Foundation Plant Services
UCDAVIS

FPS GRAPE PROGRAM NEWSLETTER

50-YEAR ANNIVERSARY ISSUE 1958–2008 OCTOBER 2008

Looking Forward to the Next 50 Years

Deborah Golino, Director

IT WAS ON JULY 1, 1958 THAT TWO PROGRAMS—the California Grape Certification Association and the virus-free cherry stock program—were officially combined as "Foundation Plant Materials Service" (FPMS). The University announced that FPMS was established to maintain virus-tested stock of cherry and grape in a foundation block and distribute this stock as part of the state "Grapevine and Tree Certification Program." Other crops followed, swelling the unit's responsibilities to include grapes, fruit and nut trees, strawberries, sweet potatoes and roses by 1995. For many years, FPS has managed the release and distribution of new grapevines, strawberries, fruit trees, nut trees, and rootstocks developed by UC Davis breeders.

The 2003 name change to "Foundation Plant Services" reflects that, in addition to plant material (cuttings, seeds, potted plants), FPS offers laboratory testing services for plant pathogens, DNA tests to determine cultivar identity, and custom services for grape importation and virus therapy.

On July 1, 2008, FPS celebrated its 50th anniversary at a luncheon attended by more that 160 of our stakeholders. This fall the Davis campus is celebrating its 100th anniversary. These milestones remind of us of the contributions of time and financial resources that made our modern University and FPS what they are today—contributions by faculty, staff and students as well as our industry partners.

It is fitting that for the first time, FPS is receiving federal funds to help support our programs and expand their scope. The recent Farm Bill appropriated $20 million ($5 million annually for 4 years) for clean plant programs. Congress provided general guidance to the USDA for allocation of Farm Bill resources by way of language in the Food, Conservation and Energy Act of 2008. Congress directed the USDA Secretary to establish a National Clean Plant Network to produce and maintain clean material throughout the United States and, where practicable, to use existing state and federal facilities for the clean plant centers. Crops such as "grapes, apples, peaches and other fruits" were mentioned as being particularly vulnerable to viruses.

The mission of the National Clean Plant Network (NCPN) is to provide high quality asexually propagated plant material free of targeted plant pathogens and pests that cause economic loss to protect the environment and ensure the global competitiveness of specialty crops producers. FPS has already been chosen to house the grape network main office. We expect our tree program to benefit as well. As the vision for the network is fleshed out, it is possible some of our other crop programs may benefit. For more information about the NCPN see the website FPS has created with our colleagues across the country at *http://ucanr.org/ncpn*.

Festive food, demonstrations, featured speakers and music marked Foundation Plant Services' 50th anniversary gala.

We are excited and hopeful about the potential of the NCPN to serve our specialty crop nurseries with state-of-the-art services and world class plant materials in the years to come.

INSIDE:

Dormant Order Deadline: November 15

Orders for 2008-09 Season

Demand for grape propagating material from FPS is on the upswing! Orders for dormant cuttings were up steeply in the 2007-08 season, and requests for mist propagated plants (MPPs) are on the rise as well. We expect the trend will continue this year. To ensure sufficient time to process the large volume of orders expected, the deadline for dormant cutting orders, which was extended to December 1st for the past two years, will return this year to the traditional November 15th deadline.

A list of registered grape selections available from FPS, as well as the current price list, can be accessed on the FPS Web site at *http://fps.ucdavis.edu/Grape/GrapeProgramIndes.html*.

Both dormant cuttings and custom-produced MPPs can be ordered from the registered list. To place an order, please complete and sign two originals of the FPS Order Form/Grower Agreement, downloadable at *http://fps.ucdavis.edu/WebSitePDFs/Forms/FPSOrderFormRev102303.pdf*, and mail both signed originals along with the required prepayment to the FPS office no later than November 15, 2008. Printed copies of the variety list, price list and order form may be obtained by calling the FPS office.

Upcoming Events

FPS Annual Meeting: November 10, 2008 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 13, 2008, 9:00 am–4:00 pm at the DaVinci building in Davis. Registration and information is provided at *www.extension.ucdavis.edu*

2009 Unified Wine and Grape Symposium to be held January 27–29 at the Sacramento Convention Center, 1400 J Street, Sacramento, California. For more information, go to *www.unifiedsymposium.org*

60th Annual Meeting of the American Society for Enology and Viticulture will be held June 22–26, 2009 in Napa, California. Details are available at *www.asev.org*

3rd Annual National Viticulture Research Conference will be held July 8–10, 2009 at UC Davis. Further details and online registration are posted at *http://ucanr.org/nvrc*

Foundation Plant Services

FPS Grape Program Newsletter is published by Foundation Plant Services, a department in the College of Agricultural and Environmental Sciences at the University of California, Davis.

Foundation Plant Services
University of California
One Shields Avenue
Davis, California 95616-8600
Phone: (530) 752-3590
Fax: (530) 752-2132
Email: *fps@ucdavis.edu*
Web: *http://fps.ucdavis.edu*

FPS Director: Dr. Deborah Golino

FPS Plant Pathologist: Dr. Adib Rowhani

Plant Introduction and Distribution Manager: Cheryl Covert

Newsletter Editor: Bev Ferguson

This publication is available online at *fps.ucdavis.edu*

New Public Grape Varieties and Selections Available for 2008-09

by Cheryl Covert, Plant Introduction and Distribution Manager, Foundation Plant Services

ALL NEW PROVISIONALLY-REGISTERED SELECTIONS available from FPS are listed on the ***New Materials Available From FPS In The 2008-09 Season*** list. It may be viewed online at *http://fps.ucdavis.edu/WebSitePDFs/Price&VarietyLists/GrapeNewSelectionList.pdf*, or a printed version may be requested from the FPS office.

The following newly-available public grape varieties and selections successfully completed testing over the last year, and were released and planted in the FPS Foundation Vineyard in 2008. They are now available as disease-tested provisionally registered stock, and custom prepared mist propagated plants (MPPs) may now be ordered for delivery beginning in the summer of 2009. Actual delivery dates will depend on demand and the size of the orders that are received. Dormant cuttings should become available for most of the new selections in about two years.

NEW IMPORTS:

Aglianico FPS 05 – Identified by the supplier as "Aglianico Di Taurasi," this selection from Southern Italy was imported in February 2000 from Carlo Mastroberardino, Atripalda, Italy, who donated it to the FPS public collection. After initial testing showed the material to be diseased, this selection underwent successful microshoot tip tissue culture disease elimination treatment and was released from federal quarantine in March 2008. Jancis Robinson's *The Oxford Companion To Wine* (2006) notes this varietal's best results are achieved in the DOC of Taurasi in Campania.

Clairette blanche ENTAV-INRA® 208 – Proprietary ENTAV-INRA® registered clone 208 was imported directly from ENTAV-INRA, France in February 2006 and released in March 2008. According to ENTAV's *Catalogue of Selected Wine Grape Varieties and Clones Cultivated in France* (1997 English version), Clairette B. is a vigorous white wine variety requiring control by short pruning and planting on poor, dry, shallow and calcareous soils. The clone/grape can produce dry, sweet or sparkling wines with high alcohol content that are slightly acid with a touch of bitterness, hardness and apple aromas. Clone 208 is identified in the Catalog as "superior" in sugar content and ranked as one of two (of 10) clones in the highest production potential group A. Propagating material may at the present time be obtained in the U.S. only from official ENTAV-INRA® licensee Sunridge Nurseries.

Hungarian Riesling FPS 01 – The product of the grape breeding program begun in the 1950s by the University of Veszprem Georgikon Faculty of Agriculture, this variety was introduced to the FPS collection in March 2003 from the collection at University of Veszprem, Hungary and donated to the FPS public collection with the kind assistance of faculty member Dr. Kocsis Laszlo. It tested negative for disease except for Rupestris stem pitting, and was released from quarantine in March 2008. According to an article by Laszlo Bakonyi of the University of Veszprem faculty on the ISHS *Acta Horticulturae* Web site, this variety is a hybrid of (Italian Riesling x Ezerjó) x (Italian Riesling x Pinot Gris). He notes its sugar content is usually higher than that of the Italian Riesling and has a high yield even when pruned short. Bakonyi indicates the wine is similar to the Italian Riesling though it is more acidic and it is richer in flavor. He says it is good base material for sparkling wine production.

Piedirosso FPS 01 – Imported in February 2000 from the Mastroberardino family collection in Atripalda, Italy and donated to the FPS public collection by Carlo Mastroberardino, a selection of this classic Southern Italian variety underwent microshoot tip culture for disease elimination treatment, and was released from quarantine in Spring 2008. This is a red wine grape grown in the Campania region. The Wine News Magazine's 1999 cover story "Campania—The World's Original Vineland" author Tom Maresca quotes Taburno producer Domenico Ocone as saying "Winemakers prize the variety…because of its deep color, good tannins and bright acidity, coupled with rich, fruit basket aromas and complex flavors." Maresca says it is used in many of Campania's DOC blends, often with the other important Southern Italian variety Aglianico. In the Naples area, a product known as "Lachryma Christi del Vesuvio" is produced from this grape. It is also bottled as its own varietal.

Valdepenhas FPS 01 – California synonyms for the Portuguese Valdepenhas include Valdepeñas and Tempranillo. This is an early harvested, thick-skinned, black wine variety that, according to the UC Integrated Viticulture Online (IV) Web site, produces good- to excellent-quality wines with good color under optimum conditions at lower crops levels, and whose uses range from a good blending varietal to high-quality table or

port-wine blends. Thought to be originally from northern Spain, this variety is planted throughout Spain and in the Rioja region. The IV Web site notes that vines are productive to very productive, capable of bearing medium to large crops of 8 to 12 tons per acre. This selection was imported in 2006 from and donated to the FPS public selection by an anonymous source in Portugal. It tested negative for virus disease except for Rupestris stem pitting, and was released in late 2007.

Verdelho FPS 07 – This Portuguese wine variety was imported in December 2003 from the South Australia Vine Improvement Association (SAVII), Nuriootpa, South Australia for the FPS public collection. The original material tested negative for disease except for Rupestris stem pitting, and the selection was released from federal quarantine and planted in the Foundation Vineyard in 2008.

Vinhão FPS 01 – Imported in January 2005 from Viveiros Plansel S.A., Montemor-O-Novo, Portugal and donated to the FPS public collection by Plansel proprietor Jorge Boehm, Vinhão is a red grape variety from the Vinho Verde region of Portugal. Its official Portuguese name is Sousao (or Souzao). According to Jancis Robinson in *The Oxford Companion To Wine* (2006), it is a dark-skinned variety widely planted in northern Portugal, where the wine is notably high in acidity and color, and therefore valued in making port-style wines. The original material tested negative for disease (except for Rupestris stem pitting), and was released from quarantine on March 2008.

Viura FPS 01 – Imported in November 2004 from Viveiros Plansel S.A., Montemor-O-Novo, Portugal and donated to the FPS public collection by Plansel proprietor Jorge Boehm, Viura is the dominant white grape variety in the Rioja region of Spain, where it is known as Macabeo. According to Jancis Robinson in *The Oxford Companion To Wine* (2006), it is a vigorous vine that buds late for regions prone to spring frosts, can be quite productive in regions where dry autumns help in minimizing rot, and can tolerate hot, dry conditions. She notes that wine produced tends to have a vaguely floral character and relatively low acidity unless picked early. The original material tested negative for disease (except for Rupestris stem pitting), and was released from quarantine in March 2008.

NEW DOMESTIC SELECTIONS:

Durif FPS 06, 07 and 08 – Stag's Leap Winery has long collected 'Petite Sirah' clones. In 2004 these three selections were gifted to FPS by the winemaker for the public collection. Since materials called 'Petite Sirah' can be any one of a number of varieties, these selections have been DNA tested, and are all the variety 'Durif.' The original material of selection 06 tested negative for disease, including Rupestris stem pitting. Selections 07 and 08 tested negative for disease except for Rupestris stem pitting. All three were released and planted in the FPS Foundation block in 2008.

Frontenac gris FPS 01, La Crescent FPS 01 and Marquette FPS 01 – These three University of Minnesota-patented wine grape varieties are reported to be cold hardy and moderately- to highly disease resistant. A feature article on cold-hardy varieties has expanded information about these varieties beginning on page 10.

Petite Sirah FPS 08 – This Petite Sirah selection was donated to the FPS public collection in 2003 by Louis Foppiano of Louis Foppiano Ranches, Healdsburg, California. It underwent microshoot tip culture for disease elimination treatment, tested negative for disease in post-treatment testing, and was released and planted in the Foundation Vineyard in 2008.

Riesling FPS 20 – This selection came to FPS in 1999 from Clos Pepe Vineyards, and was donated to the FPS public collection by Wes Hagen of Clos Pepe Vineyards, Lompoc, California. It is reported to be from Alsace, France. The selection underwent microshoot tip culture for disease elimination treatment. Post-treatment testing was successfully completed in late 2007, and source vines were planted in the Foundation Vineyard in 2008.

UCD GRN-1, 2, 3, 4 and 5™ Rootstocks – Nematode-resistant rootstocks bred by Andy Walker, UC Davis Department of Viticulture and Enology, were released in Spring 2008. Please see the feature article on the Walker rootstocks on page 6.

Grape Selections Now Available From FPS "Next Generation" Vineyard

WORK IS PROGRESSING TO INCLUDE ADDITIONAL VARIETIES and selections in the FPS Next Generation Vineyard, in which all selections have been through microshoot tip culture, a presumptive treatment for *Agrobacterium vitis*, the bacterium that causes crown gall disease. FPS is currently working with Cornell University crown gall researcher Tom Burr to put in place a reliable screening test for crown gall for the materials included in the Next Generation vineyard. All of the rootstock varieties planted in the Next Generation collection in 2005 were tested in Dr. Burr's lab in the winter of 2007, and were negative for crown gall infection. Additional screening of both the Next Generation Vineyard and FPS' Foundation Vineyard collection is planned as part of the National Clean Plant Network (see article on page 1).

In addition to the nineteen rootstock selections originally planted in the block in 2005, twenty-three wine and table grape selections were planted in the block in 2008. The varieties included in the block are listed below. Provisionally-registered material may now be ordered from the Next Generation block. Rootstock varieties can be requested as dormant cuttings, but wine and table varieties will only be available as mist propagated plants (MPPs) on a custom order basis for the first couple of years. Because the selection numbers are the same for selections in the Next Generation block as in the regular Foundation Vineyard, if you want FPS to supply material from the Next Generation block, please be sure to note this clearly on your order form for each item requested.

Rootstocks

O39-16 FPS 01
Couderc 1616 FPS 02
Couderc 3309 FPS 05
Dog Ridge FPS 04
Freedom FPS 01
Harmony FPS 05
Kober 5BB FPS 06
Malègue 44-53 FPS 01
Millardet et de Grasset 101-14 FPS 01
Millardet et de Grasset 420A FPS 05
Oppenheim #4 FPS 09
Paulsen 1103 FPS 01
Richter 99 FPS 01A
Richter 110 FPS 01
Riparia Gloire FPS 04
Ruggeri 140 FPS 01
Salt Creek FPS 08
Schwarzmann FPS 01
Teleki 5C FPS 08

Scion Varieties

Black Corinth FPS 02
Cabernet Franc FPS 01
Cabernet Sauvignon FPS 06
Cabernet Sauvignon FPS 15
Chardonnay FPS 04
Cinsaut FPS 02
Concord FPS 07
Crimson Seedless FPS 01
Italia FPS 04
Malbec FPS 06
Mourvèdre FPS 04
Pinot noir FPS 02A
Pinot noir FPS 23
Riesling FPS 09
Riesling FPS 12
Riesling FPS 17
Rubired FPS 02
Sauvignon blanc FPS 01
Sémillon FPS 05
Shiraz FPS 01
Tempranillo FPS 02
Thompson Seedless FPS 02A
Tinto Cão FPS 01A

Five Nematode Resistant Rootstocks are Released

UCD GRN-1™ (8909-05), UCD GRN-2™ (9363-16), UCD GRN-3™ (9365-43), UCD GRN-4™ (9365-85) and UCD GRN-5™ (9407-14)

by Cheryl Covert, Plant Introduction and Distribution Manager, Foundation Plant Services

In January 2008 the University of California released five new UC-patented grape rootstock cultivars developed in Dr. Andy Walker's grape rootstock breeding program in the UC Davis Department of Viticulture and Enology, with the participation of Professor Howard Ferris in the Department of Nematology. The rootstocks were selected for broad resistance to nematodes. Each was also screened to ensure that it was resistant to phylloxera. Brief descriptions of the new rootstocks are included below. Additional information on the characteristics, trial data, and performance of the new rootstocks can be requested by contacting Dr. Walker by email at *awalker@ucdavis.edu* or by phone at 530-752-0382.

Dr. Andy Walker introduced the newly-released rootstocks (with mist-propagated plants behind) at a press conference held at the FPS nursery.

All five cultivars were put through complete disease testing at FPS to qualify them for provisionally-registered status in the CDFA Registration & Certification Program for Grapevines (R&C Program), and pre-release production of mist-propagated plants (MPPs) at FPS ensured that a modest number of plants were ready for delivery to nurseries in spring 2008. The initial release of MPPs to UC-licensed CDFA R&C Program nursery participants occurred at a press conference held at FPS on March 31, 2008, attended by UC dignitaries and representatives of nurseries, industry funding organizations, UCD Viticulture & Enology faculty and the press.

Local television stations and media featured the importance of new nematode-resistant grape rootstock cultivars.
Photos by Bev Ferguson, UC Davis

FPS is continuing to produce MPPs on a custom order basis for delivery to official UC licensees. UC Davis Technology Transfer Services (TTS) is currently accepting requests for licensing for the new rootstocks only from current nursery participants in the CDFA R&C Program. For more details or to request licensing, please contact Clint Neagley at TTS by email at *chneagley@ucdavis.edu* or by phone at (530) 754-8720.

UCD GRN-1™ (8909-05) - The most resistant of the five, GRN-1™ is a *Vitis rupestris* x *Muscadinia rotundifolia* hybrid. One of the rare sources of resistance to ring nematode, this cultivar has extremely strong and broad nematode resistance, and is a member of a group of *Vitis species* x *M. rotundifolia* selections currently being tested for their ability to induce fanleaf tolerance. Mother vines have sterile flowers, moderately-long shoots with shorter internodes and more

laterals than the other rootstocks. Though GRN-1™ was originally thought to be "too rotundifolia-like" to allow it to root well, it has rooted and grafted at 80% success from dormant cuttings. However, its one-year-old canes were damaged by a recent year's 20°F winter temperatures, affecting its rooting ability.

UCD GRN-2™ (9363-16) - GRN-2™ acquires its nematode resistance from *V. rufotomentosa* (highly resistant to *Xiphenema index*) and *V. champinii* 'Dog Ridge' (strong resistance to root-knot and dagger nematodes), and roots and grafts easily because of its *V. riparia* parentage. GRN-2™ is a good mother vine with staminate flowers, long shoots and internodes, and few laterals. It is susceptible to citrus and ring nematodes, but has excellent resistance to root-knot and dagger nematodes.

UCD GRN-3™ (9365-43) - A sibling to GRN-4™, its strong nematode resistance is derived from *V. rufotomentosa*, *V. champinii* 'Dog Ridge' and from c9038, a form of *V. champinii* that appears to intergrade with *V. monticola*. *Vitis monticola* is an unusual species that grows on very dry, gravelly or rocky limestone sites. *Vitis riparia* was used in the cross to impart good rooting and grafting abilities. GRN-3™ has excellent nematode resistance, resists citrus and lesion nematodes, and is moderately susceptible to ring nematodes. Pistillate-flowered, its mother vines have moderate vigor, long straight canes with moderately long internodes and a moderate number of lateral shoots.

UCD GRN-4™ (9365-85) - A sibling to GRN-3™, it shares resistance and rooting characteristics with GRN-3™. With very good resistance to root-knot and dagger nematodes, it also resists citrus and lesion nematodes, but is susceptible to ring nematodes. GRN-4™'s resistance to *Meloidogyne arenaria* HarmA was the most severely impacted by higher temperatures when compared to the other four rootstocks. It is an excellent mother vine with long canes, good internode lengths and few lateral shoots.

UCD GRN-5™ (9407-14) - This selection derives its resistance from *V. champinii* 'Ramsey' and from c9021, a form of *V. champinii* that appears to intergrade with *V. berlandieri*. *Vitis riparia* was used to improve the rooting and grafting of cuttings. GRN-5™ has excellent root-knot and dagger nematode resistance, resists citrus and lesion nematodes, and supports low numbers of ring nematodes. This rootstock supported the highest level of nodosity-based phylloxera (similar to 101-14 Mgt), but research to date has concluded that high nodosity level feeding does not cause vine damage. Mother plants are staminate-flowered with moderate growth, long canes, good internode lengths and few laterals.

Virus Status Update:
FPS Source Vines and Selections

by Cheryl Covert, Plant Introduction and Distribution Manager, Foundation Plant Services

Followup on 2007 Arabis Mosaic Virus Finding in BKS Vineyard Block

In the 2007 FPS Grape Program Newsletter, we reported that the Malègue 44-53 FPS 01 source vine at BKS M9 V3 had been confirmed to be positive for Arabis mosaic virus (ArMV) and indicated we had recommended that CDFA cancel registration on all propagations from this vine in R&C Program increase blocks and nursery rows. Those who received propagating material from this source vine directly from FPS were also individually notified of this situation in September 2007.

On October 3, 2007, CDFA sent a letter to all participants in the R&C Program notifying them of the cancellation of registration and certification of Malègue 44-53 FPS 01 propagating material from FPS source location BKS M9 V3. The notice required participants to remove all vines in registered increase blocks or certified nursery rows that were propagated from the ArMV-positive source vine, and indicated that budwood and grafted plants produced from this source vine were no longer eligible to be identified as California Registered or Certified stock. Subsequent to the ArMV finding and notification to recipients and CDFA nursery participants, FPS took a number of measures to reduce the risk that surrounding materials to which ArMV might have spread would be distributed.

First, FPS laboratory testing staff put together a map of the strike site and surrounding plants and blocks that included the results of any ArMV testing that had been completed on this group of plants. The small handful of vines that tested positive for ArMV were clustered very near the ArMV-positive Malègue 44-53 plant and nowhere else in the surrounding vines and adjacent blocks. Then, to further ensure that no potentially-infected vine could be distributed, FPS took the precautionary measure of removing the entire block in which the strikes were found (BKS M block), all vines in adjacent vineyard blocks J, K and L, and a large portion of block N.

This action had little impact on the inventory of selections available to FPS customers since nearly all of the selections in these blocks had already been propagated into newer FPS blocks. The few items not available elsewhere in the collection—Couderc 1616E, EVEX 13-5, Paulsen 779 and Richter 99 Prosperi Super—were propagated prior to removal and will undergo full field indexing and PCR testing before planting into new vineyard locations. They should become available again in a couple of years.

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 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.

A major new development on the NGR site in the past year was a clonal profile feature. The word "clone" is the equivalent of "selection" for this feature. Although many people use the terms interchangeably, FPS prefers the term "selection" because the term "clone" implies that unique character has been established, which is often not true for "clonal" collections. Almost 1000 clonal biographies were added to further define the plant material available at the nurseries and public collections. Information was imported from in-depth articles on grape varieties such as Chardonnay, Pinot noir and Zinfandel from the FPS Grape Program Newsletter. Profiles were developed from other detailed research completed during the year on Tempranillo and Cabernet Sauvignon.

Other helpful features added to the NGR site this past year were a cross-link to the detailed varietal information contained on the Integrated Viticulture Online website and a new Glossary of Terms.

National Viticulture Research Conference
ucanr.org/nvrc

Whether you have managed to attend the NVRC, or missed it the past two years, this website will keep you informed on the events. The NVRC is three days of scientific presentations on all aspects of viticulture and a good deal of socializing with students and colleagues from around the country and beyond. Abstracts of the presentations and photos are posted from the 2008 conference, and online registration will begin in January for the 2009 NVRC. A feature article on page 12 has additional details.

UC Integrated Viticulture Online
iv.ucdavis.edu

This website is simple to maneuver through, with menu selections for UC Researchers, where users can find contact information for UC academics and Cooperative Extension specialists, and Viticultural Information. Each topic under the latter includes descriptions and links to experts, related websites and, wherever possible, pdfs of articles or chapters from UC publications.

The number of videotaped UC Davis Extension classes and other events has been expanded and can be found under Video Seminars and Events on the main menu. This is tremendously exciting as it makes some of the best seminars that were offered at UC Davis available to all, including the popular Variety Focus series and the 2008 symposium on Leafroll Disease. 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

Progress has been made this year on funding and organizing the National Clean Plant Network (NCPN). This website serves as an informational "catch-all" for documents, meeting notices, agendas and minutes, and also has the PowerPoint presentations that were shown at many of the meetings. These documents have been provided and reviewed by the program organizers from regions around the country.

The NCPN will be a network of clean plant facilities, with oversight of the funds and planning by several levels of individuals including government regulatory agencies, nursery representatives, researchers, etc. An article by Deborah Golino on page 1 has further descriptions of the NCPN mission and funding.

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.

Identity Resolved for Sangiovese and Vernaccia Selections:
FPS now has registered Sagrantino and Bianchetta trevigiana

by Cheryl Covert, Plant Introduction and Distribution Manager, Foundation Plant Services

THIS YEAR FPS WAS ABLE TO RESOLVE identity issues for two winegrape selections whose identity has been in question for a number of years and, as a result, the FPS collection gained two "new" registered grape varieties.

Sangiovese FPS 22 changed to Sagrantino FPS 01

The first selection, originally identified as Sangiovese (FPS 22), was donated to the FPS public collection by a California vineyard in 1996. It underwent microshoot tip culture and post-treatment testing, and provisionally-registered source vines were planted in the Foundation vineyard in 2001. Dr. Andy Walker noted during a visual inspection in 2005 that these source vines were not Sangiovese, but appeared to be the variety Sagrantino. The vines were put on distribution "hold" pending identity confirmation. Though the FPS DNA ID testing lab was quickly able to confirm that the vines were not Sangiovese, the lab did not have the necessary standard DNA reference profile for Sagrantino at that time.

In 2008, DNA ID lab manager Jerry Dangl obtained the needed reference profile from Dr. Jean-Michele Boursiquot in France, and was able to confirm that the FPS source vines originally identified as Sangiovese FPS 22 were actually Sagrantino. These vines have therefore now been registered and renamed Sagrantino FPS 01, and can be ordered as dormant cuttings or MPPs from FPS.

FPS records show that no distributions were made of the misidentified Sangiovese FPS 22, so no formal customer notifications were required.

Vernaccia FPS 01 renamed Bianchetta trevigiana FPS 01

The second selection, originally identified as Vernaccia FPS 01, was imported from Zanzivivai Ferrara s.r.l., Italy for a California winery in 1981. Vernaccia is a name commonly used for several unrelated Italian grape varieties. As was standard practice at that time, FPS labeled the selection with the variety name as submitted. After undergoing heat treatment and post-treatment testing, the selection was released in 1989 and planted in the Brooks Foundation block at FPS at locations BKS H5 V7 and 8.

After new Vernaccia FPS 01 source vines were propagated from the original BKS vines into the new Nyland block in 1999, visual identification inspections of the leaves on the vines prior to fruiting by Dr. Jean-Michele Boursiquot in 2000 and Dr. Andy Walker in 2001 suggested the vines could be Vernaccia. However, Dr. Boursiquot also noted that a more precise name for the plants would be Bianchetta trevigiana. A second visual inspection of the fruiting vines by Dr. Walker in 2002 confirmed that the vines were likely Bianchetta trevigiana. The vines were put on distribution "hold" pending DNA identity confirmation.

In 2008, FPS' DNA ID lab obtained the needed reference profile for Bianchetta trevigiana from Dr. Boursiquot in France, and was able to confirm that FPS' two current source vines labeled Vernaccia FPS 01 match the standard profiles for Bianchetta trevigiana, and should therefore be more correctly labeled Bianchetta trevigiana. This change was made in accordance with FPS' current policy to use the least ambiguous when deciding among multiple names that can be used for a variety. These vines have now therefore been registered and renamed Bianchetta trevigiana FPS 01, and can be ordered as dormant cuttings or MPPs from FPS.

FPS records show that fifteen FPS customers received material of the imprecisely-identified Vernaccia FPS 01 from the time of its release in 1989 through the time the source vines were put on hold in 2002—all distributions were from the original BKS vines which were removed in 2002. Those customers and CDFA were all recently notified.

FPS wishes to make every effort to see that grape materials distributed in the industry are correctly identified. As our collection is examined by experts and our DNA database increases in size, we regularly review naming decisions for the materials in our collection. Based on our work this year, we recommend that recipients change the name of all their source vines and propagations that came from FPS materials identified as Vernaccia FPS 01 to Bianchetta trevigiana FPS 01, and notify those to whom they've distributed material of this change as well.

R&C Program Supervisor Susan McCarthy has advised FPS that R&C Program participants who have the imprecisely-identified Vernaccia 01 in their increase blocks or nursery rows will be able to keep this selection in their blocks as long as they relabel all source plants and propagations with the more accurate name Bianchetta trevigiana FPS 01. Should CDFA have additional instructions related to these materials, they will notify Program participants separately.

Cold Climate Grape Varieties From Eastern U.S. Breeding Programs

by Cheryl Covert, Plant Introduction and Distribution Manager, Foundation Plant Services

FPS has stepped up its efforts in recent years to acquire and add to the collection a variety of the most important cold-hardy grape varieties and make them available as disease-tested stock to our nursery, grower and winery customers for use in cold climate growing regions of the U.S.

Planning is in progress at FPS to move the most important cold-season varieties into its new Next Generation block, in which all source vines have been put through shoot tip tissue culture as presumptive treatment for crown gall, a disease of particular concern in cold-climate growing regions. Though only a portion of the selections planted in the Next Generation block to date have been tested for crown gall, the plan is to eventually screen all Next Generation selections for crown gall.

In addition to the traditional cold-hardy varieties that have long been available from the FPS collection, including Catawba, Chardonnay, Concord, Himrod, Isabella, New York Muscat, Niagara and Riesling, a newer group of interspecific hybrids are being developed by breeders at Cornell University and University of Minnesota especially suited to thrive in cold climate regions. Many of these varieties have been added to the FPS collection over the last few years. Included in this article are descriptions of two leading breeding programs in the Eastern U.S. with a focus on cold-climate breeding, along with information about their promising varieties, and references to information about other eastern U.S. research centers that focus on cold-climate viticulture.

CORNELL-GENEVA GRAPEVINE BREEDING AND GENETICS PROGRAM

Currently led by grape breeder and professor Bruce Reisch, the Cornell breeding program at the New York Agricultural Experiment Station in Geneva has used interspecific hybridization to select wine grapes with cold hardiness, high yield, disease resistance and high wine quality. Some of their earlier successful releases include 'Cayuga White,' 'Melody,' 'Chardonel,' 'Marquis,' and 'Traminette,' the latter three of which are patented and all of which are currently available as disease-tested Foundation stock from FPS. The characteristics of these five cultivars are described in greater detail in the 2004 FPS Grape Program Newsletter, October 2004, which can be viewed online at: *http://fps.ucdavis.edu/WebsitePDFs/Newsletters&Publications/GrapeNewsletterOct2004.pdf*, pp. 5 and 15.

The next group of Cornell varieties, developed and tested by Bruce Reisch and Cornell enology professor Thomas Henick-Kling and released in 2006, were 'Noiret'™, 'Corot noir'™ and 'Valvin Muscat'™. This trio of Cornell-patented and trademarked varieties offered distinct improvements in the varietal options available to cold-climate grape growers. These three varieties are also available as disease-tested Foundation-status stock from FPS. Their release and detailed descriptions were profiled in the 2006 *FPS Grape Program Newsletter*, available online at *http://fps.ucdavis.edu/WebsitePDFs/Newsletters&Publications/GrapeNewsletterNov2006.pdf*, pp. 14-15.

Another Cornell red wine grape variety—GR7 (Geneva Red 7, released in 2003)—was submitted to the FPS program in 2006 for disease testing and inclusion in the FPS collection. Disease testing was successfully completed for GR7 in late 2007, and provisionally-registered source vines were planted in the FPS Foundation Vineyard in Spring 2008. Though not patented, GR7 is proprietary to Cornell University, and those requesting material must sign a Cornell "grape grower's agreement"—nurseries must be licensed and collect royalties on sales.

A short description of GR7 (FPS 01) from the Cornell breeding program Website states "**GR7 (Geneva Red 7)** – A cross of 'Buffalo' x 'Baco noir', GR7 is a highly vigorous, highly productive and winter hardy grapevine, with moderate resistance to diseases. It makes dark red wines with a classical hybrid aroma, with better tannin structure than Baco noir and De Chaunac…It has a place in traditional red hybrid blended wines, and is already in limited commercial production."

Photo by Bruce Reisch

Information about all Cornell releases, as well as links to additional resources and information on cold-climate varieties and viticulture, is available at *http://www.nysaes.cornell.edu/hort/faculty/reisch/grapeinfo.html#breed*.

UNIVERSITY OF MINNESOTA COLD HARDY GRAPE BREEDING PROGRAM

The University of Minnesota initiated its breeding program for wine grapes in the mid-1980's and, in 2000, completed a state-of-the-art enology lab and research winery. The goal of the program is to develop high quality, cold hardy, and disease resistant wine and table grape cultivars. In its ten acres of research vineyards with approximately 10,000 experimental vines, seedlings are produced each year using a diverse genetic base that includes classic *Vitis vinifera* cultivars, quality French hybrids, and cold hardy, disease-resistant selections based on *Vitis riparia*, Minnesota's native grape. Over 1,000 vines are planted each year and subjected to high standards of evaluation. Currently over 100 advanced selections are being tested, as well as over 400 cultivars and selections from other breeding programs. In addition to cold hardiness and disease resistance, viticultural traits such as productivity, cluster size, growth habit, bud break, and ripening times are evaluated.

In the period from 1996 through 2006, the U of M breeding program developed and released four cold-hardy, productive, moderate- to highly-disease resistant wine grape varieties—Frontenac, Frontenac gris, La Crescent and Marquette—the latter three of which were submitted to the FPS program by U of M Horticulture Research Center scientist Peter Hemstad in March 2006.

The original material submitted to FPS successfully completed disease testing in late 2007. Provisionally-registered source vines of Frontenac gris, La Crescent and Marquette were planted in the FPS Foundation Vineyard in Spring 2008, and mist propagated plants (MPPs) can now be requested from FPS on a custom order basis. Because all three varieties are patented, FPS may supply material only to official licensees. To inquire about licensing, please contact James Rhodes at the University of Minnesota Technology Commercialization Office by email at *rhode086@umn.edu* or by phone at 612-624-0550. Grapevines may also be obtained from licensed nurseries, a list of which may be viewed online at *http://www.grapes.umn.edu/nurseries.html*.

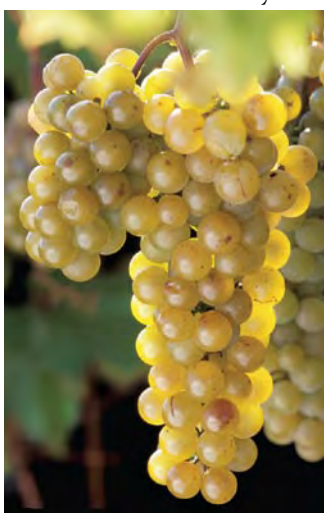
The following descriptions of the three U of M-patented varieties included in the FPS collection are excerpted from the breeding program website at *http://www.grapes.umn.edu*, from which additional information about the varieties may also be obtained.

Frontenac gris (FPS 01) – According to the U of M website, this is a single-bud mutation of the University of Missouri's red wine cultivar 'Frontenac' that produces gray fruit and amber-colored juice. The authors describe Frontenac gris as reflecting the best characteristics of its parents, *V. riparia* 89 and the French hybrid Landot 4511. This vine has borne a full crop after temperatures as low as -33ºF, and is very disease resistant, with near-immunity to downy mildew. It is a consistently heavy producer, with small berries in medium to large clusters. Arching canes and minimal tendrils provide easy training and pruning to simplify vine management. In Minnesota, Frontenac gris ripens in late mid-season and is a good sugar producer with 24-25° Brix not uncommon.

Frontenac gris
photo by *David Hansen, University of Minnesota*

Propagation of Frontenac gris has increased rapidly since its introduction in 2003. The U of M website describes Frontenac gris wines as presenting "aromas of peach and apricot with hints of enticing citrus and tropical fruit. A brilliant balance of fruit and acidity creates lively, refreshing wines. Unique and complex flavors make this an excellent grape for table, dessert, and ice wines."

La Crescent (FPS 01) – This white wine grape came from a cross of St. Pepin and a Swenson selection from *V. riparia* x Muscat Hamburg. According to the U of M website, trunks have survived at -36° F. Moderately disease resistant, the leaves sometimes exhibit downy mildew. La Crescent propagation has increased rapidly since its introduction in 2002.



La Crescent
photo by *David Hansen, University of Minnesota*

The U of M website description states "La Crescent's intense nose of apricot, peach, and citrus lends itself to superior quality off-dry or sweet white wines. The grape's high acidity provides good structure for excellent dessert or late-harvest style wines."

Marquette (FPS 01) – Marquette is a cousin of Frontenac and grandson of Pinot noir. This red wine variety originated from a cross of MN 1094, a complex hybrid of *V. riparia*, *V. vinifera*, and other *Vitis* species, with Ravat 262. The researchers at the University of Minnesota report that resistance to downy mildew, powdery mildew, and black rot has been very good, and that the open, orderly growth habit makes vine canopy management efficient. Marquette was officially introduced in 2006, and vines are in very high demand and short commercial supply.

The U of M website describes finished wines from Marquette as "complex, with attractive ruby color, pronounced tannins, and desirable notes of cherry, berry, black pepper, and spice on both nose and palate."

Marquette
photo by *David Hansen, University of Minnesota*

Additional Eastern U.S. Information Sources on Cold-Season Varieties and Viticulture

Missouri State University	*http://mtngrv.missouristate.edu/mvec/index.htm*
North Carolina State University	*http://www.ces.ncsu.edu/resources/winegrape*
Northwest Berry & Grape Information Center	*http://berrygrape.oregonstate.edu*
Penn State University	*http://winegrape.cas.psu.edu*
University of Vermont	*http://pss.uvm.edu/grape/Horticulture*
USDA-ARS Cold Hardy Grape Collection	*http://www.ars.usda.gov/Aboutus/docs.htm?docid=6245*

Three Days of Viticulture at the NVRC

The second annual National Viticulture Research Conference (NVRC) was held July 9-11, 2008 at the Mondavi Center on the UC Davis Campus. This three-day conference featured talks and poster presentations by researchers in the areas of grapevine breeding, diseases, evaluation of plant materials, genetics, pests, and viticultural practices. The conference attracted 127 attendees from around the country, Canada, Mexico and Israel. A common sentiment was "this was so enjoyable and informative, the food was outstanding... can't wait to come back next year!" Mark your calendars—the 3rd annual NVRC will be held at UC Davis on July 8, 9, and 10, 2009.

Competitions for cash prizes and free registration to the 2009 NVRC was once again held for students, with the following winners recognized for excellence at the conference dinner program.

Student Oral Presentations:

1st place: Carrie McDonnell, J.Lohr Vineyards and Wines and University of Adelaide, "*The Effect of Crop Load and Extended Ripening on Vine Balance and Wine Quality in Cabernet Sauvignon*"
2nd place: Joshua Rubin, UC Davis, "*Genetic and Phenotypic Resistance to Pierce's Disease in* Vitis arizonica/candicans *Selections from Monterrey, Mexico*"
3rd place: Elvis Takow, Texas A&M University, "*Utility of the American Viticultural Areas of Texas Information System (AVATXIS) as a Tool in the Characterization of Texas Wine Regions.*"

Student Poster Presentations:

1st place: Tanja Voegel, UC Davis, "*A Novel Approach for Generating* Xylella fastidiosa *Resistant Grapevines*"
2nd place: Christine Stockert, Department of Viticulture and Enology, UC Davis, "*The Physiological Basis Of Rootstock Control Of Grape Fruit Nitrogen Composition*"
3rd place: Judy Yang, Foundation Plant Services, UC Davis, "*Use of Genetic Markers to Assess Pedigrees of Grape Cultivars and Breeding Program Selections*"

The organizing committee appreciates the presenters and the many individuals and organizations whose efforts and contributions made the conference a success. Special thanks to Paraiso Vineyards for student award prizes, to E&J Gallo Winery and J.Lohr Vineyards and Wines for wine for the poster session reception and dinner. Proceedings of the meeting and photos of the event are online at *http://ucanr.org/nvrc*.

Plant Introduction and Distribution News

by Cheryl Covert, Plant Introduction and Distribution Manager, Foundation Plant Services

FPS "Blue Book" Info Now Accessed on NGR Web Site

With the addition this year of information about grape selections (or "clones") to the National Grape Registry (NGR) web site, FPS has decided to discontinue publishing its longtime publication entitled Nursery Sources for California Certified Grape Material (aka the "Blue Book"). Last published in 2006, the Blue Book was long relied upon by nurseries and other FPS customers for locating certified nursery stock, and many have called over the last couple of years to ask for an updated version.

Because all of the information formerly included in the Blue Book can now be accessed online at the NGR web site *http://www.ngr.ucdavis.edu/index.cfm*, following discussion and general acceptance of the idea by nursery representatives present at our February 29, 2008 nursery meeting, it was decided to discontinue this publication. The Web site has the advantage of being updated in "real time" as representatives of the public collections and private nurseries update their inventories. Nursery participation in providing the information needed to update the Blue Book was often incomplete. Customers will continue to be able to look up on the NGR site which nurseries have reported that they have particular varieties and selections in their CDFA registered increase blocks, both by nursery and by variety/selection number, and will still be able to obtain complete contact information for each nursery. Nurseries are now responsible for updating their own listings of registered (and other) varieties and selections (or "clones") included in their registered increase (and other) blocks. Future updates of the NGR Web site will incorporate information about new selections entering the collection from domestic and international sources as well.

Anyone who is unfamiliar with the NGR site or unsure how to navigate through it to find the desired information, or who wants to learn how to set up a listing for their nursery on the site, may contact NGR site manager Nancy Sweet (nlsweet@ucdavis.edu; 530-752-8646) or, in her absence, the FPS office (530-752-3590) for assistance and a friendly "talk-through." Those without internet access are welcome to contact Nancy or the FPS office for assistance in locating certified planting stock.

What Happened To My Foundation Stock Tags??

You may have noticed that, beginning in late Winter of the 2007-08 season, CDFA Registration & Certification (R&C) Program participating nurseries are no longer receiving the physical white CDFA Foundation Stock tags that formerly accompanied FPS plant material deliveries. As workload pressures in the FPS plant introduction unit have grown and efforts to eliminate unnecessary tasks have intensified, the Foundation Stock tags were eliminated.

Originally developed by CDFA to be placed on seed bags and individual lots of plants to document their sources and official status in the state certification program, for Foundation stock supplied by FPS they were never attached to the plant materials themselves, but instead included with the FPS packing list at delivery. By the late 1980s/early 1990s, when FPS began including the CDFA Foundation stock tag numbers issued on its new computer-generated customer packing lists and submitting regular database-generated reports of tags issued directly to CDFA, the physical tags themselves were no longer essential.

After consulting late last year with R&C Program officials, who enthusiastically supported elimination of the white Foundation stock tags, and receiving a favorable response to a presentation about the issue from participating nursery representatives at an FPS nursery meeting held on February 29, 2008, FPS distribution unit manager Cheryl Covert worked with R&C Program staff to develop a new "virtual tag" numbering system to be generated within the FPS database. FPS seamlessly switched over to the new system this spring. Anyone with questions or feedback about the new system may contact Cheryl by email at *clcovert@ucdavis.edu* or by phone at 530-754-8101.

Susan Nelson-Kluk, Retired After More Than 30 Years

by Mike Cunningham, Production Manager, Foundation Plant Services

On July 1, 2008, Susan Nelson-Kluk retired from a long career at Foundation Plant Services. Serving the last 14 years as Grapevine Program Manager, Susan experienced and in many respects engineered the rapid growth and influence of FPS through the 1980's and early 1990's.

Susan began working at UC Davis in the department of Plant Pathology, under the tutelage Dr. George Nyland. Susan replaced Leon Corey, the retiring manager of what was then known as Foundation Plant Materials Service (FPMS) in late 1980. The department at that time consisted of three employees, one greenhouse, and 20 acres of farmland. At the time, clonal designations for grapevines were unimportant, and it was generally accepted that grapevine viruses did not move vine to vine. Importation and disease testing of grapevines were the responsibility of others.

The retirement of Dr. Austin Goheen in 1985, brought to a close the "simple life" for Susan and the FPMS staff. Over the next few years Susan and FPMS became responsible for the above mentioned tasks. Additionally, the UC Strawberry Clean Stock Program was moved to the Davis campus from Berkeley, and a new greenhouse was constructed for maintenance and testing of that crop. As interest in grapevine importation increased and the need for larger and more updated facilities became apparent, Susan took a lead role in the planning, fundraising, and early operation of the $6 million Grapevine Importation and Clean Stock Facility. Due in large part to her persistence and diligence, this state-of-the-art facility was dedicated in 1994, complete with expanded office space, an up-to-date laboratory, tissue culture technology, a bank of growth chambers, and thousands of square feet of greenhouse and screenhouse space.

As Grapevine Program Manager, Susan oversaw a record keeping evolution from NCR paper in the earlier days to the creation of a complex computer database, maintaining endless records concerning grapevine importation, testing, identification, and distribution. She composed and edited the annual Grape Program Newsletter for many years, updated variety information for FPS clientele, and answered grape-related telephone calls for FPS customers from backyard enthusiasts to the likes of the Mondavi and Gallo businesses.

Together with her husband Mike, Susan has fostered a long time dream of self-reliant living, away from the city. The two are now establishing themselves on a 20-acre piece of ground outside of Grass Valley and have planted an orchard and a vineyard of their own. We at Foundation Plant Services will certainly miss Susan's knowledge and anecdotal experiences that were so valuable to the growth and success of FPS, and are watching with a touch of envy as she is off to her new life.

Overview of New Grapevine Regulations and the Rulemaking Process to Adopt these Regulations

by Susan McCarthy, California Department of Food and Agriculture Nursery, Seed and Cotton Program

DRAFT REGULATIONS for the grapevine registration and certification (R&C) program were submitted to the California Department of Food and Agriculture (CDFA) earlier this year. The current regulations have been in place since 1984. An effort was made to revise the regulations in the 1990s but was not completed. The current effort was initiated in the fall of 2005 when a series of meetings (October 12, 2005; January 23, 2006; February 22, 2006; April 26, 2006; and February 28, 2007) was held to discuss program changes. Meeting participants included R&C program participants, grape industry members, CDFA staff and staff of Foundation Plant Services (FPS).

MAJOR CHANGES TO THE PROPOSED REGULATIONS:

Provisional materials from FPS: The proposed regulations codify an accepted practice of allowing provisional Foundation stock to be planted in registered increase blocks. Provisional Foundation stock means propagative materials from a candidate selection that has passed all of the required disease tests but has not been verified true-to-variety. Participants assume the risks associated with propagating unidentified materials.

Primary and Secondary increase blocks: The proposed regulations create two levels of registered blocks – "primary" and "secondary." Under current regulations, program participants may use propagating wood from a permanent increase block to augment the size of the increase block **in the same field**. In the proposed regulations, a participant may take propagating wood from a primary increase block and establish a secondary increase block **in another location**. If the secondary increase block is on land not owned by the registrant of the primary increase block, he/she will still be responsible for obtaining and maintaining registration of the secondary increase block. Both rootstock and scion varieties will be allowed in secondary increase blocks. Top-working or block expansion with materials from within the block will not be allowed in secondary increase blocks.

Increase blocks planted before 1993 will not be eligible for primary increase block status, but can be converted to secondary increase blocks with negative results in proper testing.

New disease testing: At the **Foundation Block level**, new selections added after the proposed regulations take effect will be screened, using lab-based tests, for leafroll-associated viruses 1, 2, 3, 4, 5, 6, 7, 9 and 2-RG; Grapevine virus A (GVA, which causes Kober stem grooving disease); Grapevine virus B (GVB, which causes corky bark disease); grapevine fanleaf virus; and tomato ringspot virus. These tests are in addition to the ones used to qualify new materials. Two more herbaceous tests (cucumber and tobacco) will be added.

At the **registered block level**, increase blocks planted between 1993 and January 1, 2002 must undergo testing for fanleaf, tomato ring spot and leafroll-associated viruses in 2007 or later in order to qualify for primary increase block status.

All primary and secondary increase blocks must be tested for fanleaf, tomato ring spot and leafroll-associated viruses at least once every five years to remain in the program. These tests will increase the costs of the R&C program. Currently, the California Fruit Tree, Nut Tree and Grapevine Improvement Advisory Board subsidizes some fanleaf and leafroll sampling, and may or may not increase this subsidy in the future. Therefore, the impact of this additional testing on fees paid by the R&C participants is not known at this time.

Propagation by tissue culture: Registered grapevine nursery stock may be propagated from Foundation or registered stock using tissue culture methods. The participant will be responsible for verification of trueness-to-variety.

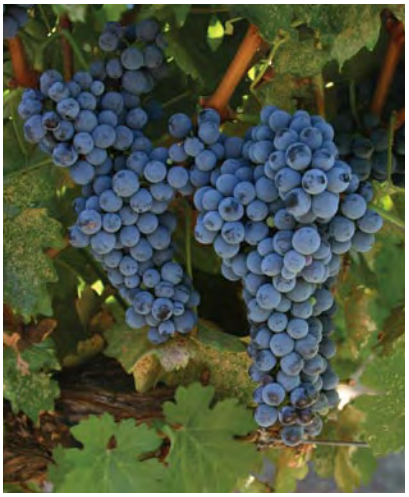
NEXT STEPS IN THE PROCESS:

CDFA regulatory staff have reviewed the proposed regulations, made some minor revisions and reorganizations, and are drafting the documents that must accompany the regulations in the rulemaking process. These are the initial statement of reasons, which explains the specific purpose of each proposed change, and the notice of rulemaking.

Once these are complete, CDFA will publish a notice in the California Regulatory Notice Register, mail a notice to all persons who have filed a request for notice of regulatory actions and all participants in the grapevine R&C program, and post the notice and text on CDFA's website for a 45-day public comment period.

CDFA prepares final documents, including comments and responses, and a final statement of reasons, and submits to the Office of Administrative Law (OAL), as required by the Administrative Procedures Act.

OAL has 30 working days to review a regulation. If OAL approves the regulation, OAL files it with the secretary of state. The regulations would usually take effect within 30 days of that date.



Cabernet Sauvignon at FPS

by Nancy Sweet, Foundation Plant Services

French ampelographer and author Pierre Galet referred to the Cabernet Sauvignon grape as "the greatest of the noble French grape varieties." (Galet, 1998). There is no question that high quality wine has been produced from the Cabernet Sauvignon grape for close to 400 years in France. The popularity that the variety has enjoyed in California for the past thirty years shows no sign of abating. Cabernet Sauvignon is clearly one of the most highly regarded grapes in the premium wine making regions of the world.

The Bordeaux region of southwest France is most likely the birth place of the Cabernet Sauvignon grape. (Galet, 1998). Three rivers—the Garonne, Dordogne and Gironde—mark the Gironde Estuary where red wine grapes have reputedly been grown since the Bordeaux region was part of the Roman Empire.

The Dutch drained the marshy terrain of the Médoc on the west side of the Gironde Estuary in the mid-17th century, creating conditions under which premium red wine grapes would thrive in that area. The warm climate, short winters, humid Gulf Stream currents and prevailing westerly winds favored the vines planted on the Medocain estates, primarily in the last third of the 17th century. (Robinson, 2006; Taber, 2005). An old Bordeaux saying is: the best wines come from vines that can see the rivers that lead out to the ocean. (Taber, 2005).

There are few specific details on the origin of the Cabernet Sauvignon grape. Two of the known *Vitis vinifera* varieties growing in Bordeaux in those early years were Cabernet franc and Sauvignon blanc (a white wine grape). "Sauvignon" is thought to be derived from the French word "*sauvage*," meaning "wild." Literature from the time indicates that Cabernet franc was extensively planted and used for wine-making long prior to any reference to Cabernet Sauvignon. (Robinson, 2006).

At the end of the 20th century, UC Davis scientists John Bowers and Carole Meredith solved the mystery using DNA fingerprinting technology that proved that Cabernet Sauvignon was the progeny of a surprising spontaneous crossing of the Bordeaux cultivars, Cabernet franc x Sauvignon blanc. (Bowers and Meredith, 1997). The scientists concluded that the cross must have been spontaneous because there was no known grape breeding activity conducted in Bordeaux at the time. (also, Jancis Robinson, 2006).

It is certain that, by the 18th century, Cabernet Sauvignon had become well-established on the west side of the Gironde Estuary (the "Left Bank") in the gravel-based soils of the Médoc and Graves. The other great black grape variety of Bordeaux, Merlot, preferred the limestone and clay-based soils on the 'Right Bank' (east side) of the Gironde Estuary. Both black grape varieties figured prominantly in the high quality blended and varietal red wines that came to distinguish the Bordeaux region.

VARIETAL CHARACTERISTICS

Several qualities associated with Cabernet Sauvignon became apparent to grape growers and wine makers as they began to develop the variety into a premier Bordeaux wine.

Cabernet Sauvignon thrives in a warm climate moderated by a cooling marine influence. The variety is a 'late budder and late ripener' that can be grown in cooler climates with less risk of damage from Spring frost because of late bud break. (ENTAV-INRA-ENSAM-ONIVINS, 1995).

At the same time, Cabernet Sauvignon is considered to be a 'mid- to late-season variety' with a long vegetative cycle that requires many hours of warm sunlight and heat days in Mediterranean climates with maritime influences.

The average daily temperature in Bordeaux in August is a high of 79° F. The average daily temperature in St. Helena (Napa County) from May to September (1990-2007) was 83-84 degrees F. (Sullivan, May 2008). The warm temperatures during the day in the growing season are critical to successful ripening.

Cabernet Sauvignon ripens so late that a cool, cloudy late summer can seriously affect its quality—it might not ripen properly. Cooler climates bring out an herbaceous aroma in the grape, and overly warm climates prevent the grape from developing its normal varietal character. (Robinson, 2006).

The Cabernet Sauvignon grapevine is extremely vigorous. Thick skins on the berries and hardy wood on the vines make it easy to grow the variety. Cabernet Sauvignon berries ripen slowly and are less sensitive to the time of harvest; the berries can endure a long hang time.

The vineyards can easily yield 6-7 tons per acre on flat, fertile soils, and 3 to 4 tons per acre on hillsides or shallow soils. Deep soils can dilute the colors and structure of the grape. The variety does not perform well on poorly-drained soils. The crop may need to be thinned significantly at veraison to eliminate later-ripening fruit. (Wolpert, 2003).

Cabernet Sauvignon produces distinctive small black berries covered with bloom, making them look like blue berries. The berries adhere firmly to the pedicels. Thick skins are characterized by a highly astringent flavor, high tannin, acidity, and dark color. Wine produced from the berries usually needs aging or blending to reduce or soften the bitterness. (Galet, 1998).

Cabernet Sauvignon can age for over a century without losing structure. Cabernet Sauvignon grape juice possesses a deep color and a remarkable concentration of complex phenolics that require extensive aging in barrel or bottle, resulting in a wine with much structure and evolving pungent aroma and flavors. (Robinson, 2006).

It is said that the variety has a special affinity for oak, which softens the bitterness. Subtle fruit flavor compounds, fermentation, alcohol and oak work on the wine as it ages. The fruit flavor compounds have been described as reminiscent of currants, violets, wild fruit and green pepper. (Robinson, 2006; Galet, 1998). Jancis Robinson aptly described the aging process for Cabernet Sauvignon as the "wine slowly making itself." (Robinson, 2006).

In Spring, 1988, wine writer Gerald Asher attended a tasting of Château Margaux wines from fifty vintages from the two-hundred year period between 1771 and 1984. The blend used in the 1771, 1791, 1847 and 1848 premier grand cru vintages was 75% Cabernet Sauvignon, 20% Merlot, and 2% each Cabernet franc and Petit Verdot. Asher was struck by the 'youthful purity of color, bouquet and flavor' of the 18th century wines (1771, 1791), made by men living at the time of the American and French Revolutions. (Asher, 2002).

By contrast, the Margaux wines from Bordeaux's 'Golden Age' (late 1840's to 1875) had deepened in color and changed in fragrance due to the change from Baltic to French oak for the aging process. The Margaux wines' startling longevity underscores the observation that wine from Cabernet Sauvignon grapes can accomodate a long period of aging. (Robinson, 2006; Galet, 1998).

PRE-PROHIBITION IN CALIFORNIA

The Cabernet Sauvignon grape came to California during Bordeaux's Golden Age. Northern California provided a 'second home' to the variety when a few prescient importers caused the Bordeaux varieties to be planted in the southern Bay Area, Napa and Sonoma counties. Early Cabernet Sauvignon plantings in California provided the basis for many of the FPS Cabernet Sauvignon selections currently in the collection.

The first documented instance of importation of Cabernet Sauvignon to California occurred in 1852, when Antoine Delmas, a French nurserymen, brought French vines (including one called 'Cabrunet') to the Santa Clara Valley. (Sullivan, 2003; Alley *et al.*, 2000). Vineyards were planted with Cabernet Sauvignon vines in the Santa Clara Valley in 1857-1858. (Sullivan, May 2008).

Specific information is scarce regarding importation of Bordeaux varieties into the northern Bay Area in the 1850's. Some believe that Agoston Haraszthy imported the variety into the Napa/Sonoma area from his trip to Europe in 1861. (Goheen, undated). But that importation is not documented. Glen Ellen's Captain James Drummond planted the first significant Bordeaux vineyard (including Cabernet Sauvignon) in the North Coast in Sonoma County in 1878. H.W. Crabb brought Cabernet Sauvignon to Napa at about the same time. (Sullivan, 2008).

In 1884, Chief Executive Viticultural Officer Charles Wetmore reported to the State Viticultural Board that Cabernet Sauvignon was present in California in experimental lots only. (Wetmore, 1884; Goheen, undated). By the mid-1880's, Cabernet Sauvignon was established in Sonoma, Napa and Santa Clara counties. The late 1880's saw a dramatic increase in the planting of Bordeaux varieties in California. (Alley *et al.*, 2000; Sullivan, May 2008). Wetmore himself imported Bordeaux varieties (including Cabernet Sauvignon) for his Cresta Blanca vineyard in Livermore, Alameda County, at the end of the 19th century. (Wetmore, 1884). By 1891, however, Cabernet Sauvignon plantings had become rare due to phylloxera that decimated California vineyards. (Walker, 2000).

The State of California initiated the Department of Viticulture & Enology at the University of California, Berkeley, in 1880. Professor Eugene Hilgard spearheaded the planting of University Experiment Station vineyards throughout northern California. Research efforts to improve California wine with better varieties and wine making techniques began in 1882. Frederic Bioletti was hired soon thereafter to research which varieties were best suited to specific regions of the state. (Walker, 2000).

In 1907, Bioletti reported on the differences in suitable grapes for the interior valleys and coastal counties in California. He initially developed a more basic version of the regional approach that later become known as the 'Winkler climate regions', based on an 1883 study done in France. (Walker, 2000). Bioletti acknowledged that the finest wines produced in California to that time were the product of Cabernet Sauvignon but noted that growers consistently rejected the variety almost everywhere due to low yields. He ultimately recommended Cabernet Sauvignon for the coastal counties with the caveat that it not be planted in rich valley soils. (Bioletti, 1907).

When Prohibition started in 1920, the University suspended enological research but not viticultural research. (Alley *et al.*, 2000). Many of the California vineyards with red Bordeaux varieties were not maintained because there was no commercial value in most of the plantings. Cabernet Sauvignon was not a variety sold to home winemakers

on the East Coast during Prohibition. By the end of the Prohibition era in 1933, the estimated acreage of Cabernet Sauvignon in California was down to about 200 acres, mostly in Napa. (Sullivan, May 2008).

POST-REPEAL UNIVERSITY EVALUATIONS

In a 1934 University of California publication assessing desirable varieties for wine making in California, Bioletti again addressed the suitability of Cabernet Sauvignon plantings. He found that the variety "had merit" but was "not largely planted." He stated:

> "This is the red wine grape which by common consent is given first place among the grapes of the Médoc. The reason for placing it last here is that its area of usefulness is very limited in California. In the hotter regions it not only bears little, but its marked characteristic aroma is so intensified as to be displeasing. In the cooler regions where the quality of its wine is excellent, it is not sufficiently superior to several other varieties such as the Petite Sirah, Beclan and Tannat to make its cultivation profitable except in a few favored situations." (Bioletti, 1934).

In this post-Repeal period, the University reinstated the campaign for improved wine varieties, and winemaking investigations were initiated on the Davis campus in 1935. (Olmo, undated).

Harold Olmo began a clonal selection program at this time at UC Davis to provide improved plant material to California growers. Notwithstanding Bioletti's remarks in 1934, Cabernet Sauvignon was one of the first varieties to be chosen for evaluation in Olmo's trials.

In 1938, Professor Albert Winkler in UC's Department of Viticulture & Enology further redefined the 'climate region' analysis begun by Bioletti. The approach is still in use today for reference as to the appropriate climate region in California in which to plant various wine grape varieties. Winkler grouped the state into five climatic regions based on the amount of heat accumulated during the growing season, defined as degree-days above 50° F for the period April to October. (Amerine and Winkler, 1944).

Four distinct Winkler regions contain areas with climates that can be considered "coastal areas" for purposes of growing wine grape varieties such as Cabernet Sauvignon. The Napa County/Sonoma County region contains Winkler zones I (the coolest in which grapes are grown), II (the prime table wine district) and III (moderately warm zone). The Livermore Valley is within climate region III. The Santa Clara Valley is variable from regions I-III. The Santa Cruz Mountains area is the coolest and is in a low region I zone. (Amerine and Winkler, 1944). Pierre Galet places Bordeaux, France in Winkler region I using the Winkler standards. (Galet, 2000).

The climate region analysis was the product of a long history of university research that evaluated grapes and wines (including Cabernet Sauvignon) in the coastal regions of California—from 1882 to 1958—in both university vineyards and private grower test plots. The major university test plot was at the Oakville Experiment Station in Napa County.

Amerine and Winkler reviewed the grape and wine research up to the decade of the 1940's and presented the university's recommendation for Cabernet Sauvignon, as a "very good quality grape" for planting in regions I, II and III (climates with a coastal influence). They concluded that Cabernet Sauvignon wines of the Napa and Sonoma valleys had the most color and generally aged into superior wines that are long lived. (Amerine and Winkler, 1944; Ough and Alley, undated).

Research by the university relative to field performance and wine trials continued for the succeeding decades. Ough and Alley reported on a study of six grape varieties (including Cabernet Sauvignon) at UC Davis from 1935-58. (Ough and Alley, 1966; Ough and Alley, undated). Winkler and Amerine summarized Post-World War II trials and concluded that Cabernet Sauvignon's distinctive aroma was the main basis of the wine's high quality. (Amerine and Winkler, 1963).

All of the research demonstrated that Cabernet Sauvignon produced low yields and high tannins and the wine was slow to age. At the same time, the researchers praised the distinctive aroma and flavor in the consistently high quality wines. The recommendation from the university in the mid-1960's reiterated that Cabernet Sauvignon was the "variety of choice for red table wines" in Winkler climate regions I and II, where it can be grown under cool climatic conditions. (Amerine and Winkler, 1963; Ough and Alley, 1966)

CABERNET SAUVIGNON ACREAGE

In a 1954 Grape Day talk, Harold Olmo exhibited a table of acreage statistics for the principal wine grape varieties in California; Cabernet Sauvignon was not mentioned by name but was included among "other black grape varieties." (Olmo, 1954). In a 1957 handout for one of Olmo's classes in the Department of Viticulture & Enology, the 1956 California acreage for Cabernet Sauvignon was estimated at 700 acres. (Olmo, 1957).

In 1964, Winkler surveyed the premium quality wine grape varieties being grown in the coastal counties (Winkler regions I-III). He found a continuing increase in grape plantings from the 1950's to 1963. Cabernet Sauvignon acreage increased 133% during that time period, to a total of 1417 acres by 1963, third for red wine grapes after Zinfandel and Petit Sirah. (Winkler, 1964).

By the time the 1973 Stag's Leap Wine Cellars Cabernet Sauvignon prevailed over wines from some of the oldest Bordeaux chateaux in a blind tasting at the Judgment of

Paris in 1976, Cabernet Sauvignon acreage in California had increased to 27,000 acres, the third highest acreage for red wine varieties after Zinfandel and Carignane. (Taber, 2005; Olmo, 1978).

In the past 20 years, Cabernet Sauvignon plantings have increased substantially in regions that are high (warm) Winkler region II to high Winkler region III (e.g., central Napa Valley, parts of Sonoma County) and region IV (the Lodi area of the San Joaquin Valley). (Wolpert, 2003). Starting in the mid-1990's, Cabernet Sauvignon experienced the greatest growth of all major wine grape varieties in California for the ensuing 15-year period. (Volpe *et al.*, 2008).

In 2007, the crop reached 76,000 total acres and 425,000 tons crushed. (CDFA Grape Acreage Report, 2007 Crop). Cabernet Sauvignon is now by far the largest red wine grape crop in the state and is second only to Chardonnay in total acreage planted.

In 2007, Napa County had the highest percentage among California counties in total Cabernet Sauvignon grape acreage (25% - 18,744 acres), followed by Sonoma County (15% - 11,563 acres), San Joaquin County (14% -10,537 acres) and San Luis Obispo County (12% - 8,900 acres). Napa County accounted for one-half of the total Cabernet Sauvignon grapes crushed in California in 2007. (Sullivan, May 2008). The average prices received for grape crush in the North Coast are now significantly higher than those received in the rest of California. (Volpe *et al.*, 2008).

Historian Charles Sullivan states that by 2004, the valley and uplands north of Napa City had become "Cabernet country" in consumers' and wine writers' minds. (Sullivan, 2008). Wine writer Jancis Robinson characterizes Napa County, part of Sonoma County (Alexander Valley and Sonoma Valley) and the inland side of the Santa Cruz Mountains as prime country for Cabernet Sauvignon in California. (Robinson, 2006). The statistics support these assertions.

EARLY FPS SELECTIONS

Foundation Plant Services released its first registered Cabernet Sauvignon selection in 1965. There are now 35 registered selections and one provisional selection in the California Grapevine Registration & Certification (R&C) Program.

The source of the FPS selections is not always clear. Records of wine grape sources for grapevines planted at the university and its field stations were not well kept during Prohibition. Early plantings of Cabernet Sauvignon at Davis are not easily traced. (Goheen, undated).

The UC Cabernet Sauvignon selections were made originally in commercial vineyards in the Livermore and Napa Valleys and in older experimental plantings, such as the Foothill Experiment Station. Austin Goheen wrote: "the best selections seem to be those made from early importations to California, which were found growing commercially in the coastal valleys at the time that our program started. These probably were imported directly from France sometime between 1880 and 1900." (Goheen, undated).

Cabernet Sauvignon FPS 02 is known as the "Oakville selection" and came to FPS from UC's Oakville Experiment Station in the Napa Valley. Harold Olmo selected and developed FPS 02. The history of this selection in California begins in the 1880's.

Capt. John H. Drummond was a Scotsman who resigned his commission in a British infantry regiment and, in 1878, purchased a portion of the Rancho Los Guilicos estate near Glen Ellen in Sonoma County. Documents from the time show that Drummond imported Cabernet Sauvignon cuttings from Châteaux Margaux and Lafite Rothschild and the Hermitage in Bordeaux, France, and planted those and other varieties in 150 acres of his new Dunfillan Vineyard property. (Peninou,1998; Wait, 1973). Charles Sullivan characterizes the planting as "the first plot of useful Bordeaux vines in the North Coast." (Sullivan, 2008).

In the 2nd Annual Report to the Board of State Viticultural Commissioners (1882-1884), President Charles Wetmore reported that an 1882 Cabernet Sauvignon varietal made by Drummond was "more admired at the last State Viticultural Convention than any other on exhibition." (Wetmore,1884). The Dunfillan vineyard was regarded as one of the finest vineyards in the country. (Wait, 1973). Drummond also had a nursery in Sonoma and made cuttings available to grape growers and wine makers in the area.

Capt. Drummond died in 1889 and the property was sold and renamed Beltane Ranch. For a time, the property was no longer used as a vineyard because the vines were diseased and yields were low. (Peninou, 1998).

James A. Shaw was an Australian who came to Sonoma in 1850. In 1867, he purchased Rancho Los Guilicos acreage adjacent to and northwest of the property that later became Dunfillan Vineyards and named it Wildwood Vineyards and Winery. By 1885, there were reports of a vineyard planted to fine *vinifera* varieties (including Cabernet Sauvignon) at Wildwood Vineyards. (Peninou,1998). It is not unreasonable to assume that Shaw, as a neighbor and contemporary of Capt. Drummond, would have looked to Dunfillan Vineyard for plant material. (See Unzelman, 2006). Shaw was forced to replant the original vineyard with resistant stock in the 1890's when the original Wildwood Vineyard succumbed to phylloxera.

In 1904, a German immigrant named Louis Kunde purchased the Wildwood Vineyards and Winery from James Shaw. (Peninou,1998). The Kunde Estate home page explains that the Kunde Estate vineyards were first planted in the 19th century by viticultural pioneers Shaw and Drummond with imported cuttings from Châteaux Margaux and Lafite Rothschild. *www.kunde.com*. The ruins of

the stone winery at Dunfillan are located on the Kunde property. (Hiaring, 1992).

Immediately after receiving his PhD degree in genetics from UC Berkeley in 1934, Harold Olmo was hired by Frederic Bioletti to perform viticultural work at UC Davis at the Oakville Experiment Station. Olmo began a clonal selection program at UC Davis in 1935. He selected the first Cabernet Sauvignon mother vines in 1939 from Charles Kunde's Wildwood Vineyard in Glen Ellen, Sonoma County. (Olmo,1976; Olmo, undated).

In a statement for the California Wine Industry Oral History Project, Olmo spoke about those original Cabernet Sauvignon selections:

> "Charles Kunde's vineyard, near Sonoma] is actually a very old vineyard, one of the oldest in the Sonoma Valley. It's called Wildwood Vineyard now, but it goes back to a very early settler there, in fact Bioletti's step father-in-law, J.H. Drummond. He was a pioneer in the introduction of many varieties and also in vineyard practices. Drummond was one of the early pioneers there, then the Kundes took the vineyard over. I think it changed hands two or three times. But, anyway, the planting certainly did go back to, perhaps, the 1890s or so. The vines were real low, very big vines." (Olmo, 1976).

One of the first vineyards to work cooperatively with the university on progeny tests of the Wildwood Cabernet Sauvignon selections was Larkmead Vineyards, owned by the Salmina family in Napa County. A Larkmead Vineyards' publication represents that Dr. Olmo established a station at Larkmead Vineyards during the 1930's and 40's. (*www.larkmead.com*).

Olmo budded vines at Larkmead with the Wildwood Cabernet Sauvignon selections in 1939. (Olmo, 1976). After five to eight years of yield and wine tests, the best clones were selected for a closely-controlled and replicated test at the university field station at Oakville. (Olmo, undated).

Cabernet Sauvignon FPS 02 in the Foundation Vineyard at FPS.

Cabernet Sauvignon FPS 02 was subjected to clonal trials at Oakville (row 11 v1), after which it was presented to FPS sometime prior to 1963. The "Oakville selection" tested negative for all diseases and did not undergo any treatment. Cabernet Sauvignon FPS 02 first appeared on the registered list of the California Grapevine Registration & Certification Program (R&C Program) in 1965.

Plant material began to move from Europe to the Americas in the 16th century, when commercial vineyards were first established in Mendoza, Argentina's most important wine-growing province. (Robinson, 2006). Two Cabernet Sauvignon selections—**Cabernet Sauvignon FPS 04 and 05**—were imported to Davis in 1964 from Mendoza. According to FPS Director Deborah Golino, Austin Goheen arranged the importation because he believed that grape plant material obtained from South America was less likely to be infected with virus. (Golino, 2008).

Cabernet Sauvignon FPS 04 and 05 arrived labelled incorrectly as "Merlot clones 11 and 12." No disease elimination treatment was required for either selection. They were later properly identified and appeared for the first time in 1966 on the list of registered vines in the California Grapevine Registration & Certification (R&C) Program.

Cabernet Sauvignon FPS 06 is known as the "Jackson" selection because it was harvested from the old Foothill Experiment Station in Amador County.

Eugene W. Hilgard, UC's first Professor of Agriculture and Director of Experiment Stations, established a small demonstration vineyard with 73 grapevines on the Berkeley campus in 1874-75. Hilgard's reports on the vineyard do not list the source material for the 73 grapevines. Hilgard believed that the Berkeley campus was unsuitable for grapevines due to its climate and the presence of phylloxera. (Hilgard, 1890).

Hilgard also implemented a series of University Experiment Stations in the late 1880's. The small vineyard at Berkeley was designated as the "Central Experiment Station." The "Sierra Foothill Experiment Station" was located 4 ½ miles northeast of Jackson in Amador County, California. In March, 1889, Hilgard caused Cabernet Sauvignon cuttings to be taken from the Central Station and planted in Block G (G8 v1-10) of the Sierra Foothill Station.

One of the Cabernet Sauvignon FPS 06 vines in the Foundation Vineyard at FPS. *Photos by Bev Ferguson, UC Davis*

The Sierra Foothill Station was abandoned by the University of California in 1903. However, the vineyards were not removed. Austin Goheen "rediscovered" the old vineyards in 1963 and later obtained a map of the 1889-1892 plantings from the archives of the University of California library at Berkeley. The complete story of Goheen's rediscovery of the vineyard is contained in the 2006 *FPS Grape Program Newsletter*.

In 1964, Goheen selected cuttings from a Cabernet Sauvignon vine located at position G8v10 in the old Foothill Experiment Station vineyard. Notes obtained from a manuscript notebook maintained by the vineyard manager at the Foothill Station in 1889 indicated that the vine at position G8 had come from Berkeley.

The Foothill Station vineyard had never suffered from phylloxera, so the "own rooted" vines were phylloxera-free. (Alley *et al.*, 2001). Amand Kasimatis recalls that Goheen selected the Cabernet Sauvignon plant material because it was a fruitful vine that appeared to be free of disease. (Kasimatis, 2008).

[Author's note: There was a second Cabernet Sauvignon vine in Block L of the old Foothill Experiment Station vineyard. That vine originated from the Cupertino Experiment Station, which was a two-acre plot donated to the university in 1883 by grower and winemaker John T. Doyle. Hilgard and Doyle experimented with premium varieties on that property. The vine in Block L at the Foothill Experiment Station came from the Cupertino Station in 1890. The FPS records are clear that FPS 06 was taken from the vine in Block G, not from Block L, of the Foothill Station. At least one source has erroneously attributed the origin of FPS 06 to the vine in Block L].

The Cabernet Sauvignon plant material from Block G at the Foothill Station became Cabernet Sauvignon FPS 06. Virus testing of the selection was negative. FPS 06 first appeared on the list of registered selections in the R&C Program in 1969.

Cabernet Sauvignon FPS 07, 08 and **11** originated from the same source vine at the Concannon Vineyard in Livermore, California. They were distributed widely and formed the backbone of California Cabernet Sauvignon plantings in the 1970's and 1980's. Clonal testing demonstrated that the selections gave "high yields of very good wine quality." (Olmo, 1991).

Concannon founder, James Concannon, emigrated from Ireland to Boston, Massachussetts, in June, 1865. After moving west to San Francisco, he purchased 47 acres of an old ranch in Livermore in 1883 and began planting vines and making wine. The soils in the southern Livermore Valley had the same rocky, gravelly character as parts of Bordeaux. (Concannon, 2006).

The Cabernet Sauvignon vine from which FPS 07, 08 and 11 were propagated most likely came to Concannon Vineyards from Bordeaux, France. The namesake and grandson of founder James Concannon is in possession of 1904 correspondence from a supplier in Royan, France, a port city located at the mouth of the Gironde Estuary north of the city of Bordeaux. The letter offers special prices to Concannon for grapevine cuttings including Cabernet Sauvignon, and mentions that Concannon would be well served to continue working with Charles Wetmore as agent for transmittal of the supplier's plant material to the Concannon vineyard. (Concannon, 2008; Paul Gros Gendre & Co., 1904).

Charles Wetmore imported wine grape varieties from Bordeaux to his Cresta Blanca vineyard in Livermore in the late 19th century, including Cabernet Sauvignon cuttings from Château Margaux. (Pinney, 1989; Wetmore, 1884). Wetmore supplied Cabernet Sauvignon cuttings to Concannon. (Wente, 2008). Whether the Cabernet Sauvignon provided to Concannon was propagated from the Cresta Blanca Château Margaux vines or was other French clonal material sent by the supplier is unclear.

The Concannon Cabernet vines were not lost during Prohibition. Concannon Vineyards was able to survive the Prohibition era because Concannon was active in preparing altar wines.

The University of California became interested in Concannon clonal material in the 1960's. In 1965, Curtis Alley, manager of Foundation Plant Services (then known as Foundation Plant Materials Service), harvested cuttings from vine 2 in row 34 of the Concannon Cabernet Sauvignon block. He brought the cuttings to FPS for virus testing and heat therapy treatment. Plants from those cuttings underwent heat treatment for varying lengths of time and received different selection numbers, even though harvested from a single vine source.

Cabernet Sauvignon FPS 07 underwent heat treatment for 62 days. Alley initially assigned #101 to the selection, but it was later renamed FPS 07. The selection was planted in the foundation block in June 1967 and first appeared on the list of registered vines in the R&C Program in 1970.

Cabernet Sauvignon FPS 08 (initially labelled #102) underwent heat treatment for 168 days. The current FPS 08 foundation planting is a sub-clone of that original cutting that arrived at FPS in 1965. The original cutting had been propagated into several locations at FPS in the late 1960's and early 1970's. FPS 08 was planted in the Foundation Vineyard in blocks J (1970) and K (1972). Cuttings were made and also planted in the Tyree Vineyard (MO2 v28-29) in 1975, where the vines obtained full foundation stock status. FPS 08 first appeared on the list of registered vines in 1971.


Cabernet Sauvignon FPS 08

In 1992, FPS began testing the Foundation Vineyard for leafroll virus using the newly-developed ELISA technology. All of the Cabernet Sauvignon FPS 08 plants in Foundation Vineyard blocks J and K tested positive for Grapevine leafroll associated virus-3. However, the FPS 08 vines from the Tyree vineyard tested negative. The Tyree vines were subsequently fully re-indexed and were designated as a 'subclone' of the original material sent to FPS. The healthy Tyree FPS 08 vines were propagated for planting in the new Brooks North foundation block. The decision was made to retain the selection name Cabernet Sauvignon FPS 08 for this popular FPS clone. Nurseries that had received FPS 08 plant material prior to 1992 were instructed to remove or retest their vines.

According to Jim Wolpert, Specialist in Cooperative Extension in the Department of Viticulture & Enology at UC Davis, FPS 08 is a high-yielding, late-maturing selection. (Wolpert, 1995; 1998 FPS Grape Program Newsletter).

Cabernet Sauvignon FPS 11 came to FPS from Concannon in 1965 and underwent heat treatment for 168 days. It was planted in the West Armstrong Vineyard and underwent indexing in 1970-71. Cuttings were taken for propagation into the Foundation Vineyard in 1972. FPS 11 appeared for the first time as a registered vine in 1974.

Cabernet Sauvignon FPS 10 came to Davis in 1959 from the State Teaching & Research Institute for Viticulture & Horticulture in Neustadt, Germany. Neustadt an der Weinstrasse is a market town in the wine-making region of the Rhineland-Palatinate area of Germany. The selection underwent heat treatment for 148 days and first appeared on the registered list for the R&C Program in 1973.

Seven FPS Cabernet Sauvignon selections—**Cabernet Sauvignon FPS 12, 13, 14, 15, 19, 20** and **21**—were propagated from a single vine source in Chile in 1971.

In the 1880's, Chilean politician and businessman Don Melchor Concha y Toro brought noble French grapevines (including Cabernet Sauvignon) from the Bordeaux region of France to Chile. He planted vineyards throughout the country, including in the Cachapoal Valley near the coastal mountain range.

Chile has not been affected by the phylloxera epidemic that destroyed grapevines in other parts of the world. Concha y Toro is one of the oldest Chilean wineries, dating from 1883. (Robinson, 2006; *www.conchaytoro.com*).

Lloyd Lider, then Professor in the Department of Viticulture & Enology at UC Davis, imported Cabernet Sauvignon cuttings from one of the Concha y Toro Vineyards located in Peumo in the Cachapoal Valley in March, 1971. The import documents indicate that all the cuttings were "Cabernet Sauvignon from r(ow) 3 v(ine) 1, Cachapoal Vineyard, Block 25." Viña Concha y Toro is the designated source.

The cuttings underwent heat treatment for different periods of time: FPS 12 (103 days); FPS 13 (111 days); FPS 14 (111 days); FPS 15 (111 days); FPS 19 (137 days); FPS 20 (137 days); FPS 21 (141 days). All seven selections first appeared on the list of registered selections in the R&C Program in 1978. Cabernet Sauvignon FPS 15 is currently on "hold" status at FPS to avoid confusion with ENTAV-INRA® Cabernet Sauvignon 15EV.

Cabernet Sauvignon FPS 22 and **23** were selected from a vineyard in Napa County, California, in 1986. Both selections underwent heat treatment – 60 days and 136 days, respectively – and first appeared on the list of registered selections in 1990. It is reported that the selections are very aromatic.

Cabernet Sauvignon FPS 24 came to FPS from Laurel Glen Vineyard in Glen Ellen, Sonoma County, California, in 1988. It received no treatment and was first registered in the R&C Program in 1994.

CABERNET SAUVIGNON HERITAGE SELECTIONS

Cabernet Sauvignon FPS 29 is one of three Cabernet Sauvignon clones that were selected by Phil Freese and FPS Director Deborah Golino from Napa Valley vineyards with a reputation for quality wine production. FPS 29 is the Niebaum-Coppola Cabernet Sauvignon Heritage clone.

Captain Gustav Niebaum purchased the Inglenook Winery property in Napa County in 1879. Capt. Niebaum imported many varieties, including Cabernet Sauvignon, from nurseries in southern France between 1882 and 1885. Niebaum planted the original Cabernet Sauvignon block in 1882. Former Niebaum-Coppola (now Rubicon) winemaker Scott McLeod stated that the original block was the source of all subsequent plantings on the estate. (McLeod, 2008). The original material became a "massale" selection – a mix of genetic material (dormant cuttings) that was continuously replanted to the original selection and was made into wine over an extended period of time. (Heald and Heald, 2002).

Former Niebaum-Coppola vineyard manager and historian Rafael Rodriguez assisted Golino and Freese with selection of the heritage clonal material for FPS. Rodriguez directed

them to a Pritchard Hill vineyard on the former Inglenook estate that had been planted in 1933 with vines descended from Niebaum's original plantings. The cuttings that later became FPS 29 were harvested from that vineyard in 1989.

Virus testing at FPS established that the original material was infected with several viruses. Microshoot tip culture was used in 1990-1991 to propagate a new selection free of the viruses. The new Cabernet Sauvignon FPS 29 was released to the donor (Niebaum-Coppola) in 1996 but did not appear on the registered list for the R&C Program until 1999, when it first became available to the public.

The original FPS 29 plant material showed negative results for fleck virus when initially subjected to field index testing in 1997. However, the source vines in the foundation block recently tested positive for the fleck virus using PCR (polymerase chain reaction) procedures. Although a positive PCR test for fleck virus is not alone actionable in the California Grapevine Registration & Certification Program, the FPS 29 vines have been placed on "Hold" status in the program, which means that potential customers will be notified of the PCR test results prior to purchase.

Full PCR testing on all Cabernet Sauvignon FPS 29 source vines and any backups will be done once again and the vines will be subjected to full field indexing tests next year. New microshoot tip culture propagation has been initiated on the FPS 29 selection, and the plants could be available in mist propagated plant form as soon as 2011.

The second heritage selection brought to FPS by Golino and Freese in 1989 was the Disney-Silverado Heritage selection **Cabernet Sauvignon FPS 30**.

The Disney-Silverado selection came from an old vineyard near the Silverado Trail in the Stag's Leap District of Napa Valley. The source of the selection is not clear. In fact, the clone is most likely a massale selection composed of plant material from a number of California vineyards.

The property from which FPS 30 was taken was once owned by Harry See of See's Candies, who sold the property in 1979 to Mrs. Lillian Disney. Mrs. Disney renamed the property Silverado Vineyards. The Cabernet Sauvignon vines were already planted at the See Ranch by the time Mrs. Disney purchased the property. By that time, the vines had come to be known as the Cabernet Sauvignon 'See clone.'

John Brock was the vineyard manager who lived on the property and developed the See Ranch vineyard. He personally planted the See vineyard, including the Cabernet Sauvignon vines, all of which were planted in 1969. The budwood for the vineyard was obtained from multiple sources in California. Brock obtained Chardonnay and (he believes) some Cabernet budwood from Wente vineyards in Livermore. Brock also recalls that he received select material from Joe Heitz and Martha's Vineyard. Finally, he recalls harvesting wood from a vineyard near Healdsburg but cannot remember the name of the grower. (Brock, 2008).

Harry See was connected to the people associated with the Martha's Vineyard Cabernet Sauvignon grapevines. It is logical that cuttings from that source would find their way to the See Ranch vineyard in 1969. Wine merchant Darrell Corti knew Harry See. Harry See was a friend to Belle and Barney Rhodes, who Corti believes persuaded See to purchase the property in the Napa Valley.

The Rhodes originally owned and planted the reknown Martha's Vineyard in Oakville in 1961 with 12 acres of Cabernet Sauvignon cuttings taken from the Winkler plot at the University of California Experiment Station, rows 34-38. Those Cabernet vines had been budded at the Experiment Station in 1948 and showed good production and a healthy appearance. The Station is across the road from Martha's Vineyard. (Sullivan, 2008; Corti, 2008; Hiaring, 1979). The Rhodes were later shareholders in Heitz Cellar and socialized with Harry See and Joe Heitz. (Waugh, 1972).

There are two separate accounts of the origin of the See clone relating back to Wente Vineyards. John Brock recalls that he may have obtained some Cabernet Sauvignon cuttings from Wente Vineyards in Livermore at the same time he harvested some Chardonnay cuttings. (Brock, 2008).

Heritage selections in the FPS Foundation Vineyard From left: Cabernet Sauvignon FPS 29 (Niebaum-Coppola), Cabernet Sauvignon FPS 30 (Disney-Silverado), and Cabernet Sauvignon FPS 31 (Mondavi). *Photos by Bev Ferguson, UC Davis*

It is difficult to trace the particular plant material that Brock received from Wente at the Livermore site. The Cabernet Sauvignon grapevines located at Wente Vineyards in Livermore in the 1960's were developed from plant material brought to California by Charles Wetmore from Château Margaux in France at the end of the 19th century. (Wetmore, 1884; www.wentevineyards.com). It is believed that similar germplasm was provided to Concannon Vineyards, resulting in Cabernet Sauvignon FPS 07, 08, and 11.

However, Philip Wente explains that, in the late sixties it was quite common for growers to go to Wente's Livermore facility to pick up bundles of cuttings made from the certified increase blocks in Arroyo Seco in Monterey County. Wente did not sell any wood from the Livermore Vineyards at that time as the availability of virus free wood had become the driver of the new planting requests. Philip Wente believes that Cabernet Sauvignon wood obtained by Brock in Livermore was from the increase blocks in Monterey. (Wente, 2008).

Wente Vineyards was one of the largest suppliers of certified, inspected wood from the FPMS program in the late 1960's. Wente Vineyards in Monterey had available Cabernet Sauvignon budwood at that time. Wente received cuttings of Cabernet Sauvignon FPS 03 (Mendoza, Argentina) in 1966 and planted them in Wente's increase block 36 in Monterey County. (Wente, 2008). FPS 03 arrived at FPS in 1964 at the same time as FPS 04 and 05 but is no longer maintained in the FPS collection.

Although Wente received a subsequent shipment of Cabernet Sauvignon FPS 07 and 08 (Concannon) from FPMS in 1972 and planted those vines in Monterey County increase block 113, the timing of the See Ranch planting in 1969 suggests that Brock received Cabernet Sauvignon FPS 03 from the Wente Monterey block.

A second account of the origin of the Cabernet Sauvignon See clone is related to the Wente vineyards in Monterey. There is substantial evidence that some of the See clone massale planting was obtained from a vineyard owned by Sterling Winery, who obtained its grapevines from the Wente block in Monterey containing FPS 03.

Jack Stuart, the former winemaker for Silverado Vineyards, states that the Cabernet Sauvignon vines were planted on the See Ranch within the approximate time period of 1968 to 1971. He believed that cuttings were taken from different vines in a vineyard owned by Sterling Winery. Stuart observed that there appeared to be two different types of the Cabernet Sauvignon vines on the See property; some were characterized by small loose clusters and others had small berries. (Stuart, 2008). Stuart's recollection lends credence to the massale selection theory.

Alex Vyborny worked for a vineyard management company that managed the See vineyards in 1973. He said that See vineyard Cabernet Sauvignon was planted by John Brock in 1968 or 1969 with cuttings from Sterling Winery's Bear Flat vineyards, located on Highway 29 south of Larkmead Lane. Vyborny described the "See clone" as having lighter cluster weight, smaller berry size, lower acid and softer tannin. (Vyborny, 2008).

Silverado assistant winemaker Elena Francheschi indicated that Silverado Winery (the current owner of the See property) was able to establish that the original "See clone" Cabernet Sauvignon cuttings came from Sterling Winery's Bear Flat vineyard. Sterling Winery reportedly obtained those Cabernet Sauvignon cuttings from Wente in Monterey County. (Heald and Heald, 1999). Ms. Francheschi characterized the See clone from the Stag's Leap District as completely different from See clones she has seen planted in other vineyards.

Ric Forman joined Sterling Winery as winemaker in 1969, the year of its first vintage. At that time, the Cabernet Sauvignon vines in the Sterling Bear Flat vineyard had already been planted for a few years and were producing a crop. He believes that the Bear Flat vines may have been planted in 1966 or 1967. (Forman, 2008). At that time, the Wente increase blocks in Monterey contained the FPS 03 selection.

The Disney-Silverado plant material that was brought to FPS in 1989 as FPS 30 was infected with virus and underwent shoot tip tissue culture treatment. It appeared on the list of registered vines for the R&C Program in 1999.

An ongoing replicated trial containing the FPS heritage clones located in Oakville, Napa County (Winkler zones II and III) produced data for a three-year period from 2005-2007. Cabernet Sauvignon FPS 30 (the Disney-Silverado heritage clone) was included in the study, in both its original form and after having undergone virus elimination therapy. The other two FPS heritage clones (FPS 29 and 31) along with several other FPS selections were included in the trial. (Wolpert, 2008).

Deborah Golino and Jim Wolpert reported on the results of the Oakville study at the Variety Focus: Cabernet Sauvignon seminar sponsored by UC Davis Extension on May 15, 2008. Talks and presentations from Variety Focus: Cabernet Sauvignon may be viewed at UC Integrated Viticulture Online *http://iv.ucdavis.edu* under Videotaped Seminars and Events.

The relevant finding of Cabernet Sauvignon FPS 30 is that it performed much like the popular selection Cabernet Sauvignon FPS 08 (Concannon). FPS 29 (Niebaum-Coppola heritage clone) and FPS 30 (Disney Silverado heritage clone) performed closer to the traditionally higher-yielding FPS 08 – 95, 94, 107 berries per cluster for FPS 08, 29 and 30 respectively; 92, 88 and 97 grams cluster weight for the three, respectively. The trend was maintained for the 3-year average for the trial. Jim Wolpert stated that FPS 29 and 30 "looked a lot like FPS 08." (Wolpert, 2008).

The third FPS heritage selection **Cabernet Sauvignon FPS 31** was donated to FPS by Mondavi from one of the most famous vineyards in Napa Valley, the ToKalon Vineyard near Oakville, California.

H.W. Crabbe probably planted the first commercial Cabernet Sauvignon in Napa Valley. He originally planted the ToKalon vineyard in the 1870's with cuttings of premium varietals from France. (Sullivan, 2008; Siler, 2007). Robert Mondavi purchased most of the ToKalon vineyard in 1962, which by then had been producing well-regarded Cabernet Sauvignon grapes for many years. (Siler, 2007). He purchased additional ToKalon acreage in 1968. Mondavi believed that the vineyard was ideal for growing Cabernet Sauvignon due to sunny days and cool nights during the growing season and the flat, fertile plain on which the vineyard was situated. (Mondavi, 1998).

The FPS Mondavi selection was from 50-year old vines in the ToKalon vineyard (S block, vine 2). Cabernet Sauvignon FPS 31 tested positive for viruses at FPS. Shoot tip tissue culture propagation was used to create a selection that tested free of specified viruses. FPS 31 appeared for the first time on the list of registered vines in the R&C Program in 1999.

Phil Freese spent 12 years with Robert Mondavi Winery (1982-1993), in part as Vice President of Winegrowing. He recommended the ToKalon clone for the heritage collection because the Mondavi Winery has had success with it and the clone appears to be unique. The replicated trial conducted by UC and FPS researchers, described above, confirms a possible genetic basis for Freese's opinion.

The replicated trial was described, above. Clonal material in the trial included: the three FPS heritage clones, both original material and virus-treated (FPS 29, 30 and 31); standard FPS selections that have been in the collection for a period of time (FPS 02, 04, 06, 08, and 14); some of the newer FPS selections (FPS 24, FPS 26-now FPS 38, FPS 27-now FPS 39); and ENTAV clone 169.

At the UC Davis Extension Course 'Variety Focus: Cabernet Sauvignon,' Jim Wolpert reported that significant surprising results were revealed regarding the yield results for the Mondavi heritage clone FPS 31. He compared the clone to Cabernet Sauvignon FPS 06 (Jackson), which has consistently produced low yields in prior trials—60% of the yield of Cabernet Sauvignon FPS 08, Concannon. (Wolpert, 2008).

Berry weight is a component closely watched by winemakers, who desire smaller berries for higher surface:volume ratio and concentration of color. (Wolpert *et al.*, 1995). In 2007, FPS 31 produced a slightly lower yield than FPS 06 – fewer berries per cluster (52 for FPS 31 versus 70 for FPS 06) and a lower cluster weight (51 grams for FPS 31 versus 58 grams for FPS 06). The 3-year average showed that FPS 31 performed at levels similar to or lower than FPS 06 over time.

The Oakville trial also compared the performance of the three FPS heritage clones in their original condition (suffering from viruses) with the corresponding FPS selections that had undergone virus-elimination therapy. At the Variety Focus: Cabernet Sauvignon, Deborah Golino exhibited data showing that, even though all three heritage selections initially had similar virus profiles, the effect of virus elimination on yield was to significantly increase yield, cluster weight and berries per cluster for two of the heritage clones (FPS 29 and 31). (Golino, 2008).

The original infected materials for all three heritage selections have been preserved at an isolated site on the UC Davis campus, since all three of the original vineyards from which the heritage clones were taken no longer exist.

Cabernet Sauvignon FPS 40 was donated to FPS in 2001 by Kendall-Jackson Winery. The plant material originated at Mt. Eden Vineyards, a small wine estate located in the Santa Cruz Mountains since 1945. The Mt. Eden Winery focuses on small lots of wines, including Cabernet Sauvignon. FPS 40 did not undergo treatment and became available through the R&C Program in 2003-2004.

Cabernet Sauvignon FPS 42 was donated to the FPS public collection in 2002 by Larry Hyde of the Hyde Vineyard in the Carneros region of Napa County, California. In an article for the 2004 FPS Grape Program Newsletter, Mr. Hyde described the selection as an early-producing clone with spice flavor and large berries and clusters. FPS 42 did not undergo any treatment and was first available through the R&C Program in 2004-2005.

CLONAL MATERIAL FROM FRENCH SOURCES

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. The former OSU grape importation program was able to import French clonal material, which was later shared with the public collection at FPS in 1988-89. FPS refers to that material as generic French clones. This importation project preceded the official ENTAV-INRA® clone authorization program (2001), so the identity of the generic French clones cannot be guaranteed under that official program. Generic clones are "reported to be" the French clone number assigned at the time of the importation.

The 1988-89 transaction through OSU did not include Cabernet Sauvignon plant material. However, an Oregon viticulturalist involved in the project (David Adelsheim) later assisted Dr. Austin Goheen and FPS Grape Program Manager, Susan Nelson-Kluk, with importing some additional French clones, including Cabernet Sauvignon, directly to FPS using funds remaining after the original Winegrowers' Project.

In 1989, FPS received three clones directly from the Chambre d'Agriculture de la Gironde, France. The Chambre d'Agriculture is a semi-governmental agency that exists in each geopgraphical area in France; in some areas, the Chambre works with growers to help them select appropriate clones. The Chambre d'Agriculture de la Gironde is located in Blanquefort, just north of the city of Bordeaux. The three clones sent to FPS in 1989 were: **Cabernet Sauvignon FPS 33** (reported to be French clone 191), **Cabernet Sauvignon FPS 37** (reported to be French clone 339), and **Cabernet Sauvignon FPS 47** (reported to be French clone 337).

All three of the French Cabernet Sauvignon selections tested positive for virus and underwent microshoot tip culture. FPS 33 (reported to be French clone 191) first appeared on the list of registered selections in 2003, and FPS 37 (reported to be French clone 339) first appeared in 2005.

Cabernet Sauvignon FPS 47 is the long-awaited clean version of the generic French material reported to be French clone 337. In the English version of the *Catalogue of Selected Wine Grape Varieties and Certified Clones Cultivated in France*, the official ENTAV descriptions of the wine grape varieties and clones, Cabernet Sauvignon 337 is described as a superior clone which produces well balanced wines with good aging qualities.

The original material was imported directly from France in 1989 and tested positive for leafroll and fleck viruses. It took a long time to clean it up with tissue culture because of a propagation error made in the 1990's. DNA analysis was performed in the fall of 2007 to confirm that this selection is indeed Cabernet Sauvignon. FPS 47 will be available in the form of mist propagated plants in fall 2008.

Cabernet Sauvignon FPS 34 and **35** came to FPS from France as proprietary selections in 1995. FPS 34 is reported to be French clone 191. FPS 35 is reported to be French clone 585. Both selections underwent shoot tip tissue culture therapy and first appeared on the list of registered vines in 2002-2003. Their proprietary status expired in 2002.

Isaac Rainwater trains a young Cabernet Sauvignon FPS 47 vine in the FPS Foundation vineyard.

Cabernet Sauvignon FPS 43 came to FPS from France via a California vineyard in 2002 and is reported to be French clone 15. No treatment was necessary for this selection, which attained registered status in 2006.

Six Cabernet Sauvignon selections currently in the pipeline at FPS as the Vincent series were donated to the FPS public collection by a well-respected producer of French wine near Bordeaux, France. The donor, who wishes to remain anonymous, named the series after his vineyard manager in France as well as the patron saint of winegrowers, St. Vincent of Saragossa. The Vincent series also contains Merlot and Cabernet franc selections.

The Cabernet Sauvignon selections in the Vincent series are **FPS 44** (Vincent series #2), **45** (Vincent series #5), **46** (Vincent series #6), **48** (Vincent series #7), **49** (Vincent series #8) and **50** (Vincent series #10). None of the selections underwent treatment, and all are awaiting professional identification. They currently have Provisional status in the R&C Program. FPS 44, 45 and 46 should be available to the public after September, 2008. FPS 48, 49 and 50 will be proprietary until May, 2009, after which they will be available to the public.

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 the management and coordination of the French national clonal selection program. ENTAV maintains the French national repository of accredited clones and has created an ENTAV-INRA® authorized clone trademark to identify its official clonal materials internationally. The trademark is a good indication that the clonal identity of a vine is correct. Trademarked importations come directly from official French source vines. ENTAV retains the exclusive rights to control the distribution and propagation of its trademarked materials, which are only available to the public from nurseries licensed by ENTAV.

The selection numbers used to identify ENTAV-INRA® authorized clones in the FPS collection equate to the same numbers used by the official trademarked clones. For example, Cabernet Sauvignon ENTAV-INRA® 15EV corresponds to official French clone 15. **Cabernet Sauvignon ENTAV-INRA® 15EV** came to FPS in 1999 and appeared on the registered list in 2003.

Cabernet Sauvignon ENTAV-INRA® 169 came to FPS in 1997 and first appeared on the list of registered vines in 2003. **Cabernet Sauvignon ENTAV-INRA® 170, 338, 412** and **685** came to FPS in 2000 and first appeared on the list of registered vines in 2003 (170, 338 and 412) and 2004 (685). None of the ENTAV-INRA® selections received treatments at FPS. All of the ENTAV selections are available to the public through ENTAV-INRA licensees (California Grapevine Nursery, Mercier California LLC, Herrick Grapevines, and Sunridge Nurseries).

Italian selections

Two Cabernet Sauvignon selections from Italy came to Davis as a result of the project funded by Winegrowers of California. The plant material was sent to FPS in 1989 by Dr. Antonio Calò from the Istituto Sperimentale per la Viticoltura di Conegliano (now the Centro di Ricerca per la Viticoltura) in northern Italy.

Cabernet Sauvignon FPS 38 is Italian clone ISV-V-F-6. The selection underwent microshoot tip culture and first appeared as a Provisional selection in 2001-2002. It became a registered selection in 2003.

Cabernet Sauvignon FPS 39 is Italian clone R5. The selection underwent microshoot tip culture and first appeared as a Provisional selection in 2003-2004. It became a registered selection in 2004.

CLONAL EVALUATIONS

Cabernet Sauvignon was an important variety selected early on by UC Davis for virus treatment and evaluation. There are few reports of clonal evaluations for winegrapes in California prior to 1995. (Wolpert *et al.*, 1995).

Harold Olmo began a clonal evaluation and selection program when he arrived at UC Davis in 1934. In a 1964 article for Wines & Vines magazine, Olmo reviewed the clonal evaluation and selection process that he initiated at Oakville in 1939 for Cabernet Sauvignon. He searched the oldest vineyards for "outstanding individual vines for uniformity to type, healthfulness and high yield." (Olmo, 1964). The vines were observed for several years, and select buds were harvested and planted into new plots.

Crops from the new plantings were measured each year; for Cabernet Sauvignon alone, 960 vines were harvested and weighed separately. From the 40 original vines, several were selected as being much superior to the others. Unfortunately, Olmo did not identify those he called superior. Fifteen consecutive years of records were obtained but are not published. (Olmo, 1964).

Olmo wrote the following about the Cabernet Sauvignon selections that were identified as superior to the rest:

> "The best Cabernet Sauvignon selections have since been sources of practically all new plantings in Napa and Sonoma counties. The young Cabernet Sauvignon vineyards of California now appear to be the best in the world, from the standpoint of both variety-purity and health." (Olmo, 1964).

Curtis Alley, Professor of Viticulture at UC Davis and former manager of the FPMS program, reported on a 1975 planting at Davis of 7 Cabernet Sauvignon clones, including FPS 1A (no longer available), 02, 03, 06, 08, 10, 21. (Alley, 1977). In a three-year trial involving three of those clones, data consistently showed that FPS 08 (Concannon) produced high yields (16.6 kg/vine per year), FPS 02 (Oakville) produced moderate yields (12.1 kg per year) and FPS 06 (Jackson) produced low yields (7.5 kg per year). (Bowen and Kliewer, 1990). Alley's categorization of the three clones as high, moderate and low yielding was later supported by a similar yield relationship at Oakville in the Napa Valley. (Wolpert *et al.*,1995; Bowen and Kliewer, 1990).

Several evaluations of field performance of Cabernet Sauvignon clones have been reported in more recent years. The general trends in terms of relative yield parameters have stayed consistent throughout the trials.

Lodi-Woodbridge Trial

A three-year trial was conducted by UC Extension personnel in the Lodi-Woodbridge District of the Northern San Joaquin Valley, considered to be high Winkler III to low IV climate zones. Cabernet Sauvignon FPS 02, 04, 05, 06, 08, 10 and 21 were budded onto Harmony rootstock. Data were reported from 1990-1992. (Wolpert *et al.*, 1995).

Yield results confirmed the trend discovered by Alley in the earlier trial. FPS 08 (Concannon) and FPS 21 (Chile) produced the highest average yield at 9.4 kg per vine and 9.7 kg per vine, respectively. FPS 06 (Jackson) had the lowest average yield at 7.0 kg vine. FPS 02, 04, 05, and 10 were in the intermediate range with yields in the 8.4-8.8 kg range. The yield differences were highly correlated to cluster weight, attributed to berry weight and berry number per cluster. On average, FPS 06 had 20 fewer berries per cluster than the other selections. (Wolpert *et al.*,1995).

Mondavi Trial

At about the same time period, Mondavi Winery conducted a replicated trial at the ToKalon vineyard in Oakville using six FPS selections—Cabernet Sauvignon FPS 02, 04, 06, 07 (from the same source vine at Concannon as FPS 08), 10 and 14. The rootstock used was 110R. Vine yield and yield component data were reported from 1991-1994. (Williams and Bledsoe, 1995).

The Mondavi study concluded that FPS 06 was the most distinctive selection, with crop weight (1.68 kg per vine) and cluster weight (.075 kg per vine) significantly lower than those for the other five selections. The low cluster weight figure was primarily attributed to fewer berries per cluster (85 berries), almost half that of the highest yielders FPS 07 and 10 (149 berries). Almost all the variation in yield was due to differences in cluster weight.

FPS 07 had the highest cluster weight (.164 kg) and crop weight per vine (3.88 kg) of the six selections. FPS 07 exceeded FPS 06 almost two-fold for every yield measurement in the trial. FPS 07 was taken from the same source vine at Concannon as FPS 08, but the two selections underwent heat treatment for differing lengths of time. A previous 4-year study of 17 FPS Cabernet Sauvignon selections led to the conclusion that varying lengths of heat

therapy on the same plant material had no bearing on crop yield or yield components. (Bledsoe, 1991). Therefore, it was not surprising that FPS 07 should perform in the same relative position as did FPS 08 in the Lodi trial.

Beaulieu Trial

Six FPS Cabernet Sauvignon selections (FPS 1A, 02, 04, 06, 08 and 10) were included in a replicated trial of 14 clones at Beaulieu Vineyards in Oakville. Data reported for 1990-1993 showed that FPS 08 and 10 had the highest cluster weights, and FPS 06 the lowest cluster weights. The other selections were in the intermediate range. The significantly different yields were driven by variability in cluster and berry weights. (Aiken *et al.*,1995).

Lake County Trial

A replicated trial of seven FPS selections (Cabernet Sauvignon FPS 02, 04, 05, 06, 08, 10 and 21) on 5C rootstock was conducted at a higher elevation site near Kelseyville in Lake County, California. The vineyard was planted in a site with high potential vigor. The vines were trained to a spur/cordon divided canopy. The number of degree days necessary to ripen fruit in this location averaged 2960 hours, which puts the trial in Winkler region II. Data was reported for 1998-2000.

Significant differences were found in the yield of the clones, clusters per vine and cluster weights. FPS 04 (Mendoza, Argentina) had the highest average yield (14.6 kg per vine) and number of clusters per vine (115 clusters). FPS 04, 08 and 10 had the highest average cluster weights. FPS 06 had a significantly lower average vine yield and cluster weight (8.28kg per vine and 85g per cluster), followed by FPS 2 (11.3 kg per vine and 101g per cluster). FPS 06 had the fewest number of clusters per vine (97) compared to the high yielder, FPS 04 (115).

The researchers did a chemical analysis on the berries from each selection and concluded that the clones with lower yields and lighter clusters (FPS 02 and 06) produced riper fruit with better acidity and more favorable pH results. (McGourty *et al.*, 2001). The results of the study were presented to the Lake County Wine Grape Commission in June, 2001.

Fresno Trial

In 2003 eleven percent of California's Cabernet Sauvignon vines were grown in the central and southern San Joaquin Valley, which is a very warm Winkler V climate region. A replicated trial was conducted near Fresno in an effort to assist farmers in that region in selecting Cabernet Sauvignon clones that would maximize yield of acceptable-quality fruit. (Fidelibus *et al.*, 2006).

Six FPS Cabernet Sauvignon selections (FPS 02, 08, 10, 21, 22, and 24) were planted on their own roots in 1997. Data was taken in 2000-2003. FPS 08 (Concannon), FPS 21 (Chile) and FPS 22 produced more than 15% higher average yields than selections 02, 10 and 24. The highest yielding selections had larger clusters than the lower yielding selections but similar numbers of berries per cluster. The researchers concluded that berry weight was the key determinant in yield differences. They found that the high yield (23 kg per vine) and early maturity of FPS 22 was distinctive. FPS 08 also had high yield (21kg per vine) but the fruit matured later than FPS 22. (Fidelibus *et al.*, 2006).

FPS selections have also been included in clonal studies on Cabernet Sauvignon in Australia. Cabernet Sauvignon FPS 07 (Concannon) – the sister plant to FPS 08 – consistently produced high yields in those trials. (Cirami and Ewart, 1995; Cirami *et al.*, 1993; Whiting and Hardie, 1981).

Interest in the Cabernet Sauvignon variety in California shows no sign of abating. The FPS heritage clones and other selections currently in the pipeline, such as the Vincent series, offer interesting alternatives to the traditional standard FPS selections that have served the grape and wine industry well over the years. Foundation Plant Services is proud of the diversity in the Cabernet Sauvignon selections in its collection.

ACKNOWLEDGMENTS

In addition to the helpful contributions of the individuals expressly mentioned in the article, I would like to express my appreciation to the following who contributed information and advice for this article: Deborah Golino, Susan Nelson-Kluk, Axel Borg, John Skarstad, Andy Walker, Samuel Barros, Phil Freese, Jack Stuart, Clay Brock, Jim Concannon and Philip Wente.

REFERENCES

Aiken, Joel, Bell, Anthony, Hansen, Graciela, and Selfridge, Thomas. 1995. Comparison of Fourteen Selections of Cabernet Sauvignon. Proceedings of the International Symposium on Clonal Selection, American Society for Enology and Viticulture, Portland, Oregon.

Alley, C.J. 1977. An update on clone research in California. Wines & Vines 58 (4): 31-32.

Alley, Lynn, Golino, Deborah and Walker, Andrew. 2001. Retrospective on California grapevine materials, part 3. Solutions for a growing industry. Wines & Vines.82(4): 63-68 (April, 2001).

Alley, Lynn, Golino, Deborah, and Walker, Andrew. 2000. Retrospective on California grapevine materials, part 1. Wines & Vines 81 (11): 148-152 (November 2000).

Amerine, M.A. and Winkler, A.J. 1963. California Wine Grapes: Composition and Quality of their Musts and Wines. California Agr. Exp. Sta. Bul. 794. (emphasis on Post-World War II studies).

Amerine, M.A. and Winkler A.J. 1944. Composition and Quality of Musts and Wines of California Grapes. Hilgardia 15 (6): 493-673.

Asher, Gerald. 2002. The Pleasures of Wine: Selected Essays. 'Château Margaux: Time Recaptured.' Chronicle Books LLC. San Francisco, California.

Bioletti, F.T. 1934. Elements of Grape Growing in California. California Agr. Extension Service, Circular 30. Original was drafted in March, 1929, revised April, 1934.

Bioletti, F.T. 1907. The best wine grapes for California. Calif. Exp.Sta.Bul. 193: 141-145.

Bledsoe, A.M. 1991. Performance of 17 different selections of Cabernet Sauvignon. Presented at the 42nd Annual Meeting of the American Society for Enology and Viticulture. Seattle, Washington.

Bowen, P.A. and Kliewer, W.M. 1990. Influence of Clonal Variation, Pruning Severity, and Cane Structure on Yield Component Development in 'Cabernet Sauvignon' Grapevines. J. Amer. Soc. Hort. Sci. 115(4): 530-534.

Bowers, John and Meredith, Carole. 1997. The parentage of a classic wine grape, Cabernet Sauvignon. Nature Genetics 16(1): 84-87.

Brock, Clay. 2008. Personnal communication with author. August 25, 2008. Clay Brock is the son of John Brock.

California Department of Food & Agriculture (CDFA). 2008. California Grape Acreage, 2007 Crop. USDA National Agricultural Statistics Service. Sacramento, California. *www.nass.usda.gov/ca*

Cirami, R.M. and Ewart, J.W. 1995. Clonal Selection, Evaluation, and Multiplication in Australia. Proceedings of the International Symposium on Clonal Selection, American Society for Enology and Viticulture, Portland, Oregon.

Cirami, R.M., McCarthy, M.G., Nicholas, P.R. 1993. Clonal selection and evaluation to improve production of Cabernet Sauvignon grapevines in South Australia. Australian Journal of Experimental Agriculture 33: 213-20.

Concannon, James. 2008. Letter from James Concannon to author dated April 14, 2008.

Concannon, Jim. 2006. Concannon : the First One Hundred and Twenty-Five Years. Andy Katz Photography. Healdsburg, California.

Corti, Darrell. 2008. Personal communication with author, August 20, 2008.

ENTAV-INRA-ENSAM-ONIVINS. 1995. Catalogue of Selected Wine Grape Varieties and Clones Cultivated in France. Ministry of Agriculture, Fisheries and Food, CTPS. (English version).

Fidelibus, Mathew W., Christensen, L. Peter, Katayama, Donald G., and Verdenal, Pierre-Thibaut. 2006. Yield Components and Fruit Composition of Six 'Cabernet Sauvignon' Grapevine Selections in the Central San Joaquin Valley, California. Journal of the American Pomological Society 60(1): 32-36.

Forman, Ric. 2008. Ric Forman personal communication with author in June, 2008.

Galet, Pierre. 2000. General Viticulture. Oenoplurimedia sarl. Chaintré, France.

Galet, Pierre. 1998. Grape Varieties and Rootstock Varieties. Oenoplurimedia sarl. Chaintré, France.

Goheen, A.C. (Undated). Cabernet Sauvignon Sources in California. Unpublished paper.

Golino, Deborah. 2008. Presentation at UC Davis Extension seminar "Variety Focus: Cabernet Sauvignon," held at UC Davis on May 15, 2008. Variety Focus: Cabernet Sauvignon may be viewed at UC Integrated Viticulture Online *http://iv.ucdavis.edu* under Videotaped Seminars and Events.

Heald, Eleanor, and Heald, Ray. 2002. Saving a heritage clone. Practical Winery & Vineyard vol. XXIII, no. 6: 30-40 (March/April 2002).

Heald, Eleanor, and Heald, Ray. 1999. Growing distinctive Cabernet Sauvignon. Practical Winery and Vineyard vol. XIX, no. 6: 48-53 (March/April, 1999).

Heintz, William. 1999. California's Napa Valley: 160 Years of Wine Making. Scottwall Associates, San Francisco, California.

Hiaring, Philip E. 1992. 'Kunde Estate brings history back to the Sonoma Valley.' Wines & Vines 73(1).

Hiaring, Philip E. 1979. 'Martha's Vineyard: a place and a wine.' Wines & Vines 60(5): 70-73.

Kasimatis, Amand. 2008. Personal communication with author in March, 2008.

Hilgard, E.W. 1890. The Central Experiment Station. Report on the Agricultural Experiment Stations of the University of California for the Years 1888-1889.

McGourty, Glenn T., Elkins, Rachel, Tylicki, Steve and Nosera, Jim. 2001. An Evaluation of 7 Cabernet Sauvignon Clones in Lake County. For the Lake County Wine Grape Commission. The report was not published but can be viewed on the Mendocino County website at *http://cemendocino.ucdavis.edu/files/5356.pdf*.

McLeod, Scott. 2008. Presentation at UC Davis Extension seminar "Variety Focus: Cabernet Sauvignon," held at UC Davis on May 15, 2008. Variety Focus: Cabernet Sauvignon may be viewed at UC Integrated Viticulture Online *http://iv.ucdavis.edu* under Videotaped Seminars and Events.

Mondavi, Robert. 1998. Harvests of Joy. Harcourt Brace & Company. New York, San Diego, London.

Nelson-Kluk, Susan. 2008. Personal communication with author.

Olmo, Harold P. 1991. Letter from Harold P. Olmo to James Concannon, September, 1991.

Olmo, H. P. 1978. The Role of New Varieties in the Wine Industry. University of California, Davis. (Unpublished paper).

Olmo, Harold P. 1976. Plant Genetics and New Grape Varieties. Oral History, interview #1 (April 8, 1973). California Wine Industry Oral History Series, University of California.

Olmo, Harold P. 1964. Improvements in Grape Varieties. Wines & Vines 45(2): 23-25.

Olmo, H.P. 1957. Black Wine Varieties in California. Viticulture 105, University of California, Davis.

Olmo, H.P. 1954. Our Principal Wine Grape Varieties – Present and Future. Am. J. Enol. Vitic. 5: 18-20.

Olmo, H.P. (Undated). Early Work on Clonal Selection in California Vineyards. (Unpublished paper).

Ough, C.S. and Alley, C.J. 1966. An Evaluation of Some Cabernet Varieties. Wines & Vines 47: 23-25.

Ough, C.S. and Alley, C.J. undated. Cabernet-type grapes and wines from the coastal regions of California, Department of Viticulture & Enology, University of California, Davis.

Paul Gros Gendre & Co. 1904. Letter from Paul Gros Gendre & Co. to James Concannon, dated April 23, 1904.

Peninou, Ernest P. 1998. History of the Sonoma Viticultural District, Volume 1. Nomis Press. Santa Rosa, California.

Pinney, T.A. 1989. A History of Wine in America: From the Beginnings to Prohibition. University of California Press. Berkeley, California.

Robinson, Jancis. 2006. The Oxford Companion to Wine. 3d ed. Oxford University Press. Oxford, England.

Siler, Julia Flynn. 2007. The House of Mondavi: The Rise and Fall of an American Dynasty. Gotham Books, New York.

Stuart, Jack. 2008. Jack Stuart personal communication with author on June 9, 2008.

Sullivan, Charles L. 2008. Napa Wine: A History from Mission Days to Present. 2d ed. Napa Valley Wine Library Association, South San Francisco, California.

Sullivan, Charles L. May, 2008. 'Cabernet Sauvignon: Past, Present, Future.' Presentation at UC Davis Extension seminar "Variety Focus: Cabernet Sauvignon," held at UC Davis on May 15, 2008. Variety Focus: Cabernet Sauvignon may be viewed at UC Integrated Viticulture Online *http://iv.ucdavis.edu* under Videotaped Seminars and Events.

Sullivan, Charles L. 2003. Zinfandel: A History of a Grape and Its Wine. University of California Press. Berkeley and Los Angeles, California.

Taber, George M. 2005. Judgment of Paris: California vs. France and the Historic 1976 Paris Tasting that Revolutionized Wine. Scribner, Avenue of the Americas, New York.

Unzelman, Gail. 2006. Sonoma County Wineries. Arcadia Publishing.

Volpe, R, Green, R, Heien, D and Howitt, R. 2008. Recent Trends in the California Wine Grape Industry. Giannini Foundation of Agricultural Economics, University of California.

Vyborny, Alex. 2008. Alex Vyborny personal communication with author on August 22, 2008.

Walker, M. Andrew. 2000. UC Davis' Role in Improving California's Grape Planting Materials. Proceedings of the ASEV 50th Anniversary Annual Meeting, Seattle, Washington.

Wait, Frona Eunice. 1973. Wines and Vines of California. Howell-North Books. Berkeley, California. (first published in 1889).

Waugh, Harry. 1972. Diary of A Wine Taster. Quadrangle Books, New York.

Wente, Philip. 2008. Philip Wente e-mail communications to author on June 6 and August 27, 2008.

Wetmore, Charles A. 1884. Ampelography of California. Reproduced and revised from San Francisco Merchant of January 4th and 11th, 1884.

Wetmore, C.A. 1884. Part V. Ampelography. Second Annual Report of the Chief Executive Viticultural Officer to the Board of State Viticultural Commissioners, for the Years 1882-1884, pp. 103-151.

Whiting, J.R. and Hardie, W.J. 1981. Yield and Compositional Differences Between Selections of Grapevine Cv. Cabernet Sauvignon. Am. J. Enol. Vitic. 32 (3): 212.

Williams, D. and Bledsoe, A. 1995. Evaluation of Six Registered Clones of Cabernet Sauvignon. Proceedings of the International Symposium on Clonal Selection, American Society for Enology and Viticulture, Portland, Oregon.

Winkler, A.T. 1964. Varietal Wine Grapes in the Central Coast Counties of California. Amer.Journal of Vit. & Enol. 15: 204.

Wolpert, James. 2008. Presentation at UC Davis Extension seminar "Variety Focus: Cabernet Sauvignon," held at UC Davis on May 15, 2008. Variety Focus: Cabernet Sauvignon may be viewed at UC Integrated Viticulture Online *http://iv.ucdavis.edu* under Videotaped Seminars and Events.

Wolpert, James A. 2003. Wine Grape Varieties in California. University of California, Agriculture and Natural Resources, Communication Services, Oakland, California.

Wolpert, J.A., Kasimatis, A.N. and Verdegaal, P.S. 1995. Viticultural Performance of Seven Cabernet Sauvignon Clones in the Northern San Joaquin Valley, California. Am. J. Enol. Vitic. 46(4): 437-441.

Wolpert, James A. 1995. Evaluation of Winegrape Clones in Coastal California: Current Activities and Future Prospects. Proceedings of the International Symposium on Clonal Selection, American Society for Enology and Viticulture, Portland, Oregon.

Summary of FPS Cabernet Sauvignon Selections

FPS#	Reported source	Registration status	Availability	Treatment
02	UC's Oakville Experiment Station	Registered 1965	FPS	None
04	Mendoza, Argentina	Registered 1966	FPS	None
05	Mendoza, Argentina	Registered 1966	FPS	None
06	UC's former Foothill Experiment Station near Jackson, CA	Registered 1969	FPS	None
07	Concannon Vineyard, Livermore, CA (formerly known as #101)	Registered 1970	FPS	Heat treatment 62 days
08	Concannon Vineyard, Livermore, CA (formerly known as #102)	Registered 1971	FPS	Heat treatment 168 days
10	Neustadt, Germany	Registered 1973	FPS	Heat treatment 148 days
11	Concannon Vineyard, Livermore, CA	Registered 1974	FPS	Heat treatment 168 days
12	Cachapoal Valley, Chile	Registered 1978	FPS	Heat treatment 103 days
13	Cachapoal Valley, Chile	Registered 1978	FPS	Heat treatment 111 days
14	Cachapoal Valley, Chile	Registered 1978	FPS	Heat treatment 111 days
15	Cachapoal Valley, Chile	Registered 1978	FPS	Heat treatment 111 days
15EV	ENTAV-INRA® Authorized clone 15 from France	Registered 2003	ENTAV-INRA® licensees	None
19	Cachapoal Valley, Chile	Registered 1978	FPS	Heat treatment 137 days
20	Cachapoal Valley, Chile	Registered 1978	FPS	Heat treatment 137 days
21	Cachapoal Valley, Chile	Registered 1978	FPS	Heat treatment 141 days
22	Vineyard in Napa County, CA	Registered 1990	FPS	Heat treatment 60 days
23	Vineyard in Napa County, CA	Registered 1990	FPS	Heat treatment 136 days
24	Laurel Glen Vineyard, Sonoma County, CA	Registered 1994	FPS	None
29	Niebaum-Coppola Heritage clone from Pritchard Hill vineyard on former Inglenook estate in Napa County, CA	Registered 1999	FPS	Shoot tip tissue culture
30	Disney-Silverado Heritage clone from vineyard near the Silverado Trail in Napa County, CA	Registered 1999	FPS	Shoot tip tissue culture
31	Mondavi Heritage clone from ToKalon vineyard near Oakville, CA	Registered 1999	FPS	Shoot tip tissue culture
33	Chambre d'Agriculture de la Gironde, Bordeaux, France - reported to be French clone 191	Registered 2003	FPS	Shoot tip tissue culture
34	Reported to be French clone 191	Registered 2002-03	FPS	Shoot tip tissue culture
35	Reported to be French clone 585	Registered 2002-03	FPS	Shoot tip tissue culture

Summary of FPS Cabernet Sauvignon Selections (cont.)

FPS#	Reported source	Registration status	Availability	Treatment
37	Chambre d'Agriculture de la Gironde, Bordeaux, France - reported to be French clone 339	Registered 2005	FPS	Shoot tip tissue culture
38	Italian clone ISV-V-F-6 from Conegliano, Italy	Registered 2003	FPS	Shoot tip tissue culture
39	Italian clone R5 from Conegliano, Italy	Registered 2004	FPS	Shoot tip tissue culture
40	Mt. Eden Vineyards, Santa Cruz Mountains, CA	Registered 2003-04	FPS	None
42	Larry Hyde Vineyard in Carneros region of Napa County, CA	Registered 2004-05	FPS	None
43	France via a California vineyard -reported to be French clone 15	Registered 2006	FPS	None
44	Vincent series #2 from Bordeaux, France	Provisional	FPS	None available to the public after 9/08
45	Vincent series #5 from Bordeaux, France	Provisional	FPS	None available to the public after 9/08
46	Vincent series #6 from Bordeaux, France	Provisional	FPS	None available to the public after 9/08
47	Chambre d'Agriculture de la Gironde, Bordeaux, France - reported to be French clone 337	Provisional 2007-08	FPS	Shoot tip tissue culture
48	Vincent series #7 from Bordeaux, France	Provisional	FPS	None will be available to the public in 2009
49	Vincent series #8 from Bordeaux, France	Provisional	FPS	None will be available to the public in 2009
50	Vincent series #10 from Bordeaux, France	Provisional	FPS	None will be available to the public in 2009
169	ENTAV-INRA® Authorized clone 169 from France	Registered 2003	ENTAV-INRA® licensees	None
170	ENTAV-INRA® Authorized clone 170 from France	Registered 2003	ENTAV-INRA® licensees	None
338	ENTAV-INRA® Authorized clone 338 from France	Registered 2003	ENTAV-INRA® licensees	None
412	ENTAV-INRA® Authorized clone 412 from France	Registered 2003	ENTAV-INRA® licensees	None
685	ENTAV-INRA® Authorized clone 685 from France	Registered 2004	ENTAV-INRA® licensees	None

Update on Heritage Zinfandel Selections at FPS

by Nancy Sweet , Foundation Plant Services

Zinfandel Advocates and Producers (ZAP) and Dr. Jim Wolpert, Viticulture Extension Specialist at the University of California, Davis, have agreed to release to the public grape collection all Zinfandel Heritage Project selections previously brought to FPS. Twenty heritage clones have attained foundation stock status in the California Grapevine Registration & Certification (R&C) Program. Mist-propagated plants (MPPs) may be available for distribution from FPS to R&C participating nurseries as soon as spring 2009.

The Zinfandel Heritage Project was initiated in the 1990's to preserve germplasm from historical California Zinfandel clones for the benefit of the public. The effort was directed by Wolpert and funded by ZAP, a trade association of producers and consumers of Zinfandel wine.

The Zinfandel Heritage Project team collected Zinfandel clones from vineyards planted before 1930. The team wanted the collection to represent as wide a geographic range as possible; when complete, the collection represented fourteen California counties from San Bernardino to Mendocino. The team also specifically sought vines with loose clusters and small berries.

Sixty-three selections were budded onto rootstock at a research vineyard at UC's Oakville Station in 1995-96. Twenty-two additional selections were added in 1999. The intent of the Phase 1 research in the Zinfandel Heritage Project was to do initial screening of the clones and preserve the clonal material. Although this stage of the research did not involve replicated trials, data describing juice chemistry as well as vegetative and reproductive growth were collected from each of the selections for six years.

Foundation Plant Services donated disease testing and elimination treatment services to the Zinfandel Heritage Project. Budwood from 20 of the Zinfandel Heritage Project vines was sent to FPS starting at the beginning of the project under code names to commence the registration and certification process. The selections arrived in three groups —1991, 1997, and 2001—and were screened for virus.

Ten of the heritage selections were not required to undergo virus elimination therapy. The remaining ten selections underwent shoot tip tissue culture treatment after virus testing. It is expected that all twenty heritage Zinfandel selections will attain registered or provisional status by the time the FPS list of Registered Grape Selections for the 2008-2009 Dormant Season is released in January 2009.

ZAP and Wolpert advanced 18 heritage selections and 4 standard UC selections (Zinfandel FPS 02 and 03 and Primitivo FPS 03 and 06) to Phase 2 trials in the Zinfandel Heritage Project. The Phase 2 research was set up as a replicated trial, allowing for more meaningful data collection. FPS received the majority of its Heritage Zinfandel selections early in the project, so few of the selections are in the Phase 2 trial at Oakville.

In Phase 2, the decision was made to increase the plot size and vine number per selection to make larger, more representative wine lots. Three years of research wine (2006-2008) was made by Ravenswood Winery and evaluated. Performance data was also accumulated in this phase.

Planning for Phase 3 of the Zinfandel Heritage Project is currently in progress. Cuttings have been taken from FPS' Foundation Vineyard for a future ZAP clonal research study to be administered by Wolpert. This phase of the project will yield data relative to the selections featured at FPS. The purpose of Phase 3 research is to evaluate how *terroir* (site conditions) affects the performance of each heritage selection.

ZAP and Wolpert are in the process of identifying 'grower-cooperators' to establish the Zinfandel Heritage selections in diverse locations throughout California. They are looking for ideal research sites with uniform soil and adequate size.

The Zinfandel Heritage Project selections at FPS will be available to the public five years after they are released to Wolpert and ZAP. However, MPPs of the selections may be made available to R&C Program participating nurseries as soon as spring 2009.

The original source of each Zinfandel Heritage Project selection will remain confidential for the present time. ZAP and Wolpert do not want undue influence placed on association with a place name or winery over actual performance and wine research results. They encourage selection of clones based on performance in replicated trials.

For more information on the Zinfandel variety, visit *iv.ucdavis.edu* or the 2007 *FPS Grape Program Newsletter* article 'The Zinfandels of FPS' at *http://fps.ucdavis.edu/WebSitePDFs/Newsletters&Publications/GrapeNewsletter-Nov2007.pdf*.

Leafroll Virus Threatens California Vineyards

by Nancy Sweet, Foundation Plant Services

GRAPEVINE LEAFROLL VIRUS MOST LIKELY ORIGINATED in the Eastern Mediterranean region long ago and co-evolved with *Vitis vinifera*, later spreading throughout the world by the movement of infected vines and cuttings. (Weber *et al.*,1993).

Symptoms of leafroll disease were observed in California in the early 20th century, but the disease remained unrecognized or unimportant for decades. Loss of AXR-1 rootstock due to phylloxera and development of powerful new virus technology in the 1990's raised the profile of the disease in California.

A recent example of leafroll spread in a Napa Valley vineyard illustrates how quickly the debilitating virus could enter a vineyard and cause serious damage.

Leafroll virus poses a significant threat to the California grape industry due to reductions in tonnage and fruit quality and the need for frequent vineyard replanting.

Leafroll virus

Grapevine leafroll virus is a member of the ancient and diverse virus family *Closteroviridae*, which can be transmitted by phloem-feeding insect vectors such as aphid, mealybug and whitefly. (Karasev, 2000). There are at least nine serologically distinct, closely-related viruses associated with grapevine leafroll disease. Each of those viruses has a unique RNA sequence, so much so that the viruses are distinct species rather than simply separate strains of the same virus.

The family *Closteroviridae* was revised in 2002. *Grapevine leafroll-associated virus* 2 (GLRaV-2) is located in the genus *Closterovirus*. GLRaV-7 cannot be assigned to a genus until additional molecular data is developed. (Martelli *et al.*, 2002).

The *Ampelovirus* genus was added to the family in 2002. *Ampelos* is the Greek word for grapevine. *Grapevine leafroll-associated viruses* (GLRaV) -1, -3, and -5 are separate mealybug-transmitted species located within *Ampelovirus*, and GLRaV-4, -6 and -9 are tentative species within the genus. (Fauquet *et al.*, 2005; Alkowni *et al.*, 2004; Martelli *et al.*, 2002).

FPS scientist Dr. Adib Rowhani has recently isolated a new viral species (tentatively referred to as *Carnelian*) that appears to be related to GLRaV-4, -5 and -6 on the *Ampelovirus* branch of the phylogenetic tree for the family *Closteroviridae*.

Photo by Mike Anderson

There are reports of possible additional species (newly identified GLRaV-De and -Pr, sometimes referred to as GLRaV-10 and -11) within the *Ampelovirus* genus. (Maliogka *et al.*, 2008). Work is currently in progress to reclassify the species/strains within the Ampelovirus genus.

Leaf and fruit symptoms can be used to diagnose leafroll disease in some varieties of *Vitis vinifera* grapes.[1] Visual symptoms develop as the crop matures.

Leafroll virus symptoms that occur on infected vines resemble nutritional deficiencies and premature senescence, which can make them difficult to diagnose by visual inspection, particularly in the early years of infection. (Karasev, 2000).

Leafroll disease causes degeneration of primary phloem cells in young shoots, leaves and fruit pedicels. (Weber *et al.*,1993). In woody perennials such as grapevines, the virus may cause problems in vascular tissue development manifested by leaf-rolling, stem-pitting, stunting, reduced vigor, and reduced quantity and quality of the harvested fruit. (Karasev, 2000).

The presence of leafroll virus is often indicated by physical symptoms on leaves resulting from the impaired

[1]Unlike the situation with *V. vinifera* grapes, visual symptoms are not reliable as an indicator of leafroll disease in most North American species and hybrids, including most rootstock varieties.

vascular tissue. The most distinctive leaf symptoms appear between the time of harvest and leaf drop. However, knowledgeable growers can sometimes see mild symptoms as early as June.

The margins of the leaf blades roll downward starting with the basal leaf on the cane of an affected vine. The area between the major veins turns yellow or red, depending on whether the variety produces white- or red-colored fruit. In some varieties, the area adjacent to the major veins remains green until late fall. (Golino *et al.*,1992). It is more difficult to detect leafroll virus from a visual examination of white grape varieties than it is with red grape varieties.

Leafroll trials at Oakville demonstrate red leaf symptoms, poor fruit color and quality, and reduced yields. *Photo by Sue Sim*

The most significant effect of leafroll disease on grapevines is a reduction in yield and quality of fruit from infected vines. The damage to phloem tissue caused by the virus further results in delayed sugar accumulation and reduced anthocyanin production in red varieties. Fruit from infected vines will be low in sugar, poorly colored and late in ripening. In some varieties, fruit maturity is delayed so that fruit on the affected vine may be pale or even whitish at harvest when fruit on healthy vines is ripe. (Golino *et al.*, 1992). Annual pruning weights, cluster number and cluster size are all reduced in infected vines. (Weber *et al.*, 1993).

The lack of symptoms in any type of grapevine does not guarantee freedom from infection by the viruses that are the causal agents of leafroll disease. (Weber *et al.*, 1993). Leafroll viruses have been historically difficult to study because they are at low titers in grapevines, the viruses have only limited (if any) alternate hosts, and it is extremely difficult to purify intact virus particles from plant tissue. Recent developments in laboratory techniques have addressed some of these challenges, and tremendous progress has been made in the last decade studying these viruses.

Leafroll infestation in a vineyard is usually not fatal to the crop in the first few years – however, significant losses can occur in the form of reduced yield and quality over time as leafroll spreads throughout the vineyard. (Golino *et al.*, 1992). Yield losses of 10 to 20% are fairly typical. (Weber *et al.*, 1993). Some studies have estimated losses as high as 30% to 40%. (Golino *et al.*, 2002). Vine death occurs most often when leafroll disease is combined with other virus diseases, according to FPS Director Deborah Golino. Viruses are particularly insidious because an infected vine will never recover from the disease—no curative measures are available. Prevention is the key management strategy for grapevine leafroll virus. Vineyards must be maintained in a virus-free condition in order to avoid damage caused by the disease. (Golino *et al.*, 1992).

History of Leafroll Virus in California vineyards

Very little mention of grape leafroll virus disease appeared in scientific literature in the United States in the first half of the 20th century.[2] Early references to a "red leaf" condition were made in a 1905 Agricultural Experiment Station Bulletin (Sonoma, California) and in a 1931 unpublished book proposal by Frederic T. Bioletti (UCD) in a chapter entitled "Vine Trouble Attributed to Climatic, Soil and Cultural Conditions." (Alley and Golino, 2000; Goheen and Cook, 1959; Butler, O., 1905). That red leaf condition was later identified as grape leafroll virus. (Goheen and Cook, 1959).

The first suggestion that a virus might be the causative agent in poor vineyard performance for a California grape appeared in the 1940's when UC Davis and USDA researchers validated that theory using the red table grape 'Emperor.'

Growers had had problems with color development and sugar levels in that important variety, causing them to conclude that there were actually two Emperor varieties, the normal red 'Emperor' and 'White Emperor.' UC researchers determined that the color differential was perpetuated by vegetative propagation and theorized that a virus was the cause. In 1946, USDA scientists Frank Harmon and Elmer Snyder produced evidence indicative of a virus when they proved that the "White Emperor' condition was graft transmissible to red 'Emperor' vines. (Alley and Golino, 2000; Goheen, Hewitt and Alley, 1959).

Subsequent research showed that grapevine leafroll disease produced adverse effects on vines of other grape varieties such as the wine grape 'Ruby Cabernet.' (Goheen and Hewitt, 1964; Alley *et al.*,1963).

[2]In Germany, a researcher named Scheu identified and studied leafroll virus on grapevines in 1936. Scheu's results were not widely accepted by viticulturalists. (Goheen and Hewitt, 1964)

Leafroll virus was included on a list of serious threats to California vineyards in a published article in 1951 by Dr. William Hewitt, UC Davis plant pathologist and a 'father of modern grapevine virology.' (Alley and Golino, 2000). A compilation of surveys from the 1950's reported by Austin Goheen, William Hewitt and Curtis Alley concluded that on the basis of leafroll symptomology the incidence of leafroll was 80% or more in many California vineyards, particularly wine-grape vineyards in the coastal counties. They further observed that not all vineyards in California were as seriously affected and some were completely free of the disease. (Goheen, Hewitt and Alley, 1959).

The mechanism for the spread of leafroll disease was discussed in the early literature only in reference to propagation from old diseased vines or grafting onto diseased rootstock, as no vector was evident to the researchers at that time.

Foundation Plant Services work with leafroll virus management

Significant progress was made in the decades following the 1950's in reducing the incidence of leafroll disease in California vineyards. The most successful approach developed during that period (and still in use today) is the planting of disease-tested grapevine nursery stock, produced in California at Foundation Plant Services (FPS) at UC Davis through the California Grapevine Registration and Certification Program. (Alley and Golino, 2000). Grape scions and rootstock tested as free from all known or harmful viruses are available to replace contaminated stock in commercial propagation.

The grapevine clean stock concept was first implemented by the precursor organization to FPS, the California Grape Certification Association (CGCA), formed in 1952. The primary mission of that cooperative venture between the University of California and industry members was creation of virus-free grape stock that was true to variety name. A virus indexing program began in 1953 when Curtis Alley was hired as manager of the program.

The state of California became involved in regulatory oversight of the fledgling clean stock program when the California Department of Food & Agriculture (CDFA) established the California Grapevine Registration & Certification (R&C) Program in 1956. The program provided for voluntary participation by nurseries and licensed propagators and targeted the elimination of specific grapevine virus diseases, including leafroll.

Unfortunately, spread of leafroll disease is being observed—often between an old, infected vineyard and younger vineyards which were planted with healthy vines. Here, leafroll has spread from the old infected Zinfandel in the foreground to healthy Merlot vines in the adjacent block on the left. *Photo by Ed Weber*

Foundation Plant Materials Service—now Foundation Plant Services (FPS)—was created in 1958 when two certification programs—grape and cherry —were combined. FPS thereafter maintained virus-tested propagative sources of foundation materials for distribution to grapevine nursery participants. The program was one of the first clean stock programs in the world. (Golino *et al.*, 2002; Alley and Golino, 2000).

The R&C Program was guided at the outset by two assumptions about grapevine leafroll disease. The existing state of scientific knowledge at the time was that grapevine leafroll viruses spread only by grafting healthy stock with infected stock and did not spread naturally in vineyards. (Golino *et al.*, 2002; Goheen *et al.*,1959). The second assumption was that the viruses that caused leafroll disease were evenly distributed through infected vines. (Rowhani and Golino, 1995). New technologies and many deteriorating vines later proved both assumptions inaccurate.

Conventional wisdom about the mechanism by which leafroll virus spread was challenged at FPS when evidence of leafroll disease was discovered in the virus-tested section of the Foundation vineyard at UC Davis. Based on the premise that leafroll virus would not spread naturally in a vineyard, certain leafroll-infected selections had been planted adjacent to foundation vines in the Old Foundation Vineyard. (Weber *et al.*, ASEV Forum, 1993).

Dr. Adib Rowhani began developing an enzyme-linked immunoabsorbent assay (ELISA) test for leafroll detection in FPS vines in 1988. The virus serological test was new technology and, in 1992, revealed the presence of grapevine leafroll virus in previously healthy vines in the older foundation propagating block where leafroll positive vines had been planted near previously-clean foundation vines. The 1992 ELISA results suggested active and recent virus spread (1983-1988), a finding counter to the assumption that leafroll virus was spread only by propagative means. (Golino *et al.*, 2002; Rowhani and Golino, 1995).

Mealybug vectors as mechanism for spread

The discovery of leafroll disease in the FPS block focused attention acutely on the mechanism for leafroll virus spread in California vineyards. In the 1980's and early 1990's, researchers outside of California began to observe a natural spread of leafroll disease in vineyards which those researchers attributed to mealybug vectors. (Golino *et al.*, 2002). No evidence of such spread had been documented in the United States prior to 1992. (Weber *et al.*, ASEV Forum, 1993).

Prior to the discovery of leafroll virus in the FPS vineyard in 1992, only three species of mealybugs were commonly found in California vineyards: the grape mealybug, *Pseudococcus maritimus* (North Coast, Central Coast and San Joaquin Valley); and the obscure, *Pseudococcus viburni,* and longtailed, *Pseudococcus longispinus,* mealybugs (Central Coast). The low population levels of these mealybugs and effective biological and chemical controls had kept the infestations at a manageable level.

The finding of leafroll virus in the FPS Foundation Vineyard prompted a study conducted between 1992 and 2001. When the distribution of infected plants in the FPS Foundation Vineyard was mapped, it became apparent that new infections were frequently found adjacent to known diseased grapevines. The FPS researchers identified mealybugs as the putative leafroll vector and structured a research project on that theory.

The results of the research confirmed that four mealybug species found in California (obscure; longtailed; citrus, *Planococcus citri*; and grape) were capable of transmitting domestic isolates of *grapevine leafroll-associated virus* 3. It was the first experimental evidence of GLRaV transmission by obscure and grape mealybug, which had been collected for the study from Napa Valley. The study further reported for the first time that GLRaV-5 can be transmitted by longtailed mealybug. (Golino *et al.*, 2002).

The vine mealybug (*Planococcus ficus*) was not included in the study. VMB first appeared in table grape vineyards in the Coachella Valley (California) in the early 1990's but did not appear in northern and central California vineyards until approximately 2000. (Weber, 2002).

FPS responded by increasing isolation distances and implementing a comprehensive virus screening program using the ELISA test and newly developed PCR technology. (Golino *et al.*, 2002).

Napa Valley study: 2002-2006

While scientists were developing the ELISA virus-detection methodology, a vineyard was planted in Napa that later illustrated the devastating effect that the unchecked spread of leafroll virus can have on a grape crop.

A 7.2-acre parcel in a vineyard near Oakville in the Napa Valley (referred to here as Block 1) was planted in 1989 with Cabernet Sauvignon wood that was believed to be clean onto several different rootstocks (110-R, 3309-C, Teleki 5C). Vine rows were oriented in an east-west direction, with six feet between rows and 3.3 feet between vines.

The Cabernet wood was believed to be clean based on the lack of symptoms in the block from which the budwood was collected. The source of the budwood is uncertain. No leafroll virus symptoms were observed on the vines in

the initial 9 to 10 years following the planting, suggesting that the original stock was free of virus. Leafroll symptoms began to appear as described below in 2000.

The vines in the experimental site abutted a dirt road that ran along the eastern end of Block 1. A second block of Cabernet Sauvignon vines, known as Block 2, was growing across the road from Block 1. Block 2 had been planted in 1970-72 and was heavily infested with grapevine leafroll virus, evidenced by red leaf symptoms throughout Block 2.

When Block 1 was installed in 1989, the assumption was that leafroll virus was spread by propagative techniques and not by insect vectors. The characteristic red leaves caused by leafroll virus on black grape varieties began to appear on the Cabernet Sauvignon vines in Block 1 in 2000, concentrated primarily at the eastern end of the rows.

Deborah Golino (FPS Director) and Ed Weber (former UC Extension Farm Advisor for Napa County) were doing fieldwork at virus sites in Napa in the fall of 2002 when a research viticulturist at a winery in the Oakville area called their attention to Block 1, where the spread of leafroll virus was observed. Golino and Weber decided to map the incidence and pattern of vines with symptoms of leafroll virus in Block 1, beginning in fall of 2002.

Mapping Methodology

The goal of the mapping project was to make a visual assessment of leafroll spread throughout the block by observing all the vines over a period of years. Leafroll-positive Cabernet Sauvignon vines normally produce strong, characteristic visual symptoms. The documented observations comprised a precise record of the presence of the virus. The project team, led by Weber and Yvonne Rasmussen (UC Extension) and Sue Sim (FPS), made observations on all the vines in Block 1 in 2002, 2003, 2004, 2005, and 2006.

The leafroll mapping team in October 2002. From left: Judy Lee, Jodi Azulai, Justin Jacobs, Sue Sim, Mike Cunningham (all of FPS), Yvonne Rasmussen and Ed Weber (UC Extension, Napa County). *Photo by project team member Bev Ferguson*

Block 1 consisted of 98 vine rows containing approximately 15,680 vines. Leafroll-positive Cabernet Sauvignon vines normally produce strong, characteristic visual symptoms. In 2002, each vine in Block 1 was rated individually for symptoms of leafroll disease, using the following scoring template: 0=no symptoms; 1=mild or severe symptoms; Q=questionable (difficult to determine whether virus was present, usually because of mite feeding); C=canker symptoms masked possible leafroll symptoms; and X=a dead or missing vine.

In the first year of the mapping study, the scoring protocol was assessed for accuracy by comparison of the visual ratings with lab test results on a subset of the Block 1 vines. Seventy-five petiole samples were tested for GLRaV-1, -2, -3, and -4 using ELISA testing methods. (Weber *et al.*, 2002). Thirty-five of the 75 samples were from vines that had been rated positive (1) for the presence of leafroll, twenty were from vines with no leafroll symptoms (0), and 20 samples were from vines rated questionable for leafroll virus (Q).

The accuracy assessment showed that the visual observations of symptoms were highly correlated with the lab results showing presence of virus. Although not in perfect agreement with the lab results, the visual symptom ratings were very accurate. ELISA test results showed only GLRaV-3 in the samples from symptomatic vines; the other three GLRaV viruses showed negative. All 35 samples from vines visually rated as #1 (mild or severe symptoms) were also positive for GLRaV-3 by ELISA testing.

All vines rated as Q (Questionable) tested negative for leafroll virus. However, of the vines that exhibited no symptoms in the field (0), two of the twenty samples (10%) tested positive for GLRaV-3. It is possible that the two false visual negatives were samples from infected vines which had not yet begun to show symptoms. The high correlation rate for visual rating vis à vis ELISA test results led researchers to conclude that the visual assessment method was credible for use in the large scale mapping project.

In the fall of 2007, lab tests were repeated on 204 of the vines. The results again showed that the visual symptom ratings were very accurate. 100 of the 101 vines that were rated positive on the basis of visual symptoms tested positive for GLRaV-3 using ELISA testing. 100 of 103 vines that were rated negative on the basis of visual symptoms tested negative for GLRaV-3 on the basis of ELISA testing. The researchers concluded that it is probable that the three vines that tested positive from non-symptomatic vines represented early stage leafroll infection where symptoms were mild or where there were not yet any visible symptoms.

The rating system was amended after review of the results from the 2002 accuracy assessment. In 2003 and after, each vine was scored in one of three categories: positive for leafroll symptoms (1); negative for leafroll symptoms (0); or dead or missing (X). The Questionable and Canker categories were eliminated.

Results

2002 – The mapping results from 2002 showed that leafroll symptoms were present in 23.3% of the vines in Block 1. Nearly all the vines on the eastern end of the rows were rated positive for leafroll disease, and only a few vines on the western end were positive. There was a clear distribution pattern of symptomatic vines throughout the vineyard, suggesting that the leafroll virus originated from a vineyard (Block 2) located across the road that runs along the eastern end of Block 1. The supposition is that leafroll virus from that older vineyard initially crossed the road and continued to spread westerly down the rows of Block 1.

2003 – The percentage of symptomatic vines in Block 1 had increased to 41.2% by the fall of 2003. The pattern of diseased vines continued to demonstrate spread from east to west within the vineyard. Leafroll symptoms were also observed at this time on the recently-planted (1998) vines in Block 2, indicating that the virus had returned to the vineyard across the eastern road.

2004 – In 2004, 45.8% of the vines in Block 1 suffered from leafroll disease. By that time, grapes from healthy and diseased vines differed so greatly in fruit quality and ripening patterns that the vineyard was harvested twice. Grapes from healthy vines ripened two weeks earlier and exhibited better quality than grapes from diseased vines. The better quality fruit was picked several weeks ahead of the diseased vines and was incorporated into reserve wine at the winery. Grapes from the diseased vines fell below the standard for inclusion in reserve wines.

2005 and 2006 – Leafroll virus infected more than a majority of the vines in Block 1 within the following two years. The percentage of symptomatic vines increased to 49.8% in 2005 and then to 66.1% in 2006. The quality of the fruit from the diseased vines continues to be inferior. The owner is now faced with need to replant the block after only 15 years due to the pervasive negative influence of the leafroll virus.

In the year after the final observations were made, researchers at FPS began extensive laboratory testing of the affected vines from Block 1 using current PCR methodology and primers to enable detection of new virus types identified since 2002.

The researchers concluded that the grape mealybug was the most likely vector for the spread of leafroll disease in the Napa vineyard. Grape mealybug was observed in Blocks 1 and 2 and surrounding vineyards for many years, but the vector was usually present at low population levels that were deemed not to be a threat to the vines. The risk of leafroll spread from such small populations had not previously been a consideration when assessing potential damage from grape mealybug.

In much of Napa Valley, similar low population levels of grape mealybug are regularly observed but were not problematic due to biological controls and insecticides. Nevertheless, researchers in this study strongly suspect that grape mealybug was responsible for transmitting GLRaV-3 from Block 2 to Block 1 and for spreading the virus throughout Block 1.

Dr. Golino commented on the research findings: "The results of this mapping study constitute the first documentation of significant and rapid field spread of leafroll disease in a California vineyard."

Concerns for the Future

Vineyards in other areas of the Napa Valley have shown signs of leafroll spread at rates similar to those documented in this study. Growers' concerns have been heightened by the recent discovery in California of the vine mealybug, a vector that could substantially aggravate the spread of the virus in Napa and elsewhere. The fairly rapid spread of leafroll virus in a relatively unnoticed fashion in the presence of excellent researchers and observant vineyard managers suggests that something fundamental has changed in the vineyard environment. Several causative factors for the increased rate of spread have been proposed.

The first possibility considered is a new leafroll vector or changing vector populations. Grape mealybug has been present in the Napa Valley for many years and was present in all of the vineyards where rapid spread of leafroll virus has occurred. However, there is no evidence to suggest that grape mealybug population levels have increased, either in response to changing vineyard management strategies or any other circumstance. Vine mealybug is not established at this time in the locations where leafroll spread has been observed.

Vine mealybug, *Planococcus ficus,* is a relatively new and dangerous threat in terms of the spread of leafroll virus in California vineyards. Vine mealybug (VMB) spread from the Coachella Valley in southern California to the southern San Joaquin Valley in the late 1990's and to the Central Coast vineyards in 2000 and 2001. The pest

first appeared in Sacramento, Sonoma and Napa counties in mid-2002. The first reported case of vine mealybug infestation in Napa County occurred in when the insect was found in two vineyards near St. Helena. (Intardonato, 2007; Weber, 2002). VMB has since been controlled by extensive eradication efforts.

Vine mealybug may present a more serious threat to California vineyards than other mealybugs for several reasons. It is difficult to control and requires repeated insecticide treatments far exceeding that of other mealybugs. VMB has fewer natural enemies in California, where it is not native. (Weber, 2002). VMB reproduces at a higher rate than other species, enabling small numbers of mealybugs to reach damaging levels in a single season. VMB produces as many as seven generations per year, and all life stages are present all year round due to overlapping generations. In comparison, the grape mealybug has only one or two generations per year. (Intardonato, 2007). Detection and identification can be a problem as VMB, like most mealybugs, hibernates in crevices and under the bark on the vine and cannot be confirmed with an ordinary hand lens.(Intardonato, 2007; Daane *et al*., 2004).

Although not yet observed in the Napa Valley in significant numbers, proliferation of the vine mealybug population could facilitate rapid spread of viruses throughout the vineyards of Central and Northern California.

International literature published in the 1980's was the first to report that vine mealybug could transmit leafroll virus. In South Africa, whose climate closely approximates that of California, leafroll disease spread quite rapidly due largely to the presence of vine mealybug. (Weber *et al*., 1993). Expert pathologists expect that vine mealybug will be a very efficient vector of leafroll virus in California. University of California scientists at Davis and Berkeley are currently conducting research on the transmission biology of *grapevine leafroll-associated virus* 3 by the vine mealybug. Effective control (management) of this resilient pest before it can gain a foothold in northern California is critical.

The bottom line for Napa vineyards threatened by leafroll disease at the present time is that neither increased populations of grape mealybug nor the presence of vine mealybug was responsible for the vineyard experiencing the rapid spread of leafroll virus. The "vector factor" was discounted as the likely cause for the rapid spread of the virus observed in this study.

The second factor identified as a possible facilitator of the rapid spread of leafroll in Napa is the use of newer rootstocks in the post-phylloxera period after the 1990's. The previous generation of vineyards in Napa Valley was planted primarily on AXR #1 or St. George rootstocks, which are much more tolerant to leafroll infection than are the 10 to 15 rootstocks that are now commonly in use. It is even more critical at the present time for the vineyard environment to remain free of leafroll virus, due to the susceptibility of the rootstock selections planted today. It is possible that leafroll virus has always been present in the Napa vineyards but that the symptoms were not obvious due to rootstock tolerance of the virus.

The final factor proposed as the cause of the apparent increased rate of spread is the possibility of new forms of leafroll virus in California. New more readily transmissible strains (subsets within a species) of the virus could have been inadvertently introduced to California on grape cuttings that were smuggled into the state, bypassing quarantine procedures. This is a reasonable inference for the cause of leafroll spread given the number of illegal grapevine importations known to have occurred in California in the past twenty years. Furthermore, a new strain of one of the GLRaV isolates could gradually mutate to a more aggressive form than its relatives. (García-Arenal *et al*., 2001).

Careful monitoring of leafroll disease and mealybug activity in California is critical. A collaborative effort is planned by UC Davis scientists and industry researchers to monitor and evaluate the interrelationship between existing GLRaV species isolates and mealybug species in California. The research effort will be guided by FPS scientists Dr. Deborah Golino, Dr. Adib Rowhani and Sue Sim. An extensive vineyard will be planted in the Plant Pathology research block at UC Davis with vines and rootstock artificially inoculated with various combinations of leafroll and other viruses. The goal of the project is to study the symptoms and effects of various species of leafroll virus on grape scions grafted onto different rootstocks.

Golino and Rowhani are looking forward to the opportunity of learning more about the effects of leafroll and the diversity of this important group of viruses.

The full study may take as many as 20 years to complete, but answers to many questions about leafroll virus should be apparent within the first few years.

ACKNOWLEDGMENTS

I would like to express my appreciation to Dr. Deborah Golino, Dr. Adib Rowhani and Susan Sim for their helpful input and review of this article.

BIBLIOGRAPHY

Alkowni, R., Rowhani, A., Daubert, S., and Golino, D. 2004. Partial characterization of a new ampelovirus associated with grapevine leafroll disease. J. Plant Pathol. 86: 123-133.

Alley, C.J., Goheen A.C., Olmo H.P., and Koyama A.T. 1963. The Effect of Virus Infections on Vines, Fruit and Wines of Ruby Cabernet. Am.J.Enol.Vitic. 14(3): 164-170.

Alley, L., and Golino, D. 2000. The Origins of the Grape Program at Foundation Plant Materials Service. American Journal of Enology and Viticulture, Proceedings of the 50th Annual ASEV Meeting, Seattle, WA. AJEV 51: 222-230.

Butler, O. 1905. Observations on some vine diseases in Sonoma County, California. California University Agricultural Experiment Station Bulletin No. 168, pp. 5-17.

Daane, Kent, Weber, Ed and Bentley, Walt. 2004. Formidable pest spreading through California vineyards. Practical Winery & Vineyard (May/June 2004) vol. XXVI, no. 1, pp. 60-68.

Fauquet, C.M., Mayo M.A., Maniloff, J., Desselberger, U. and Ball, L.A. 2005. Virus Taxonomy. Eighth Report of the International Committee on Taxonomy of Viruses. Elsevier Academic Press. San Diego, California & London, England.

García-Arenal, Fernando, Fraile, Aurora, and Malpica, José. 2001. Variability and Genetic Structure of Plant Virus Populations. Annu. Rev. Phytopathol. 39: 157-86.

Goheen, A.C. and Cook, James A. 1959. Leafroll (Red-leaf or Rougeau) and its Effects on Vine Growth, Fruit Quality and Yields. Am.J.Enol.Vitic. 10: 173-181.

Goheen, A.C., and Hewitt, Wm. B. 1964. Diagnosis of Leafroll Grapevines. Rivista di Patologia Vegetale. Serie III, Volume IV: 427-442. Pavia, Tipografia Popolare S.R.L., Via Rezia, 11.

Goheen, A.C., Hewitt W.B., and Alley C.J. 1959. Studies of Grape Leafroll in California. Am.J.Enol.Vitic. 10(2): 78-84.

Golino, Deborah A., Sim, Susan T., Gill, Raymond and Rowhani, Adib. 2002. California mealybugs can spread grapevine leafroll disease. California Agriculture (November/ December) 56 (6): 196-201.

Golino, D.A., Uyemoto, J.K., and Goheen, A.C. 1992. Grape Virus Diseases. Grape Pest Management, 2d ed. University of California Division of Agriculture & Natural Resources Publication 3343, Oakland, CA.

Intardonato, John. 2007. Understanding the Vine Mealybug and Leafroll Virus. Wine Business Monthly (March, 2007) vol. XIV, no. 3.

Karasev, Alexander V. 2000. Genetic Diversity and Evolution of Closteroviruses. Annu. Rev. Phytopathol. 38: 293-324.

Maliogka, Varvara I., Dovas, Chrysostomos I., and Katis, Nikolaos I. 2008. Evolutionary relationships of virus species belonging to a distinct lineage within the Ampelovirus genus. Virus Research 135: 125-135.

Martelli, G.P. (Chair), Agranovsky, A.A., Bar-Joseph, M., Boscia, D., Candresse, T., Coutts, R.H.A., Dolja, V.V., Falk, B.W., Gonsalves, W., Jelkmann, W., Karasev, A.V., Minafra, A., Namba, S., Vetten, H.J., Wisler, G.C. and Yoshikawa, N. 2002. The family Closteroviridae revised. Arch Virol 147 (10): 2039-2044.

Rowhani, Adib, Uyemoto, Jerry K., Golino, Deborah A. and Martelli, Giovanni P. 2005. Pathogen Testing and Certification of Vitis and Prunus Species. Annu. Rev. Phytopathol. 43: 6.1-6.18.

Rowhani, Adib and Golino, Deborah. 1995. ELISA test reveals new information about leafroll disease. California Agriculture 49(1): 26-29

Sforza, René, Boudon-Padieu, Elisabeth and Greif, Charles. 2003. New mealybug species vectoring Grapevine leafroll-associated viruses-1 and -3 (GLRaV-1 and -3). European Journal of Plant Pathology 109: 975-981.

Weber, Ed. 2002. Vine Mealybug Found in Napa County!. Vineyard Views, September 18, 2002. University of California, Cooperative Extension, Napa County.

Weber, E., Golino, D.A., and Rowhani, A. 2002. Laboratory testing for grapevine virus diseases (PDF). Practical Winery and Vineyard vol. XXII, no. 2, pp. 13-26.

Weber, Ed, Golino, Deborah and Rowhani, Adib. 1993. Leafroll disease of grapevines. Practical Winery and Vineyard. (March/April 1993).

Weber, Ed, Rowhani, Adib and Golino, Deborah. 1993. The Current Status of Leafroll Infections in FPMS Vineyards. Grapevine Virus & Certification Issues Forum, 44th Annual Meeting of the American Society for Enology and Viticulture. Sacramento, CA.

In Memory

Ed Weber

Ed Weber died from a heart condition while riding his bicycle to a volleyball game in Yountville on December 31, 2007. He was 51.

Ed earned his B.S. in Plant Science (specializing in floriculture) and his M.S. in Horticulture (specializing in viticulture), both from UC Davis. He moved to the Napa Valley in 1983 to become the viticulturist for Joseph Phelps Vineyards. He began his career with UC Cooperative Extension as a Napa County viticulture farm advisor in 1988. In 2001, he was promoted to Director of Napa County Cooperative Extension.

Because Ed knew Napa Valley's vineyards intimately, he was an invaluable resource to other researchers. Faculty and specialists at Davis and Berkeley relied heavily on Ed for assistance in water and soil issues and pests. He had extensive responsibilities and was respected among his colleagues for his scientific research. That he could tackle contentious subjects and retain the respect of both sides is a testament to his diplomatic skills, beyond simply finding the answer.

An expert in winegrape production, rootstocks, Pierce's disease, phylloxera and other grape pests and diseases, Weber was often interviewed for radio, television and newspaper articles dealing with grape production issues. With his exceptional speaking and writing skills, he took the most complicated data and conveyed its importance to the general public in concise and interesting language.

He wrote nearly 60 industry trade journal articles in his career. After completing a field research project, he not only presented the results at meetings, but consistently also wrote them up for statewide audiences. He was efficient and productive in his work, focused on issues important to grape growers and the wine grape industry.

Ed was also chair of the Communications Advisory Board for four of the six years he served on the board.

He is survived by his wife of 22 years, Anne Jungerman; their three sons Reid, Grady and Owen; his mother, Wanda Minnick Weber of Napa; and sisters Susan Weber of Berkeley, Jane Weber McCabe of Laguna Hills, and Marilyn Weber Kleinhein of Los Angeles.

Michael E. Vail

Michael E. Vail passed away September 19th, 2008 at his home in Windsor, California at age 45.

Graduating from high school at 16, he went to Purdue University where he joined the Delta Triton Chapter of the Phi Sigma Kappa fraternity and earned a B.S. in Agronomy in 1986, followed by a M.S. in Plant Pathology from UC Davis in 1990.

Mike spent the next 18 years in progressively responsible viticulture positions. He shared his knowledge and expertise as a member of the American Phytopathological Society, the American Society of Agronomy, and the American Society for Enology and Viticulture where he was currently serving on the Board. He was also involved in the American Vineyard Foundation, the Lake County Winegrape Commission, and the Lodi-Woodbridge Winegrape Commission and served as a Licensed Pest Control Advisor. He co-authored articles on his research on grapevine wood-decaying fungi including *Botrytis*.

He is survived by his mother, Kitty Belle Vail, wife Rosa, daughter Gabi "D," and step-son David Quezada.

James Lider

James Vernon Lider, former Napa County director and farm advisor, died November 19, 2007 at age 82. Lider was born in Esparto and worked on his family's farm in Yolo County in his youth.

At 18, he was drafted into the Army and served under General Patton. He fought in the Battle of the Bulge. While in Europe, Lider received the World War II Victory Medal, Good Conduct Medal, the European Theater of Operations Medal and the combat Infantryman's Badge.

Lider earned a B.S.degree in horticulture and a M.S. degree in horticulture/viticulture from UC Davis. He became a Napa County farm advisor in 1952, then was promoted to county director in 1968.

After serving UC for 20 years, Lider became a private viticulture consultant, opening Lider Ranches Vineyard Services in Napa. He also started Casa Verde Grapevines, a family-run grapevine nursery, in Yolo County.

He is survived by his wife, Cecelia Marie; children David Lider, Joseph Lider, Mary Lider White, Anita Lider Hart, and Patricia Lider Springer; 12 grandchildren, and two great-grandchildren.

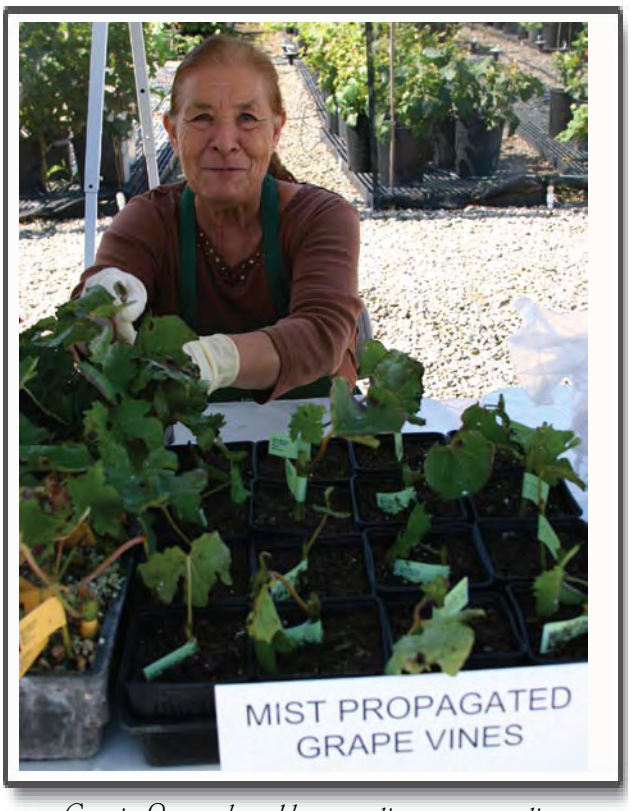
Scenes from Foundation Plant Service's 50th Anniversary Celebration

July 1, 2008

Guests mingled and viewed the exhibits

Mike Cunningham displayed dormant grape budwood

Sue Sim and Waclawa Pudlo explained tissue culture methods

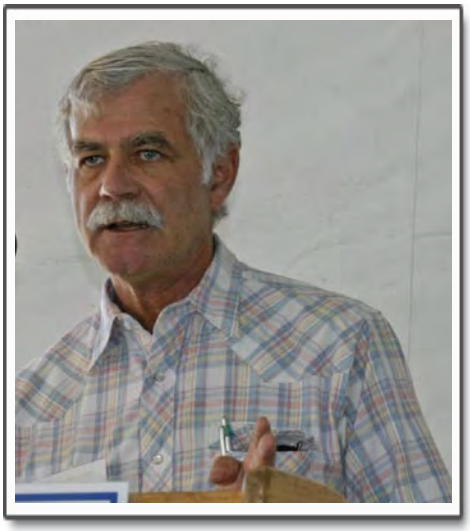


Connie Lopez shared her expertise on propagation

Cheryl Covert and Tracy Pinkelton provided information on FPS and the plant introduction and distribution process

Scenes from Foundation Plant Service's 50th Anniversary Celebration

July 1, 2008



Industry remarks were provided by (from left): Craig Stoller, Chair, California Grape Rootstock Commission; Robert Woolley, Owner, Dave Wilson Nursery; and Bill Burchell, Chair, FPS Tree Advisory Committee

Lunch in the tent included wines donated by E&J Gallo Winery, entertainment and dessert

photos by Bev Ferguson, Foundation Plant Services