University of California
Agriculture and Natural Resources

Vine Lines

San Joaquin Valley Viticulture Issues

February 2013

Stephen J. Vasquez, Viticulture Farm Advisor

"Least Toxic Pesticides" Applied as a "Last Resort"

Recommendations and decisions to use "least toxic pesticides" and "pesticides as a last resort" have flourished in the last decade, but according to three scientific organizations – the Weed Science Society of America (WSSA), the American Phytopathological Society (APS) and the Plant-Insect Ecosystems Section of the Entomological Society of America (P-IE ESA) – these are not the correct approaches to the pesticide component of an Integrated Pest Management (IPM) program.

The three organizations have joined to take an objective look at the problems associated with "least toxic pesticides" applied as a "last resort" and today issued the following statement:

IPM is fundamental wherever pests must be controlled

It is essential to practice IPM, whether managing weeds, insect pests or plant diseases, in the vineyard, on commercial sites, on public lands, or in or around the home. Key components of IPM include making the habitat unfavorable for pests, excluding pests where feasible, using proper sanitation practices, monitoring the infestation level, knowing the pest tolerance level for the specific situation and implementing the necessary management practices.

Judicious use of pesticides is a critical component of many IPM programs. Judicious (careful) use refers to various practices – following all label directions and making all appropriate stewardship decisions required in the particular situation. This includes applying a product registered for the target pest(s) after accurate pest identification, and consideration of the level of infestation and the potential for economic, health or other negative pest impacts. Careful use extends beyond pesticides to household chemicals, automobiles, medicines, alcoholic beverages, and countless other products that are part of our daily lives.

The problem with selecting only "least toxic pesticides"

• "Least toxic" implies there are pesticides available for every pest spectrum that are least toxic to everything else. This is not true. The toxicity of a pesticide depends on what

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In this Issue:

Breeding Salt Tolerant Rootstocks

Kevin Fort and Andy Walker, Department of Viticulture and Enology, UC Davis

Salinization of soil via the slow accumulation of salts from irrigation water continues at a pace that often goes unnoticed. With each successive irrigation, pure water is transpired by crop plants and evaporates from the soil surface, leaving behind a little more salt than was there before. To complicate matters, chloride – one of the most damaging mineral ions for vineyards – moves readily in the soil, and can be leached below the root zone by heavy rainfall or excess irrigation. If a region receives adequate rainfall or has abundant high quality water to leach salts downwards, excessive soil salt may never become a problem.

In the arid or variably arid regions of California, soil salinity is commonly due to the accumulation of salts over time. In addition, California's large population, and political and environmental pressures due to climate change will negatively impact the availability of high quality water to leach salts out of the root zone. Grape growers will need to regularly monitor the salinity of their soil, especially when rainfall is low over multiple years. By the time leaf symptoms are observed, soil salinity is often at serious levels that can negatively impact vine growth and production.

Figure 1. *Vitis vinifera* (raisin, table and wine grapes) are weak excluders of salts and display burned or necrotic leaf blades.

Tolerance of salt by grapevines is largely synonymous with chloride exclusion. In the 1960s, it was determined that some *Vitis* species prevent the uptake of chloride better than others. For unknown reasons, *Vitis vinifera* table, raisin and wine grapes are very "weak" chloride excluders, meaning that they readily accumulate soil salt in their leaves and fruit (Fig. 1). Researchers found that some grapevine rootstocks being used for phylloxera and nematode resistance had the unexpected and beneficial side effect of being "strong" chloride excluders. Short- and long-term screening of rootstocks has shown consistent strong chloride exclusion by genotypes such as 140Ru, St. George and Schwarzmann.

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Rootstocks *(Continued from page 2)*

The rootstock Ramsey, also referred to as Salt Creek, has in previous decades maintained a reputation as a strong chloride excluder. This may be a result of its synonym, which conjures the image of a vine growing in the wild along a salt-encrusted riverbank. In reality, our greenhouse screens and published long-term field trials indicate that while Ramsey does exclude salt better than *V. vinifera*, it does so less effectively than the other rootstocks listed above. Ramsey's true value is in its ability to resist drought in concert with its moderately strong salt exclusion— two soil conditions that often occur together. Most other commercial rootstocks appear to have an intermediate capacity for salt exclusion, though some are clearly weak chloride excluders, no better than *V. vinifera*. Rootstocks with good chloride excluding ability can have a significant positive impact on yields in moderately stressful years and can keep severe damage from occurring in extremely stressful arid years.

Figure 2. *Vitis* species collected from around the nation are evaluated to determine their ability to exclude salts.

In order to develop better salt tolerant rootstocks, grape breeders need germplasm with strong chloride exclusion capability and rapid, inexpensive ways to screen and identify optimal individuals for breeding. The UC Davis and USDA grape collections have a broad range of diverse *Vitis* species, including many new wild grapevines that we have collected from arid and saline areas of the southwest U.S. (Fig. 2). However, until recently none of this material had been tested for its ability to exclude chloride. Researchers working on salt tolerance in many crops have noted that improvement for this trait is difficult, presumably because salt tolerance is genetically complex and/or easily affected by the environmental variability. Some of the previous studies of salt tolerance of grapevine found that greenhouse results did not match field results.

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Grape Breeder, David Ramming Retires

After 38 years, David Ramming has retired from the USDA Agricultural Research Service (ARS)-Parlier, California, where he bred grapes for California's raisin and fresh market industries. Starting in 1975, he replaced John Weinberger who had just released 'Fiesta', the first grape developed to replace 'Thompson Seedless'; the primary raisin grape for 100+ years. Since 1995, David has introduced four raisin grapes that helped make mechanized harvest a reality. 'DOVine', which ripens 2-3 weeks earlier than 'Thompson Seedless' was the first to be grown by San Joaquin Valley growers. Trained using quad cordons, it is a vigorous variety that needs a large overhead trellis to grow. His most recent release in 2001, 'Selma Pete', was named after the late L. Peter Christensen, a world renowned UC Cooperative Extension Specialist who worked closely with David in developing cultural practices for new varieties. 'Selma Pete' has become the most widely planted raisin grape to date from David's program and is grown on both open gable and overhead trellis systems. Additionally, two Muscat flavored raisin grapes were released prior to 'Selma Pete'.

A technique pioneered by David known as embryo rescue has greatly shortened the breeding timeline for seedless grape advancement. Embryo rescue (see page 11) allows for seedless by seedless crosses by removing the small seeds and placing them on a nutrient-rich media, which allows them to grow into viable plants. All of David's raisin and table grape varieties have been developed using this novel technique, which also has benefited California's private table grape breeding programs.

David's most recent work has focused on incorporating resistance to powdery mildew and Pierce's disease. He has been working with colleagues to determine what North American grapes have resistance and then using them to improve his breeding lines. Using molecular markers to find the progeny that have disease resistance in them, he has shortened the time between screening and availability to growers. Young plants grown in incubators has saved time and money by not having to grow plants to maturity out in the field for evaluations or trials.

In retirement, David plans on spending more time with his family and grandkids.

Rootstocks *(Continued from page 3)*

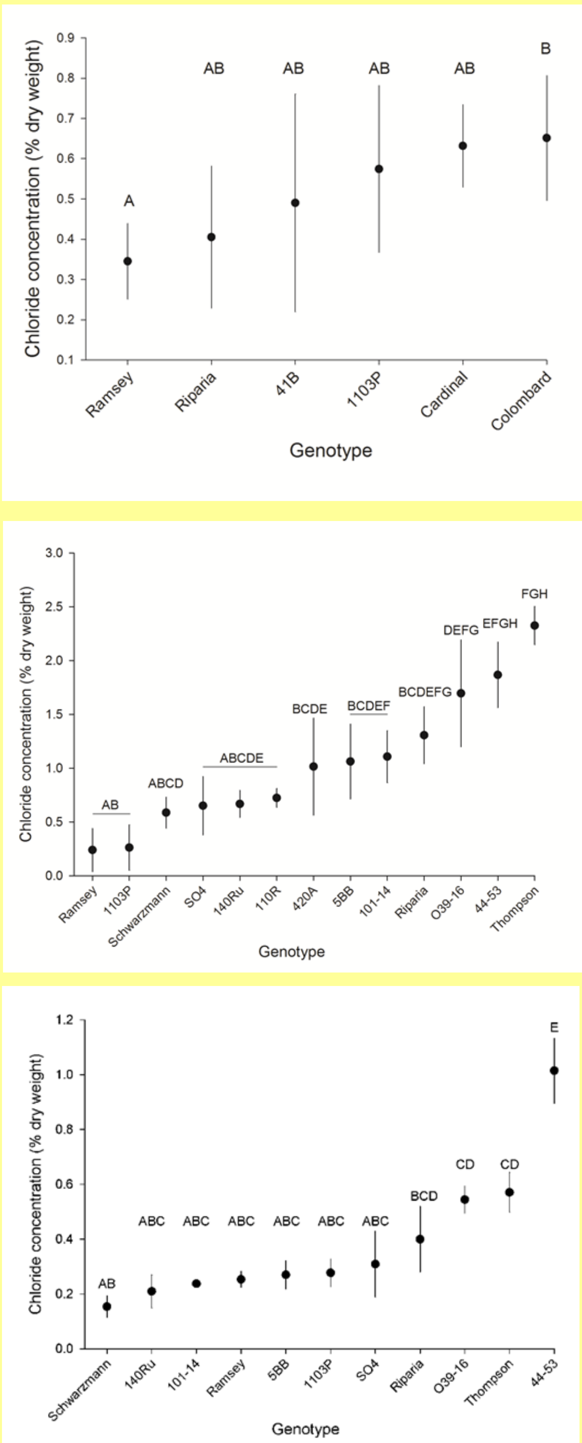

Figure 3. Chloride concentration in leaf tissue from 3 separate salt exclusion assays.

Environmental impacts of the genetic control of salt tolerance

The appearance of all biological organisms is a function of the specific makeup of the DNA carried by the cells of the organism. Although DNA is what distinguishes one species from another, DNA can at times have little or even no effect on measurable differences between two different individuals within the same species. It is currently thought that every trait possessed by an individual organism results from an interaction between its DNA blueprint and the environment in which it lives. Every grower knows this firsthand – an outstanding tomato hybrid is useless if grown in sand with insufficient water, warmth, and fertilization. A fundamental challenge to research biologists is, in the absence of a complete DNA sequence of every organism under study, how to separate what part of an organism's appearance results from its unique DNA and what part results from the influence of the environment.

The capacity to exclude salt in grapevines is a trait that is environmentally moderated, a condition also noted in many other crop plants. As a result, the screening process of breeding grapevine rootstocks for an enhanced capacity to exclude chloride must clearly distinguish between an experimental rootstock that is genetically superior and a rootstock that merely appears to be superior under specific experimental conditions.

This interaction can be illustrated by comparing the chloride-excluding ability of the rootstock 1103P to cultivated *Vitis vinifera*. In the top graph of Figure 3, 1103P propagated from dormant cuttings and grown in a container in a shadehouse was not distinguishable from two different cultivated varieties of *V. vinifera*. This

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Rootstocks *(Continued from page 5)*

is a very different result from what can be expected when any *V. vinifera* is grafted onto 1103P and assayed for chloride uptake in the field. In the middle graph of Figure 3, individuals were propagated from dormant rootings and the results were markedly different. The chloride uptake of 1103P in this second assay was easily distinguished from the *V. vinifera* cultivar Thompson Seedless, and its chloride exclusion far exceeded what is generally observed when tested under field conditions. While strong- and weak-excluding grapevine genotypes will generally accumulate 2- to 5-fold differences in chloride concentration in the leaves, in this assay they differed nearly 10-fold. The impact of the environment on chloride uptake in 1103P demonstrates how malleable the phenotype can be, and underscores the importance of developing an assay that produces data more closely aligned with field results. Fortunately, as seen in the lower graph of Figure 3, results from an assay that used herbaceous rooted cuttings grown in a fritted clay media performed according to expectations, both in the rank ordering of genotypes and in their relative concentrations of chloride in the leaf tissue.

Developing molecular markers for chloride exclusion

Research on chloride exclusion in grapevines began in 1960, and since then most studies have tested relatively small sets of rootstock selections in the greenhouse or field. This work was able to characterize the chloride exclusion capacity of widely available rootstocks. For example, the excellent exclusion capacity of both 140Ru and St. George is now firmly established, although more work needs to be done to characterize all commercially available rootstocks for chloride exclusion. The next step for rootstock improvement is a big one: the characterization of hybrid populations numbering 200-300 genotypes, with each genotype represented in a screen by multiple clonal individuals, so that chloride exclusion can be incorporated with pest resistance in a rootstock breeding program. Accurate screening is also necessary to identify improved chloride exclusion from wild germplasm. There are currently no published studies

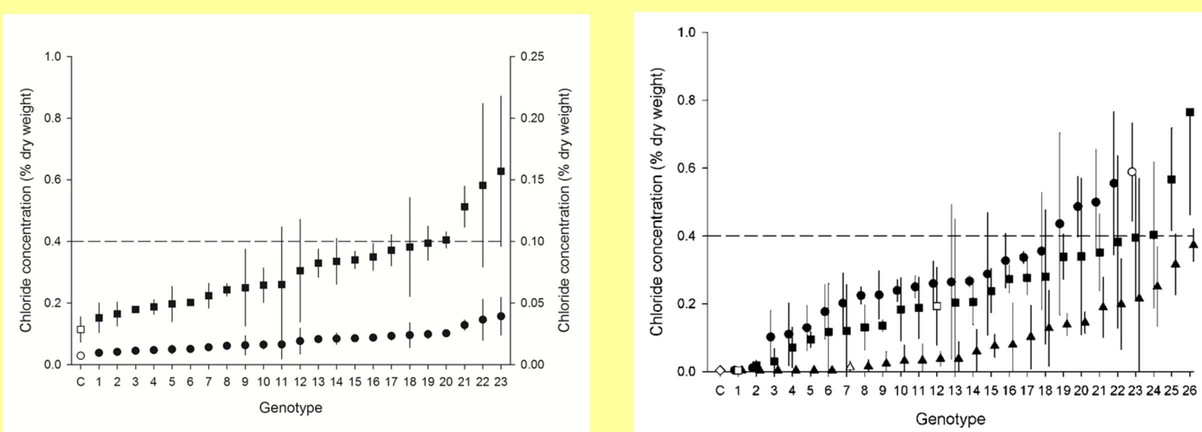

Figure 4. Chloride concentration in leaf tissue from hybrid subpopulations. Square symbols in left graph are the same data as circles, but plotted with the increased resolution of the right-side Y-axis. For comparison, the left Y-axis corresponds to that used in the right graph.

Rootstocks *(Continued from page 6)*

examining the chloride exclusion behavior of a segregating population of hybrids large enough to develop molecular markers. Our years of work in developing a workable screen that could be scaled to large populations was intended to accomplish this goal.

The next step is to identify an appropriate population of plants from which to develop markers. This can be as simple as crossing the most divergent parents for the trait of interest and phenotyping the resulting progeny. However, because some traits are dominant, all of the resulting hybrids may exhibit a single form of the trait – meaning that all of the hybrids possess either strong or weak chloride exclusion, rather than the mix of phenotypes needed for molecular marker development. We therefore tested subpopulations of six different populations to first characterize the population-level behavior of each. We found a diverse response to high chloride in several of these populations (see the right graph of Figure 4), and very strong chloride exclusion in a hybrid population bred from *V. berlandieri* (left graph of Figure 4). This indicated two things. First, the *V. berlandieri* trait appeared to be dominant. Thus, developing molecular markers from this source would require an additional cross to create a second set of hybrids that segregate for chloride exclusion; a task that was completed in the Spring of 2012. Second, this behavior may mimic that observed in an Australian study (Newman and Antcliff 1984), which claimed that resistance in another selection of *V. berlandieri* was due to a single gene. This source was unfortunately never pursued for marker development. If we find a similar behavior in our *V. berlandieri* source in 2013, this would greatly simplify and speed the development of a molecular marker that could quickly be employed in our breeding program.

Breeding rootstocks that exclude chloride

Once markers are obtained, incorporating superior resistance to chloride accumulation into rootstocks already bred for pest and disease resistance will be greatly accelerated. However, multiple resistance sources may be needed. The already mentioned *V. berlandieri*-derived population is currently being pursued, and we are simultaneously developed other promising populations. Several screens have also been performed on wild grapevine germplasm, and potential sources of superior exclusion have been identified, at levels above that seen in 140Ru and St. George. Because salt tolerance is considered a complex trait (Flowers and Flowers 2005), it is possible that genes will be identified that control different physiological attributes contributing to exclusion. Optimal forms of each gene could then be combined to produce a level of exclusion superior to that which occurs when these genes are present individually.

Least Toxic Pesticides *(Continued from page 1)*

is being evaluated – short-term or long-term toxicity – and who or what may be affected (e.g. applicators, farmworkers, livestock, wildlife, pets, birds, fish, beneficial insects, earthworms, sediment-dwelling organisms, crops). It is also important to remember that toxicity is not the same as risk, which is dependent on both toxicity and exposure.

• The risk associated with the use of pesticides and other chemicals is managed by establishing safe exposure levels based on the toxicity specific to each product. Assigning a “most” or “least” toxic rating does not equate to actual risk when the product is properly applied. For example, the label of a pesticide product that may cause skin irritation will also contain requirements for personal protective equipment that safeguards the skin, while a product that may affect fish will contain use directions, precautions and possibly even restrictions intended to protect fish. This is why the EPA-approved label instructions must be followed.

• All pesticides – including those referred to as “least toxic,” “organic” and “natural” – are toxic to one or more pests and possibly humans and other organisms as well. Use of these terms can lead to false security regarding the need for careful handling of pesticides and proper environmental stewardship.

• Over-reliance on a “least toxic” pesticide can cause new problems. For example, glyphosate is considered a “least toxic” herbicide choice, but overreliance on it has led to significant weed resistance problems. Over-use or misuse of any pest management tactic can cause problems – for example, cultivation to control weeds on hilly land can cause soil erosion, and excessive hand-hoeing can cause back injuries and increase the risk of skin cancer.

• Often, “least toxic” products do not work as well on the pest(s), leading to the need for retreatment with another pesticide on larger and/or harder-to-control pest infestations. This can result in higher costs, reduced control and undesirable environmental effects attributable to the pest. The problem with using pesticides only “as a last resort.”

The Problem with Using Pesticides Only “As a Last Resort”

• “Last resort” implies that pesticides will work as well when every non-chemical control technique is attempted first. However, delaying application of a pesticide can cause buildup of the pest(s) in crops, gardens, buildings and other sites, with negative impacts on yield, quality and/or health. In fact, delaying treatment can significantly increase the ecological and economic damage to crop and non-crop areas.

• Using pesticides as the last line of defense can result in a more limited choice of pesticides, as well as reduced crop tolerance, the need for higher rates, and less effective control because of higher infestation levels and/or more tolerant pest stages. For example, seedling weeds and

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Least Toxic Pesticides *(Continued from page 8)*

early-stage insect larvae and diseases are usually more easily controlled than later pest stages.
• Effective pesticide choices, when they are applied as a "last resort," means fewer options to rotate pesticides, which is a critical step in preventing a pest from becoming resistant to a pesticide. "Last resort" pesticide strategies may also increase the need for multiple products and higher application rates to control the pest effectively.

• "Last resort" suggests pesticides are always the worst choice, which is not true. First using non-chemical techniques that are ineffective or inefficient has the potential to add to the cost of pest management, intensify the pest problem or create new problems.

• Branding pesticides as the "last resort" choice certainly does not stimulate a strong public interest in funding education on their proper use. Pesticides are widely used, but discretionary federal funding of the U.S. Pesticide Safety Education Program has been eliminated in 2011 and 2012. This program is vital to educate pesticide users and dealers who must be certified to apply or sell pesticides, and to teach the public how to use pesticides safely.

There is no benefit or scientific basis to simplistic messages like "use least toxic pesticides as a last resort" for the large number of pesticide users who apply pesticides according to the label and practice good stewardship. Nor are these messages beneficial for those who neither seek training nor adequately read the label believing instead that it is safe, practical, and effective to simply choose a product considered a "least toxic pesticide" and apply it only as a "last resort."

These messages hinder pesticide safety and stewardship education and practices that are in the best interest of the pesticide user, our food supply, public health and ecosystem preservation.

The WSSA, APS and P-IE ESA do not promote the use of pesticides above other pest management techniques. Pesticides should ONLY be used when needed, when risks to non-target organisms and habitats have been carefully considered, and when diligent attention will be given to following all label directions and other applicable laws. In addition, general and product-specific stewardship must always be practiced to prevent undesired effects under the particular application conditions.

Pesticides are an important component of many IPM programs for a variety of reasons. A fungicide, for example, may prevent disease, have curative effects, induce plant resistance to disease or promote plant health and yield. The most important message is to follow the label – the entire label, including all safety and other precautions – and practice good stewardship. Suggesting that only "least toxic pesticides" be used, as a "last resort," ignores the extensive

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Least Toxic Pesticides (*Continued from page 9*)

research, regulatory, educational and stewardship efforts that make important pesticide tools available and define their proper and safe use in Integrated Pest Management programs.

Professional Societies renew their endorsement of IPM

No pest management-related term has been defined in so many different ways as "Integrated Pest Management." WSSA, APS and P-IE ESA strongly oppose a non-scientific approach to IPM and re-endorse the USDA National Road Map definition:

"Integrated Pest Management, or IPM, is a long-standing, science-based, decision-making process that identifies and reduces risks from pests and pest management related strategies. It coordinates the use of pest biology, environmental information and available technology to prevent unacceptable levels of pest damage by the most economical means, while posing the least possible risk to people, property, resources and the environment. IPM provides an effective strategy for managing pests in all arenas, from developed agricultural, residential, and public areas to wild lands. IPM serves as an umbrella to provide an effective, all encompassing, low-risk approach to protect resources and people from pests." (USDA National Road Map for Integrated Pest Management).

Real examples of the risks when pesticides are used only as a "last resort" and the benefits of using appropriately timed pesticides as part of an integrated pest management program, as well as common questions and answers, are available online.

UC IPM Year-round Programs for Grapes

Year-round IPM programs have been developed for raisin, table and wine grape production by University of California researchers. These practices are recommended for a monitoring-based IPM program that reduces environmental quality problems related to pesticide use. Information, including forms and photos, on how to monitor, document and manage pests is outlined for each year-round IPM program. You can track your progress through the year with the annual checklist form. Specific information on vineyard pests can be found in the UC IPM Guidelines. The UC IPM Guidelines represent the best information currently available to growers and are intended to help make the best choices for an IPM program. Not all registered materials are mentioned. Always check the label and with your local Agricultural Commissioner for the most up-to-date information regarding registration and restrictions on pesticide use.

Embryo Rescue: Making the Impossible Happen

Grapes like DOVine, Selma Pete, Sweet Scarlet and Scarlet Royal likely would not exist were it not for ARS scientists' expertise with a laboratory technique known as "embryo rescue." The technology "allows us to use two seedless grape plants as parents for new, seedless offspring," says grape breeder David W. Ramming with USDA Agricultural Research Service (ARS) at Parlier, California.

Figure 1. Small seeds being excised are placed on a growth medium to start new plants.

"Seedless" grapes actually have a small seed inside, "but it's so small that your tongue can't detect it," says Ramming. What's the point of embryo rescue? To literally rescue the embryo within the minuscule seed so that it can be grown into an experimental vine for testing in the research vineyard.

DOVine, developed by the USDA ARS in 1995, as an early ripening raisin was the first variety released from the hybridization of two seedless grapes using embryo rescue techniques. DOVine resulted from a cross of 79-101 x Fresno Seedless made in 1983. 79-101 is a blue seedless grape of unknown parentage, probably bred by Elmer Snyder of USDA; Fresno Seedless is a sibling of Flame Seedless and resulted from the cross of (Cardinal x Thompson Seedless) x [(Red Malaga x Tifafihi Ahmer) x (Muscat of Alexandria x Thompson Seedless)].

As might be expected, when two seedless grapes are chosen as parents, the seeds inside the grapes of their offspring are also extremely small. Says Ramming, "In nature, those seeds would abort" instead of developing into hard little spheres, each with a healthy embryo inside.

To save otherwise-doomed embryos, Ramming and colleagues excise them with surgical precision from the developing berry (Fig.1). Then, the researchers nurture the embryos on a gel-like bed of nutrients until they form seedlings hardy enough to transplant.

Ramming pioneered the use of embryo rescue several decades ago to breed superb seedless grapes. Today, it still remains the survival secret of many of the team's most innovative grapes and used by private breeding programs.

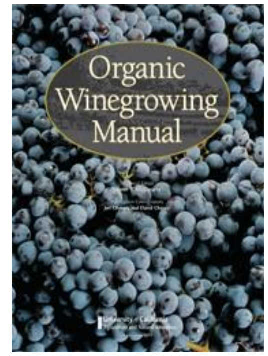
Publications from the University of California

VINEYARD PEST IDENTIFICATION CARDS

Keep your vineyard healthy by staying on top of pest activity with this pack of 50 sturdy, pocket-size laminated cards. This is the perfect quick reference to identifying and monitoring vineyard diseases and pests. Twenty-seven common insects and mites, 8 diseases, 6 beneficial insects, and a variety of other disorders, weeds, and invertebrate pests are covered in 244 photos. These 50 information-rich cards will help growers, and vineyard managers identify and manage most common problems. **See page 5 for special pricing.**

ORGANIC WINEGROWING MANUAL

Interest in California organic wine grape production inspired this publication that provides a full-color guide with information on soil management, including soil considerations when selecting a vineyard site, developing organic soil and fertility programs and selecting cover crops. An extensive section covering weed, disease, insect, mite, and vertebrate pest management options for organic grape production is covered. The chapter on organic certification contains an overview of considerations for evaluating and selecting a certifier.



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Organic Winegrowing Manual	3511		$ 35.00	

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CALENDAR OF EVENTS

Local Meetings and Events

UC Grape Day
August 13, 2013
8:00 a.m. - 12:00 p.m.
Kearney Agricultural Center
Parlier, CA
559-646-6500
Additional information forthcoming.

U.C. Davis University Extension Meetings
(800) 752-0881

Wine Filtration Short Course
April 13 & 14, 2013
8:30 a.m.— 5:30 p.m.
Robert Mondavi Institute for Wine and Food
Old David Rd. Davis, CA
Section: 124VIT201

Out of State Compliance: Legal Requirements for Shipping out of State
April 26, 2013
9:00 a.m.— 4:00 p.m.
Da Vinci Building, 1632 Da Vinci Ct.
Davis, CA
Section: 124VIT203

Introduction to Wine Analysis
May 18, 2013
9:00 a.m.— 6:00 p.m.
Robert Mondavi Institute forWine & Food
Old David Rd. Davis, CA
Section: 124VIT205

7th International Table Grape Symposium

Attention table grape growers and attendees of the 6th International Table Grape Symposium, I am pleased to announce the **7th International Table Grape Symposium** will be held in Australia in early November 2013.

Persons interested in presenting a paper at the 7th International Table Grape Symposium should contact: David Oag
+61 427427517
david.oag@deedi.qld.gov.au

If you are interested in receiving more information as it becomes available please email me at: sjvasquez@ucanr.edu

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Vine Lines

San Joaquin Valley Viticulture Issues

Vine Lines is produced by UC Cooperative Extension Farm Advisor Stephen J. Vasquez. Contact me for further article information, or to be added to the e-mail list.

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