA will tell you that it varies within the orchard and among years. They will also tell you that PFA is highly dependent upon the overlap of pollen shedding on the pistillate bloom. Pollen sources include Serr, pollinizers in the orchard and from adjacent orchards. An excellent example is 2007, in which the Serr catkins emerged well ahead of the female peak bloom, thus reducing the amount of pollen and making last year low in PFA and generally high in Serr yield regardless of whether you used ReTain® or not.

Previous research by Dr. Polito, Plant Sciences Department, UC Davis, and UC farm advisors demonstrated the significant yield benefits of reducing pollen within Serr orchards by removing pollenizers and/or shaking catkins when they begin to elongate. However, the limitations of this approach include tree removal, which may not be fully compensated for by expansion of the remaining trees, access to a shaker at the proper time, the possibility of needing multiple shakes to adequately reduce the pollen density, the inability to access wet orchard floors, and the inability to reduce pollen from adjacent orchards. In 2007, a test was performed in Kings County to compare catkin removal against ReTain® application. The results suggest that ReTain® improves yield as well as catkin shaking four times, which virtually eliminated all but a few catkins per tree. Combining catkin shaking with ReTain® treatment did not provide any greater yield improvement. A ReTain® application alone provided a 20 pound per tree or 1000 lb/ac increase in dry yield over the untreated and unshaken controls.

Tests were also conducted in Kings County to determine the effect on efficacy of adding copper to ReTain®. Combining copper and ReTain® reduced fruit set by 20% compared to ReTain® alone. If copper is applied prior to a ReTain® treatment, one should wait at least two and preferably three days before applying ReTain®. Copper appeared to have no affect on ReTain® performance when ReTain® was applied one or three days **before** the copper treatment.

The use of ReTain® or any other method to reduce the effects of excessive pollen is not a cure-all for poor orchard performance caused by poor water management, pest problems, low fertility, or shaded canopies. These factors all reduce flower number, which is the critical component for high yields.

Do we now know everything about ReTain® and reducing PFA? By no means! Several walnut growers report little benefit from ReTain® use. Additional research work is needed to understand the various factors affecting product performance and to further refine application guidelines. In the meantime, ReTain® seems to have rejuvenated the Serr variety in the southern walnut districts to the point that growers are talking about planting new orchards, especially when the grades sheets show up to 59% edible yield!

UC Guidelines For ReTain Application

1) ReTain® prevents walnut flowers from falling off due to excessive pollen. It is NOT a general enhancer of fruit set. It may not work in some orchards in some years.

2) For maximum effect, apply 50 grams active ingredient per acre (one bag of product) in 100 gallons of spray solution.

3) Application should be timed at an estimated 30% bloom, or when the maximum number of flowers are present in the early stage of receptivity.

4) Coverage is critical! ReTain® does NOT translocate. It must contact the flower to be effective.

5) Ground applications should be made with speed sprayers calibrated having 66% of the spray volume in the upper half of the manifold. Travel no faster than 2 mph! Research shows 100 gallons of spray solution per acre is sufficient to provide good coverage, providing the proper application speed is observed.

6) Spray concentrations less than 66 ppm (one-half bag in 100 gallons of water) have been shown less effective, especially under high PFA conditions.

7) Aerial application should only be used when ground treatment is not possible. For optimal coverage, apply one-half bag of ReTain® in 20 gal/ac, and fly in the direction of the tree rows. Then repeat the same application rate, but fly perpendicular to the tree rows to minimize the shadow effect.

8) Applications made under conditions of higher humidity, such as prior to dawn, may enhance product performance due to extended absorption time.

9) Do not combine ReTain® with copper-based fungicides, due to their adverse effect on ReTain® performance. If possible, apply ReTain® at least one day **prior** to copper treatment. Delay ReTain® treatments for three days **following** copper application.

10) Read and follow label instructions.

UC Farm Advisors [1] Kings/Tulare Counties, [2] San Joaquin County, [3] Stanislaus County, [4] Sutter/Yuba Counties, respectively

Guidelines for Care of Young Walnuts From Planting Through the First Season

Bill Krueger, UCCE Glenn County

1) Make the planting hole just deep and big enough to accommodate the root system using an auger or shovel and plant the tree no deeper than it was in the nursery. Trees can be planted on a mound or a berm to insure good water drainage away from the crown. This can be particularly useful on heavier and poorly drained soils.
2) Do not allow the trees to dry out while they are waiting to be planted. Store them in the shade and cover with a moist blanket.
3) Prune broken roots or roots that won't fit in the hole without bending
4) If a crown gall preventative spray is used with K-84 bacteria, it's success will depend on the resistance or susceptibility of the strains of crown gall bacteria present in the orchard.
5) Spread roots and work soil around roots, orient strongest roots in the prevailing wind direction and, to the extent possible, avoid leaving the bud crook (the flat side opposite where the scion bud emerged) with a southwest exposure.
6) Do not put fertilizer or organic material into the hole.
7) If the soil is moist and friable it should not be necessary to water the trees at planting time. Work the soil around the roots to insure good soil to root contact. If the soil is dry, water with one ato two gallons to establish good root to soil contact and eliminate air pockets.
8) Head the tree back to 3 to 5 buds above the graft union (usually 15 to 24 inches above the ground) to insure vigorous growth.
9) Paint trees with a 1:1 mixture of interior white latex paint or similar tree whitener that will not peel or crumble to prevent sunburn. Avoid paints which contain mineral oil or refined petroleum which may injure the tree. Make sure that the base of the trunk at the soil level is protected.
10) Check trees after settling and pull up if necessary to make sure that they are not too deep.
11) Stake trees with a stake that is 8 ft out of the ground for conventional plantings and 8-10 inches away from the tree on the prevailing wind side so that the wind blows the tree away from the stake.
12) Delay irrigation until the onset of rapid shoot growth. Monitor soil moisture in the root zone with a soil tube, auger or shovel and irrigate to the depth of rooting when the soil begins to dry. Young walnuts do best with light frequent irrigations. Intervals will vary depending on environmental conditions, soil type, and irrigation system. Young walnut trees stressed for water stop growing and will take several weeks to resume growth once water is reapplied.
13) Nitrogen is usually the only nutrient that may be required the first year. Apply sparingly from late spring to mid summer once there is sufficient growth. Avoid applying near the trunk. Discontinue applications by end of August to reduce late season vigorous growth which could be susceptible to freeze injury.
14) The objective of the first year is to grow one strong shoot to serve as the trunk. After 10 to 12 inches

of growth, choose one shoot to be the trunk and start tying it loosely up the stake. Keep the side shoots pinched back to encourage growth of the main shoot and remove suckers. Do this frequently throughout the summer. After the shoot reaches a height of 9 feet or more, if necessary, the shoot can be pinched back, removing only the growing point, to prevent it from bending or breaking.

15) Slow growth of vigorous trees to reduce the risk of freeze injury by reducing watering in September until the terminal bud sets on the main shoot. Then, normal watering can usually be resumed without stimulating new growth.

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