Foundation Plant Services
UC DAVIS

FPS GRAPE PROGRAM NEWSLETTER

fps.ucdavis.edu

OCTOBER 2009

Proposal for the Russell Ranch Foundation

Deborah Golino, Director

FOR THOSE NEW TO OUR OPERATIONS, I'll start with a bit of background to put the new developments in perspective. Foundation Plant Services (FPS) has a unique facility on the UC Davis campus with its business office, high-tech laboratory, microshoot tip culture rooms, array of greenhouses and acres of field growing grounds. FPS currently maintains 60 acres of foundation level grapevines, which include more than 650 grape scion and rootstock varieties and more than 2000 different clones (selections). It is extremely important that foundation vineyards be isolated from non-tested vines since grapevine pathogens (especially viruses) are spread by vectors that move from vine to vine. FPS is an essential component of California clean plant programs for grapevines and fruit trees and exercises leadership in the newly established National Clean Plant Network (NCPN), of which the Grape Clean Plant Network is a key component.

One of the important decisions reached in February 2009 by the Grape Clean Plant Network was to set the future national standard for grapevine foundation material in the United States at an extremely rigorous new level. Foundation vineyards contain the elite, pathogen-tested plant material that is ultimately distributed to the industry through nurseries certified by clean plant programs. Compliance with that standard will ultimately be required as a prerequisite to NCPN certification for foundation vineyard collections throughout the United States.

We are tremendously excited about our proposal to establish a new foundation vineyard. The 100-acre parcel at Russell Ranch has an ideal location for a foundation vineyard in compliance with NCPN standards. This property is remote and isolated from current UCD vineyards. There is adequate acreage to accommodate the numerous FPS varieties and clones. It is expected that the FPS collection will expand rapidly due to the infusion of NCPN funding that will allow acquisition of new clones from foreign and domestic sources. The outbuildings on the Russell Ranch property are particularly desirable since the equipment servicing the vineyard must be dedicated solely to the new foundation vineyard. FPS proposes to phase-in the new planting by initially establishing vines on 30 acres of the Russell Ranch property. The campus has granted us permission to begin planting, and we hope to eventually utilize the full 100 acres. Propagation of FPS foundation vineyard vines is already underway using microshoot tip tissue culture—a technique for eliminating pathogens such as viruses.

The idea was enthusiastically greeted by the National Clean Plant Network Governing Board in their first review of proposals in summer 2009. We received the initial funding needed to begin developing this property with the hope of planting in the spring of 2011.

In this difficult year of financial challenges, I especially would like to thank our customers, industry supporters and the national clean plant center organizers for recognizing the value of our programs. It is through the efforts and confidence of many that we are thriving and able to productively serve in an increasingly international arena.

INSIDE:

DORMANT ORDER DEADLINE: November 15

2009-10 Season Orders

FPS is now accepting orders for the 2009-10 season. To request unrooted, ungrafted dormant cuttings for delivery in January-March 2010 or green mist-propagated plants (MPPs) for 2010 delivery, submit your order by November 15, 2009. This will help ensure that you receive a share of any varieties/selections that are in short supply. Orders received after November 15 will be filled on a first-come, first-served basis after orders received by the deadline are filled. To place an order, complete and sign an FPS Order Form/Grower Agreement, available on the FPS Web site at *fps.ucdavis.edu*, and submit it to FPS.

Updated lists of registered grape selections, new grape selections, prices and order forms are available on the FPS Web site at *fps.ucdavis.edu/grape.html*. Additional details about FPS selections, including source and status information, and whether a selection has been through tissue culture, may be accessed on the National Grape Registry at *ngr.ucdavis.edu*. Anyone with questions on navigating this Web site to find information may contact site manager Nancy Sweet (*nlsweet@ucdavis.edu*; 530-752-8646) or the FPS introduction and distribution office (*fps@ucdavis.edu*; 530-752-3590). Non-internet users are welcome to call Nancy or the FPS office for assistance in obtaining information on FPS selections.

Submitting Signed Order Forms and Service Agreements Just Got Easier

Campus policy requiring original signatures on FPS order forms and service agreements has changed. FPS can now accept these documents with FAXed or scanned signatures. These options can shorten the order acknowledgement process. Submit signed forms or service agreements to FPS using one of the following methods:

FAX to (530) 752-2132

E-mail as a PDF attachment to *trpinkelton@ucdavis.edu*

U.S. Postal Mail:

Foundation Plant Services
University of California
One Shields Avenue
Davis, CA 95616-8600

Express courier (FedEx, UPS, etc.) Note this is different from the postal mailing address:

Foundation Plant Services
University of California
455 Hopkins Road
Davis, CA 95616

Upcoming Events

FPS Annual Meeting: November 12, 2009 at the Buehler Alumni and Visitors Center, UC Davis. Advance registration required; online form and details posted at *ucanr.org/FPSevents* or contact Joanna Luna, phone: (530) 754-7851.

Current Issues in Vineyard Health, UC Davis Extension class. November 19, 2009, 9:00 am–4:00 pm at the DaVinci building in Davis. Registration and information is provided at *www.extension.ucdavis.edu*

2010 Unified Wine and Grape Symposium to be held January 26–29 at the Sacramento Convention Center, 1400 J Street, Sacramento, California. For more information, go to *www.unifiedsymposium.org*

Wine and Wine Grape Research 2010 will be held February 18, 2010, from 9:00 am–4:00 pm at Freeborn Hall, UC Davis. $49. UC Davis Extension at *www.extension.ucdavis.edu/winemaking*

Variety Focus: Sauvignon Blanc, Seventh in the series of UC Davis Extension courses. May 6, 2010, at UC Davis. Registration and information is provided at *www.extension.ucdavis.edu/winemaking*

61ST Annual Meeting of the American Society for Enology and Viticulture June 20–25, 2010 in Seattle. Details are available at *www.asev.org*

Foundation Plant Services

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Also available online at ***fps.ucdavis.edu***

New Public Grape Varieties and Selections Available for 2009-10

by Cheryl Covert, FPS Plant Introduction and Distribution Manager

All new provisionally-registered selections available from FPS are on the *New Materials Available From FPS In The 2009-10 Season* list. It may be viewed or downloaded online at *http://fps.ucdavis.edu/WebSitePDFs/Price&VarietyLists/GrapeNewSelectionList.pdf* or a printed version may be requested from the FPS introduction and distribution office. Proprietary selections released this year are included in the new materials list.

The following newly-available public grape varieties and selections successfully completed testing, and were released and planted in the FPS Foundation Vineyard in 2009. They are now available as disease tested provisionally registered stock, and custom mist propagated plants (MPPs) may be ordered now for delivery beginning in summer 2010. Actual delivery dates will be determined by demand and the size of orders received. Dormant cuttings should become available for most of the new selections in about two years.

NEWLY AVAILABLE IMPORTS

Public Selections

The imported public selections released this year all came to FPS from the nursery of private Iberian clonal program Viveiros PLANSEL, S.A. in Montemor-O-Novo, Portugal. This group includes 2 Spanish clones imported from Portugal in March 2005 and a group of 13 Iberian clones, both Spanish and Portuguese, that were imported in January 2007. All selections were generously donated to the FPS public collection by PLANSEL owner Jorge Boehm. All were released from federal quarantine in spring 2009.

Alfrocheiro FPS 01 & FPS 02 (Sub clones JBP 460 & 539, respectively) Alfrocheiro is an indigenous, early-ripening Portuguese red wine grape variety, sometimes called Alfrocheiro Preto (black Alfrocheiro), grown primarily in the Dão region of Portugal, but also found in the Alentejo, Ribatejo and Bairrada regions of the country. Jancis Robinson (*The Oxford Companion to Wine*) says Alfrocheiro produces deep-colored wines with good alcohol/acid balance, and names it one of the most promising red varieties in the Dão region. These two selections are reported by Viveiros Plansel to come from the Dão region of Portugal.

Mazuela FPS 01 (Clone 206.1) According to the NGR website, this black wine grape variety originated in the province of Aragón in northeast Spain near the town of Cariñena. The grape was known in Spain as Mazuela, Mazuelo and Cariñena. Mazuela (Mazuelo) is the Rioja name for Carignan. The variety was also so widely planted in France under the name Carignan (Carignan noir) that it also became closely identified with that country. The variety is known as Carignane in the United States. This clone is reported to have been obtained by Viveros Plansel from a nursery in Spain.

Merlot FPS 31 – A French black wine grape variety. This clone is reported to have come from an anonymous nursery in Spain.

Pinot noir FPS 124 – A black wine grape that originated in France. This clone is reported to have come from an anonymous nursery in Spain.

Shiraz FPS 10 – Shiraz is the Australian name for the French black wine grape variety Syrah. This clone is reported to have come from an anonymous nursery in Spain.

Tempranillo FPS 16–20 and 22 – One of the most popular respected red wine grape varieties grown in Spain. Jancis Robinson notes that this early-ripening grape is “thick skinned and capable of making deep-colored, long-lasting wines that are not…notably high in alcohol.” There are many synonyms for Tempranillo, and some of the clones listed below came to FPS originally with some of these other names as noted below. Because the DNA profiles are identical for all of these selections, they have all been renamed ‘Tempranillo’ in the FPS collection. All are reported to have been obtained by Viveiros Plansel from Spain.

Tempranillo FPS 16 arrived labeled ‘Tempranillo’ and is reported to have come to Viveiros Plansel from a nursery in Spain, where it is known by the synonym ‘Aragonez.’ Tempranillo FPS 17 and 18 are reported to have come to Viveiros Plansel from a nursery in Spain, where they are known by the synonym ‘Aragonez.’

Tempranillo FPS 19: Originally imported under the name ‘Tinta (del) Pais,’ this clone is reported to have come to Viveiros Plansel from a nursery in Spain, and is the ‘Tinto del Pais type’ of Tempranillo. Because the DNA profiles are identical, this selection was renamed ‘Tempranillo’ in the FPS collection shortly after it was released.

Tempranillo FPS 20: Originally imported under the name 'Tinta Toro,' this clone is reported to have come to Viveiros Plansel from a nursery in Spain and is the 'Tinto de Toro type' of Tempranillo. Because the DNA profiles are identical, this selection was renamed 'Tempranillo' in the FPS collection shortly after it was released.

FPS 22 : This clone is reported to have come to Viveiros Plansel from a nursery in Spain, where it is known by the synonym 'Aragonez.'

Xarello FPS 02 & FPS 03 (Sub clones JBP 564 & 565, respectively) A description of Xarello on the NGR website says this white grape from Spain is native to Cataluña. The variety is most commonly found in Penedès where it goes into cava blends with Parellada and Macabeo. These two clones are reported to have come to Viveiros Plansel from a Spanish nursery.

Zalema FPS 01 (Clone 214-4) A white grape variety from Spain that is grown mainly in the Spanish Levant. This clone is reported to come to Viveiros Plansel from a nursery in Spain.

Two newly released selections originating from the USDA National Clonal Germplasm Repository at Geneva, New York: at left, red wine grape Maréchal Foch and below, Vidal blanc.

NEWLY RELEASED DOMESTIC SELECTIONS

Auxerrois FPS 02 – This selection of the white wine variety Auxerrois came to FPS in 1988 from Oregon State University, which imported it from Colmar, France. The federal quarantine testing and release occurred at Oregon State University prior to arrival at FPS. Held for many years in a quarantine block at FPS awaiting resources for further testing work, FPS was finally able to complete the disease testing to qualify this selection for planting in the Foundation Vineyard in January 2009. This Rupestris stem pitting-positive selection is reported to be French clone 36.

Chardonnay FPS 107 – This selection came to FPS in 2001 from Hyde Vineyards identified as the 'Calera clone.' The selection underwent microshoot tip tissue culture disease elimination treatment, tested negative for disease in post-treatment testing, and was released and planted in the FPS Foundation Vineyard in 2009.

Chardonnay FPS 108 – This selection came to FPS in 2004 from El Molino Winery. It underwent microshoot tip tissue culture disease elimination treatment, tested negative for disease in post-treatment testing, and was released and planted in the FPS Foundation Vineyard in 2009.

Maréchal Foch FPS 01 (Kuhlmann 188-2) An interspecific hybrid that came to FPS in 2005 from the USDA National Clonal Germplasm Repository at Geneva, New York. The New York State Agricultural Extension Service website describes Maréchal Foch as a very early-ripening black grape with small berries and clusters that produce a fruity light red table wine. The vines are hardy and medium in vigor and production. It notes that Maréchal Foch should be grafted on a resistant rootstock to ensure adequate vigor, and says birds are attracted to the small black berries.

Vidal blanc FPS 01 (Vidal 256) An interspecific hybrid that came to FPS in 2005 from the USDA National Clonal Germplasm Repository at Geneva, New York. The New York State Agricultural Extension Service website describes Vidal blanc as a heavily productive white wine grape which produces good quality wine when the fruit reaches maturity. It requires sites with long growing seasons and moderate winter temperatures. Small berries are borne on very large, compact, tapering clusters. Cluster thinning is required to prevent overcropping. Vidal blanc is one of a group of interspecific varieties that are sensitive to attack by soilborne virus diseases of the ringspot complex. Grafting these varieties onto virus resistant rootstocks is advisable for this reason.

FPS "Pipeline" Spotlight: Nero D'Avola

by Cheryl Covert, Plant Introduction and Distribution Manager, FPS

FPS HAS RECEIVED MANY INQUIRIES THIS YEAR from customers seeking a source for the Sicilian red wine grape variety Nero D'Avola.

Translated as "Black of Avola" in Italian, and also known as "Calabrese," this grape produces dark, rich wines with characteristics similar to Syrah. The most widely-planted red wine grape in Sicily, it was initially grown on the southern tip of the island near the small town of Avola where, due to the excellent climate and soils, the best Nero D'Avola wines are still produced.

Like Syrah, Nero D'Avola requires dry warmth and low vine training to succeed. Jancis Robinson (*The Oxford Companion To Wine*, 2006) notes that "at its best, it produces deep coloured wines that have a wild plum and chocolate character, high levels of tannins, and decent acidity," and that producers value "the body, deep colour and aging potential which Nero D'Avola can bring to a blend."

Though FPS does not yet have registered Nero D'Avola available for distribution, three selections are currently in the plant introduction "pipeline" at FPS; one a domestic selection submitted in 2003 for the FPS public collection, another a selection imported directly from Sicily and submitted for quarantine processing in 2008. A third proprietary selection imported from Sicily in 2008 is not expected to be available for public distribution. Both public selections tested positive for disease in initial testing and are at various stages in the disease elimination treatment and post-treatment testing process. The status of each of the two public selections is detailed below, along with estimates of when they may be released.

Nero D'Avola FPS 2003-5-7420 This domestic selection from a private Mendocino County vineyard was submitted to FPS in 2003 for eventual inclusion in the FPS public collection. In initial testing, this selection tested positive for Leafroll, Fleck and Rupestris stem pitting. Disease elimination treatment by microshoot tip tissue culture has produced four tissue culture explants. Two of the explants were advanced to post-treatment testing and included on the 2009-10 grape field index. Results of laboratory, herbaceous and field index testing are expected to be compiled at the beginning of 2011. If all tests are negative, this selection could be released in spring 2011. Although the selection's donor has requested that the first available plants go to a designated nursery, after that it will be publicly available, first as custom ordered mist-propagated plants (MPPs), and then approximagely two years later as dormant cuttings.

Nero D'Avola FPS 2008-3-8482/8483 This selection from Vivaio Federico Paulsen in Palermo (Sicily), Italy, came to FPS in February 2008 as a result of a varietal exchange arranged between former FPS grape program manager Susan Nelson-Kluk and the director of the Vivaio Federico Paulsen institute, Dr. Vincenzo Pernice. The selection tested positive for nepoviruses in initial herbaceous testing, and was also symptomatic for nepoviruses on the 2008-09 grape field index. The FPS tissue culture lab is currently in the process of producing tissue culture explants of this selection, which could proceed to post-treatment testing in about 2011. If tissue culture explants are of sufficient size to graft onto the 2011-12 grape field index as we would anticipate, and if all tests are negative, the earliest this selection might be released would be in the spring of 2013. Mist-propagated plants could then be ordered that spring, with dormant cuttings becoming available approximately two years later.

Those interested in requesting Nero D'Avola material from FPS when it becomes available are recommended to periodically check the FPS collection listing on the National Grape Registry (NGR) website at *http://ngr.ucdavis.edu*, since new FPS releases are regularly added. Questions about these or other other selections in the FPS "pipeline" can be directed to Cheryl Covert by email at *clcovert@ucdavis.edu* or by phone at 530-754-8101.

Notes from the Plant Identification Lab

by Gerald Dangl, Manager, FPS Plant Identification Lab

Foundation Plant Services made significant progress during the past year in confirming the cultivar identification of our grape selections. Visual inspection (ampelography) and DNA fingerprint analysis has allowed us to move over 50 selections from Provisional to Registered status and to correct the identification of several selections.

Sadly, one of our blocks of grapevines is in the way of progress. Construction began this summer on West Village, a major development on 205 acres of UC land west of Highway 113 between Russell Boulevard and Hutchison Drive. The plan calls for 475 houses for UC faculty and staff as well as apartments and dorms for 3,000 students. There will also be stores and office space. The first student apartments are scheduled to open in fall 2011.

On what will be the west edge of West Village is my personal favorite block of grapevines, General Quarantine 1A, affectionately known as GQ1A. Some of the first leaf samples I ever collected for DNA fingerprinting were from GQ1A. The small block of around 600 vines (over 250 cultivar names) was planted primarily in 1989. Most of the vines were collected by the late Dr. Harold Olmo in the late 70's and early 80's from old Californian vineyards and from grape collections and vineyards around the world. They were a motley assortment of varieties—many with very obscure names—the perfect group of suspects for sleuthing using DNA fingerprinting.

The vines had been under the care of Dr. Austin Goheen, a plant pathologist with the USDA Agricultural Research Service. The vines were in pots awaiting evaluation including disease testing and treatment. When Dr. Goheen retired in 1986, FPS inherited responsibility for the potted vines. Because their disease status was unknown, the vines needed to be planted away from other grapevines. Space was found for the new quarantine block on Pomology Department land north of the intersection of Hopkins Road and Hutchison Drive.

In 2004 we began scrutinizing the records and vines of QG1A to ensure no important or interesting cultivars would be forever lost to the bulldozer. Many of the more exotic cultivars had already been propagated into the National Clonal Germplasm Repository at Davis (NCGR-D). Nearly all the rest of the GQ1A vines have been propagated into the new quarantine block at FPS or are in our 'pipeline' awaiting testing and treatment.

Cultivar names such as A'asemi from Yemen or Fayoumi from Egypt, which shares its name with an Egyptian chicken, illustrate the tremendous grape genetic diversity preserved in this small block of vines. The viticultural potential of many of these cultivars in California is largely unexplored.

Some of the names of cultivars in GQ1A are well known in other countries. For these vines we used DNA analysis to confirm that the names on our vines are consistent with those in other countries. We did this by comparing the DNA fingerprints of our vines with reference DNA fingerprints provided by collaborators from countries where the cultivar is we known. However, some of the cultivar names of vines in GQ1A are not known here or in other countries, including the country where the vines were collected. DNA fingerprint analysis can often help clarify these issues as well.

Identification Issues Resolved

There were two selections of Tinta Santarem in GQ1A (S1 and S2). Records for both show they were imported from Portugal in 1981 by Dr. Olmo. Reported by Dr. Olmo to be a Port variety, the name Tinta Santarem, which literally means red grape from Santarém, is not used in Portugal or anywhere else. To complicate the issue, the grapes of Tinta Santarem S1 were red, as expected, while those of S2 were white. During an inspection of our collection in 2000, expert ampelographer Jean-Michel Boursiquot concluded that the red-fruited S1 was Grand Noir, a fact later confirmed by DNA analysis. FPS already had two Registered selections of Grand Noir, so the decision was made to abandon Tinta Santarem S1.

Dr. Boursiquot, however was not able to identify the white-fruited Tinta Santarem S2, which was propagated into our block in the Tyree Vineyard to save the selection. This was fortunate. Subsequent DNA analysis showed our Tinta Santarem S2 is actually Malvasia Fina, a well documented synonym of Boal Cachudo, and also known as Boal de Madeira. The DNA profile of our Tinta Santarem S2 matched a reference profile of Malvasia Fina from researchers in Portugal as well as profiles of Boal Cachudo and Boal de Madeira accessions at the NCGR-D; the result confirms the identification and the synonymies. As a result the name of Tinta Santarem S2 has been changed to Malvasia Fina; new cuttings from the non-registered vines in Tyree are awaiting testing and treatment.

Bountiful Malvasia Fina vines in the UC Davis Tyree Vineyard. Originally collected by the late Dr. Harold Olmo and labelled 'Tinta Santarem S2,' DNA analysis was used to correct the identification. *Photo by Bev Ferguson*

This cultivar is grown primarily on the south coast of the island of Madeira, where small plantings are used to produce a white medium sweet wine. The vines in the Tyree Vineyard, as well as the synonymous Boal Cachudo and Boal de Madeira vines at the NCGR-D, are vigorous and fruitful. Tasting some of the fruit this summer I was delighted by the great flavors and acid levels. Malvasia Fina might be worth exploring for dry white wine production in warmer regions of California.

OTHER NAME OR REGISTRATION CHANGES

There is an ongoing effort at FPS to confirm and clarify the cultivar names of our selections using both ampelography and DNA analysis. This year, over 50 Provisional selections were Registered based on DNA analysis. We also changed the names of several selections.

Tinta Bairrada 01

The registration status of Tinta Bairrada 01 was changed from Provisional to Registered. The DNA profile for this selection was found to match that of the synonym Baga. The reference profile came from collaborators in Portugal, the country of origin for this cultivar.

Muscadelle du Bordelais 01

The registration status of Muscadelle du Bordelais 01 was changed from Provisional to Registered. It is important to note that this is not the same grape as the Muscadelle grown in the Bordeaux and Bergerac regions of France. They are related only in name. Muscadelle du Bordelais is really only known in California. Its origin is not known though it does have a slight Muscat flavor unlike the French Muscadelle. We confirmed the identity of Muscadelle du Bordelais by matching profiles of vines from several sources. DNA analysis also confirms that Muscadelle du Bordelais is one parent of Emerald Riesling, a release from Harold Olmo's breeding program. Dr Olmo's records refer to Muscadelle du Bordelaisas as "Muscadelle CA," clearly emphasizing that the parent was not the Muscadelle of France. The French Muscadelle, known as Sauvignon vert or in Australia as Tokay, is also available at FPS as the Registered selection Muscadelle 02.

Olivette Blanche 03

The name of Olivette Blanche 03 has been changed to Santa Paula. In Califorrnia, Olivette Blanche has long been used informally as a synonym for Santa Paula. However, there is a distinct different cultivar named Olivette Blanche, which has a symonym of Bican du Cher. Olivette Blanche 03 at FPS was identified as Santa Paula by Jean-Michel Boursiquot and DNA analysis. To avoid possible confusion, we have changed its name to Santa Paula.

Breeding Pierce's Disease Resistant Winegrapes

by Andrew Walker, Alan Tenscher and Summaira Riaz, Department of Viticulture and Enology, UC Davis; and David Ramming, Crop Diseases, Pests, and Genetics Research Unit, USDA-ARS, Parlier

Rapid progress towards the release of Pierce's disease (PD) resistant winegrapes is being made in a project that combines molecular genetic advances with traditional breeding. The foundation of this work was the discovery of very strong resistance to PD's bacterial disease agent, *Xylella fastidiosa*, in Mexican forms of *Vitis arizonica*. Harold Olmo collected these plants in 1961 and their pollen cross-contaminated a number of crosses he made in 1988. We later began using progeny from these crosses and discovered they were very resistant to a number of pests and diseases, and later discovered that their listed parentage was incorrect. Instead of hybrids of *V. rupestris* x *Muscadinia rotundifolia*, they were hybrids of *V. rupestris* by a number of the grape species Olmo collected in Mexico. The most resistant of these were hybrids with forms of *V. arizonica*.

We spent a number of years determining what these Mexican species were and created many seedling populations designed to determine the genetic control of resistance to PD and nematodes. Further work discovered the chromosome on which PD resistance was located and led to the development of very tightly linked DNA markers to this resistance region (locus). These markers are now being used to pre-screen progeny from crosses with this resistance source very soon after germination. Progeny with the markers are advanced to greenhouse testing and those without the markers are discarded.

We have also optimized the training of seedlings so that a large percentage of field-planted seedlings bloom in their second year. This process involves planting early, inducing strong growth with careful irrigation and fertilization, and bi-weekly passes to remove lateral shoots and direct growth into one shoot. If this shoot can reach about six feet, there is a strong chance that some upper dormant buds will be fruitful the following year. Grapes are normally slow to bloom when grown from seeds, taking five or more years to flower for the first time. This rapid training process can reduce the seed-to-seed generation time to three years, greatly accelerating the breeding process.

The breeding process involves crossing high quality *V. vinifera* cultivars with a PD resistance source. The source of that resistance is critical and the reason why relatively little progress has been made in the production of high quality PD resistant grapes in the southeastern United States, where this disease is widely spread. Breeders in the southeastern United States have used sources of PD resistance that are complex and controlled by multiple genes. When this resistance is used in a cross to a high quality *V. vinifera* parent very few of the progeny are resistant, because the multiple resistance genes are independently distributed in the progeny and are infrequently found as an effective group in many of the progeny. This problem compounds over cycles of crossing back to high quality *V. vinifera* parents to improve fruit or wine quality and prevents useful progress.

There are many examples of highly PD resistant hybrid cultivars from southeastern U.S. breeding programs, but their fruit and wine quality is inferior to *V. vinifera* cultivars. Most of these hybrids are the result of a single generation of breeding because their multi-gene resistance sources produce few resistant progeny per generation. In addition, very few resistant progeny with a useful combination of high quality fruit characters and resistance are produced since those characters also assort independently in the progeny.

However, PD resistance from one form of *V. arizonica* is controlled by a single dominant gene we termed *PdR1*; in the case of *V. arizonica/candicans* b43-17 this gene is homozygous so that all progeny in a cross of *V. vinifera* x b43-17 are resistant to PD. Fruit quality of this F1 generation is quite poor as they are 50% *V. vinifera*, but the best progeny from this cross can be crossed back to *V. vinifera*. That generation is the first back cross (BC1), and half of its progeny will be resistant and 75% *V. vinifera*; therefore the odds of finding good fruit quality and resistance are increased. These progeny are heterozygous for PD resistance, so in the next cross back to *V. vinifera* (BC2) half of the progeny will again be resistant and those progeny will be 88% *V. vinifera*. Because we vary the *V. vinifera* parent in the back cross generations to prevent problems with inbreeding, these generations are modified back crosses (mBC).

The next generation would be mBC3 and progeny will be 94% *V. vinifera* and half will be PD resistant. Thus the odds of finding PD resistance and fruit and wine quality equal to that of *V. vinifera* increase each generation. This process does not function in a 5–8 year breeding cycle since it would overwhelm a typical breeder's career. However, with a very rapid generation cycle—3 years seed-to-seed as a result of aggressive training and care—and a marker-assisted selection (MAS) system to aid in the identification of resistant progeny, new parents can be chosen before they flower for the first time and the next generation can be made.

Using this germplasm and these techniques, we have made rapid progress toward developing high quality PD resistant wine grapes. Wines were made this fall from PD resistant selections that contain 94% *vinifera* and *PdR1* from the *V. arizonica/candicans* resistance source b43-17. The next generation (mBC4) was also created to produce PD resistant wine grapes with 97% *V. vinifera*, and those seedlings will be planted in Spring 2010.

The PD winegrape breeding program has two overall objectives: To breed PD resistant winegrapes through backcross techniques using high quality *V. vinifera* winegrape cultivars and PD resistance from *V. arizonica/candicans* b43-17; and to characterize PD resistance and winegrape quality traits (color, tannin, ripening dates, flavor, productivity, etc) in novel germplasm sources, our breeding populations, and in our genetic mapping populations.

The progeny from these crosses are first tested for the presence of *PdR1* with DNA markers (simple sequence repeat markers used for mapping and parentage analysis). Progeny with the markers are greenhouse tested for PD resistance. This is done because bacterial levels in resistant plants range from very low, almost undetectable levels to moderate levels. Plants with moderate levels of bacteria are field resistant to PD, but might act as reservoirs of bacteria if the sharpshooter insect vector of PD fed on them. We select parents from each generation that have the lowest bacterial levels to maintain the greatest level of resistance in the back cross generations.

In 2006, multiple vines of eight 88% *vinifera* with *PdR1* selections (50% Syrah or Chardonnay from the last cross) were planted for small-scale wine making tests. Wine lots of these selections made in 2007 and 2008 have shown significant promise and ranked well when compared to Syrah, Pinot noir, Chardonnay and Lenoir (also known as Jacquez or Black Spanish, a southeastern U.S. *V. vinifera* x *V. aestivalis* hybrid considered to be the highest quality PD resistant red wine variety in the southern US) made at a similar small-scale (Table 1). These wines were also evaluated at the UCD Viticulture and Enology alumni gathering in May 2009 and at the North American Grape Breeders Conference in Tallahassee, Florida in August 2009 with similar results.

In 2008, we planted replicated vines of four other promising 88% *vinifera* PdR1 selections, siblings of the 2006 plantings, and of eight 94% *vinifera PdR1* selections. In

Table 1. Results of a blind tasting of 2008 vintage wines tasted 12/9/2008 by 10 tasters comprised of faculty and staff in the department of Viticulture & Enology, UC Davis. Wines were rated on a hedonic quality scale from 1=poor to 5=v. good.

Wine name	Group Total	Low score	High Score	Consensus Descriptors: color; aroma; flavor-texture
U0502-20	34.0	2	5	pale yellow-green; pineapple, grassy, gooseberry, lemon zest; smooth with a nice acid balance
Syrah	32.8	2	4	dark red-purple; plum, mint, fruity, violets; rich, chewy tannins, good length.
Chardonnay	32.3	2	5	light yellow; tropical, aromatic, pear, melon; round, warm finish
U0501-12	30.5	1	4	dark red-purple; stone fruit, raspberry; medium body, more acidic and elegant
U0502-10	30.5	1	4	medium red; stone fruit, raspberry, smokey, red licorice; simple but pleasing structure
Lenoir	26.0	1	4	dark red w\ brown; porty, stewed fruit, raisined; oxidized, flabby
Pinot noir	21.0	1	3.5	brick; cherry, berry, earthy, gamey; lacks structure, hot
U0502-01	20.3	1	3	light red; candy, sweet cherry; thin

Table 2a. Phenotypic observations of reference varieties and select progeny with the *PdR1* resistance source used for small lot winemaking in 2009.

Genotype	Parentage	Percent *vinifera*	2009 Bloom Date	Berry Color	Berry Size (g)	Ave Cluster Wt. (g)	Ripening Season	Prod 1=v low, 9=v high
Barbara	Historic	100%	05/09/09	B	2.4	290	late	6
Chardonnay	Gouais blanc x Pinot noir	Historic	05/14/09	W	1.0	190	early	5
07355-12	U0505-01 x Petite Sirah	93.75%	05/10/09	B	1.0	137	early-mid	6
07355-75	U0505-01 x Petite Sirah	93.75%	05/07/09	B	1.3	234	early	8
07713-51	F2-35 x U0502-48	93.75%	05/07/09	W	1.4	210	early	8
U0501-12	A81-138 x Syrah	87.50%	05/18/09	B	1.1	194	late	4
U0502-10	A81-138 x Chardonnay	87.50%	05/07/09	B	1.4	198	early	7
U0502-20	A81-138 x Chardonnay	87.50%	05/14/09	W	1.7	313	late	8
U0502-26	A81-138 x Chardonnay	87.50%	05/10/09	B	1.6	375	mid	7
U0505-35	A81-138 x Cab. Sauvignon	87.50%	05/10/09	B	1.1	158	early	6
Blanc du Bois	Fla D6-148 x Cardinal	~66%	05/14/09	W	1.2	125	mid-late	7
Lenoir	*V. aestivalis* hybrid	<50%	05/20/09	B	0.8	201	late	6

Table 2b. Analytical evaluation of advanced selections with the *PdR1* resistance source used for small lot winemaking in 2009. All analysis courtesy of ETS Laboratories, St. Helena, California.

Genotype	L-malic acid (g/L)	°Brix	potassium (mg/L)	pH	TA (g/100mL)	YAN (mg/L, as N)	catechin (mg/L)	tannin (mg/L)	Total antho-cyanins (mg/L)
07355-12	2.79	26.8	2050	3.42	0.78	275	127	585	2178
07355-75	2.88	28.2	2180	3.49	0.74	217	5	680	1941
07713-51	1.31	23.4	1700	3.56	0.49	146	-	-	-
U0501-12	2.11	21.8	1610	3.46	0.58	263	49	555	1026
U0502-10	3.97	24.9	2170	3.60	0.73	362	48	1006	1162
U0502-20	4.18	23.3	2230	3.51	0.76	383	-	-	-
U0502-26	2.24	24.0	1900	3.40	0.73	237	67	411	947
U0505-35	4.03	28.7	2450	3.66	0.81	476	47	886	1446

Table 2c. Sensory evaluation of reference varieties and advanced selections with the *PdR1* resistance source used for small scale winemaking in 2009.

Genotype	Juice Hue	Juice Intensity	Juice Flavor	Skin Flavor	Skin Tannin (1=low, 4= high)	Seed Color (1=gr, 4= br)	Seed Flavor	Seed Tannin (1=high, 4= low)
Barbara	pink-brown	low	neutral, acidic	jam, berry	2	4	nutty, spicy	3
Chardonnay	green-gold	medium	apple, pear	sl fruity	1	4	nutty	4
07355-12	red	med-dark	red fruit	plum, berry	3	3.5	woody, spicy	1
07355-75	red	medium	plum, fig	jam,prune	2	3	hot, woody	2
07713-51	green-gold	medium	apple, pear	neutral	2	3.5	woody, spicy	3
U0501-12	red	med-dark	fruity	fruit jam	2	4	neutral	2
U0502-10	pk-red-orng	med-dark	slight vegetal	sl fruity	1	4	nutty, spicy	1
U0502-20	green	medium	neutral, fruity	grass	1	4	spicy, bitter	1
U0502-26	pink	medium	bright, spicy	fruity	2	4	nutty	3
U0505-35	red	medium	CS-veg, berry	sl CS-veg	2	4	spicy	2
Blanc du Bois	gold	med-dark	floral, vegetal	sl vegetal	1	4	spicy, bitter	4
Lenoir	red	dark	mildly fruity	fruity	1	4	nutty	4

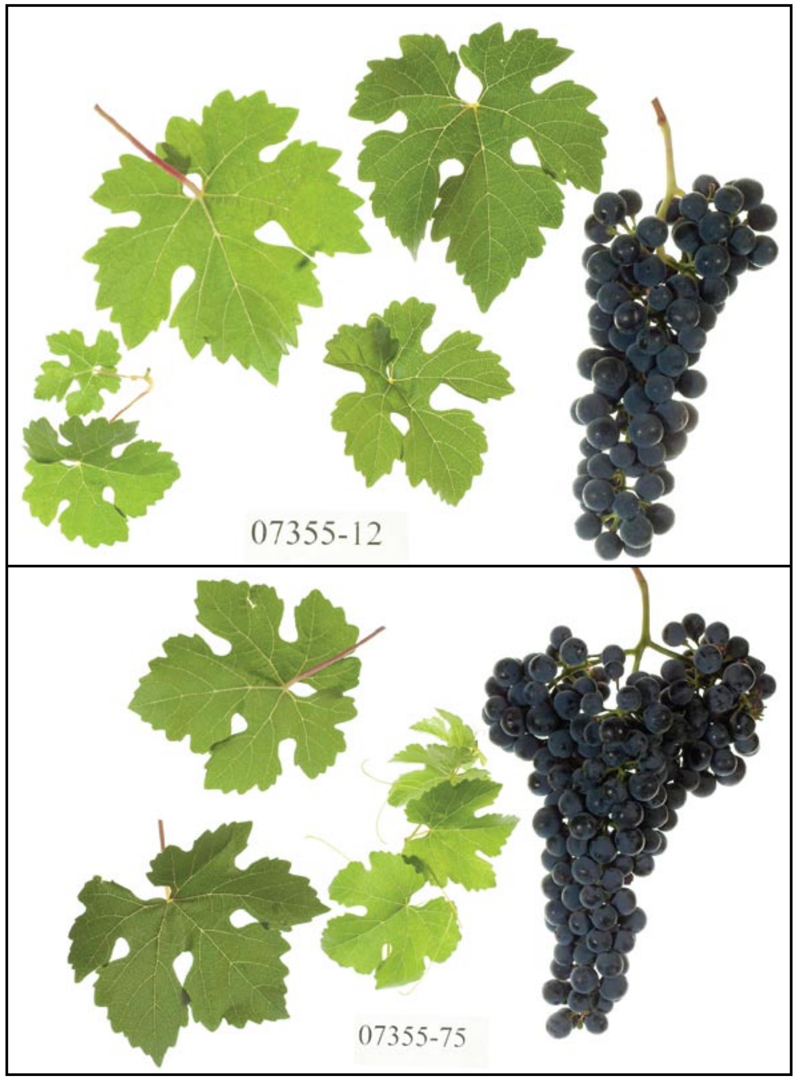
Fall 2009, 12 fermentations were made: 3 (2 red, 1 white) at the 94% *vinifera* level; 5 (4 red, 1 white) at the 87.5% *vinifera* level; and 4 (2 red, 2 white) *vinifera* and PD controls. Vine, fruit and juice analysis from these selections are presented in Tables 2a-c. These tables include data from ETS Laboratories (*www.etslabs.com*) of St. Helena, who donated their fruit analysis and phenolics panel that uses a wine-like extraction to model a larger fermentation.

We cannot field test PD resistant selections in Davis because of potential spreading of PD to campus vineyards. However, we have been field-testing our advanced PD resistant selections at the Beringer vineyard in Yountville, California. Natural sharpshooter vectoring is not depended on; rather, each plant is inoculated with the PD bacterium each spring.

Selections from the 94% *vinifera* (mBC3) crosses—the 07355 (U0505-01 x Petite Sirah) and 07370 (*vinifera* F2-35 x U0502-38) populations—were grafted onto Dog Ridge (currently the only certified virus-free PD resistant rootstock) in February 2009 and planted at Beringer in June 2009. These genotypes have been marker tested and their PD resistance status will be confirmed by greenhouse testing in 2010. In Spring 2009, selections from the 05554 (BC2, 88% *vinifera*) population were inoculated for the second time and selections from the A81 population (BC1, 75% *vinifera*) both with the *PdR1b* (F8909-08) allele were inoculated for the third time.

This year, six replicate vines of the seven most promising 88% *vinifera PdR1* types (06325-42, 06325-43, U0502-01, U0502-10, U0502-35, U0502-38, U0502-41; two of which are white and five red) were grafted onto Dog Ridge and planted at the Beringer site for small-scale winemaking trials.

Given that low levels of *X. fastidiosa* exist in resistant plants it will be important to have PD resistant rootstocks to graft with resistant scions, thus preventing failure if the bacteria moves into the rootstock. The rooting and grafting ability (with two scion varieties) of eight rootstock selections with PD resistance from PdR1 will soon be greenhouse tested for resistance and examination of bacterial movement across the graft union. The best selections will be tested for nematode and phylloxera resistance followed by field testing.



The two red 94% *vinifera* PD resistant wine grape selections (U0505-01 x Petite Sirah) used for small-scale winemaking at UC Davis in 2009. 07355-12 is upper and on the article first page; 07355-75 is the lower.

White 94% *vinifera* PD resistant wine grape selection (F2-35 (Cabernet Sauvignon x Carignane) x U0502-48) used for small-scale winemaking at UC Davis in Fall 2009.

PD resistance is also being examined and utilized from other sources. Almost all of these have a more complex multi-gene resistance, which has limited their use in the breeding program. We continue to examine resistance from other genetic backgrounds so that we can combine multiple resistances at some point to provide a broader resistance with more genes that is less likely to be overcome. Although we have no evidence that the effectiveness of the *PdR1* resistance might be overcome, there are many examples of single gene resistances being overcome by pests and pathogens. Combining alternative resistance sources with *PdR1* in the future would help prevent the breakdown of resistance.

We are also working with David Ramming at the USDA-Parlier to breed PD resistant table and raisin grapes. Many of these crosses have been made with the *PdR1* resistance source, which has allowed marker-assisted selection and very rapid progress. *Vitis arizonica/candicans* b43-17 has very small berries about the size of small peas, almost no pulp, large hard seeds, and a strong herbaceous flavor. Dr. Ramming has used his advanced seedless table grapes to produce very acceptable PD resistant raisin grape selections and PD resistant table grapes that are within a generation or two from release.

We also work on the genetics of PD resistance and have genetically mapped the position of *PdR1*. This gene or genetic region is located on chromosome 14. This resistance from the homozygous parent b43-17 has two forms, which we have termed *PdR1a* and *PdR1b*. We have also mapped another form of *PdR1* from *V. arizonica* b40-14, and are examining how the multi-gene PD resistance from *V. arizonica/girdiana* b42-26 maps and relates to *PdR1*.

In the future these multiple resistance forms will be combined in our PD breeding program to ensure the strongest resistance possible. The combination of these forms of PD resistance can only be done with the tightly linked genetic markers discovered in these mapping efforts so that the combination of the various forms of resistance can be confirmed in the interbred progeny. These mapping efforts are also essential to physically locating and characterizing PD resistance genes. At present, the chromosome region where *PdR1* exists has been sequenced and these pieces of sequence are being arranged and compared to the Pinot noir genome sequence, and to the sequences of other plants, to characterize the candidate gene function and determine which of the sequence pieces are responsible for PD resistance.

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Virus Status Update: Millardet et de Grasset 420A 05

by Cheryl Covert, FPS Plant Introduction and Distribution Manager

Early this year, FPS confirmed by field reindexing on Cabernet franc that the Millardet et de Grasset 420A FPS 05 source vine at Foundation Vineyard location BKS D2 V4 was infected with grapevine leafroll disease. Registration was subsequently pulled from this vine and its four propagations at Foundation Vineyard locations GOH A7 V1, GOH A7 V2, GOH A7 V3 and GOH A7 V4, and customers who received material from any of these five vines were notified of the finding.

The testing history of the leafroll-positive vine shows that two different Cabernet franc field indexes completed on this vine in 1984 and 2001 were both negative for Leafroll disease, and periodic ELISA and PCR tests have also been negative for grapevine leafroll-associated viruses. Then, in 2006, a routine re-index of this vine resulted in a positive Cabernet franc result for Leafroll disease. This was puzzling because ELISA and PCR tests conducted at the same time were negative. Because of the conflicting test results from different test methodologies, FPS decided to repeat the Cabernet franc index.

The results of the reindex, compiled in early 2009, were again positive for grapevine leafroll disease, confirming the 2006 index result. Dr. Adib Rowhani and his staff are working to discover an explanation for the contradiction between the lab and field index results, but for now it remains a puzzle. FPS is carefully monitoring the vineyard block in which the leafroll disease was found, and additional testing has been implemented to ensure that any possible spread of disease is immediately detected and contained.

Because grapevine leafroll disease is excluded from the CDFA Registration & Certification (R&C) Program for Grapevines, FPS notified CDFA of the finding, and the leafroll-positive source vine and its four propagations at GOH A7 V1, 2, 3 & 4 were slated for removal from the Foundation vineyard. FPS customers who received propagating material from any of these vines after 2001(when the vine last tested negative for leafroll disease on Cabernet franc) were notified of this finding in March. FPS recommended that nurseries remove any registered increase block mother vines propagated from these source vines and discard any budwood and grafted plants propagated from them. On May 4, 2009, CDFA notified all R&C Program participants that registration had been removed from all vines in registered increase blocks and certified nursery rows that were propagated from the FPS leafroll-positive 420A FPS 05 source vine and its four propagations, and directed participants to remove the de-registered vines. In addition, budwood and grafted plants produced from FPS propagation materials received after 2001 were declared no longer eligible to be identified as California Registered or Certified stock.

FPS has other registered source vines of Millardet et de Grasset 420A FPS 05 for which reindexing on Cabernet franc was completed in 2008 that were confirmed to be negative for leafroll disease. These source vines will remain Registered, and leafroll-negative propagating material of MGT420A FPS 05 will continue to be available to nurseries.

We regret any inconvenience or problems this may have created for our customers, and will continue working to maintain high standards for our Foundation vineyard. Questions regarding this issue may be directed to Cheryl Covert (*clcovert@ucdavis.edu*; 530-754-8101).

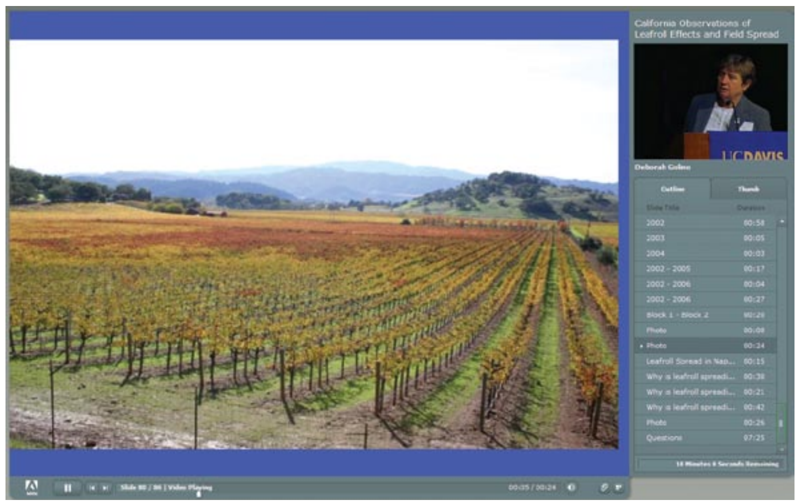
Discussions from Grapevine Leafroll Symposium 2.0

by Vicki Klaassen, Foundation Plant Services

Grapevine leafroll disease exists in every major viticulture region in the world and poses a significant threat to the grape and wine industries. The disease is associated with at least nine different plant viruses that are transmitted to healthy grapevines either mechanically by grafting, or naturally by several different mealybugs and soft scale insects. The incidence of leafroll disease has decreased in the last 50 years, primarily because of the use of clean certified grapevine nursery stock. However, in 2000 several vineyards in Napa Valley reported increased incidence of the disease. This has concerned growers and researchers seeking to understand the potential for an epidemic. We invited nine researchers with active programs on leafroll disease to discuss their work at the Grapevine Leafroll Symposium 2.0, co-sponsored by UC Davis Extension, on June 2, 2009 at UC Davis. This article summarizes the presentations, which can be viewed in their entirety at ucanr.org/grapeleafroll2.

LEAFROLL DISEASE INCIDENCE AND SPREAD

Dr. Deborah Golino, Foundation Plant Services director and Plant Pathology specialist, presented some of the work she and colleagues have done to document the recent spread. They identified a block in a Napa Valley vineyard that was infected with grapevine leafroll associated virus-3 (GLRaV-3), one of the most common leafroll-associated viruses, and mapped the spread over the course of five years. When they first started mapping in 2002, leafroll disease incidence was 22% and was confined to the edge of the block adjacent to an older vineyard that had been pulled due to severe leafroll disease. By 2006, incidence had increased to 66% with the spread predominantly moving down the rows. Since this study, more growers have reported similar spread in several other California vineyards.



Audio and video controls enable users to navigate the presentations and speakers on UC Integrated Viticulture Online *iv.ucdavis.edu*. In this screen view, Deborah Golino explains her work on leafroll spread.

Golino said grape mealybugs were present in the infected block, and that the spread of leafroll disease by mealybugs has been observed in the past. However, the current rate seems unusually high. She gave several possible explanations for a higher rate: the presence of a new insect vector that transmits the virus more efficiently, or the presence of a new virus or strain of virus that is more readily transmitted by grape mealybugs; the use of more susceptible rootstocks; or the presence of alternate hosts such as wild *Vitis* or non-*Vitis* species that serve as virus reservoirs. Golino is looking for alternate hosts and gave an update on this work in a second talk later in the day.

Dr. Bob Martin, USDA-ARS Plant Pathologist from Corvallis, OR, reported that both mealybugs and GLRaV-3 have been found in Oregon, Washington, and Idaho. The potential for spread appears to be most serious in Idaho with incidence—primarily of GLRaV-3—ranging from 0 to 100% in older plantings. Grape mealybug populations are very high and now leafroll disease is being observed in young plantings of certified nursery stock.

Martin presented data on a vineyard in eastern Washington that looked similar to what Dr. Golino found in for Napa Valley. Incidence went from one infected vine in 2002 to multiple infected vines throughout the 60-acre vineyard by 2008. And while spread has not been documented in Oregon, Martin and colleagues recently detected mealybugs in the eastern and southern parts of the state. GLRaV-3 is the most common leafroll-associated virus in these regions, so the potential for spread exists even if not yet documented.

With the documented increased incidence and spread of leafroll disease in Washington, and the potential for this situation to occur in Oregon and Idaho, Martin emphasized the need for good management practices. His advice: start with clean rootstock and scions, and scout for mealybugs. Don't just look for virus symptoms but have plants tested because symptoms vary widely between different grape cultivars and different rootstocks, and with each scion/rootstock combination. Keep good records of planting, scouting, testing, and treatments. And make a plan—remove infected vines if disease incidence is low and the vectors are absent or under control. If not, replanting is probably the best option.

MEALYBUG BIOLOGY

While we often think of mealybugs as pests that directly damage plants through feeding, **Dr. Kent Daane**, Cooperative Extension specialist from UC Berkeley, emphasized the importance of also studying the different mealybug species as a vectors of leafroll-associated viruses. With five known mealybug species in California that feed on grapevines and transmit GLRaV-3, the potential for leafroll spread is high.

According to Daane, controlling mealybug populations as vectors requires a shift away from the current practice of targeting adult mealybugs rather than the juvenile form, known as 'crawlers.' Crawlers appear better able to transmit the virus, and it's during the crawler stage that mealybugs move onto leaves and clusters and can be dispersed within and between vineyards by wind, birds, machinery and people.

Under current practices, post-dormant insecticides are applied in the late winter/early spring as adult mealybugs just begin to emerge from under the bark. If applications were delayed until summer when crawlers are present on leaves and clusters, disease incidence and spread might be reduced due to lower vector populations. This has yet to be studied, and Daane pointed out this wouldn't come without a cost. Summer is closer to harvest time, limiting the insecticides that can be used.

Shifting control efforts to the crawler stage highlights the increased challenge growers will face if vine mealybug populations ever become significant. Grape mealybugs have one to two crawler stages that can easily be targeted; vine mealybugs have multiple overlapping crawler stages. Daane offered several practical management tips:

- For sampling, note that pheromone traps don't work well when population densities are low so only put out traps during peak flying times.
- Field trials have identified effective insecticides, but their performance can be highly variable. It's important to work with industry representatives and farm advisors who have regional knowledge.
- Insecticides never result in complete mealybug eradication.
- Natural predators and parasitoids can reduce the mealybug population, but may not lower pest densities below the thresholds needed for vector management.
- Mating disruption can be used to lower vine mealybug abundance, but works best in combination with insecticides and resident natural enemies..

Dr. Rodrigo Almeida from the Department of Environmental Science, Policy and Management at UC Berkeley spoke about the importance of identifying which virus is transmitted by which pest, understanding how transmission occurs, and knowing how these factors are affected by host plant genetics and the natural environment. Ultimately the control of vector-born diseases such as grapevine leafroll is based on a strong understanding of how the vector and virus interact to produce disease.

Almeida's lab has been studying transmission of GLRaV-3 by the invasive vine mealybug. The end goal is to forecast times of the year when the risk of disease incidence is highest by combining knowledge of transmission rates with information about mealybug and virus populations. For example, preliminary data from Almeida's lab identified September and October as times in California when spraying for grape mealybugs would potentially be effective in controlling the spread of leafroll disease because this is when mealybug populations peak and virus populations are also high. The next step is to generate more data and then test their predictions in the field.

Rhonda Smith, UC Extension Viticulture Advisor for Sonoma County, presented work she and Lucia Varela, IPM Advisor for Sonoma County, did to quantify vine mealybug survival rates in pomace piles. They placed bagged clusters with known numbers of vine mealybugs into loads that were processed using a standard press regime, and then used sticky traps to quantify survivors. And survivors they found, from 2–1200 mealybugs/cluster. Are these numbers significant? Possibly, says Smith.

Given that variable numbers of vine mealybugs survive the pressing process and are therefore present in discarded pomace, Smith and Varela then tested the ability of vine mealybugs to survive in pomace piles sitting out in the sun. Their treatments included covered and uncovered piles shaped into rounds that were spiked with infested clusters. Every week for a month, bugs were trapped and counted. After one week, mealybug numbers were reduced by 99.9% in covered piles, compared to 91.9% in uncovered piles. Even after one month, the maximum reduction in uncovered piles was only 97.3%. If this uncovered pomace is spread in vineyards, vine mealybugs may be introduced if they were present on harvested clusters. Therefore, Smith cautions, do not spread fresh press pomace in vineyards; compost it or at minimum, cover it with plastic.

CULTIVARS AND ROOTSTOCKS

If some vectors are more or less efficient at transmitting viruses, are some rootstocks more or less susceptible to virus infection? Yes, according to a two-year trail conducted by **Dr. Golino** and colleagues. They grafted six commonly used rootstocks onto Cabernet Sauvignon vines that were infected with either single or multiple viruses. They found that, regardless of rootstock, brix levels were significantly lower in all the virus-infected vines except those with rupestris stem-pitting associated virus (RSPaV). In contrast, the effect on yield was highly dependent on the combination of rootstock and virus. The lowest yields occurred on vines infected with multiple viruses and grafted on the rootstock Kober 5BB. St. George, while not the highest yielding rootstock, was less affected by any of the viruses than the other rootstocks. Leaf symptoms were also highly variable depending on the rootstock and virus combination. These results indicate that some rootstocks, e.g. St. George, are more plastic when it comes to virus infections.

Dr. Golino also presented work with different rootstocks and latent viruses, or viruses that are present in a vine but are not causing disease. Latent viruses first became an issue during the planting boom of the 1990s when growers switched from AXR-1 to new, alternative rootstocks that were resistant to phylloxera. Many of the young vineyards began showing disease symptoms characteristic of graft-transmitted viruses, even though the budwood came from vineyards without disease symptoms. An important distinction was that the budwood came from primarily self-rooted vines. Golino and colleagues tested the young symptomatic vines and found up to six viruses. She proposed that these viruses had been present in the budwood, but were latent until grafted.

To test this possibility, Golino and colleagues picked up strains of latent viruses from around the state and chip-budded them onto Freedom rootstock, which appears to be very susceptible to the common grapevine viruses. The trials indicated that Freedom was indeed very susceptible and that the most severe symptoms occurred when multiple viruses were present, specifically GLRaV-2 and a vitivirus such as GVA.

Golino expanded this trial by taking some of the latent virus combinations that had the most severe effects on Freedom and tested them on 18 different rootstocks, including AXR-1 as a control. After two years, they found that new rootstocks in general are more susceptible than AXR-1 to the viruses used in this study, especially in mixed infections. However, there is significant variation between rootstocks. St. George, Ramsey, 110R, and 3309C are comparable in resistance to AXR-1; Freedom and Harmony are very susceptible, especially when multiple viruses are present. Golino's advice: "If a susceptible rootstock such as Freedom is chosen for a vineyard, be careful to use the best quality and cleanest scion wood."

Dr. Andrew Walker, professor of Viticulture, UC Davis, is using a plant breeding approach to develop a rootstock that doesn't support high levels of phylloxera or nematodes and is also tolerant of leafroll disease. His lab is crossing 5BB and Freedom, which have good resistance to nematodes but are very susceptible to leafroll, with St. George, which has good tolerance to leafroll disease but is susceptible to nematodes. So far, the lab knows that some hybrid vines have good nematode resistance but their performance against leafroll viruses has not yet been tested.

Walker explained that one of the problems they face is the time it takes to screen large populations of hybrid vines for the presence of viruses and lack of leafroll disease symptoms. Currently, his lab is evaluating the possibility of screening hybrids with a virus strain that triggers an incompatibility response in the vine so that they don't have to wait for disease symptoms to develop. There is still much work to be done but, in the absence of complete mealybug control and the lack of certified stock for every vine desired, Walker's goal is to some day be able to graft vines onto a rootstock that is resistant to multiple pathogens.

CHARACTERIZING VIRUSES

Visual symptoms may indicate the presence of a leafroll-associated virus, but determining which virus it is requires testing. And as several speakers emphasized, disease symptoms are variable—so having plants tested is always an important step in determining the virus status of a vineyard. Diagnostic tools include the conventional methods of biological indexing and serological assays, and more recently developed methods that use reverse transcriptase-polymerase chain reaction (RT-PCR).

Dr. Fatima Osman, FPS staff research associate, has spent several years developing high-throughput molecular techniques to complement conventional methods. High-throughput technologies, such as quantitative RT-PCR and low density arrays, can be used to process large numbers of samples quickly, can provide a quantitative measure of the amount of virus present, can be either very specific or more universal depending on the need, are not affected by the environment, and are typically very sensitive. But they have disadvantages such as requiring specialized equipment and trained technicians that may result in higher costs. If the virus is new, it won't be detected except by biological indexing. Osman emphasized that new high-throughput technologies are meant to complement—not replace—conventional methods, and are most cost effective for pre-screening lots of material to be used for biological indexing, and for testing certified collections and propagative material.

No diagnostic tool can compensate for poor sampling technique. Virus titer is variable not only within the year, but also within the plant structure. Osman cautioned to take multiple samples from different parts of the plant, including both sides of the vine, when sampling vines during the fall or petioles in the spring.

There are currently at least nine viruses associated with leafroll disease. Do they share common characteristics? How closely related are they? These are questions **Dr. Adib Rowhani**, project scientist at FPS, has spent most of his career addressing. And the methods he has used to answer these questions have evolved through the years. Today, although time consuming, it is possible to determine the full genomic sequence of many of the viruses that were previously only characterized by serological data. Rowhani presented new sequence data for three leafroll-associated viruses: GLRaV-6, -7, and Carnelian.

Rowhani's description of how they characterized the Carnelian virus was especially interesting because it is shows how new leafroll-associated viruses are 'discovered.' The Carnelian vines had symptoms that looked like leafroll disease but the molecular tests for all known leafroll-associated viruses were negative. However, biological indexing results were positive, indicating that a new leafroll-associated virus was involved. Rowhani's lab has since cloned and sequenced the genome of this new virus and determined that its organization is identical to that of GLRaV-4, -5, -6, and -9, confirming its identity as a leafroll-associated virus.

Another new virus was introduced by **Dr. Maher Al Rwahnih**, post-doctoral researcher at FPS, but this time the virus is not associated with leafroll disease. It is a novel virus that Rwahnih found while searching for the causal agent of syrah decline disease.

Al Rwahnih suspected that a new virus was associated with the syrah decline disease but he knew that it would be difficult to identify because RSPaV, a common grapevine virus that doesn't cause disease in Syrah, was also present in the symptomatic vines. Using a new technique, 454 high-throughput sequencing, Al Rwahnih found a unique sequence that was not present in healthy vines. He determined that it was a novel virus never before found in grapevines and named it grapevine syrah virus-1. The only catch—not all vines with the virus display syrah decline symptoms. Therefore, while new and novel, grapevine syrah virus-1 does not appear to be the causal agent of the disease. Al Rwahnih is currently analyzing sequence from more Syrah vines. (For more details about his work see his article on page 18).

LEAFROLL IN THE WILD AND VIRUS PERCEPTIONS

The high-throughput techniques make it feasible to screen large numbers of plants. **Dr. Golino** and colleagues put this to use in a preliminary search for alternate virus hosts—a proposed factor in her first talk. In fall 2008 and spring 2009, 231 samples of *V. vinifera*, wild *Vitis*, various cover crops, and exotic and native plant species were collected from in and around ten Napa Valley vineyards with leafroll symptoms. After screening for common grapevine viruses, they found that all the samples were negative for GLRaV-1, -4, -5, -7, -9, vitivirus GVD, and phytoplasmas. All the cover crops and exotic and native plant species were also negative.

Golino reported that leafroll-associated viruses were found in wild *Vitus*. *V. californica*, a native species found in Napa County, was the most common *Vitus* in their sampling, and a small percentage was infected with RSPaV and GVA. The remaining *Vitis* were escapes or *V. vinifera* x *V. californica* hybrids, and typically had mixed infections of RSPaV, GLRaV-2 and -3, GVA, or GVB. This preliminary data suggests that *V. californica* is not a leafroll host, but that *Vitis* hybrids and escapes may represent a potential reservoir. They will continue the survey this fall.

Finally, the industry perception that "a little virus" might improve wine quality is a question that Dr. Golino is attempting to answer, given the potential for "a little virus" to spread rapidly within a vineyard. Wine has to be made from grapes that are identical except for their infection state, a situation that may or may not occur naturally. Therefore, Golino and her colleagues at FPS used meristem shoot-tip therapy to create virus-free clones of three Cabernet Sauvignon Heritage selections to which they could selectively infect with four grapevine viruses.

After two years, they found that yield for the virus-infected parent was significantly lower than for the healthy clone in one clone pair. In contrast, the average brix levels were always significantly lower in the infected parents compared to the healthy clones. Therefore, sugar levels were always adversely affected by virus infection, even when there was no reduction in yield. These results indicate that viral infections can reduce grape quality. The next step will be to make wine from these grapes and evaluate any differences in quality.

Virologists, entomologists and breeders have made huge contributions to knowledge about leafroll and other grapevine diseases, but all agree there's more work to be done.

Towards Understanding Syrah Decline Disease Using Next Generation Sequencing Technology

by Maher Al Rwahnih, Post-doctoral Researcher, Foundation Plant Services

A "decline" of Syrah grapevines was first observed as an emerging disease in France in 1993 (Renault-Spilmont et al, 2004). More recently, a similar disease has been reported in Californian vineyards (Battany et al., 2004). Vines as young as three years old may show symptoms that include: leaf reddening and scorching, swelling of the graft union, superficial cracking and pitting of woody tissue, stem necrosis, and eventual death of the vines. A California vineyard survey completed in 2002 concluded that this decline in grapevines could be a consequence of cultural practices or environmental factors (Battany et al., 2004). However, French scientists studying the genetic characteristics of Syrah grapevines have been unable to correlate Syrah decline with any graft incompatibility, environmental conditions, or known pathogens (viruses, fungi, viroids, or crown gall).

In 2006 a novel strain of *Rupestris stem pitting associated virus* (RSPaV) was isolated from a diseased Syrah grapevine. The virus was characterized and designated as the Syrah strain of RSPaV (RSPaV-SY; Lima 2006). Although we have not been able to establish a clear correlation between Syrah decline and RSPaV-SY, we are pursuing the research to define the role of this virus, if any, in the etiology of the disease. Declining Syrah samples from across California (as well as from France) have been brought to our laboratory and tested for 17 different viruses including RSPaV-SY, and the results showed that two viruses were commonly present in the samples: RSPaV and *Grapevine rupestris vein feathering virus* (GRVFV).

RSPaV and GRVFV are often found together in symptomatic as well as in asymptomatic grapevines. As we become more familiar with Syrah decline, we are reaching the conclusion that the etiology of the disease is more complex than we expected and beyond the tools used in our lab for standard analysis. We have therefore upgraded the capacities of our laboratory by adapting the technology of next generation genomic sequencing.

The technique has been used for the identification of viruses associated with plant, honeybee, bird and human diseases (Al Rwahnih et al 2009, Cox-Fosteret et al., 2007; Honkavouri et al., 2008; Palacios et al., 2008). We are applying the technology to the characterization of viruses infecting grapevines. With this novel approach, we can characterize the entire complement of pathogens present in a diseased vine. Hundreds of millions of DNA and RNA bases can be sequenced in a single experiment and the sequences assembled by computer—replacing the practice of cloning single genes for analysis one sequence at a time. The automated analysis separates the mixture of total sequences into host plant and pathogens genes. The plant parasites are then further sorted into fungal, bacterial, viroids and viral categories.

To launch this technology, two Syrah grapevine clones from a UC Davis collection were selected. One clone (Syrah 6) showed severe decline (red leaves, swelling and wood necrosis at the graft union, stem pitting above the graft union); the second one was an asymptomatic control vine (Syrah 8) from the same vineyard. Total DNA and RNA was isolated from both clones and analyzed by 454 Life Sciences (Branford, CT, USA) high-throughput pyrosequencing, using the Genome Sequencer FLX. The data was sorted by comparison with all sequences that have ever been published, which are available in a public database.

Syrah decline symptoms can include leaf reddening and scorching (left) and swelling of the graft union (right). Next generation genomic sequencing is the latest tool being used to unravel the mysteries behind this disease.

Total DNA and RNA was isolated and compared from two Syrah clones at a UC Davis collection: Syrah 6 above, with severe symptoms; and asymptomatic Syrah 8, right.

The majority of the sequences for asymptomatic Syrah 8 were identified as grapevine genomic sequences. Virus-derived sequences were identified by their similarities to those of known viruses: RSPaV and GRVFV were identified at low titers. For the declining vine Syrah 6, the number of viral hits was one hundred fold greater. In addition to RSPaV and GRVFV, we found five other viruses and viroids that were not detectable using the standard pathogen detection techniques. The new pathogens included Australian grapevine viroid, Grapevine yellow speckle viroid, Hop stunt viroid, Grapevine leafroll associated virus-9, as well as a novel virus which had not previously been described. We have provisionally named this new virus Grapevine Syrah virus-1 (GSyV-1). The full genome of GSyV-1 was calculated to be 6,481 bases in length, and its genome analysis shows that it belongs to the genus *Marafivirus*.

The complete genome sequence of GSyV-1 allowed us to design PCR primers for the detection of this virus in grapevines. A survey of commercial vineyards in California for GSyV-1 was completed in 2008. 154 Syrah/Shiraz vines showing symptoms of Syrah decline from across the state were tested. Of those, 30 tested positive for GSyV-1 (19%) from four counties (Napa, Sonoma, Yolo, and Santa Barbara). GSyV-1 was also detected in leafhoppers from plants showing Syrah decline symptoms indicating a possible vector for transmission of the virus. Further field surveys and vector transmission studies are in progress. Our long term goal is to understand the transmission mechanism and spread of GSyV-1 in the field, and its contribution to the etiology of Syrah decline disease.

Using 454 sequencing, we are studying diseases that show latencies and variabilities not seen in infections caused by simple, single viruses or viroids. We are currently using the novel techniques to analyze eight more vines, five of which are Syrah clones with different types of Syrah decline symptoms, in order to further investigate the cause of the disease. We are working with other researchers in the field to bring this technology on line, and are collaborating with industry leaders such as Genome Quest and Eureka Genomics to improve the methods. The application of these automated sequencing technologies are poised to reshape the landscape of plant pathogen diagnosis and characterization.

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Variety Focus 2009: The Grapes *of* Iberia

by Nancy Sweet, Foundation Plant Services

The grapes of Iberia were the focus of a symposium held on the UC Davis campus on May 14, 2009. Iberia is the portion of southwest Europe that includes modern day Spain and Portugal. Foundation Plant Services sponsored this fifth in a series of courses focusing on the viticultural side of select wine grape varieties.

Lectures on the important varieties that originated in the Iberian region were provided by a talented group of guest speakers from California and Europe. These presentations may be viewed in their entirety through UC Integrated Viticulture Online at *ucanr.org/grapesofiberia.*

Darrell Corti

Darrell Corti, a respected and well-known wine merchant and owner of Corti Brothers in Sacramento, California, opened the symposium with an overview of his experiences with Iberian wines. He presented anecdotes describing tastings of unique wines during his travels to Spain and Portugal in the 1960's, 1970's and 1980's.

Corti observed that awareness of Iberian wines in California began in the 19th century when consumers sought a certain Bordeaux-style wine also produced in the Rioja region of northern Spain. He cited reports from the 1880's by UC's Professor Eugene Hilgard for the proposition that California's Mediterranean climate makes development of Spanish and Portuguese wine grape varieties particularly appropriate in the state.

In the history of Iberian wines, little was written about grapes other than that they produced wine from a specific location. Corti stated that "it is the appellation, before the concept existed, that was important." For example, Jerez de la Frontera was famous for its wine, sherry, before the informing grape Palomino became famous. Corti opined that quality wines in Portugal were primarily attributable to the effect of viticulture (*terroir*) over technology.

The first major varietal introduced to California was of Spanish origin—Mission (now known to be Listán prieto). Portuguese varieties have been classified in California as to type—port or Madeira—and not as table wine varieties. A spike in interest in Portuguese varieties occurred in California in the late 1970's and early 1980's when Dr. Harold Olmo imported classic port varieties at the request of wine makers.

Corti concluded with a discussion of whether there is a market in the United States for some of the original wine varieties from the Iberian region. He referenced "Portugal's patrimony of old plantings and autochthonous [indigenous] varieties that are being preserved and made more widely known." Corti stated that it is appropriate at this time to introduce into California the unique Spanish and Portuguese wine varieties, but at reasonable prices until the new varieties become established with the consumer. He proposed adoption of a European model for introduction of the new varieties, followed by a rational, slow development in the market that does not overwhelm either the market or the consumer.

During his lecture, Mr. Corti offered for tasting a very fine Portuguese white wine called Prova Regia Bucelas. 'Bucelas' is a historic white wine that is characteristically acidic and dry; the main variety in Bucelas is Arinto. (*Robinson, Jancis. 2006. The Oxford Companion to Wine.*)

Deborah Golino

Deborah Golino, Director of Foundation Plant Services, summarized the grape selections of Spanish and Portuguese origin in the FPS collection. Synonymies and naming issues have in the past presented some confusion relative to these varieties.

There are currently 30 cultivars represented by 85 selections in the Spanish collection, and 35 cultivars represented by 82 selections in the Portuguese collection. Those selections are registered or provisional in the California Grapevine Registration & Certification Program, as well as selections currently in the 'pipeline' at FPS.

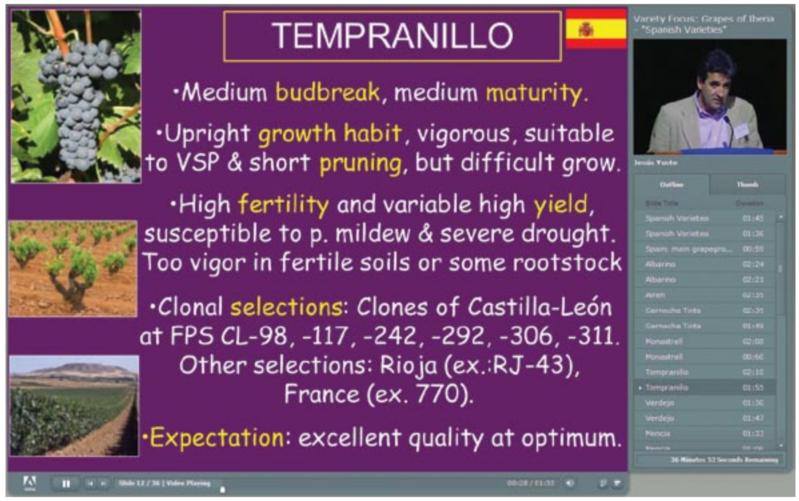
The Portuguese selections at FPS include 29 port variety selections imported by Dr. Olmo in the 1980's and a large and diverse collection of indigenous Portuguese varieties from Jorge Boehm, Viveiros Plansel S.A. in Portugal.

The oldest Spanish selection at FPS is Valdepeñas FPS 03 (syn. Tempranillo), imported to California in the 1880's and retrieved from UC's former Foothill Experiment Station, Jackson, California, by Austin Goheen in 1965. FPS has many Mission clones and 23 Tempranillo selections. As a result of an agreement with ITACyL in 2005, the FPS collection now contains 9 Spanish clones from the Spanish national collection, including Tempranillo CL-292 and CL-242, Garnacha tinta CL-52 and Verdejo CL-4.

A currently fashionable Iberian variety is a white grape called Albariño in Spain and Alvarinho in Portugal. The FPS collection contains selections from both countries.

In her April 24/25 2009 *Financial Times* wine column ('The Albariño that isn't'), Jancis Robinson detailed a case of mistaken identity involving this variety in Australia. The government research center, Commonwealth Scientific and Industrial Research Organisation (CSIRO), imported what they believed to be Albariño and distributed it widely. The Australian plant material was recently tested and found to be a different variety, the French grape Savagnin (syn. Traminer) from the Jura.

Gerald Dangl, FPS plant ID lab manager, reports that the FPS selections have been tested and match reference profiles for Albariño and Alvarinho from collaborators in Spain and Portugal, respectively. He states, "There is no confusion about this cultivar at FPS. The profile for Albariño/Alvarinho is clearly distinct from Savagnin (syn. Traminer). Analysis of the profile shows Albariño is not closely related to Savagnin and is certainly not a somatic mutation or clone of Savagnin, as has been suggested by some."



Screen view of speaker Jesús Yuste reviewing Spanish grape varieties, taken from UC Integrated Viticulture Online *iv.ucdavis.edu.* Audio and video controls enable users to navigate the day''s presentations and speakers.

Jorge Boehm

Jorge Boehm is an author, viticulturalist and owner of Viveiros Plansel S.A., in Portugal. Boehm was named Viticulturalist of the Year in Portugal in 2009. He spoke about the history of the Iberian gene pool in general and about the important Portuguese varieties, most of which are in the FPS collection.

The Iberian gene pool can be traced back to 2000 B.C. and is distinct from the gene pools present in France and Germany due to the mountains that separate the Iberian peninsula from the rest of Europe. Boehm stated that there are about 500 different varieties, including elite and regional varieties and varieties associated with green wines and cava wines.

The primary elite white wine grapes in Portugal are Alvarinho (Alentejo region), an ancient variety from the Douro called Gouveio (syn. Godello), and Arinto, a very old autochthonos vinho verde variety that produces a dynamic wine of a quality similar to that of the Spanish grape Verdejo. Boehm characterized Arinto as "Riesling for a warm climate."

The elite red wine grapes include Touriga Nacional, Touriga Franca, and Trincadeira (syn. Tinta Amarella), which resembles the Spanish grape Monastrell.

Boehm offered four wines for tasting: Plansel Touriga Nacional 2005, Plansel Touriga Franca 2007, Pintada Trincadeira 2007, and Plansel Selecta Gouveio 2008.

Jesús Yuste

Jesús Yuste Bombín is a scientist in the Viticulture Department at the Instituto Tecnológico Agrario de Castilla y León (ITACyL) in Valladolid, Spain. The Institute initiated a sanitary and clonal selection program for native grapevine varieties in 1990 and has entered into an agreement with FPS for donation of Spanish clones to the FPS public collection. (*FPS Grape Program Newsletter, November 2005.)*

Yuste spoke about important and interesting Spanish grape varieties and explained the classification system used in Castilla y León in Spain. He classified the varieties into four categories: elite varieties of Spain as a whole; varieties with clones that have a unique character in the Castilla y León region; other varieties from Castilla y León; and other varieties in Spain.

The elite national varieties in Spain include Albariño, Airén, Garnacha tinta, and Monastrell (known in California primarily as Mourvèdre and Mataró). Albariño is the most popular white wine grape in Spain. Yuste described viticultural and eonological characteristics for each variety.

'Riesling for a warm climate' is how Jorge Boehm described Arinto PLANSEL 268, one of the elite Portuguese white grapes in the FPS Foundation Vineyard. *Photo by Bev Ferguson*

Spanish grape varieties that have a unique clone or clones in the Castilla y León region are Tempranillo, Verdejo, Mencía and Prieto Picudo. Tempranillo is a red wine grape that originated in Spain. The regional clones from Castilla y León are known by the synonym names Tinta de Toro type and Tinta del País type. FPS has four active Tempranillo clones from Castilla y León: CL-117, CL-242, CL-292, CL-311. Yuste noted that Verdejo is the most prestigious of the Spanish white wine varieties and has been increasing in popularity in recent years.

Additional local varieties from Castilla y León include Albillo Mayor, Albillo Real, Juan García and Rufete. Other notable national varieties from Spain that were profiled were Malvasía (Doña blanca), Graciano, Bobal, and Viura. The FPS collection contains all of the varieties that Yuste described except for Bobal and Doña blanca.

Yuste offered two wines for tasting: Cuatro Rayas Verdejo 2008 and CÁMBRICO Rufete 2004.

Glenn McGourty

Glenn McGourty, University of California Cooperative Extension Advisor in Mendocino and Lake Counties spoke about the experience of growing Iberian varieties in those counties.

McGourty discussed the Winegrape Cultivar Trials at UC Hopland Research and Extension Center (1994-2004), Roumiguire Red Hills (1994-2000), Roumiguire Highland Springs Trial (1994-2000), McDowell Valley Vineyards Syrah Clonal Trial (1998-2008) and the UC Hopland Center trial (2006 to present). He reviewed the ripening order of the white and red varieties in the trials, which included varieties from all over Europe.

Spanish wine varieties planted in Mendocino and Lake Counties are Carignane, Grenache (syn. Garnacha), Tempranillo, Mourvèdre and Albariño. Grenache and Mourvèdre have small but increasing acreage.

McGourty offered four wines for tasting: Eaglepoint Ranch 2007 Albariño, McDowell Valley Vineyards Grenache Rosé 2008, Trinafour Carignane Niemi Vineyard 2006, and Six Sigma Tempranillo 2006.

Markus Bokisch

Markus Bokisch is a wine maker and owner of Bokisch Vineyards in Victor, California. Born in Iberia, he emigrated to America when young and has since travelled to Spain investigating clonal material. He is a Board member of the Tempranillo Advocates, Producers and Amigos Society (TAPAS). Bokisch profiled six Spanish and Portuguese grapes: Albariño/Alvarinho, Verdelho, Garnacha blanca, Garnacha tinta, Graciano, and Tempranillo. He discussed the origin (source) of the plant material, phenology, viticultural and varietal characteristics and organoleptic properties.

Bokisch then contrasted the differences in aroma and flavor profiles resulting from plantings of Albariño and Graciano grapevines on two distinct *terroirs*: Las Cerezas Vineyard on Tokay Fine Silty Loam soil in Lodi and Terra Alta Vineyard on Redding Gravelly Clay Loam in Lodi. For comparative tasting, Bokisch offered wines made from grapes from the two vineyards: Bokisch Las Cerezas Albariño 2007, Bokisch Terra Alta Albariño 2007, Bokisch Las Cerezas Graciano 2007, Bokisch Terra Alta Graciano 2007. In terms of the pure data elicited, the Graciano appeared to be more affected by the differing *terroirs* than was the Albariño.

Bokisch has donated several selections to FPS, including Albariño FPS 01 (Rías Baixas, Galicia), Mourvèdre FPS group number 7053, Tempranillo FPS 12 (Ribera del Duero, Spain) and Verdelho FPS 06 (Galt, California).

Earl Jones

Earl Jones, owner of Abacela Vineyards & Winery in Roseburg, Oregon, and board member and former President of TAPAS spoke about the history of the Tempranillo variety in the United States. He became interested in Tempranillo wine in the 1980's and began a search for the most appropriate growing location in the Western United States. The La Rioja and Ribera del Duero regions in Spain appeared to have the ideal climate, soil, and elevation. He looked for a similar Continental-Maritime climate in the United States to establish his vineyard, settling on southern Oregon in the Umpqua Valley AVA. He grows Tempranillo, Garnacha, port varieties and Albariño grapes in the Abacela vineyards.

Jones offered four wines for tasting from his Abacela Winery: Abacela Tempranillo, Cuvée 2006; Abacela Tempranillo, Estate 2006; Abacela Tempranillo, Reserve 2005; Abacela Albariño, Estate 2008. He also offered a Spanish style Tempranillo, 2005 Sierra Cantabria Rioja Crianza Tempranillo, to demonstrate the contrasting style to American-made Tempranillo.

Jones concluded with a summary of climate change data and predicted trends for Tempranillo in the United States.

Variety Focus 2010: Sauvignon blanc

The Variety Focus for 2010 featuring Sauvignon blanc will be held on May 6, 2010 on the UC Davis campus. Announcements for the event will be displayed in the Calendar section of the UC Integrated Viticulture On-Line website iv.ucdavis.edu. Reservations for the symposium are coordinated through UC Davis Extension *www.universityextension.ucdavis.edu/*.

Riesling Selections

by Nancy Sweet, Foundation Plant Services

Riesling FPS 09 in the FPS Foundation Vineyard came from Germany in 1952 and was first named 'White Riesling.' *Photo by Bev Ferguson*

THIRTY-ONE ENTRIES APPEAR when a cultivar search is performed on the name 'Riesling' on the *Vitis* International Variety Catalogue (*VIVC*) website *www.vivc.bafz.de*. The 'true Riesling' alone shows 120 synonyms on that website. White wines made in the German style with cultivars other than Riesling were often given the Riesling name. Name ambiguity has interfered with a clear identity for the true Riesling.

Riesling is versatile in terms of viticultural and enological traits. The cultivar is sensitive to the climate and soil in which it is grown, resulting in distinctly different flavors in the wines. Riesling can produce wines that are dry, medium dry, medium sweet or sweet. Shifting wine preferences have prevented the cultivar from forming a clear impression on wine consumers, particularly in California.

The Riesling grape's popularity in California has taken an uneven course. Recent trends suggest that interest is again rising. The Riesling collection at Foundation Plant Services (FPS) offers some of the best clones from the old world as well as selections that originated in California vineyards over one hundred years ago.

THE IDENTITY PROBLEM

The noble Riesling grape has a long and rich history in Germany, where it is grown along the Rhine River and its tributaries. Most authorities believe that the white wine cultivar originated in that cool temperate area around the Middle Ages. In the interim, other grape cultivars, Riesling imposters and distant relatives of the true Riesling have adopted its name to gain marketing advantage and cause confusion over the identity of the true Riesling.

In 1998, scientists in Austria used DNA technology to create a partial identity for the 'true Riesling'. They were able to determine that one of its parents is Heunisch weiss, which is known in France as Gouais blanc, the sire of other important wine cultivars such as Chardonnay, Sémillon, Gamay noir, Melon and Aligoté. Riesling and Heunisch weiss share one allele at all loci. *Regner et al., 2000-Genetic; Regner et al., 1998a.*

Heunisch weiss is a late ripening cultivar that was able to flourish in northern Europe in the Middle Ages because of a 700 year warm climate phase at that time. *Jung and Maul, 2004; Regner et al.,1998a.* The grape was supposedly imported to Europe by the Huns and was called *vinum hunicum* in the literature of the Middle Ages. Although the Heunisch vines produced wine of poor quality, that cultivar was an important crossing partner for wild vines and other grapevines in the cooler climates during that era. *Regner et al., 2000-Considerations; Regner et al., 2000-Genetic.*

The Austrian scientists were unable to identify Riesling's second parent. But they concluded that Riesling originated by a probable cross of the Heunisch variety with the other main gene pool mentioned in viticulture during the Middle Ages, the Fränkisch pool (*vinum francicum*). *Regner et al., 1998a.*

The Fränkisch pool shows close genetic ties to some wild *Vitis sylvestris* genotypes, which are the wild type *vinifera* of the region. *Forneck et al., 2003; Regner et al., 2001. Vitis sylvestris* existed and spread throughout western Europe for a very long time before cultivated grape varieties were imported to the region. It is not clear whether western European grape cultivars evolved from the local wild type or originated from imported cultivars. *Walker, 2009.* One group of scientists concluded that Riesling did not directly originate from a native wild grapevine. *Perret et al., 2000.*

The Austrian scientists mention one of the representative grape cultivars of the Fränkisch gene pool, the grapevine known as Traminer, as a candidate for Riesling's second parent. Traminer shares enough alleles with the *Vitis sylvestris* population to indicate at least a close relationship between the two, if not parentage. *Regner et al, 2000-Considerations.* Traminer was distributed throughout northern Europe by the Romans and provided a higher quality wine in terms of better sugar, higher extract values and more complex aroma. *Regner et al., 2001.*

When a pedigree search is performed on Riesling weiss in the *Vitis* International Variety catalogue (*VIVC*) at Geilweilerhof, Germany, the second parent for Riesling is shown to be *Vitis sylvestris* or (*Vitis sylvestris* x *Traminer*). However, the second parent for Riesling has not yet been definitively qualified by reported DNA findings.

If a grape has been cultivated in Europe since the Middle Ages, the cross would have occurred at least 500 years ago. Neither the geographic nor the genetic origin of a grape cultivar from that time in Europe was recorded. It is known that both Heunisch and Traminer were important crossing partners throughout Europe during the Middle Ages, and the names of both cultivars have been documented from that time. *Sefc et al., 1998.*

Riesling has been cultivated in Europe since medieval times. Specific grapevine cultivar names began to appear in documentation in the 14th and 15th centuries. Traminer (1349) and Riesling (1435) were among the earliest to be mentioned. *Sefc et al.,1998.* The most likely first written reference in Germany to the grape cultivar Riesling was in a 1435 storage inventory for a castle on the Rhine near Hochheim (in the Rhinegau): twenty-two *soliden* (currency) for *umb seczreben Riesslingen in die wingarten. Fischer, 2007; Price, 2004.* The first mention of the cultivar using the more familiar spelling was in 1552 in Hieronymous Bock's Latin *Herbal: 'Rieslinge* grows in the Mosel, Rhine and in the Worms region.' *Fischer, 2007; Price, 2004.*

Riesling flourished in the Rhine Valley region of Germany in the Middle Ages. The Rheingau is an old cultural region on the Rhine River surrounding Geisenheim and is considered by some to be the traditional home of Riesling. Geisenheim is the home of the famous viticultural institute and winemaking school. The region dates back to pre-Roman times with Celtic settlements.

The first Holy Roman Emperor Charlemagne built the Ingelheim Imperial Palace around 807 A.D., across the river from Geisenheim. Legend has it that Charlemagne himself was the first to order that vines be planted on the steep, south facing hill visible across the Rhine from the palace, because he saw that this was where the snow melted first each spring.

That vineyard site across from the Ingelheim palace is the now-famous Schloss Johannisberg—the first estate to plant a vineyard exclusively in Riesling and the location where late harvesting of Riesling grapes to make naturally sweet wine was discovered. For a time, Riesling in California was referred to as Johannisberg Riesling because of this association. *Asher, 2002; Pigott, 1991.*

From the 16th century, Riesling became recognized as the finest white wine grape in Germany, which then included the Alsace region. It was considered a luxury grape because of its low yield. Riesling was planted in 'the best sites for the connoisseurs of the time' (the church and the aristocracy). In successive centuries, church and political figures promoted the grape by ordering that '*Rissling*' be planted to the exclusion of, or to replace, other varieties. *Fischer, 2007; Price, 2004.*

The Mosel region was also home to Riesling from early times. Trier was an important Roman town where *Vitis vinifera* was cultivated by 286 A.D. The most important church decree related to Riesling came from Clemens Wenzeslaus, Elektor of Trier (Mosel), on May 8, 1787. He ordered the removal of all inferior ('poor') vines and replanting with 'good' grape varieties. Riesling was the only good white grape in the region at the time. *Fischer, 2007.*

German Riesling achieved great success in the 19th century, when Riesling prices were comparable to the great wines of Bordeaux and Burgundy. During that century Riesling grapes were first imported to California.

Identification of the true Riesling is no longer an issue given DNA technology. The primary European names of the 'true Riesling' are Riesling, Riesling weiss or Weisser Riesling. The European name translates into 'White Riesling' for the United States. Another complication exists with the use of synonyms, which is a problem with most European grape cultivars. Of the 120 synonyms listed, the most common in Europe include Rhineriesling (Austria) and Riesling renano (Italy).

The name Riesling became ambiguous in Europe and the United States when imposters and distant relatives of the true cultivar assumed the name. In Europe, some lesser quality cultivars genetically unrelated to Riesling weiss adopted its name e.g., Riesling Italico (Welschriesling; Walschriesling); Schwarzriesling or Orleans Riesling (Pinot meunier), and Laski Rizling. Distant relatives frequently carried the name, sometimes by way of a well-used synonym e.g., Frankenriesling (Sylvaner gruen); Müller-Thurgau (also known as Riesling-Sylvaner). In Australia, Sémillon grapes were used to make Hunter Riesling or Shepherd Riesling.

The Riesling grape also suffered from identity confusion in the United States, where unrelated cultivars and distant relatives again adopted the name – Grey Riesling (Trousseau gris); Missouri Riesling; Hungarian Riesling (Italian Riesling progeny); Emerald Riesling (Muscadelle du Bordelais x Riesling). Often wines made in the 'German style' from high acid, light-colored grapes such as Sylvaner and Burger were given the Riesling name even when Riesling grapes were not included in the blend e.g., Hungarian Riesling, Grey Riesling, Kleinberger Riesling.

The naming confusion was perpetuated by an additional twist when the grape came to California. References in California writings from the late 19th century refer to both White Riesling and Johannisberg Riesling. The latter name was a misnomer, as there was no such cultivar abroad. *Amerine and Winkler, 1944*. The name was apparently adopted 'by courtesy after the famous vineyard at Schloss Johannisberg, where it predominated.' *Wetmore, 1884; TTB, 1999.*

Charles Wetmore, Executive Director of the Board of State Viticultural Commissioners, explained in 1884: "Custom has, however, attached the name [Riesling] to other varieties, so that when we wish to speak of this genuine variety, we must now use the word *Johannisberg* to identify it." *Wetmore, 1884*. Premium wine producers came to use the words 'Johannisberg Riesling' to signify that the wine was made primarily or entirely from the White Riesling from the Mosel or Rhine. *Sullivan, 1994, 2008; Sullivan, 1998.*

Riesling vines were planted in the University of California's former Foothill Experiment Station in Jackson, California, in 1889 under the name Johannisberg Riesling. The same cultivar was given the name White Riesling in university vineyards in the first half of the 20th century.

In 1996, the federal Tobacco, Tax and Trade Bureau (TTB) ruled that the name Riesling may not be used on wine labels in the case of any grape that is not really a Riesling. Only the names Riesling (or the synonym White Riesling) were to be allowed on the labels. The purpose of the regulation was to standardize wine label terminology and reduce consumer confusion by reducing the number of synonyms on wine varieties. *TTB, 1999.*

In 1999, the TTB granted an extension to phase out the name Johannisberg Riesling from wine labels until after January 2006 because Johannisberg Riesling was 'not a correct name, was a German geographic term and was a specific winegrowing region in Germany.' In the course of the regulatory process, winemakers argued that many 'inferior Riesling products had been produced in the 1960's and 1970's and that the name Johannisberg Riesling was used to distinguish what they believed was their superior Riesling product.' They indicated that it would take several years to educate American consumers that the term 'Riesling' standing alone designated the same wine previously known as Johannisberg Riesling. *TTB, 1999.*

Wine writer and historian Charles Sullivan wrote that Riesling has been a confusing term in the history of California wine, and until 1997 (extended to 2006), was a term that might go on wine labels as a sort of generic expression. *Sullivan, 1998*. Wine writer Jancis Robinson wrote that the name Riesling was debased in the 1960's and 1970's by being applied to 'a wide range of white grape varieties of varied and often doubtful quality.' *Robinson, 2006.*

Ambiguity related to varietal name and frequent use of synonyms has caused confusion as to the identity of the 'true Riesling,' particularly in California. The cultivar seems now to have attained a clear definition. This article features only the FPS selections that are true Riesling and carry the name Riesling or Riesling renano.

RIESLING COMES TO CALIFORNIA

California wine makers in the 1850's believed that great wine would probably come from the established European cultivars. Riesling was one of several German cultivars (along with Sylvaner and Traminer) that helped propel the nascent California wine industry to a measure of fame in the 1870's. *Sullivan, 1998.*

In the coastal counties of Northern California, the market demanded white wines in the German style and valued White Riesling (also known as Johannisberg Riesling) for its style and elegance. *Sullivan, 2003.* Darrell Corti, a wine merchant in Sacramento, California, characterizes this elegant German-style Riesling wine as semi-dry or dry, with low alcohol, refreshing and delicious to taste with good aging ability. *Corti, 2009.* Other less elegant German-style white wine and blends made from other cultivars were occasionally given the Riesling name or were designated as *hock* (German style white wines, usually with a large amount of Burger grapes in the blend). *Sullivan,1998.*

German immigrants were primarily responsible for bringing Riesling to California around the middle of the 19th century, at the time that the cultivar was very popular in Europe. *Sullivan, 2003.* Some immigrants settled in Santa Clara and Sonoma Counties, and by 1856 those counties began to grow in importance in grape acreage planted. *Peninou, 1998; Carosso, 1951.*

Francis Stock was probably the first to import Riesling to California to his San Jose nursery prior to 1857. *Teiser and Harroun, 1983; Carosso, 1951.* Stock supplied Riesling cuttings to Dr. George Crane in Napa in 1859; these are believed to be Napa's earliest Riesling. *Teiser and Harroun, 1983.* Emil Dresel and Jacob Gundlach planted vineyards that would become Rhine Farm in Sonoma County in 1858. In 1859, Dresel returned to his home in Geisenheim on the Rhine and brought back Riesling cuttings. *Sullivan, 1994, 2008; Sullivan, 1998; Peninou, 1998.* Agoston Haraszthy secured Riesling cuttings on his trip to Europe in 1861 from the Rheingau region for his Buena Vista vineyard. *Sullivan 1994, 2008; Peninou, 1998.*

As Riesling is a cool climate grape, there are only a few regions in California that support growth of the cultivar at its full potential for high quality wine. Riesling has hard wood, which allows it to be cold hardy and frost resistant for cool wine regions. Additionally, the buds are able to withstand winter's cold temperatures. The bunches are compact and susceptible to botrytis and coulure. The botrytis allows for the production of a range of sweet wines as a result of botrytis dessication. *Walker, 2009; Robinson, 2006.*

The variety is adaptable to a wide range of soil types, with highest vigor on fertile soils with high moisture availability. Crop size can range from 4 to 8 tons per acre in California, but Riesling tends to overcrop when grown on deep, fertile soils. *Bettiga, 2003.* Darrell Corti explains that Riesling is more sensitive to soil conditions than are other cultivars. There is a slate flavor in Riesling wines grown on slatey soil and a broad or flat taste to wines grown on the loamy soil of the Palatinate in Germany. *Corti, 2009.*

One of Riesling's unique viticultural characteristics that allows for diverse wine styles is a long, slow ripening period influenced by warm summers and cold winters. The late-budding cultivar ripens early compared to most cultivars but late relative to other German plantings. The long ripening period allows for a selective harvest for desired ripeness, good flavor and acidity which would decrease over a long ripening period. *Walker, 2009; Robinson, 2006.* The result is wines with flavor diversity, from dry to very sweet dessert wines, botrytized specialities and delicate ice wines. *Fischer and Swoboda, 2007; Bettiga, 2003.*

A distinctive feature of wine made from this grape is its powerful aroma. Early ripening in warmer regions can cause the wine to lose that aroma and quality and taste dull due to the loss of acidity. *Robinson, 2006; Wetmore, 1884.* The limited supply of cooler climate areas in California inhibited the widespread planting of Riesling in the state.

Wine historian Charles Sullivan wrote that the cooler climate of Sonoma allowed winemakers to approach the German ideal for Riesling more closely than did the Napa climate. He noted that the upper Napa Valley climate was too warm. *Sullivan, 1994, 2008.* Eugene Hilgard, head of the new Department of Viticulture and Enology at UC Berkeley, spoke at the 1886 Viticultural Convention: "When a Riesling must be rushed through four or five days' fermentation, under the influence of a hot September in the Napa Valley, it is no wonder that its relationship to the produce of Johannisberg is suspected." *Sullivan, 1994, 2008.*

In 1884, Charles Wetmore noted that good Riesling was only going to come from vineyards 'where over-maturity is difficult to obtain' and where at the time of ordinary ripening the must does not exceed 22% in sugar. *Wetmore, 1884.* He wrote that "[Riesling] is an early ripener, otherwise it would not succeed on the Rhine. Experience in Europe shows that it loses its aroma and quality when cultivated in warmer countries and situations where later ripening varieties come to perfection. On the Rhine the greatest perfection is often obtained only when the berries are left on the vines until long after the usual time of vintage."*Wetmore, 1884.*

In the 1940's, UC Professors Amerine and Winkler conducted germplasm trials at UC Davis to determine the wines best suited to California viticultural regions. *Walker, 2000.* In a 1944 publication, the professors grouped the grape districts in the state of California into five climatic regions based on heat accumulation degree days.

Amerine and Winkler recommended White Riesling for high quality dry table wines only in the predominantly coastal counties of regions I and II. They concluded that White Riesling should produce superior wines in region I (Oakville in Napa County; San Benito County; Saratoga in Santa Clara County; Santa Cruz County; and parts of Sonoma County) and fairly good wines in the cooler areas of region II (Monterey County; parts of Napa County; Santa Barbara County; parts of Sonoma County). *Amerine and Winkler, 1944.*

Dr. Larry Bettiga, UC Viticultural Farm Advisor for Monterey, San Benito and Santa Cruz Counties, cautioned about placement of Monterey and Santa Barbara Counties completely within Winkler region II, stating that those two counties have 'some of the coolest growing regions in the state.' *Bettiga, 2009.* At the time of the Amerine and Winkler study (1944), those counties were minor grape growing areas and may not have received extensive testing in the study.

California preferences

Riesling has had an inconsistent track record in terms of acreage planted and wine popularity during the past 150 years in California. In the 1980's, the grape declined in popularity due to a shift in preference to a drier wine style. Recent evidence suggests that Riesling is regaining an audience.

Frederic Bioletti, of the Department of Viticulture at the University of California, did not place White Riesling on his 1907 list of recommended grapes for California. In 1921, the California acreage figure for Riesling (including Franken, Gray and Johannisberg) was estimated at 2000 acres, out of a total of 22,000 acres of white wine grape acreage. *California Grape Grower, June 1922.* In a publication in 1929, Bioletti reviewed the list of principal grapes grown in California at that time and mentioned 'Johannisberger [sic.] Riesling' only in passing reference as a blending grape with Franken Riesling (Sylvaner). *Bioletti, 1929, rev. 1934.*

Prohibition decimated the small California Riesling crop, although Riesling, Cabernet and Zinfandel were the only three varieties named in a category of their own when the State Fair wine competitions resumed in Sacramento in 1934. *Sullivan, 2003.* Department of Agriculture statistics for 1941 to 1945 show no mention of reportable acreage for White or Johannisberg Riesling in California. *California Crop and Livestock Reporting Service, CDFA Bureau of Agricultural Statistics, December 17, 1945.*

After WWII, wine makers in Germany and the United States began to make sweeter wines, which were increasingly favored by the consumer. California winemakers such as Martini and Wente made the first late-harvest botrytized quality Rieslings in the 1960's. *Corti, 2009.*

In 1960, only 282 acres of White Riesling were being grown in California. *Sullivan, 1998.* Small plantings were begun in the coastal counties between 1968 and 1972. *Winkler, 1964.* Meaningful acreage (1000 to 2000 acres of White Riesling grapevines per county) existed in Sonoma, Napa, Monterey, and Santa Barbara Counties by 1975, with small plantings in Mendocino and San Benito Counties. *Sullivan, 1998.*

In 1976, White Riesling ranked 4th in acreage (8,552 acres) among all white wine varieties (96,450 total acres) in California, behind French Colombard, Chenin blanc and Chardonnay. *Olmo, 1978 – unpublished.* The popularity of young, fruity, slightly sweet White Riesling and Chenin blanc premium wines crested in the late 1970's. *Sullivan, 1998.* Less expensive wines were made from high acid, low color grapes from cultivars other than Riesling but were given the Riesling name, e.g., Grey Riesling, Hungarian Riesling. This wine was made in a light, fragrant, fruity style popular with consumers.

The amount of White Riesling acreage in the coastal areas of California began to decrease between 1979 and 1985 in all counties except for Monterey and Santa Barbara. *Sullivan, 1998.* At the World Vinifera Conference on Riesling in Seattle in 1989, concern was expressed that in the period 1978 to 1988, vineyards of other major white wine varietals in California tripled while the area under Riesling vines fell from 8,327 acres to 6,839. *Asher, 1989.*

The Riesling wine boom peaked in the mid to late 1980's with the simultaneous ascendancy of French style dry white wines such as Chardonnay and Sauvignon blanc. The popular preference for dry white wines, along with the perception that Riesling 'is a sweet wine,' contributed to a smaller footprint for the variety in California. Riesling grape acreage in the state shrank from 11,423 acres in 1983 to 1,850 acres by 2003. *Robinson, 2006.*

Recently, sales of quality Riesling wines have increased significantly, suggesting a renaissance for quality wine now made primarily in a dry, fruity style.

In November 2006, *Wine Business Monthly* reported in an article entitled 'Riesling: The new darling white wine': "[b]etween November 2003 and August 2006, sales of the varietal have grown by 72 percent while case volume has increased 58 percent…Sales of Riesling are so strong that some believe the varietal may eventually challenge Sauvignon blanc's place as the third-largest white varietal sold in food stores." *Tinney, 2006.* A second magazine article in 2008 reported that Riesling consumption in the United States rose 54% between 2006 and 2008. *Hall, 2008.* Another author proposed that Riesling has begun to challenge Chardonnay's dominance because of Riesling's 'rich theme and variations.' *Goldberg, 2008.*

In California, Riesling acreage has almost doubled since 2000, albeit on a much smaller base than other California white wine grapes. The premium Riesling wines are limited to the few counties in California that can offer the cooler climate in which the cultivar excels. The total number of acres of White Riesling planted in 2008 was 3,073 acres; 2,322 bearing and 751 non-bearing. The total acreage is up from 2,861 in 2007. Monterey County has by far the most acreage of Riesling at 1,746 acres, followed by Santa Barbara County with 245 acres. *CDFA, 2009.* By comparison, Chardonnay remains at the top for white wines with a total of 91,522 acres.

In 2003, when the Riesling acreage reached its low point of 1850 acres, the total tons of White Riesling grapes crushed in the state of California was 8,467 tons. The number of tons has steadily increased since that time and was 15,397 tons in 2008. *Grape Crush Report, 2003 and 2008, www.nass.usda.gov/ca.*

There is still evidence of confusion among consumers related to Riesling wine. An October 2008 article in *Wine Business Monthly* reported that research commissioned by the International Riesling Foundation (IRF) showed that almost half of the respondents think Riesling is 'sweet' and do not understand the terms 'off-dry' and 'late harvest.' The survey concluded that consumers do not know what to expect in a bottle of Riesling. Riesling Sugar Guidelines have been proposed to educate consumers and the trade on the differences between dry, medium dry, medium sweet and sweet categories (sugar and acid ratios). *Hall, 2008.*

RIESLING SELECTIONS AT FPS

The FPS Riesling collection contains selections that originated in California, Germany, France, Italy, Australia and Argentina. When 'true Riesling' vines came to Foundation Plant Services before 2003, they were given the name White Riesling, one of the accepted synonyms for the cultivar. The FPS selections with that name were renamed with the simple 'Riesling' name in 2003 because that name was the preferred prime name internationally and was the TTB-approved prime name for wine labels in the United States.

SELECTIONS WITH CALIFORNIA ORIGIN

UC Professor Harold Olmo conducted clonal selection of grape cultivars in California in the 1940's and 1950's. His goal was to select variants in vineyards across the state emphasizing good cluster formation, high yields, fruit quality and disease free status. *Walker, 2000.* Olmo identified White Riesling as an important commercial variety in California in the 1940's; he commented at the time that White Riesling was a premium cultivar known to be 'variable and unreliable.' *Olmo, H.P. 1942 and 1964.*

Olmo began clonal selection work on Riesling around 1950. **Riesling FPS 10 and Riesling FPS 28** represent fruits of that effort. The two selections originated from the Martini family's Monte Rosso vineyard in Sonoma County.

The Mt. Pisgah vineyard was originally planted in 1885 on a mountainside in the Mayacamas Range overlooking the Valley of the Moon. Riesling was one of the cultivars planted in the 300-acre vineyard. Phylloxera destroyed the original vines at what became known as Goldstein Ranch. The vineyard was restored and fully producing again by the turn of the 20th century. *Peninou, 1998.* The vineyard survived Prohibition because the owner at the time sold his grapes commercially and did not make wine. *Pitcher, 2007.*

Louis Martini purchased the well-respected Mt. Pisgah vineyard in 1936 and renamed it 'Monte Rosso' (red mountain). In an oral history interview with UC in 1973, Mr. Martini mentioned that there were quite a few good varieties in the vineyard (including Sémillon, Sylvaner and Folle blanche) when he purchased it, but he did not specifically mention Riesling. Other sources report that Riesling was one of the cultivars on the property. *Pitcher, 2007.* Martini began planting grapes in the Monte Rosso vineyard in 1939, including what he referred to as Johannisberg Riesling. *Martini, L.M , 1973; Sullivan, 1994, 2008.*

In 1951, Dr. Olmo selected Riesling wood from the Monte Rosso vineyard for clonal evaluation trials. That wood was described as 'clones 1-25' from the Monte Rosso vineyard. *Olmo, undated.* In the Olmo files located in Special Collections at UC Davis' Shields Library, a paper in Olmo's handwriting dated August 1951 states: 'Bud selection. L.M. Martini, Monte Rosso. 1-25 White Riesling. Hilltop. Best vines only. Many vines of shot berry type, some flower clusters drying completely and sterile. Some not shedding calyptras.'

Louis Martini had also purchased approximately 200 acres of the Stanly Ranch in the Carneros section of Napa in 1942. *Martini, L.P., 1973.* Olmo conducted 'progeny' (clonal) tests on this property for several varieties, most notably Chardonnay. A handwritten map of the Stanly Lane vineyard property was discovered in the Olmo files in Special Collections. The map indicates that Olmo also conducted progeny tests on the White Riesling Monte Rosso clones 1-25 at the Stanly Lane site.

It is clear that **Riesling FPS 28** originated from Martini's Monte Rosso vineyard. The precise origin of **Riesling FPS 10** was not as well-documented in the FPS records.

The FPS database and old [Austin] Goheen indexing records state definitely that the source vine for **Riesling FPS 28** came to FPS around 1965 from the Martini Stanly Lane vineyard (location r10 v8), the location of the Monte Rosso clonal trials. In fact, a handwritten document in FPS files ('Foundation candidates') dated March 9, 1965, indicates that *two clones* were brought to FPS from the 'Martini vineyard, Napa'—one from location r10 v8 (clone 8) and one possibly from r23 v3 (clone 25). *Olmo, 1965.* The March 1965 paper is significant because it identifies a second Monte Rosso clone coming to FPS at that time.

FPS source information for **Riesling FPS 10** shows that it originated from 'a' Martini vineyard around 1965, but does not tie the selection to the Monte Rosso clonal tests. The documents from old Olmo and FPS files show that **Riesling FPS 10** was undoubtedly the second Monte Rosso clone that was brought to FPS from the Stanly Lane property in Napa at the same time as Monte Rosso 'clone 8' (**FPS 28**). UCD documents related to clonal trials conducted on the two selections in 1975-1981 state clearly that the source vines for **Riesling FPS 10 and 28** were not the same vine at Stanly Lane. *Alley, 1975.*

Riesling FPS 10 came to FPS around 1965 and was given the name White Riesling FPS 10. Curtis Alley, a UC Davis viticulture specialist and former manager of FPMS, also referred to **Riesling FPS 10** as superclone #107. Source information was likely entered in the White Riesling section of Goheen's indexing binder as 'No number' because the exact source location from Stanly Lane was at issue.

The two Martini Riesling clones were entered together sequentially in the indexing binder and both underwent preliminary index testing at FPS in 1964-65. After preliminary index testing, **Riesling FPS 10** underwent heat treatment for 105 days and was first planted in the foundation vineyard in 1967. The selection first appeared on the list of registered vines in the California Grapevine Registration & Certification Program (R & C Program) in 1970. The name was changed to Riesling FPS 10 in 2003.

Riesling FPS 28 proceeded in a more circuitous route to the foundation vineyard at FPS. Upon its arrival at FPS from the Martini Stanly Lane vineyard around 1965, this selection was assigned the name White Riesling FPS 15. After preliminary index testing, the selection underwent heat treatment for 154 days and was planted in the foundation vineyard in May of 1972. White Riesling FPS 15 first appeared on the list of registered vines in the R&C Program in 1991.

Although this selection never tested positive for virus, White Riesling FPS 15 underwent micro shoot tip tissue culture therapy in 1999. The reason for the therapy is unclear, except that this selection was removed from the list of registered vines after virus was discovered in the foundation vineyard in 1992-1993. In 2008, the tissue culture version of this selection was released as **Riesling FPS 28**, which at this time has Provisional status in the R&C Program.

Riesling FPS 04 came to FPS before 1963 from an unknown source. The initial entry for the selection in the Goheen indexing binder states 'No record of source.' Nothing in the historical library documents or other FPS records contradicts that statement. There is no indication in USDA files that the selection was imported from abroad, so it is most likely a local donation. The plant material was originally given the name White Riesling FPS 04 and received no treatment. The selection first appeared on the list of registered vines in 1971. Its name was changed to **Riesling FPS 04** in 2003.

GERMAN CLONES

FPS has numerous Riesling clones from Germany, the presumed home of the cultivar. The clones come from three areas: the Rheingau, the Mosel region and the Pfalz (Palatinate).

Clonal selection in Germany began in the 19th century. *Rühl et al., 2004.* Called 'systematic preservation breeding of vine varieties', the process included careful initial individual selection followed by observations and repeated testing on successive clonal descendants. Eventually the method evolved so that the successive A, B and C clone levels were all subjected to progeny testing. Research stations and private breeders adopted the concept of repetitive selection for high performance in the 1920's. *Rühl et al., 2004; Schöffling and Stellmach, 1996.*

By 2003, 99 grapevine cultivars were officially registered at the federal office Bundessortenamt. Seventy-five of those cultivars were bred during the 20th century. The 99 cultivars included 530 registered clones, of which 86 belong to one cultivar, Riesling. *Jung and Maul, 2004.*

The Institute at Geisenheim

The Rheingau region of Germany is thought of as Riesling's historical and traditional home. Some say the Golden Age of Rheingau Riesling was from 1870 to 1930. The region is a small region (forty miles long by three miles wide) and runs along the Rhine River near Wiesbaden. *Price, 2004.* Today 80% of the vineyards in the Rheingau region are planted with Riesling grapes. *Robinson, 2006.* The International Riesling Foundation reports that many Rheingau Rieslings are made in the dry style and are rich and full-bodied, usually with a pronounced acidity and spiciness to the wines.

In 1872, Prussia established a horticulture and viticulture research institute at Geisenheim (Forschungsanstalt Geisenheim—Geisenheim Research Center) in the heart of what is now the Rhinegau region. *Robinson, 2006.* The Prussian government also initiated grafting improvement measures and clonal selection to improve the health status of grapevines. The institute for grapevine breeding and grafting was later established in 1950 as part of the Geisenheim Research Center. *Rühl, September 2009.*

Clonal selection focusing on White Riesling commenced at Geisenheim in 1921. Selection criteria were based on healthy growth, absence of virus symptoms and performance measures such as consistent yields and high wine quality. One of the goals of the program was to preserve the wide genetic base of the Riesling cultivar. By the end of the 1950's, seven clones were available to growers, including 110Gm (Geisenheim), 198Gm and 239Gm. *Bettiga, 2003; Schmid et al., 1995.* The original clones were tested further and subclones were created and tested, including 239-25Gm.

The virus-tested Geisenheim White Riesling clones and subclones were tested from 1978 to 1993, and regular crops with good sugar and acid levels were produced each year. At that time, virus tests were conducted in the institute's laboratories as well as at INRA's Colmar facility. The researchers concluded that no significant differences could be detected between them in regard to yield, sugar, acid levels and pH, and attributed that result to a generally high selection level. *Schmid et al., 1995.*

Two Riesling selections of German origin thriving in the FPS Foundation Vineyard: left, Riesling FPS 12 and at right, Riesling FPS 23.
Photos by Bev Ferguson

Three Geisenheim Riesling clones are in the FPS public collection: two selections of Geisenheim 110 (110Gm), one selection of Geisenheim 198 (198Gm) and one selection of Geisenheim subclone 239-25 (239-25Gm).

German clone 110Gm is represented in the FPS collection by **Riesling FPS 09** and **Riesling FPS 24.** This clone has an extremely fruity, slightly muscat flavor, and in warmer sites it is regarded as not typical of German Riesling wines. *Bettiga, 2003.*

Riesling FPS 09 was imported to Davis from Geisenheim in 1952 with the notation that it was 'Rhein Riesling klon 110' (USDA Plant Introduction #200886). The selection was initially named White Riesling FPS 03. It underwent heat treatment for 112 days, and FPMS manager Curtis Alley assigned it the alternate designation of superclone #106 (related to the length of the heat treatment therapy). After heat treatment, the selection was renumbered White Riesling FPS 09, which was first planted in the foundation vineyard in 1965 and appeared on the list of registered vines in 1967. The name was changed to **Riesling FPS 09** in 2003. A version of **Riesling FPS 09** that has been subjected to macro shoot tip tissue culture therapy for elimination of *Agrobacterium vitis* is also available.

Riesling FPS 24 was also imported to Davis from Geisenheim in 1952 as 'Rhein Riesling klon 110'. It has the same source as Riesling FPS 09 and was originally distributed by FPS as White Riesling FPS 03. The original material for this selection tested positive for Rupestris stem pitting. The selection was dropped from the R&C Program in the early 1980's because at that time, RSP positive vines were not allowed. The plant material was maintained at FPS and the name changed in 2003 to Riesling FPS 03. In 2007, microshoot tip tissue culture therapy was used to create an RSP-free selection of 110Gm, which was given the name **Riesling FPS 24** in 2008 and recently attained Registered status.

German clone 198Gm is represented in the FPS collection by **Riesling FPS 17**. This clone has lower crop yields with wines of elegant fruitfulness and pronounced flavor, but with all components in good balance. *Bettiga, 2003*. This clone is ideal for the production of high quality semi-dry wines. Geisenheim clones 198Gm and subclones of 239Gm are recommended for planting in warmer sites. *Schmid et al., 1995.*

Riesling FPS 17 was imported to Davis from Geisenheim in 1952 under the name 'Rhein Riesling klon 198' (USDA PI #200888). The selection was named White Riesling FPS 02 and did not undergo any treatment. It was first planted in the foundation vineyard in 1961 and appeared on the list of registered vines in 1965. The name and number were changed to **Riesling FPS 17** in 2003, and the selection appeared on the list of registered vines that year under that new number. The selection number was changed to 17 because FPS already had a selection named Riesling FPS 02. A version of **Riesling FPS 17** that has been subjected to macro shoot tip tissue culture therapy for elimination of *Agrobacterium vitis* is also available.

German clone 239-25Gm is represented in the FPS collection by **Riesling FPS 23.** This versatile clone with its sub-clones is the most widely distributed selection in Germany and produces fruity wines with a wide range of terpenes, resulting in a spectrum of fruitfulness. *Bettiga, 2003; Schmid et al., 1995.*

In the mid-1980's the Oregon Winegrowers' Association and Oregon State University (OSU) collaborated on a project related to a mutual interest in European clonal material. They imported many European clones to Oregon. In response to interest from the California grape and wine industry, OSU agreed in 1987-88 to make some of the clones available for the public collection at FPS.

Riesling FPS 23 was imported from Geisenheim by OSU and then sent to FPS in 1987. OSU received the original material labeled 'Riesling 239-25Gm'. When the selection arrived at FPS, it was designated Riesling FPS S1. Tests in the late 1980's detected RSP virus, so the selection was distributed in the 1990's as non-registered, RSP+ Riesling FPS 02. [This selection should not be confused with *White* Riesling FPS 02, which was the precursor to Riesling FPS 17].

In 2007, Riesling FPS 02 was renamed **Riesling FPS 23**, which had been vegetatively propagated from a cutting of the original source plant. There is no indication in either the FPS database or the FPS tissue culture records that this selection ever underwent microshoot tip tissue culture therapy, although an article in the 2007 FPS Grape Program Newsletter so indicated. It appears that the article was in error. The new selection number was most likely a product of moving the selection from the V&E vineyard location into the FPS foundation vineyard. The new **Riesling FPS 23** planting has tested positive for the RSP virus and has recently attained Registered status.

The Mosel region

The Mosel is portrayed as the quality region for Riesling wine. Traditionally the wines tended to be delicate, lower in alcohol (often 8%), higher in acid, floral and intensely mineral. According to the IRF, the wine is usually made in an off-dry style because of the higher acidity. At the same time, this region has produced excellent botrytized wines because of the long-ripening period allowed by the sheltered river valleys and a favored moist climate to promote botrytis. *Fischer and Swoboda, 2007.* Almost 70% of the grape acreage in the Mosel region is dedicated to Riesling. Steep south-facing vineyards allow it to flourish in this northern area. *Robinson, 2006; Price, 2004.*

The Central Office for Clonal Selection is located in the cities of Trier and Bernkastel-Kues, Germany, in the Mosel region. Dr. Günther Stellmach is associated with that office and, in 1987, was responsible for sending what was then called the 'Riesling 21B' clone to the grape program at Oregon State University. *Winegrowers Project, 1988.* The selection was in turn sent that year from OSU to Foundation Plant Services as part of the Winegrowers' Project and is now known as **Riesling FPS 01.**

German clone 21B was found in the Mosel region in Bernkastel-Kues (the B in the name allegedly refers to Bernkastel). The clone is now known as Weis 21, after the breeder Hermann Weiss. *www.urbans-hof.com/mosel-pflanz-service/index.html – in German.* When the berries of Weis 21 are smaller, the must density and wine quality increase. *Schöffling and Stellmach, 1996.* A common comment from growers is that the clone is highly productive. The records are not clear whether FPS received the clone in the form in which it now exists or in some prior earlier stage in the clonal development process.

The Riesling 21B clone was initially given the name Riesling 21B S1 at FPS. Sometime prior to 2000, the name was changed to **Riesling FPS 01**. Riesling FPS 01did not receive any treatment at FPS. It was first planted in the foundation vineyard in 1990 and appeared on the list of registered vines in the R&C Program in 2000.

The Pfalz (Palatinate)

The Pfalz region in the Palatinate joined the Rheingau and Mosel as great wine region in the middle of the 19th century. The 'southern wine route' (Südliche Weinstrasse) runs from Neustadt to the French border along the Haardt Mountains. *Price, 2004.* The climate in the region is benign, and Riesling accounts for 20% of the vineyard plantings. *Robinson, 2006.*

Pfalz Riesling typically ripens to over 12 % alcohol and appears to be particularly suitable for vinification to 'completely dry, relatively corpulent' Rieslings. *Robinson, 2006.* Another description of Pfalz Riesling describes them as 'clear, pure wines'. *Robinson, 2006.* The region is also known for its spicy Spätlesen and Auslesen. This spicy character is attributed to one of the German Riesling clones, clone 90, which is unique to the Pfalz.

Neustadt in the Pfalz region is an important center for viticultural and wine research. Clonal development work is done at the Neustadt Research Institute, which is now known as Dienstleistungszentrum Ländlicher Raum Rheinfalz (known in 1963 as Landes Lehr und Forschungsanstalt at Neustadt). The wine school in Neustadt was established in 1899 by the citizens of Neustadt an der Weinstrasse. The Hessian wine academy at Oppenheim dates from 1885. *Robinson, 2006.*

Two German clones from the Pfalz region are included in the FPS public collection: **Riesling FPS 12 and Riesling FPS 21**. Both were sent to Davis in May, 1963, from the Neustadt Research Institute.

There is only one Riesling clone that was developed at Neustadt. **Riesling FPS 12** is German clone 90 (also known as N90, for 'Neustadt 90'). Clone 90 was first recognized as a superior clone by German researchers in 1913. Reportedly, years of experimentation proved the clone to be aromatic, cold tolerant and disease resistant. *Alley, 2008.*

This selection arrived in Davis in 1963 (USDA PI #289905) and was initially named White Riesling FPS 12. It received no treatment and was planted in the foundation vineyard at FPS in 1969. White Riesling FPS 12 first appeared on the list of registered vines in the R&C Program in 1970, later renamed **Riesling FPS 12** in 2003. A version of **Riesling FPS 12** that has been subjected to macro shoot tip tissue culture therapy for elimination of *Agrobacterium vitis* is also available.

The second selection imported from the Institute at Neustadt in 1963 was **Riesling FPS 21**. The source of this selection is 'clone 356'. Originally this Riesling clone was called Trautwein 356, indicating selection by a man named Trautwein. When he died, a man named Finkenauer continued selecting the A clones. Finkenauer maintained the number 356 but changed the clonal designation to 356Fin.

According to Matthias Zink, manager of the vine nursery at Neustadt, clone '356 Fin' was previously held at the Institute at Bad Kreuznach; it is now held at the Institute in Oppenheim (Dienstleistungszentrum Ländlicher Raum Rheinpfalz Rheinhessen-Nahe-Hunsrück). Curtis Alley reported that the clone sent to FPS was the clone 356 held at Bad Kreuznach. *Alley, 1977.*

Upon its arrival in Davis, clone 356 was given the name White Riesling FPS 14 and was planted in the foundation block at FPS in 1970. It does not appear on any of the lists of registered selections in the 1970's and 1980's, even though all of the original virus tests were negative. In 1981, White Riesling FPS 14 tested RSP+, which would have disqualified it for the R&C Program at that time. The name was changed to **Riesling FPS 14** in 2003. In 2006, **Riesling FPS 21** was created from **Riesling FPS 14** by use of micro shoot tip tissue culture therapy. The selection now has registered status in the R&C Program.

Private German Selections

There are three proprietary German selections held at FPS on behalf of Vino Ultima, Inc: **Riesling FPS 25, 26, and 27**. These are new subclones of clones 110, 198, 239 contained in the Geisenheim collection. The three selections came to FPS in 2006 and have Provisional status in the R&C Program. Joachim Hollerith comments that 'these are some of the best clones available in Germany and Europe. California grape growers may now access the new Geisenheim clone material from one source'. *Hollerith, August 2008.* A limited amount of grafted vines of these clones will be available in 2010.

FRENCH CLONES

The French region of Alsace, near the German border, claims to be one of the locations where Riesling was born. *Fischer and Swoboda, 2007.* A possible early written reference appeared on a 1348 map in Kintzheim, Alsace, as '*zu dem Russelinge'. Price, 2004.* The spelling was similar to several cultivars of the time, so no definitive conclusion can be drawn. Riesling was mentioned in writing for the first time during a 1477 visit by Duke René of Lorraine. *Fischer and Swoboda, 2007.* From the 16th century, Riesling became recognized as the finest white grape in Germany, which at the time included Alsace. *Price, 2004.*

There are three selections from France in the FPS public collection: **White Riesling FPS S1, Riesling FPS 20 and Riesling ENTAV-INRA®49**. All three are versions of the same French clone.

White Riesling FPS S1 came to FPS via OSU as part of the Winegrowers Project in 1987. The Winegrowers' Report indicates that White Riesling clone 813 (certified in 1971) was imported from the French government research center in Colmar, the Centre de recherché de Colmar of the Institut national de la recherché agronomique (INRA). At the time it was imported to FPS via OSU, this French clone was known as White Riesling clone 813 from Colmar, Alsace. Alsatian clone 813 has since been re-designated official French clone ENTAV-INRA®49. White Riesling FPS S1 was imported prior to ENTAV-INRA developing licensing and trademark protection for French clone 49. *ENTAV, 1995.*

White Riesling FPS S1 is currently planted in the quarantine vineyard at FPS and is undergoing index testing, results of which should be available in spring of 2010. The selection has tested RSP+ in the past. It will be assigned an FPS selection number when it is advanced in the R&C Program to the foundation vineyard.

Riesling FPS 20 was donated to the FPS public collection in 1999 by Clos Pepe Vineyards in Lompoc, California. The selection is a Riesling clone reportedly from Alsace, France, most likely Alsatian clone 813. The original material tested positive for leafroll virus, so it underwent micro shoot tip tissue culture virus elimination therapy in 2005. **Riesling FPS 20** was planted in the foundation vineyard in 2008 and now appears on the list of registered vines for the R&C Program.

The Etablissement National Technique pour l'Amelioration de la Viticulture (ENTAV) is an official agency certified by the French Ministry of Agriculture and responsible for management and coordination of the French national clonal selection program. ENTAV maintains the French national repository of accredited clones and created an ENTAV-INRA® authorized trademark to identify its official clonal materials internationally. Trademarked importations come directly from official French source vines.

Riesling ENTAV-INRA® 49 is the official French clone for Riesling 49 and came to FPS in 2000. The ENTAV-INRA literature on the clone indicates that when yields are controlled, the wines are very well balanced and very typical. Riesling ENTAV-INRA®49 is a proprietary selection at FPS and is distributed through ENTAV-INRA licensees. The selection appears on the list of registered vines for the R&C Program.

ITALIAN CLONES

Riesling was introduced to Italy in the 19th century, probably from the Rhine Valley in Germany. *Calò et al., 2001*. The best locations for planting in Italy are Trentino Alto Adige, the area above Lago di Garda in the Italian Alps and in Friuli near Slovenia. Riesling is known in Italy as Riesling renano.

There is another grape cultivar in Italy with the name 'Riesling', which is genetically unrelated to the 'true Riesling' (Riesling renano). Riesling Italico (also known as Walsch or Welsch Riesling) has characteristically different morphology and produces distinctly different wine than Riesling renano. *Calò et al., 2001*.

There are two Riesling clones from Italy in the FPS public collection: **Riesling FPS 19 and Riesling renano FPS S1**. The plant material that eventually became **Riesling FPS 19** was imported directly to FPS from Italy in 1988 as a follow up to the Oregon Winegrowers' Project. The selection came to FPS from Dr. Antonio Calò of the Instituto Sperimentale per la Viticoltura (ISV) in Conegliano, Italy, and was labeled Riesling Italico clone ISV-CPF 100. *Winegrowers Report, 1988*. Apparently 'CPF' stands for 'Centro Potenziamento Friuli' (Improvement Center for Friuli), but there is no Riesling clone (either renano or Italico) in Italy with the number 100.

Once at FPS, the selection was originally assigned the name Riesling Italico FPS S1. A new selection was created from FPS S1 in 2001 using microshoot tip tissue culture therapy, resulting in Riesling Italico FPS 03. Subsequent ampellographic and DNA analysis (2003) at FPS revealed that the FPS 03 plant material was not Riesling Italico but was, in fact, the true Riesling. The name was changed to **Riesling FPS 19** in 2005 to reflect its correct cultivar identification. **Riesling FPS 19** first appeared on the list of registered vines for the R&C Program in 2005.

The second true Riesling from Italy in the public collection is **Riesling renano FPS S1**. This selection was imported directly to FPS in 1988 as part of the Winegrowers' Project. The plant material was supplied by Dr. Calò of the ISV (Conegliano) and was labeled clone ISV 10. *Winegrowers' Report, 1988*. **Riesling renano FPS S1** is planted in a quarantine vineyard at FPS and is currently undergoing index testing. It should be ready for release in spring 2012 if it tests negative for pathogens. When it advances in the program, it will be assigned an FPS selection number under the name Riesling.

A third Riesling clone at FPS is a proprietary clone from Vivai Cooperativi Rauscedo (VCR), clone VCR 3. It is reported that VCR 3 has small clusters and average and uniform berries, with good resistance to botrytis bunch rot. *Calò et al., 2001*. The selection came to FPS in 1998 from Italy and underwent micro shoot tip tissue culture disease elimination therapy in 2003. **Riesling renano FPS 01** is distributed by Novavine Nurseries. Novavine has chosen to retain the name Riesling renano for this selection.

SOUTHERN HEMISPHERE CLONES

Australia

In 1970, Dr. Goheen imported a White Riesling clone from Victoria, Australia. The plant material was sent by R.H. Taylor at the Victorian Plant Research Institute in Burnley, Victoria, and was labeled White Riesling 'Tulloch S.A. 140' (USDA PI # 364292). **Riesling FPS 16** did not receive any treatment and was first planted in the foundation vineyard in 1973. When nearby vines tested positive for virus, the registered FPS 16 vines were put on hold status. The foundation vines for this selection later tested positive for GVA. Meristems have been taken from those vines to begin the process of micro shoot tip tissue culture disease elimination therapy. Index testing on the new tissue culture vines will begin if they survive.

Argentina

Riesling FPS 22 was imported to Davis in August, 1961, from Fernandez-Montero in Mendoza, Argentina, under the name 'Riesling' (USDA PI #277335). The selection was initially assigned the name White Riesling FPS 13 and planted in the foundation vineyard in 1967. The selection does not appear on any of the lists of registered vines in the 1970's and 1980's. White Riesling 13 tested positive for RSP in 1981, which would have disqualified it for the R&C Program at that time. In 2003, the name was changed to Riesling FPS 13. In 2006, **Riesling FPS 22** was created from Riesling FPS 13 by microshoot tip tissue culture therapy. The selection now has registered status in the R&C Program.

CLONAL TRIALS

Not surprisingly, there have been few clonal trials of FPS Riesling selections in California. The climate is suitable for optimal Riesling production in only a limited portion of the state. One major clonal trial occurred in Davis in the late 1970's, and another has only recently begun in the more suitable environment of Monterey County.

Dr. Harold Olmo conducted clonal selection and wine trials on White Riesling from the 1950's through the 1970's. His clonal selection program on the Martini property in Napa did yield selections with different characteristics; two of those selections are in the FPS public collection. *Olmo, 1978*. Details of specific data are absent from the Olmo files and FPS. A clonal test plot containing FPS selections 3, 4, 9 and 10 was planted at Oakville in 1969. The study does not appear to have been published or have reported results.

In 1975, Curtis Alley (UC Davis Department of Viticulture and Enology) began a clonal study in the Davis research vineyard on nine FPS White Riesling selections – FPS 02 (198Gm), FPS 03 (110Gm), FPS 09 (110Gm), FPS10 (Martini, Napa), FPS 11 (Neustadt), FPS 12 (N90, Neustadt), FPS 13 (Argentina), FPS 14 (356, Neustadt), and 15 (Martini, Napa). The plots were made up of 26 single vine replications. They were brought up to vertical cordon by 1977. *Alley, 1977*. Considerable data was noted by Alley on handwritten files between 1978 and 1981, although data for 1977 was considered unreliable due to scale malfunction. *Alley letter to Berti, December 6, 1977*. A summary of four years' data prepared by Alley and A.T. Koyama (dated June, 29, 1982) is available. *Alley and Koyama, 1982*. A progress report submitted to the sponsor of the Riesling trial is also available in the old files. *Alley letter to Berti, 1981*.

The clones were scored on the basis of 'overall viticultural rating' by allowing 10 points (a=10, b=7, c=4, d=1) for crop weight, which was the most important factor; 3 points each for vine vigor and cluster number (a=3, b=2, c=1), and 2 points for cluster size (a=2, b=1). *Alley letter to Berti, 1981*.

After two years of data, no significant differences were noted for fruit production. All clones produced an exceedingly high 10.9-12 tons per acre. No significant differences were observed for mean cluster numbers or size. Clones 13 and 14 showed the most vine vigor (brush weight). The scoring using the viticultural rating system gave the highest rating to clones 2 (198Gm, now Riesling FPS 17) and 11 (a Neustadt clone that is no longer at FPS); intermediate ratings to clones 9 (110Gm), 10 (Martini), 12 (N90), 13 (Argentina, now Riesling FPS 22), and 15 (Martini, now Riesling FPS 28); and the lowest rating to clones 3 (110Gm, now Riesling FPS 24) and 14 (clone 356, now Riesling FPS 21). *Alley letter to Berti, 1981*.

There is an abbreviated summary of data from the complete duration of the trial, 1978-80. *Kasimatis letter to Alley, 1982*. Three years of data was collected and tabulated. The performance of the White Riesling clones did not show definite differences. Four selections from the nine clones were made, based on their differences in yield: high – clones 2 and 11; medium – clone 15; low – clone 13. *Alley and Koyama, 1982*. Yield for clones 2 and 11 was high (9.2 tons and 9.1 tons per acre), for clone 15 was moderate (8.5 tons) and for clone 13 was low (7.0 tons). All clones were similar for vine vigor (10.5-12.8 pounds per vine). Mean cluster numbers per vine were: clone 2 (124.2), clone 11 (125.2), clone 15 (114.5) and clone 13 (106.3). The mean cluster weight for all four clones was .32 pounds. *Kasimatis letter to Alley, 1982*.

Current clonal evaluation in a climate more suitable to Riesling is underway in Monterey County. Dr. Larry Bettiga has developed a trial at a vineyard in the Arroyo Seco appellation of Monterey County to evaluate the following selections: FPS 01, FPS 04, FPS 09, FPS 10, FPS 12, FPS 17, FPS 20, FPS 21, FPS 22, and FPS 23, and ENTAV-INRA®49. Data collection is expected to begin in 2010. The trial will evaluate viticultural differences between the clones. There are also plans with a cooperating winery to make wines from this site.

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Riesling Selections at Foundation Plant Services

(September 2009)

Name	FPS Selection	FPS Status	Treatment	Source
Riesling FPS 01	0000-0-5674-01	R	None	Riesling clone 21B (now known as Weis 21), Germany via Oregon State University in 1988
Riesling FPS 04	0000-0-345-04	R	None	Unknown, to FPS around 1963; formerly known as White Riesling FPS 04
Riesling FPS 09	0000-0-1341-09	R; P in Goheen	Heat treatment 112 days for regular vines; macroshoot tissue culture for Goheen vines (tested for *Agrobacterium vitis*)	Geisenheim clone 110, from Germany in 1952; formerly known as White Riesling FPS 03 and White Riesling FPS 09
Riesling FPS 10	0000-0-1343-10	R	Heat treatment 105 days	Martini Monte Rosso vineyard in Sonoma County via Martini vineyard in Napa County in 1965; formerly known as White Riesling FPS 10
Riesling FPS 12	0000-0-1346-12	R; P in Goheen	None for regular vines; macroshoot tissue culture for Goheen vines (tested for *Agrobacterium vitis*)	Neustadt clone 90, from Germany in 1963; formerly known as White Riesling FPS 12
Riesling FPS 16	1970-0-1350-16	N	Currently undergoing microshoot tip tissue culture therapy	Victorian Plant Research Institute in Burnley, Victoria in 1970; registered foundation vines are on HOLD status; tissue culture therapy in progress on plant material from registered vines
Riesling FPS 17	0000-0-7690-17	R; P in Goheen	None for regular vines; macro shoot tissue culture for Goheen vines (tested for *Agrobacterium vitis*)	Geisenheim clone 198, from Germany in 1952; formerly known as White Riesling FPS 02
Riesling FPS 19	1988-0-8033-19	R	Microshoot tip tissue culture	Instituto Sperimentale per la Viticoltura, Conegliano, Italy, in 1988; initially misidentified as Riesling Italico FPS 03; DNA analysis (2003) showed that this selection is Riesling weiss
Riesling FPS 20	1999-15-7995-20	R	Microshoot tip tissue culture	Alsace, France via Clos Pepe Vineyards, Lompoc, California 1999
Riesling FPS 21	1963-0-8172-21	R	Microshoot tip tissue culture from FPS 14	German clone 356Fin (formerly Trautwein 356) from Neustadt, Germany in 1963; formerly White Riesling FPS 14 and Riesling FPS 14; underwent tissue culture therapy in 2006 because Riesling FPS 14 was RSP+

*Proprietary selections are indicated in boldface type

*FPS Status: R=Registered; P=Provisional (awaiting professional identification); N and Q=in the Pipeline at FPS

Riesling Selections at Foundation Plant Services (cont.)

Name	FPS Selection	FPS Status	Treatment	Source
Riesling FPS 23	1987-0-8346-23	R	None, RSP+	Geisenheim clone 239-25, from Germany via Oregon State University in 1987; formerly known as Riesling FPS 02
Riesling FPS 24	0000-0-8394-24	R	Microshoot tip tissue culture from White Riesling FPS 03	Geisenheim clone 110, from Germany in 1952; formerly known as White Riesling FPS 03 and White Riesling FPS 24; underwent tissue culture therapy in 2007 to eliminate RSP virus
Riesling FPS 25	2006-14-8118-25	P		Proprietary subclone (clone 110) from Geisenheim Germany for Vino Ultima
Riesling FPS 26	2006-14-8119-26	P		Proprietary subclone (clone 198) from Geisenheim Germany for Vino Ultima
Riesling FPS 27	2006-14-8120-27	P		Proprietary clone (clone 239) from Geisenheim for Vino Ultima
Riesling FPS 28	0000-0-8543-28	P	Heat treatment 154 days; microshoot tip tissue culture from White Riesling FPS 15	Martini Monte Rosso vineyard in Sonoma County via Martini vineyard in Napa in 1965; formerly known as White Riesling FPS 15; underwent tissue culture therapy in 2008
Riesling ENTAV-INRA®49	2000-7-7790-49	R	None	Authorized ENTAV-INRA® clone 49 from France; to FPS in 2000; proprietary to ENTAV licensees
Riesling renano FPS 01	1998-7-7359-01	P	Microshoot tip tissue culture	Vivai Cooperativi Rauscedo clone 3, from Italy in 1998; proprietary to Novavine Nurseries
Riesling renano FPS S1	1988-0-2661-S1	Q	Currently undergoing microshoot tip tissue culture therapy	Clone 10 from Instituto Sperimentale per la Viticoltura, from Conegliano, Italy in 1988; estimated release is Spring 2012
White Riesling FPS S1	1987-0-2613-S1	N	Currently undergoing index testing; RSP+	Reported to be Alsatian White Riesling clone 813 from Colmar, France via Oregon State University in 1987; precursor to French clone 49; earliest availability in Spring 2010

*Proprietary selections are indicated in boldface type

*FPS Status: R=Registered; P=Provisional (awaiting professional identification); N and Q=in the Pipeline at FPS

Pest Alerts and Updates

LBAM Quarantine Expands to Yolo County

by Cheryl Covert, Plant Introduction & Distribution Manager, FPS

As many of you are aware (*2007 FPS Grape Program Newsletter* article), in July of 2007 Light Brown Apple Moth (LBAM) was discovered in Solano County, in which a portion of the FPS field plantings are located. Solano County and USDA officials surveyed the FPS plantings at that time with no LBAM findings, and a monitored trapping program was established in our vineyards and greenhouses. A Cooperative Light Brown Apple Moth (LBAM) Quarantine Program Compliance Agreement was established at that time with Solano County/CDFA/USDA in which FPS agreed to move regulated plant materials in accordance with the quarantine requirements, ensure all shipments of plant material from the quarantined area include copies of the federal compliance certificate/shield stamp, and keep records of all distributions of plant material originating from the quarantined area. FPS has complied with the conditions of the state and federal LBAM quarantines when distributing propagating material from all LBAM host species, including grapevines.

In April 2009, a moth was discovered in a trap in Davis, and a little over a month later a second moth was detected within 2 miles of the first find. This triggered on June 4, 2009 the extension of the federal and state LBAM quarantine to a 38-square-mile portion of Yolo County that includes most of the vineyards in the FPS collection. Therefore, FPS has now also established a Cooperative Light Brown Apple Moth (LBAM) Quarantine Program Compliance Agreement with Yolo County. The terms of the compliance agreement are identical to those of the Solano County agreement. Because FPS already implemented the LBAM quarantine requirements in our vineyards and greenhouse facilities with the advent of the 2007 Solano County quarantine, we don't expect the quarantine's extension to Yolo County will result in any procedural or shipping documentation changes that will affect our California and U.S. customers.

We do, however, expect to see some changes in our ability to ship plant materials to destinations outside the U.S. Already, Mexico and Canada have restricted imports of plant material from infested areas; China has taken steps toward such restrictions; and others, including Chile, Korea, Peru and South Africa list the moth as a quarantine pest and may require certification that a California export is pest-free. The threat of export restrictions imposed on California crops is one of the greatest concerns the LBAM quarantines represent to the industry.

To date, no Light Brown Apple Moths have been detected in the FPS collection. State officials are currently planning and working through the public review process required to implement various eradication strategies such as pesticide application(s), pheromone mating disruption and sterile insect release. The 60-day public comment period ended on September 28, 2009 on the Draft Programmatic Environmental Impact Report required to initiate any of the alternative strategies. Health-related complaints from previous spraying campaigns in Monterey and Santa Cruz counties and a number of legislative bills and city resolutions to ban spraying over urban areas are some of the obstacles that need to be resolved in order to carry out the state's recommended strategy.

Questions about FPS compliance can be directed to Cheryl Covert at *clcovert@ucdavis.edu*; phone (530) 754-8101. Web sites with current information about LBAM and the quarantine program include:
CDFA: *http://www.cdfa.ca.gov/lbam*
University of California IPM: *http://www.ipm.ucdavis.edu/EXOTIC/lightbrownapplemoth.html*

New Pest Found: European Grapevine Moth

Napa County Agricultural Commissioner Dave Whitmer reported in mid-October 2009 that a European grapevine moth, *Lobesia botrana*, and larvae had been found in Oakville and Rutherfield area vineyards. This moth has not previously been detected in the United States, and the Napa County Department of Agriculture is trapping and surveying the area in cooperation with the USDA and California Department of Food and Agriculture in an effort to determine its spread. Traps have also been placed in parts of Sonoma County.

European grapevine moth activity is greatest from early spring ot mid-late summer. The number of generations varies from two to four annually, depending on climate, food availability, predation, etc. First generation larvae feed on buds and flowers, while later generations feed on single or several berries. A wide range of alternate host plants has been documented. Prefering dry temperate areas, it is a serious grapevine pest in Europe and the Mediterranean, southern Russia, Japan, Middle and Near East, portions of Africa, and more recently, spreading in Chile.

Regulatory actions are under review to determine monitoring and treatment protocols. Information can be found on the Napa County website *www.co.napa.ca.us* or the CDFA website *www.cdfa.ca.gov*, or contact your UC Cooperative Extension advisor.

Grapevine Regulations in Final Revision Process

The proposal to amend the regulations of the California Grapevine Registration & Certification (R&C) Program is presently undergoing final revision by the California Department of Food and Agriculture (CDFA).

After filing the draft revision of the grape regulations with the state Office of Administrative Law (OAL) in the fall of 2008, the ensuing public comment period yielded substantive comments requiring a response by CDFA. On March 17, 2009, a public hearing was held at UC Davis to enable oral presentation of comments to CDFA.

Statements made in writing during the formal comment period and during the March public hearing necessitated amendment of the original proposed regulations, as well as amendment of the initial statement of reasons in support of the draft amended regulations.

CDFA withdrew the draft regulations from the OAL process as a result of the scope of the changes required by the comments. The draft undergoing revision at CDFA will be refiled with OAL and a new comment period initiated once the final revisions are completed.

Mike Colvin, CDFA Nursery, Seed and Cotton Program Supervisor, indicated that CDFA staff has worked diligently since the March hearing to respond to industry concerns, stating "We are very close to issuing a final product that addresses the concerns expressed by industry members. We believe that the amended regulations will result in a significantly improved and stronger R&C Program and will meet the needs of the grapevine industry." Colvin will present an update of the regulatory process at the FPS Annual Meeting at UC Davis on November 12, 2009.

ON THE WEB

National Grape Registry

www.ngr.ucdavis.edu

The National Grape Registry website is a user-friendly reference for locating grape plant material within the United States. Important features on the site include grape variety and clonal profiles, extensive synonym lists, and an easy search function that links prime names with their synonyms. Many commercial nurseries and five public collections list their available plant material.

Other helpful features are a cross-link to the detailed varietal information on the UC Integrated Viticulture Online website and a Glossary.

A project has been initiated to add to the site photos showing grape clusters, leaves and shoots for each clone in the FPS collection.

A 'Pipeline' list for FPS is in the works, and should be available after January 1, 2010. Pipeline means that is in process (testing, tissue culturing, etc.) and not yet available as Provisional or Registered material.

FPS Events

ucanr.org/FPSevents

Our newest website contains information on the FPS events and classes of interest to those involved in our programs. Information on the FPS annual meeting can be obtained here along with the online registration form.

UC Integrated Viticulture Online

iv.ucdavis.edu

Here users have menu selections for UC Researchers, and Viticultural Information, plus useful resources. Viticultural topics include descriptions and links to experts, related websites and, wherever possible, downloadable articles or chapters from UC publications. Look for expanded content in 2010!

Most popular are the videotaped UC Davis Extension classes and other events. These can be found under Video Seminars and Events on the main menu, and include some of the best seminars offered at UC Davis available to all. Look for the Variety Focus series, Leafroll Disease 2008 and 2009 Symposiums, and the Wine and Wine Grape Research 2009 talks. The video crew at UC ANR Communication Services filmed the seminars in high quality. User controls are provided on these Adobe Presenter files.

National Clean Plant Network

ucanr.org/ncpn

This website serves as an up-to-date informational area for meeting notices, agendas and minutes, documents, and PowerPoint presentations for the NCPN. The NCPN is a network of clean plant facilities, with oversight of the funds and planning by several levels of government regulatory agencies, nursery representatives, and researchers.

Photo by Sue T. Sim

The 16th meeting of the International Council for the Study of Virus and Virus-like Diseases of the Grapevine (ICVG) was held August 31–September 4, 2009 in Dijon, France. The ICVG is a scientific organization of grapevine virologists whose mission is to promote research related to virus and virus-like diseases of grapevine and international scientific collaboration. The meeting was organized by Dr Elisabeth Boudon-Padieu and her colleagues of INRA Dijon and Colmar as well as of the University of Burgundy. The Louis Latour winery (shown above) on the famous Corton hill in the Côte d'Or region of Burgandy hosted a wine tasting and vineyard tour for the ICVG attendees.

Over 160 scientists from viticultural regions around the world participated. Deborah Golino, Adib Rowhani, Fatima Osman and Sue Sim from Foundation Plant Services, UC Davis, and Rodrigo Almeida from UC Berkeley attended and presented the following talks and posters:

Comparison of High Throughput Low Density Arrays, Rt-PCR and Real-Time Taqman® RT-PCR in the detection of grapevine viruses–Osman F., C. Leutenegger, D.A. Golino, A. Rowhani

High-Throughput sequencing analysis of RNAs from a grapevine showing Syrah decline symptoms reveals a multiple virus infection that includes a novel virus–Al Rwahnih M., S. Daubert, D.A. Golino, A. Rowhani

Survey of wild grapes, weed and cover crop species for grapevine viruses–Golino D.A., S.T. Sim, F. Osman, R. Aldamrat, V. Klaassen, A. Rowhani

Rapid spread of leafroll disease in Cabernet Sauvignon grapevines in Napa Valley, California–Golino D.A., E. Weber, S.T. Sim, A. Rowhani

Virus effects on vine growth and fruit components of three California 'heritage' clones of Cabernet Sauvignon–Golino D.A., J. Wolpert, S.T. Sim, J. Benz, M. Anderson, A. Rowhani

Virus effects on vine growth and fruit components of Cabernet Sauvignon on six rootstocks–Golino D.A., J. Wolpert, S.T. Sim, J. Benz, M. Anderson, A. Rowhani

The role of seasonality on mealybug transmission of Grapevine leafroll-associated viruses: an ecological hypothesis–Almeida R.P.P., C-W. Tsai, K.M. Daane

Extended abstracts were published in a special edition of *le Progres Agricole et Viticole* and will also be posted at the ICVG website *www.icvg.ch/index.html*

Every three years the ICVG meeting is held at various locations throughout the world. We are pleased to announce the next meeting in 2012 will be hosted by FPS in Davis. This meeting will celebrate the organization's 50th anniversary and is a kind of homecoming, as the ICVG was founded in Davis in 1964. More information will be available at the FPS website as the date approaches.