Foundation Plant Services
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FPS GRAPE PROGRAM NEWSLETTER

fps.ucdavis.edu

October 2011

From the Director's Desk

Deborah Golino, Director

Foundation Plant Services has come through a difficult year; smaller, but in good health with exciting projects underway.

We have been given permission by the College of Agricultural and Environmental Sciences Dean's office to move forward with the first stage of building the FPS Trinchero Family Estates Building. This project will add a 5,600-square-foot building adjacent to our current facility. The project aims to achieve LEED silver certification with a variety of sustainable design features, including water and energy efficiency. Features include a meeting room for hosting classes and stakeholder gatherings, sufficient space to replace an aging trailer, and office space for our laboratory scientists. We have successfully completed the campus planning process and, at this writing, we are going out for bid. We will be able to begin 'Phase I' of the construction, building the cold shell of the building once a contractor has been chosen by the campus bid process. The next important step will be fundraising for the remainder of the $3.8 million needed to complete the building and provide the tenant improvements. We have had help putting together a very attractive brochure on the project and I would be delighted to provide copies to anyone interested in learning more about the project or helping me with our fundraising activities.

Just prior to going to press with this newsletter, we heard additional good news that Bill SB 707 (Cannella) Agricultural Development was signed by Governor Brown. Text of that bill can be found at *www.leginfo.ca.gov/pub/11-12/bill/sen/sb_0701-0750/sb_707_bill_20110926_chaptered.pdf*. SB707 adds olive trees to the production crops subject to IAB assessment. Further, it authorizes CDFA to enter into agreements with the University of California (at FPS) to develop olive planting materials. Since many of our grape newsletter readers also work with the California Olive Oil industry, we wanted to share that news here. The addition of crops and nursery participants will strengthen the IAB going into the future. It should be interesting to explore a vision for this new program with our olive stakeholders.

Funding from the USDA National Clean Plant Network (NCPN) has continued to make it possible to realize our new vision for the Russell Ranch Foundation. In the 2008 USDA Farm Bill, $20 million were set aside to create a new National Clean Plant Network (NCPN), administrated

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Inside:

Drawing above is an artist's depiction of Foundation Plant Service front with the anticipated FPS Trinchero Family Estates Building on the left.

DORMANT ORDER DEADLINE: November 15

2011–12 Season Orders

FPS is now accepting orders for the 2011-12 season. To request unrooted, ungrafted dormant cuttings for delivery in January-March 2012 or green mist-propagated plants (MPPs) for 2012 delivery, submit your order by November 15, 2011. This will help ensure that you receive a share of any varieties/selections that are in short supply. Orders received after November 15 will be filled on a first-come, first-served basis after orders received by the deadline are filled. **To place an order**, sign and submit an FPS Order Form/Grower Agreement, available at *fps.ucdavis.edu/WebSitePDFs/Forms/FPSOrderForm.pdf*.

Updated lists of registered grape selections, new grape selections, prices and order forms are available on the FPS Web site at *fps.ucdavis.edu/grape.html*.

Additional details about FPS selections, including source and status information, and whether a selection has been through tissue culture, may be accessed on the National Grape Registry at *ngr.ucdavis.edu*.

Anyone with questions on navigating this Web site to find information may contact site manager Nancy Sweet (*nlsweet@ucdavis.edu*; 530-752-8646) or the FPS office (*fps@ucdavis.edu*; 530-752-3590). Non-internet users are welcome to call Nancy or the FPS office for assistance in obtaining information on FPS selections.

Submit signed forms or service agreements to FPS by one of the following methods:

FAX to (530) 752-2132

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

U.S. Postal Mail:
Foundation Plant Services
University of California
One Shields Avenue
Davis, CA 95616-8600

Express courier (FedEx, UPS, etc.) Note this is different from the postal mailing address:
Foundation Plant Services
University of California
455 Hopkins Road
Davis, CA 95616

Upcoming Events

FPS Annual Meeting: November 1, 2011 at the Buehler Alumni and Visitors Center, UC Davis. Advance registration required; online form and details posted at *ucanr.org/sites/FPSevent* or phone FPS (530) 752-6000.

Current Issues in Vineyard Health, UC Davis Extension class. November 30, 2011, 9:00 am–4:00 pm at the DaVinci building in Davis. Registration and information are at *www.extension.ucdavis.edu*

2012 Unified Wine and Grape Symposium to be held January 24–26 at the Sacramento Convention Center, 1400 J Street, Sacramento, California. For more information, go to *www.unifiedsymposium.org*

63rd Annual Meeting of the American Society for Enology and Viticulture June 18–22, 2012 in Portland, OR. Details are available at *www.asev.org*

17th Meeting of the ICVG Will be held in October 2012 at UC Davis. Information will be available at *ucanr.org/sites/ICVG* (currently 'under construction').

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New Naming Convention Preserves Historic Identity of Selections in the Russell Ranch Foundation Vineyard

Nancy Sweet, Foundation Plant Services, UC Davis

To be eligible for the Russell Ranch Foundation Vineyard, grape material must meet two criteria: the vines must be generated using microshoot tip tissue culture techniques; and they must test negative for pathogens as described on the Protocol 2010 list. The eligibility criteria for the new vineyard will help ensure the cleanest possible grapevine material in the United States.

A naming issue is presented when existing registered and provisional selections currently planted in the FPS Classic Foundation Vineyard are relocated to the Russell Ranch Foundation Vineyard. Some Classic Foundation selections were created using microshoot tip tissue culture therapy, and some were not. If those classic selections previously created by tissue culture successfully complete 2010 Protocol testing, they may keep their existing selection numbers when they move to the Russell Ranch vineyard.

For named selections in the FPS Classic Foundation Vineyard that have never undergone tissue culture treatment, a tissue culture form must first be identified or produced. A special numbering scheme for those tissue culture selections has been developed with the primary goal of preserving the historical identity of the new tissue culture vines by associating them directly with their established, familiar sister plants. The new numbering scheme differs significantly from the system previously used at FPS.

In the past at FPS, a vine that was created by microshoot tip tissue culture treatment from original source material was traditionally given a completely different selection number. That system did not name untreated and treated vines from a common source in a way that made it obvious that the two types of plant material originated from the same source. For example, the plant material that became Riesling FPS 14 was imported from Germany in 1963, successfully completed disease testing, and was planted in the FPS foundation vineyard without undergoing any treatment. In 2006, FPS decided to generate a new selection from Riesling 14 because it had tested positive for *Rupestris stem pitting* virus. The resulting new selection, created using tissue culture therapy, was named Riesling FPS 21 because that was the next available Riesling number in the FPS database.

Many of the important and popular selections on the list of registered vines currently planted in the FPS Classic Foundation Vineyard have not undergone tissue culture treatment, including long-time favorites such as Chardonnay 04 and Cabernet Sauvignon 07 and 08. Those selections were not required to undergo treatment because the original plant material successfully tested negative for the diseases proscribed by the regulations of the California Grapevine Registration & Certification Program, making them eligible for the foundation vineyard in an untreated state. The familiar and popular untreated selections will enter the Russell Ranch Foundation Vineyard via tissue culture plants derived in one of two ways:

1) Using microshoot tip tissue culture techniques for the selection. That process has begun for many of the untreated established selections, such as Chardonnay 04 and Cabernet Sauvignon 08, in the FPS Classic Foundation Vineyard.

2) Utilizing vines that were initially created by tissue culture therapy and planted into the Classic Foundation Vineyard but have not yet been assigned a selection number. These vines were created from original source material as tissue culture 'backups' when the original grapevine material underwent disease testing upon arrival at FPS. (The tissue culture backup material would be immediately available in the event that the original untreated material tested positive for a prohibited disease.)

Whether derived from new tissue culture plants or former backup material, these two sources of Russell Ranch vines require new selection names (numbers) distinguishing them from their sister vines of untreated plant material. A special naming convention was developed for selections that fall into this category. The grapevine nursery industry participating in the California R&C Program expressed concern about losing the identity of the original grapevine material by the former 'next in order' renumbering system. The consensus of the nursery members was that any renumbering scheme adopted for these new selections made from old favorites should readily identify the new vines as successors to their former source vines.

The special numbering system identifies a tissue culture selection with its familiar untreated sister vine planted in the FPS Classic Foundation Vineyard by adding a '.1' to the prior established selection number. Selections in the Russell Ranch foundation vineyard that show a '.1' extension in future FPS plant lists are related to previously established FPS foundation vines. The '.1' extension may indicate that a vine was created by microshoot tip tissue culture of an untreated established selection in the FPS Classic Foundation Vineyard, i.e. Cabernet Sauvignon 08.1 was recently created using tissue culture treatment from Cabernet Sauvignon 08. The '.1' extension will also be used when tissue culture backup vines from the Classic Foundation Vineyard are used at Russell Ranch in lieu of their untreated sister vines. For example, tissue culture backup vines created in 1996 from the original source material for untreated Barbera 06 were identified as candidates for the Russell Ranch Foundation Vineyard. The backup material successfully completed testing for the 2010 Protocol and is now known as Barbera 06.1.

Transition from the Classic Foundation Vineyard to the Russell Ranch Foundation Vineyard presents many challenges. FPS will implement this substantial project with as little inconvenience and disruption to industry members as possible.

New FPS Public Grape Varieties and Selections

Nancy Sweet, Foundation Plant Services, UC Davis

All FPS newly available Provisional selections are included in the list *New Grape Selections Available from FPS,* which is accessible on the FPS website at *fps.ucdavis.edu* under 'Grapes.' The list represents all selections that have acquired Provisional status in the California Grapevine Registration & Certification Program within the past four years but have not yet attained Registered status.

A selection obtains Provisional status in the R&C Program by completing all disease testing with negative test results. All that remains for these selections to attain Registered status is professional identification.

The new public and proprietary grape selections that successfully completed testing during the past year were released and planted in the FPS foundation vineyard in 2010 and 2011. Mist propagated plants (MPPs) may be ordered for summer 2012 delivery (actual dates subject to change depending on demand). Dormant cuttings may also be ordered, but it normally takes approximately two years for newly-planted vines to produce adequate wood. Contact FPS to discuss the readiness of a particular selection for dormant cuttings. Order forms and a price list are available on the FPS website under 'Grapes.'

The newly-released public selections for 2011 include domestic cultivars and ones originating from Greece, France, Italy and other European regions.

CULTIVARS FROM THE UNITED STATES

Pixie FPS 01 Pixie was donated to the FPS public collection in 2008 by Dr. Peter Cousins, Cornell University and USDA-ARS Plant Genetics Research Unit, New York State Agricultural Experiment Station at Geneva, New York. Dr. Cousins is a geneticist who helped develop Pixie with UC Davis scientist David Tricoli. Pixie is used for research and breeding. The cultivar is a dwarf grapevine regenerated from embryogenic cells of the Pinot Meunier variety. A natural mutation causes shortening of internodes and causes the vine to produce flowers instead of tendrils. Mature Pixie clusters measure slightly less than four inches long, and the cultivar can be grown to maturity in a greenhouse. The cultivar is unusual in its ability to initiate fruit all year round, which allows for accelerated research projects to be conducted. Pixie 01 has successfully completed disease testing at FPS and did not require any treatment.

Kingfisher, Matador and Minotaur Rootstock Three rootstock selections developed by Dr. Peter Cousins were released in 2011. Detailed descriptions of these rootstocks can be found in his article 'Three Root-knot Nematode Resistant Rootstocks Released by USDA Agricultural Research Service' on page 12.

New Triplett selections Fay Triplett was a botanist who farmed wine grapes near Ceres in Stanislaus County. He enjoyed plant breeding and began making grapevine crosses in the 1940s. He was in close contact with Dr. Harold Olmo, and began collecting breeding material from UC Davis and several European collections. Mr. Triplett made his new cultivars available to Gallo Winery and the UC Davis Department of Viticulture & Enology for winemaking and evaluation.

UC Extension Viticulture Specialist Peter Christensen collaborated with Mr. Triplett in moving some of the more promising breeder selections to the Agricultural Station at Kearney, California, where data was collected from about 40 selections. All but 21 of the selections were eliminated by Christensen based on performance data, fruit composition and perceived potential for production or breeding.

FPS began cooperating with Christensen around 2002 to preserve the twenty-one selections. Several of the Triplett selections were sent to FPS for disease testing and disease elimination therapy. The Triplett selections that have been released to date include Triplett blanc (2004), Maxine Rouge (2007), Rougett (2007) and Fay Rouge (2010). Detailed descriptions of these past releases may be found in FPS Grape Program Newsletters for 2002, 2004, 2007 and 2010 at the FPS website under 'Publications.'

In 2011, two additional Triplett selections successfully completed disease testing following microshoot tip tissue culture disease elimination therapy. The two selections have not been named with other than breeder numbers, but they are available for interested researchers and producers. The characteristics and performance data for the two selections are as follows:

Triplett T182-4 FPS 01 'T182-4' is a white grape cultivar, the result of a cross between Malvasia bianca and Colombard. Christensen reports that this selection is a vigorous vine with semi-erect shoots and a medium dense canopy. The clusters are medium size, well-filled

to compact, and conical with occasional shoulders. The medium berries are round to slightly oval shaped.

Performance data was accumulated by Christensen and provided to FPS. Five years of harvest data resulted in the following averages: berry weight 2.3 g; soluble solids, 20.8 ºBrix; titratable acidity, 0.76 g; pH, 3.59; clusters per vine, 154; cluster weight, 0.54 pound; clusters with rot, 5; and total yield, 68.2 pounds per vine. Christensen reported that the wine produced is well-balanced and slightly fruity, with a slight muscat character.

Triplett 30-47 '30-47' is a black grape cultivar that is a cross between Ruby Cabernet and Calzin. The vine reportedly has a dense and vigorous canopy. The vines can become excessively vegetative due to over-pruning (too low bud numbers).

The medium- to small-sized clusters are conical, loose (Syrah-like) and often winged. The medium berries are round to slightly oval and very dark with distinct vegetal character in the skins (Cabernet-like). The juice produced from the berries is balanced and fruity when the berries are ripe.

Seven years of harvest data resulted in the following averages: berry weight 1.70 g; soluble solids, 21.6 ºBrix; titratable acidity, 0.82; pH, 3.68; clusters per vine, 92; cluster weight, 0.48 pound; clusters with rot, 7; and total yield, 39.0 pounds per vine.

CULTIVARS OF GREEK ORIGIN

Three Greek wine cultivars have been added to the public collection at Foundation Plant Services (FPS). Two of the cultivars were obtained from Greece in 1948 by Dr. Harold P. Olmo, former Professor in the Department of Viticulture & Enology at University of California, Davis. The third cultivar was imported to FPS directly from Greece in 2006.

Assirtico FPS 01 Assýrtiko (syn. Assyrtico, Assirtico) is one of the best known Greek varieties outside Greece. It is a white grape cultivar that maintains a high level of acidity even in hot Mediterranean summers. Although it is now planted throughout Greece, Assýrtiko is noted for being the predominant variety used for wines on the island of Santorini. The cultivar reportedly is suitable for crisp and structured white wines, as well as dessert wines. *Robinson, J. 2006. Oxford Companion to Wine, 3rd ed.; Boutaris, M. 2000. Thesis, Master of Science in Horticulture, University of California, Davis.*

Shortly after World War II, Dr. Olmo contacted Professor B.D. Krimbas, who was at the time the authority on Greek cultivars and author of an extensive and definitive Greek ampelography (*Hellenike Ampelographia*). Krimbas was responsible for a large grapevine collection at the University of Athens. Olmo obtained many Greek cultivars from that collection. *Boutaris, 2000.*

Assirtico FPS 01 was obtained by Olmo from that collection in 1948 and was eventually donated by him to the USDA-ARS National Clonal Germplasm Repository (NCGR) at Davis, California, in 1983 (DVIT 0645). The plant material came to FPS in 2004 from the NCGR and tested positive for virus. It underwent microshoot tip tissue culture disease elimination therapy, after which it successfully tested negative for pathogens proscribed by the California Grapevine Registration & Certification (R&C) Program.

Fileri FPS 01 Filéri is a polyclonal cultivar grown throughout Greece, particularly in the Arkadia province in the central and eastern Peloponnese region. The various clones of the cultivar produce white (Fileri), red (Mavrofilero) and pink (Moschofilero) grapes. Filéri exhibits an intense, easily recognizable fragrance and produces dry white wines.

Fileri FPS 01 was originally obtained from Greece in 1948 by Dr. Olmo and was donated to the National Clonal Germplasm Repository in Davis in 1983 (DVIT 1044; PI 171346). The plant material came to FPS from the Repository in 2004 and tested positive for virus. After undergoing microshoot tip tissue culture disease elimination therapy, Fileri FPS 01 successfully completed testing for the California Grapevine R&C Program in 2011.

Moschofilero FPS 01 Moschofílero (syn. Moscophilero) is the most well-known clone of the Fileri clone group and exhibits a muscat flavor. Its berry color resembles that of Gewürztraminer, and the cultivar produces white and blush wines. Moschofílero differs from Filéri in that Moschofílero has higher yields, darker berries, and a more aromatic and muscat character. In Arkadia, Moschofílero is the designated variety for 'Mantinia' (A.O.C.), a crisp white wine with a subtle Muscat bouquet. *Robinson, 2006; Lefort, F. and K.Roubelakis-Angelakis. 2001. Genetic Comparison of Greek Cultivars of Vitis vinifera L. by Nuclear Microsatellite Profiling, Am.J.Enol.Vitic. 52:2; Boutaris, 2000*

Moschofilero FPS 01 was imported to FPS in 2006 from the Peloponnese region of southern Greece. The plant material initially tested positive for virus and underwent microshoot tip tissue culture disease elimination therapy. After successfully completing testing at FPS, Moschofilero FPS 01 attained Provisional status in the California Grapevine R&C Program in 2010.

CULTIVARS OF FRENCH ORIGIN

Cabernet Sauvignon FPS 62 Cabernet Sauvignon 62 was donated to the FPS public grape collection in 2007 by Ridge Vineyards in Cupertino, California. It has been designated the 'Fountain Grove B' selection. Prior to arriving at FPS, microshoot tip tissue culture disease elimination therapy was performed at STA Laboratory. The treated plant material obtained Provisional status in the California R&C Program in 2011 and will be available for distribution to the public in 2013; two years after release to the owner.

Carignane FPS 11 Carignane FPS 11 originated in the Morisoli Heritage Vineyard in Napa, California. The selection was donated to the FPS public collection in 2002. The original plant material tested positive for virus and underwent microshoot tip tissue culture disease elimination therapy at FPS. The treated plant material successfully completed testing and was planted in the foundation vineyard in 2011.

Chardonnay FPS 112 A group of Chardonnay clones with aromatic overtones in Wente clonal material was donated to the FPS public collection in 2002. Larry Hyde, a well-respected Napa grape grower who has developed a variety of Chardonnay clones over the years, made six clones available to the public through the California Grapevine R & C program. The 130-acre Hyde vineyard in the Carneros region supplies grapes from these and other clones to more than a dozen wineries, frequently resulting in high quality wines. For a complete description of the FPS Chardonnay selections, including the Hyde clones, see the FPS 2007 Grape Program Newsletter, 'Chardonnay History and FPS Selections' on the website in the Publications section.

Chardonnay FPS 112 is one of the six clones donated by Hyde. The selection is named the 'Hyde clone' which originates from a 20-year-old block in the Carneros region of Napa County. The Hyde clone suffers from corky bark virus in its original state. Hyde reports that the clone is productive with high acidity. He explains that the grapes yield an unusual and unique complex flavor profile, characterized by 'nutmeg as young wine, followed by a peach like fruit flavor in one or two months'. FPS has performed microshoot tip tissue culture disease elimination therapy on this selection, which successfully completed disease testing in 2011.

Gouais blanc FPS 01 and 02 Gouais blanc is an ancient light-skinned cultivar that was planted in France sometime in the Middle Ages. The cultivar is known as Heunisch weiss and Belina Drobna in Eastern Europe. Although the grape was not well regarded in France, Gouais blanc has been an extremely successful parent who, along with Pinot, produced offspring such as Chardonnay, Aligoté, Auxerrois, Melon, and Gamay noir. *FPS 2007 Grape Program Newsletter, 'Chardonnay History and FPS Selections.'*

Gouais blanc FPS 01 and 02 were imported for the Foundation Plant Services public collection in 2000 from the Ministere de l'Agriculture, Office National Interprofessionel des Vins (ONIVINS), Domain de Vassal, France. [The name on the paperwork for Gouais blanc 01 was erroneously noted in FPS records at the time as Baii blanc.] Jean-Michel Boursiquot indicates that the correct ONIVINS name for the selection is Bouillenc, a synonym for Gouais blanc. The name on the paperwork for Gouais blanc 02 was Bouillenc.

The original plant material for both Gouais blanc 01 and 02 tested positive for virus and underwent microshoot tip tissue culture disease elimination therapy at FPS. The treated material successfully completed disease testing in 2011 and both selections have Provisional status at FPS.

Peloursin FPS 02 and 03 Peloursin FPS 02 and 03 were donated to the Foundation Plant Services public collection in 2004 by Robert Brittain, Stags' Leap Winery, in Napa, California. Cuttings from three separate vines were provided to FPS (FPS group numbers 7691, 7692, and 7693). All three selections tested positive for viruses and underwent microshoot tip tissue culture disease elimination therapy. The treated plant material for Peloursin FPS 02 and 03 successfully completed disease testing in 2011.

Syrah FPS 21 Syrah FPS 21 was donated to the FPS public collection in 2002 from the Morisoli Heritage Vineyard in Napa, California. The original material tested positive for virus and underwent microshoot tip tissue culture disease elimination therapy at FPS.

Syrah FPS 22 The plant material that eventually became Syrah FPS 22 was imported from France by Dr. Harold Olmo. The cuttings were sent to Davis in October, 1973, by M. Claude Valat from the Association Nacionale Technique pour l'Amelioration de la Viticulture, Domaine de l'Espiguette, in France (USDA Plant Introduction No. 391452). FPS labeled the original plant material Sirah 01 (FPS group 256), which tested positive for *Rupestris stem pitting* virus. At that time, plant material that tested positive for RSP virus was not allowed in the California R&C Program nor in the FPS foundation vineyard. Sirah 01 underwent microshoot tip tissue culture disease elimination therapy in 1997. The resulting plant material tested negative for the viruses proscribed by the California R&C Program and was planted in the foundation vineyard as

Syrah 09. Syrah 09 first appeared on the list of registered vines in 2001–2002.

In 2006, one of the two Syrah 09 vines in the foundation vineyard tested positive for GVA, Kober stem grooving virus, and the selection was put on hold pending retesting. The Syrah 09 plant material underwent microshoot tip tissue culture therapy again in 2007. The resulting plants tested negative for all viruses in the R&C Program and were released in 2011 with a new name, Syrah FPS 22.

Tannat FPS 03 The original material for this selection came to Foundation Plant Services in the mid-1960's from the vineyard of the University of California, Department of Viticulture & Enology (locations D5:1-2 and then I76 v5). When the original material came to FPS, it was subjected to heat treatment for 146 days and was given the name Tannat FPS 01. In 2005, the Tannat 01 vines in the foundation vineyard tested positive for leafroll virus and were removed from the vineyard. Tannat 01 plant tissue underwent microshoot tip tissue culture disease elimination therapy in 2007. After successful completion of testing, the new plants were released in 2011 with the name Tannat FPS 03.

Trousseau FPS 03 Trousseau FPS 03 originally came to Foundation Plant Services around 1961 from the vineyard of the Department of Viticulture & Enology at UC Davis (location J126 v6). The Trousseau plant material was subjected to heat treatment for 168 days upon its arrival at FPS. After testing was completed, the selection was planted in the foundation vineyard in 1965 under the name Trousseau 02 (FPS group 1330). In 1995, tests on the Trousseau 02 vines revealed that the vines had leafroll virus. Cuttings were taken from Trousseau 02 vines before the vines were removed from the foundation vineyard and were planted in the quarantine vineyard at FPS. Eventually, tissue from Trousseau 02 underwent microshoot tip tissue culture disease elimination therapy in 2007. After successful completion of testing, the new plants were released in 2011 as Trousseau FPS 03.

CULTIVARS OF ITALIAN ORIGIN

Nebbiolo 02 Nebbiolo 02 is clone CVT 36 from the Centro di Studio per il Miglioramento Genetico della Vite, CNR (Grapevine Breeding Center) in Torino, Italy, and came to FPS in 1993. The selection successfully completed testing at FPS and was not required to undergo disease elimination treatment. Nebbiolo 02 was released in 2011 and is now planted in the foundation vineyard.

Nero d'Avola FPS 02 Nero d'Avola 02 was donated to the Foundation Plant Services public grapevine collection in 2003 from a private vineyard in Mendocino County, California. In initial testing, the selection tested positive for multiple viruses. Nero d'Avola 02 underwent microshoot tip tissue culture disease elimination therapy to eliminate the viruses. The selection successfully completed testing in 2011 and obtained Provisional status in the California Grapevine R&C Program. The first available plants will be provided to a designated nursery at the request of the donor of the plant material. Thereafter, the selection will be available to the public.

There is another public Nero d'Avola selection currently in the pipeline at FPS. That other Nero d'Avola material came to FPS in 2008 as a result of a varietal exchange with Dr. Vincenzo Pernice, Director of the Vivaio Federico Paulsen Institute in the Sicily region of Italy. That plant material tested positive for virus and underwent microshoot tip tissue culture disease elimination therapy. The tissue culture plants are currently being tested on the grape index and could be released in 2013 if all test results are negative.

For a description of the FPS Nero d'Avola selections, see the FPS 2009 Grape Program Newsletter article 'FPS Pipeline Spotlight: Nero d'Avola' on the website under 'Publications.'

Teroldego FPS 06 Teroldego 06 was imported by Dr. Harold Olmo in 1939 from Dr. G.R. Dalmasso, Stazione Sperimentale di Viticoltura e di Enologia, Veneto, Italy. The material was planted in the vineyard of the Department of Viticulture & Enology at UC Davis at location X35:1-2 (formerly at I76 v14-21). Dr. Olmo donated the plant material to the National Clonal Germplasm Repository in Davis in 1983 (DVIT 977). The original material was tested for disease at Foundation Plant Services in 2004. Results were positive for virus, and the original plant material underwent microshoot tip tissue culture disease elimination therapy in 2007.

Vespaiola FPS 01 Vespaiola 01 came to Foundation Plant Services in 1981 from Carlo Zanzi in Ferrara, Italy. A notation on FPS records refers to '33-30, a white wine variety.' The original material tested positive for virus and underwent microshoot tip tissue culture disease elimination therapy at FPS.

ADDITIONAL *VITIS VINIFERA* CULTIVARS

Malvasia Preta FPS 01. Malvasia Preta is a black Portuguese grape cultivar. The Vitis International Variety Catalogue at Geilweilerhof, Germany, shows two entries for Malvasia Preta: (1) an entry for a cultivar with the prime name Mureto (synonyms Moreto and Malvasia Preta); and (2) a separate entry for Malvasia Preta as the prime name (synonym Moreto). The entry for the cultivar with

prime name Mureto (syn. Malvasia Preta) shows a parentage of Alfrocheiro x Jaén blanco (Cayetana blanca). The name Malvasia has been used as a varietal name for many cultivars and as a reference to a special taste or aromatic flavor for a grape cultivar. *Lacombe T. et al. 2007. Relationships and Genetic Diversity within the Accessions Related to Malvasia Held in the Domaine de Vassal Grape Germplasm Repository, Am.J.Enol.Vitic. 58:1.*

Malvasia Preta FPS 01 was imported to Davis in 1981 by Dr. Harold Olmo from Cockburn Co., Tua (Douro) Oporto, Portugal. The original material underwent heat treatment for 62 days but eventually tested positive for leafroll and Rupestris stem pitting viruses. New plants were created in 2007 using microshoot tip tissue culture. Malvasia Preta 01 successfully completed disease testing in 2011. The DNA profile for the FPS selection is consistent with the profile of the Mureto accession (synonym Malvasia Preta) in the collection at Domaine de Vassal Grape Germplasm Repository in France, as well as with Malvasia Preta references from Portugal. *Böhm, J. 2005. Portugal Vitícola O GRANDE LIVRO DAS CASTAS, Lisboa, Chaves Ferreira – Publicações, S.A.*

Parellada FPS 02 Parellada is a Spanish white grape cultivar widely used in the Cataluña region for production of Cava (sparkling wines). This selection was donated to the Foundation Plant Services public collection in 2005 by Jorge Boehm, Viveiros Plansel S.A., Portugal. The original material tested positive for viruses and underwent microshoot tip tissue culture in 2007. The new plant material successfully completed testing in 2011 and was released as Parellada 02.

Pribidrag FPS 01 In 2002, UC Davis scientists confirmed that California's grape cultivar, Zinfandel, and Italy's Primitivo shared a DNA profile with a Croatian cultivar named Crljenak kaštelanski. When the Croatian vines of this cultivar were discovered in 2001 by scientists from the University of Zagreb, there were very few vines of Crljenak kaštelanski remaining in the country. In 2002, the Croatian scientists discovered additional vines known locally as Pribidrag in the Dalmatian coastal town of Omiš. A genetic profile of Pribidrag has also been matched to Zinfandel and Primitivo. A recent scientific paper links Zinfandel cultivation in Croatia to as early as the fifteenth century under the name Tribidrag. *Malenica, N. et al. 2011. Whole genome amplification and microsatellite genotyping of herbarium DNA revealed the identity of an ancient grapevine cultivar. Naturwissenschaften, ISSN 0028-1042, DOI 10.1007/s00114-011-0826-8 (published online).* All of these discoveries support the inference that Croatian vines were the source of California's Zinfandel and Primitivo. Details of the discovery of the origin of the Zinfandel variety are in the 2002 and 2007 FPS Grape Program Newsletters on the website.

Pribidrag FPS 01 is clone VV-079 from Svinisce, Croatia. The selection was imported to FPS in 2005 as a joint proprietary selection for Ridge Vineyards and the University of Zagreb. The original material tested positive for virus and underwent microshoot tip tissue culture disease elimination therapy in 2007. Pribidrag 01 successfully completed disease testing in 2011 and attained Provisional status in the California R&C Program. The selection will be available to the public in 2013, two years after it was released to the owner.

Riesling Italico FPS 05 Riesling Italico (syn. Welschriesling) is a white grape variety grown widely in Central and Eastern Europe. Known as Olasrizling in Hungary, the cultivar is the most planted grapevine in that country. The cultivar is the most planted white wine grape in Croatia, where it is known as Grašvina.

Riesling Italico FPS 05 was donated to the FPS public collection in 2003 by Dr. Laszlo Kocsis, Georgikon Faculty, Department of Horticulture, University of Veszprem, Hungary. The plant material was originally named Italian Riesling, but the name was changed in 2010 to reflect the correct prime name for this variety. The original material was infected with virus and underwent microshoot tip tissue culture in 2007.

Zinfandel FPS 35 Zinfandel FPS 35 was donated to the FPS public collection in 2009 by Duarte Nursery in Hughson, California. Duarte Nursery has given it the clone name of 'Zinfandel Shenandoah'. Although the selection has tested positive for Rupestris stem pitting virus, Zinfandel 35 was not required to undergo microshoot tip tissue culture in order to be planted in the foundation vineyard because it successfully completed disease testing for all pathogens proscribed by the California Grapevine R&C Program.

Zweigelt-rebe FPS 01 Zweigeltrebe (syn. Rotburger or Zweigeltrebe blau) is Austria's most popular dark-berried grape variety. The cultivar is the result of a cross between Blaüfrankisch x St. Laurent made in 1922 by Dr. Freidrich Zweigelt at the Federal Institute for Viticulture & Pomology at Klosterneuberg, Austria. *Robinson, J. 2006.* Zweigelt-rebe 01 came to FPS in 2009 from the USDA-ARS National Clonal Germplasm Repository in Davis, where the accession is maintained as DVIT 2692. The plant material was originally donated to the NCGR in 1997 by Ray Johnson of the Saanichton Plant Quarantine Center (now the Canadian Food Inspection Agency) in Sidney, British Columbia. The original plant material successfully completed disease testing in 2011.

Breeding Salt Tolerant Rootstocks

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

About 6,000 years ago the Sumerians began cultivating wheat in ancient Mesopotamia, a practice that continued for generations. Over time, and unknown to them, the waters with which they irrigated the land brought in dissolved salts that slowly accumulated in the soil. When the soil concentrated these salts to a level that significantly impacted wheat yields, the Sumerians switched to barley, a more salt tolerant crop. As more time passed, higher levels of salt accumulated in the soil and even barley production became problematic. Some historians now believe that this agricultural dilemma contributed to the fall of these river valley civilizations and their ultimate replacement by Babylon (cited in Pitman and Lauchli 2002).

Salinization of soil via the slow accumulation of salts from irrigation water continues at a pace that often goes unnoticed. With each successive irrigation, pure water is transpired by crop plants and evaporates from the soil surface, leaving behind a little more salt than was there before. To complicate matters, chloride – one of the most damaging mineral ions for vineyards – moves readily in the soil, and can be leached below the root zone by heavy rainfall or excess irrigation. Concentrations can continue to build without being noticed for many years. If a region receives adequate rainfall or has abundant high quality water to leach salts downwards, excessive soil salt may never become a problem. In some areas, the water table is both saline and near the soil surface, so leaching cannot control the problem since the crop roots will still take up substantial amounts of salt from the water table.

In the arid or variably arid regions of California, soil salinity is commonly due to the accumulation of salts over time. In addition, California's large population, and political and environmental pressures due to climate change will negatively impact the availability of high quality water to leach salts out of the root zone. Grape growers will need to regularly monitor the salinity of their soil, especially when rainfall is low over multiple years. By the time leaf symptoms are observed ('salt burn', necrotic tissue on leaf margins; Fig. 1), soil salinity is often at serious levels that can negatively impact vine growth and production.

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

Figure 1. 'Salt burn' leaf symptom in grapevine.

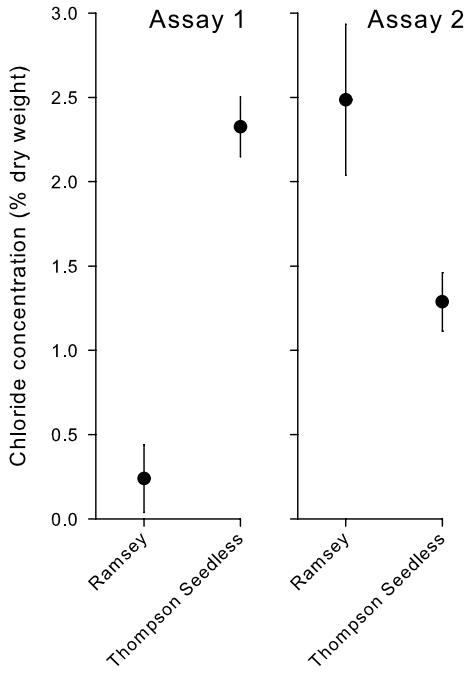
The rootstock Ramsey, also referred to as Salt Creek, has in previous decades maintained a reputation as a strong chloride excluder. This may be a result of its synonym, which conjures the image of a vine growing in the wild along a salt-encrusted riverbank. In reality, our greenhouse screens and published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

In order to develop better salt tolerant rootstocks, grape breeders need germplasm with strong chloride exclusion capability and rapid, inexpensive ways to screen and identify optimal individuals for breeding. The UC Davis and USDA grape collections have a broad range of diverse *Vitis* species, including many new wild grapevines that we have collected from arid and saline areas of the southwest

U.S. However, until recently none of this material had been tested for its ability to exclude chloride. Researchers working on salt tolerance in many crops have noted that improvement for this trait is difficult, presumably because salt tolerance is genetically complex and/or easily affected by the environmental variability. Some of the previous studies of salt tolerance of grapevine found that greenhouse results did not match field results (Sykes 1985).

We also experienced this problem in our early exploratory screens. We found that propagation from green or woody cuttings and greenhouse cultivation methods could greatly alter Ramsey's ability to exclude salt —from much better than previous field studies suggest, to no better or even worse than *V. vinifera* wine and table grapes (Fig. 2).

Figure 2. Chloride accumulation in Ramsey relative to Thompson Seedless in different greenhouse assays.



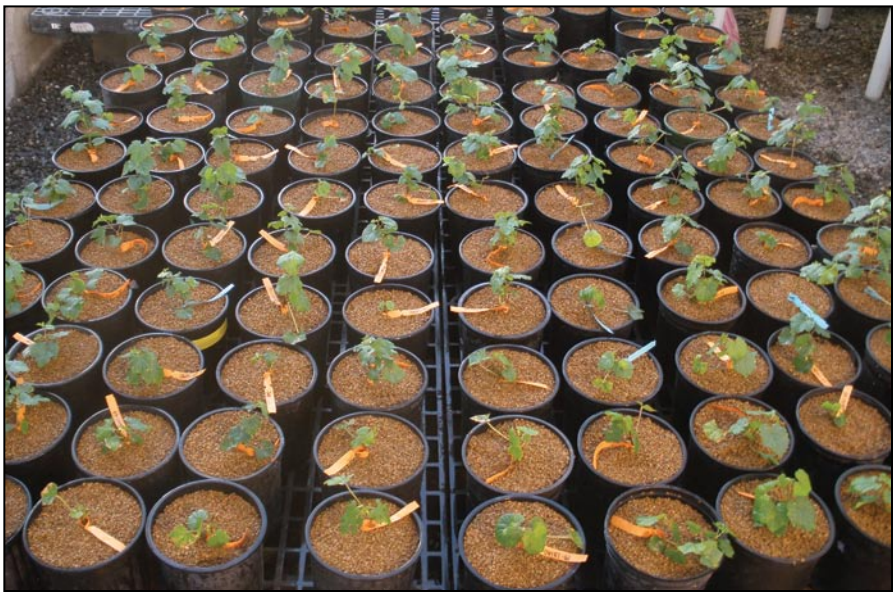
Our original intention was to optimize breeding for salt tolerance by developing genetic markers for this trait, but this requires a reliable, efficient screen that mimics field results. Fortunately, we discovered that using herbaceous cuttings and a very coarse textured potting media, like fritted clay, satisfied these requirements (Fig. 3).

Figure 3. (Right) Chloride exclusion assay using herbaceous cuttings and fritted clay potting media.

This assay confirmed the strong salt exclusion of 140Ru and Schwarzmann and the weak performance of O39-16, 44-53 and *V. vinifera* cultivars. As expected, Ramsey was intermediate, but Riparia Gloire performed inconsistently and is currently being more carefully tested. A refinement of this assay is underway based on physiological studies we have performed over the past two years, and will provide even more reliable assessments of commonly used rootstocks and those in our breeding program.

With a working assay developed, our research has taken two directions. We first focused on characterizing a large sampling of grape species that might be used to improve salt exclusion in commercial rootstocks. Many of the promising individuals were obtained from Texas and the desert Southwest, which we expected given the aridity of these regions and the presence of saline soils. We have identified individuals, often *V. arizonica* and *V. girdiana*, that exclude salt with greater efficiency than the most salt tolerant commercial rootstocks. These individuals are currently being retested to ensure the accuracy of the first test, and rooting tests are underway to confirm their ability to root from dormant cuttings.

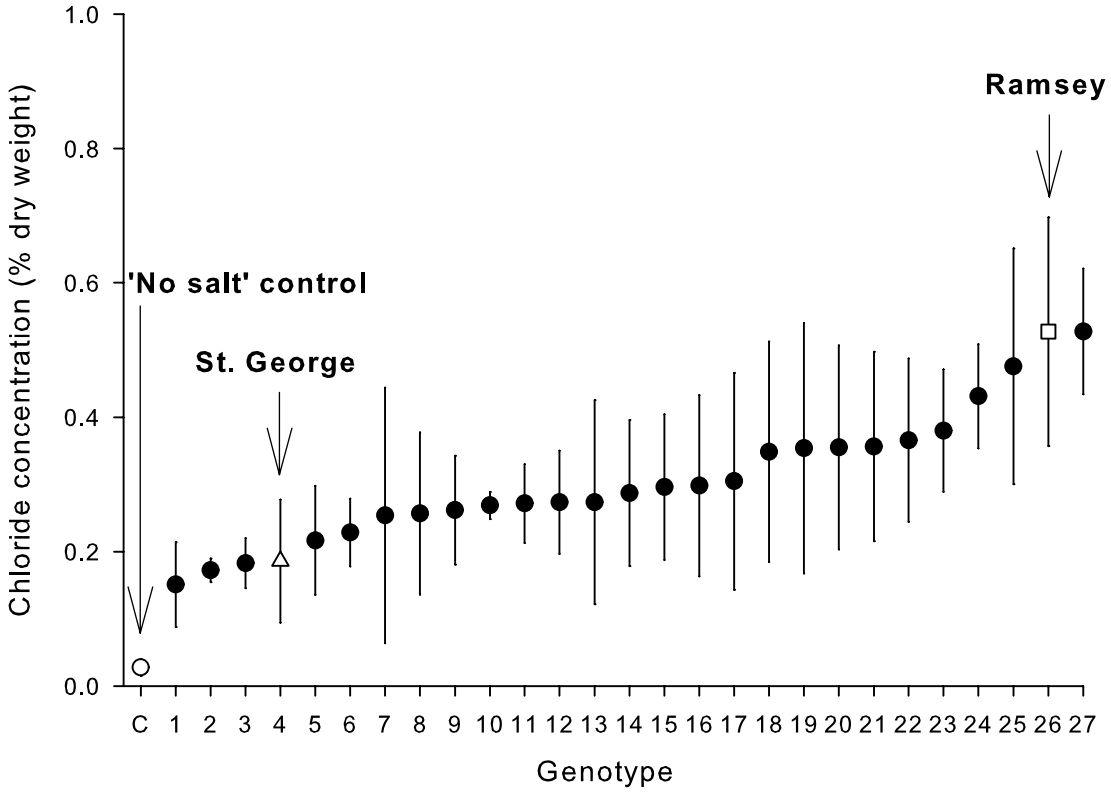
Our second major goal is to characterize the genes responsible for strong salt tolerance. To accomplish this, the best excluders have been crossed with the weakest excluders to produce populations that vary widely in their ability to exclude chloride. By finding and tracking unique segments of DNA that are tightly linked to the high-performing progeny, it becomes possible to "mark" the most important genes for a trait of interest. If these DNA markers are closely associated with a trait, they can be used to screen seedling populations as soon as seeds germinate. The progeny without the markers can be discarded without greenhouse screening, and breeding



efforts can be focused on progeny with the greatest potential. Marker-assisted selection also makes it possible to combine multiple genetic forms of a trait into one line. For example, there may be multiple forms of salt tolerance in different grape species, but greenhouse or field tests would not be able to distinguish the different forms. If genetic markers are developed for the alternate forms of tolerance, then the forms can be combined to strengthen this trait. We are currently evaluating this approach by testing populations that exhibit variation for salt exclusion and developing other breeding populations (Fig. 4).

The development of a single grape rootstock suited for all conditions is not possible because different viticultural sites have different horticultural needs. In breeding rootstocks, our end goal is to provide the industry with a range of rootstocks with different levels of vigor control that contain well-quantified resistance to pests and diseases, and to abiotic stresses (i.e., salt, drought, heat, cold, etc.). Once markers of the genes that control effective chloride exclusion are identified, incorporating them into optimized disease and pest resistant rootstocks using classical breeding methods will be a straightforward task and accomplishable within a reasonable time frame.

Figure 4. Chloride accumulation in Ramsey x St. George hybrid progeny.



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Three Root-Knot Nematode Resistant Rootstocks Released By USDA Agricultural Research Service

Peter Cousins, Grape Rootstock Breeder and Geneticist, USDA ARS Grape Genetics Research Unit, Geneva, New York

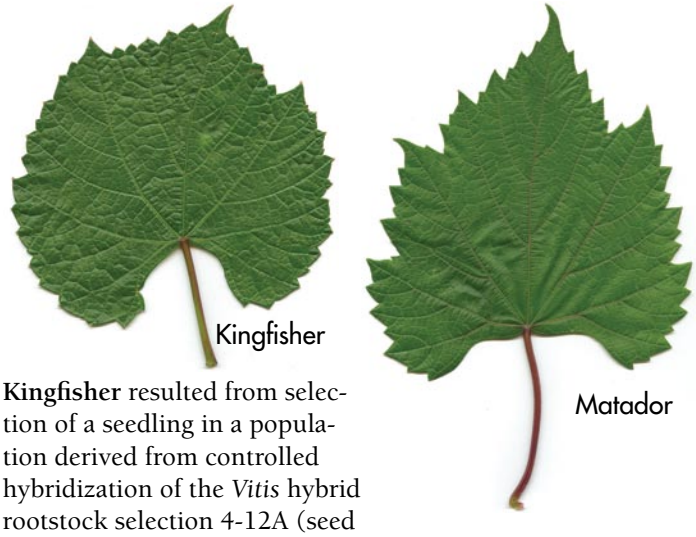
Root-knot nematodes are a chief pest of vineyards across California and the United States, but aggressive and virulent nematode populations can feed on and damage many important rootstock varieties. The USDA ARS breeding program tests the root-knot nematode resistance of rootstocks and wild grape species and combines nematode resistance and other useful traits through hybridization. We then evaluate the pest resistance, viticultural performance, and other important qualities of the new seedlings to identify candidate rootstocks. Three improved root-knot nematode resistant rootstocks: **Matador**, **Minotaur** and **Kingfisher** were released from the USDA ARS breeding program in 2010 and are available from FPS.

Matador and Minotaur resulted from selection of seedlings in a population derived from controlled hybridization of the *Vitis* hybrid rootstock 101-14 Mgt (seed parent) with the *Vitis* hybrid rootstock selection 3-1A (pollen parent). 3-1A is a cross of *V. mustangensis* and *V. rupestris*. Matador and Minotaur are full sibling rootstocks, with the same seed and pollen parent. Matador and Minotaur are easily rooted from dormant cuttings and bench grafted to *Vitis vinifera* scions.

Matador was identified as a seedling selection on July 15, 2002 and Minotaur was identified as a seedling selection on July 2, 2002 due to their complete suppression of root-knot nematode reproduction in greenhouse evaluation. The nematode population used to evaluate resistance was an N-virulent nematode population capable of feeding on and damaging N-allele grapevine rootstocks, such as Harmony and Freedom. Root-knot nematode resistance was confirmed in replicated tests of cutting grown plants.

Dormant cuttings collected from plants grown in a California vineyard were evaluated for rooting ability: 73% of dormant cuttings of Matador successfully propagated and produced callus, shoots, and roots; and 92% of dormant cuttings of Minotaur successfully propagated and produced callus, shoots, and roots. Matador and Minotaur were grafted to Syrah and planted into a rootstock trial at UC KREC, Parlier, California in 2005.

When four years of fruiting data and three years of pruning weight data are considered, vines grafted on Matador rootstock showed a fruit to pruning weight ratio of 9.43; and vines grafted on Minotaur rootstock showed a fruit to pruning weight ratio of 8.84. The check rootstock, Freedom, showed a fruit to pruning weight ratio of 6.14, demonstrating the improved production efficiency of Matador and Minotaur rootstock compared to Freedom.



Kingfisher resulted from selection of a seedling in a population derived from controlled hybridization of the *Vitis* hybrid rootstock selection 4-12A (seed parent) with *Vitis riparia* (pollen parent). 4-12A is a cross of *V. x champinii* Dog Ridge and *V. rufotomentosa*. The original Kingfisher vine was planted in 2002. In addition to nematode resistance and propagation evaluations, Kingfisher has been evaluated grafted to Syrah in a rootstock trial in California.

Kingfisher is easily rooted from dormant cuttings and bench grafted to *Vitis vinifera* scions. Kingfisher was identified as a seedling selection on December 24, 2002 due to its complete suppression of root-knot nematode reproduction in greenhouse evaluation. Root-knot nematode resistance was confirmed in replicated tests of cutting grown plants. The nematode population used to confirm resistance was an N-virulent nematode population capable of feeding on and damaging N-allele grapevine rootstocks, such as Harmony and Freedom. Dormant cuttings collected from plants grown in a California vineyard were evaluated for rooting ability; 100% of dormant cuttings of Kingfisher successfully propagated and produced callus, shoots, and roots. Kingfisher was grafted to Syrah and planted into a rootstock trial at UC KREC, Parlier, California in 2005. When four years of fruiting data and three years of pruning weight data are considered, Kingfisher rootstock showed a fruit to pruning weight ratio of 6.53. The check rootstock, Freedom, showed a fruit to pruning weight ratio of 6.14, demonstrating the improved production efficiency of Kingfisher rootstock compared to Freedom.

Minotaur, Matador, and Kingfisher rootstocks were bred by USDA ARS as a part of a research project that received grant funding from the American Vineyard Foundation, California Table Grape Commission, California Raisin Marketing Board, California Grape Rootstock Improvement Commission, and California Grape Rootstock Research Foundation in addition to appropriated funds. These three rootstocks were released as public varieties, with no intellectual property protection. For more information, please contact Peter Cousins (peter.cousins@ars.usda.gov).

Tales from the FPS Plant Identification Lab

Gerald Dangl, Manager, Plant Identification Lab, Foundation Plant Services, UC Davis
Email: gsdangl@ucdavis.edu and on the FPS website at http://fpms.ucdavis.edu/IDTesting.html

The Plant Identification Lab at FPS heads an ongoing effort to confirm and clarify the cultivar names of our grape selections using both ampelography and DNA analysis. For the most part, the DNA fingerprinting of vines in our Foundation vineyards is routine from year to year. In addition, we engage in grant-funded research. Our most recent grant-funded research project used DNA analysis to study the wild grape of northern California, *Vitis californica*, and its genetic interaction with the introduced European grapevine, *Vitis vinifera*, the species to which nearly all commercial wine and table grape cultivars belong. This research has produced results of general and historical interest. We also offer DNA-based grape cultivar identification as a service to nursery managers, grape growers, wineries, breeders, and anyone else who wants to know what grape they have. (The service is also available for almond, apricot, cherry, peach, strawberry, and walnut cultivar identification). This service work has introduced us to an extremely diverse set of clients and often offers interesting puzzles with surprising results.

Last fall, we had a call from a cold case detective in Arizona. He was revisiting a 1986 murder case in which the body was found in the desert outside of Phoenix. The detectives at the time had collected leaves from a suspect's truck with the hope that someday, the leaves could be used to link the truck to the crime scene. I told him I mostly worked on grapes and by policy we assume all vines are innocent until proven guilty. However, his question provides an interesting starting point to discuss the logical basis of our service, why it works for grape cultivars and cultivars of other clonally propagated crops, and why I was, unfortunately, unable to help the detective.

For each grape cultivar, at some time in the past there was one seedling vine, genetically unique from all other vines in the same way that each person is genetically unique from all others (except for identical twins). A grapevine becomes a cultivar (cultivated variety) when someone takes cuttings from the seedling and propagates more vines. If there are no mistakes during propagation, all the new vines and all vines propagated from them will be genetically identical to the original seeding and will share an identical DNA profile or "DNA fingerprint." Since 1997, we've been generating DNA profiles specific for grape cultivars from around the world. We collect these unique and specific profiles in a reference database. We identify a service client's sample by generating a DNA profile for the sample and then matching it to a reference profile in the database. Our confidence in our identification is only as good as our confidence in our reference profile. Our methods for validating reference profiles were addressed in the 2006 newsletter (Dangl 2006). The Phoenix detective's samples were from a wild seedling plant that has never been propagated; we could never have matched it to a reference profile, even if we did work with the species from which his sample came. His sample would need to be matched by direct comparison to the one bush it came from, which would have to be near the crime scene.

The method we use for grape cultivar identification was initially developed in the lab of Dr. Carole Meredith at the UC Davis Department of Viticulture and Enology. It uses Simple Sequence Repeats (SSR) DNA markers. SSR markers can be found in all plant and animal species. However, specific markers useful for DNA identification are unique to each species, or in some cases, groups of related species. Our grape SSR markers would not have worked on a desert brush species. To help the detective, an entirely new set of SSR markers specific to the desert brush species would need to be developed and hundreds of individual plants of that species would need to be tested to demonstrate the validity of the new system. A good local botanist might have been able to identify the species from the detective's dried samples, but it would have been a long and laborious task to develop a system capable of identifying unique individuals, even supposing the plant from which the samples were taken in 1986 was still alive to be identified. In the end, there would have been little chance of helping to solve the crime.

Though most of our service work involves wine grape cultivars, we've tested juice grapes, table grapes, raisin grapes, rootstocks, and an ornamental grape called 'Roger's Red' (Dangl *et al.* 2010). Dried leaves are the standard sample for our service. However, we have obtained usable DNA from every part of the vine, including roots, single seeds, bark, wood, dormant buds, the rachis, fresh fruit, frozen fruit, and raisins. In 2000, we received several ancient seeds excavated from a tomb in Thebes, Egypt, dated ca. 1475-1450 B.C. We were able to extract some DNA, which we proved was from grape by obtaining a partial profile; the markers we use are specific to grape and would not

have generated even a partial profile if the seeds had come from wheat or lotus. The most likely reason for the partial profile is the small amount and poor condition of the DNA yielded by the partially carbonized seeds.

Another odd sample came from a client trying to figure out what had plugged the emitters of a sub-surface drip irrigation system. He was quite upset; the emitters were supposed to have been treated to make them impervious to roots, particularly grape roots. He dug up a plugged emitter, cut it open, and scrapped out the material causing the clog. This he dried and sent to us in a small plastic bag. To our amazement, we were able to extract DNA from this unpromising material and generate a perfect DNA fingerprint that matched the rootstock 'Freedom,' which the client later said was the rootstock planted in that particular vineyard.

"Country music stars Aaron and Thea Tippin contacted us for help identifying a grapevine they had planted at their home near Nashville, Tennessee."

As the service has grown, our clients have become more diverse and interesting. We've tested samples from 13 countries. Most are known as wine- or grape-producing nations: Chili, Brazil, Argentina, Australia, South Africa, New Zealand. Others are more surprising: China, Japan and even Denmark.

Perhaps our most contentious samples were the hybrid grape 'Koshu' from several vineyards in Japan. 'Koshu' has a long history of cultivation in Japan and is the basis for a growing wine industry there. Legend says that the original "Koshu grapes" were brought from the Caucasus through the Silk Road and spread to Japan with Buddhism more than 1200 years ago. Though there have been claims that 'Koshu' is pure *V. vinifera*, it is a hybrid, and its hybrid ancestry is in part responsible for its long success in Japan. Japan lies at a similar latitude to California, but it is not sunny and dry there. The rainy season in early summer coincides with flowering and regular rain and typhoons batter vineyards just prior to harvest. These are conditions more favorable to mold than to growing traditional European varietals. 'Koshu' has large loose clusters and a tough, repellent berry skin, courtesy of its non-*vinifera* relatives; these help prevent molds from ruining the fruit. Even with these advantages, 'Koshu' vines are typically grown on enormous overhead canopy trellises (*tanazukuri*) to keep the fruit high above the dampness and allow more air to circulate among the bunches. DNA analysis of 'Koshu' accessions at the USDA/ARS National Clonal Germplasm Repository at Davis, California (NCGR-D) and the samples of 'Koshu' from several vineyards in Japan showed that the genetic makeup of 'Koshu' is, indeed, predominately *V. vinifera*. However, the DNA profile also showed a partial non-*vinifera* heritage. Thus, 'Koshu' is a hybrid that has likely been backcrossed to *V. vinifera*, perhaps for several generations. Our tests cannot determine with certainty which non-*vinifera* species contributed to the genetic profile of 'Koshu,' nor do we know how distantly in the past the contribution was made.

We've tested samples from 18 states, including wine giants California, New York, Oregon, and Washington and big juice producers Pennsylvania and Michigan. I've been surprised to learn that grapes are being grown and wine is being made across the whole country. We've had samples from places as diverse as Texas, Florida, Illinois, Indiana, North Carolina, Alabama, and Colorado. Looking through the list of states, Maine at first struck me as odd. Then I noticed who the client was and remembered the city of Concord is in Maine. We've tested samples from Utah, which has a growing industry based on traditional *V. vinifera* cultivars and cold-hardy hybrids.

Recently, we've tested a series of samples for the Vineyard & Winery Association of West Georgia. They are in the process of reviving what was historically a thriving wine industry. The samples come from vines they find in the corners and hedgerows of old houses and farms. They'd like to find remnant vines of historic importance in the area, locally adapted cultivars. These would certainly be hybrids between the European grapevine and indigenous species resistant to diseases like Pierce's disease. Pure *V. vinifera* cultivars have been very difficult to grow there in the past and would not long survive without tending. So far, we've identified local wild vines, some 'Concord,' a 'Champanel' vine, and what appear to be a few feral hybrids. It's possible some of these are old, named hybrid cultivars. Starting in the colonial era, the need to combine the fruit quality and flavor of *V. vinifera* with the disease resistance and cold-hardiness of the native vines made such hybrids popular. They are still being bred and are more important as the industry expands into *vinifera*-unfriendly areas.

Country music stars Aaron and Thea Tippin contacted us for help identifying a grapevine they had planted at their home near Nashville, Tennessee. The cutting came from a vine in Montana. Family history said Thea's great-great-grandmother brought the original vine over from Lebanon to use the leaves for cooking. It had remained in the family for over a hundred years, passed on through cuttings to the next generation, changing its location but not its genetic identity. The DNA profile suggested this mystery vine was a hybrid, but just like some of the vines from Georgia, it couldn't be further identified. It is quite possible that some

or all of these vines are old, named hybrid cultivars. Unfortunately, there are very few really old, named, hybrid cultivars in our database with which to match them. Without a positively identified reference profile, all the DNA can tell us is that these vines are hybrids. We are actively looking for the opportunity (and funding) to add some of these old hybrid cultivars to our database.

The majority of our service clients are most satisfied when we are able to identify their sample. For my part, I like finding matches as well. I like knowing we've solved a puzzle for the client and I like the degree of confidence we have in our results; our ID system is extremely robust. For instance, we received samples from two vines growing on the grounds of the Mission San Antonio de Padua. This was the third mission in California established by Padre Junipero Serra (1771), near what is now Jolon, California. Our analysis shows that the two vines are identical and, fittingly, match the classic California 'Mission' grape. This cultivar, also known as 'Criolla chica' in South America and 'Pais' in France, was the primary grape grown in and around the missions and, subsequently, throughout California. The DNA profile, the known history of the matched cultivar, and the provenance of the tested vine all came together to provide a complete story.

However, sometimes the most interesting samples are those we can't identify. A few years back, we tested a sample from a vine in Oregon that did not match any profile in our database. The profile clearly showed it was a hybrid, and that it might not contain any *V. vinifera* at all. There matters stood until 2008, when we published a study of many hybrid cultivars released from the New York State Agricultural Experiment Station in Geneva, New York (Bautista et al 2008). Some of these releases went back as far as the turn of the last century. All the new profiles generated through this study were entered into our reference database. We also checked to see if any of the new profiles were already in the database. Our new profile for 'Golden Muscat' matched the mystery sample from Oregon. We were able to tell the client that 'Golden Muscat' was developed at the New York State Agricultural Experimental Station, and was released in 1927. It is the result of a 'Muscat Hamburg' x 'Diamond' cross. The family tree for 'Golden Muscat' and pedigrees of other New York releases can be found online at *http://www.hort.cornell.edu/reisch/grapegenetics/nyreleases.html*. Much like when one learns a new word and inevitably hears and sees the word more often, within a month of updating our client in Oregon, we received two more samples of 'Golden Muscat;' one from California and one from Washington state.

One of our earliest client samples has turned out to be our most interesting. It came from a vine known to be over one hundred years old growing by the front porch of the Centinela adobe ranch house in Inglewood, California. Built in 1834, the Centinela adobe was the headquarters of the 2,200-acre ranch that became Inglewood; Wikipedia has pictures of the house and vine. A docent sent us some mature leaves with the sample for DNA testing. They were huge—obviously belonging to a hybrid or perhaps a pure non-*vinifera* grape species. We informed the client there was little chance of our being able to identify the sample. Our database contained about 350 profiles at the time; of these, 'Concord' and 'Niagara' were the only hybrids. As expected, we were not able to identify the cultivar. Our DNA profile did suggest that the sample was a hybrid with at least some *V. vinifera*, but for all we knew, it could have grown from seed. There was no way to tell whether it was a deliberately propagated, planted, named cultivar.

Then in 2004, we received three samples from the China Agricultural University in Beijing, China. One of these samples matched the Centinela Adobe Vine. For me, this is a thrill equivalent to how a real detective must feel when new evidence surfaces that solves a cold case. It is possible that I need to get out more.

The sample from China was submitted as 'Rose Honey,' and, we were told, it "was of missionary origin." This cultivar has been grown for over a century in Yunnan province in the Southwest of China. However, it was known locally as "purple grapes" until the 1990's when a French sommelier, hired by Yunnan Red Wine Company to improve their wine quality, and other "authorized botanists" determined the grape to be the extinct 'Rose Honey' from France. With this history, 'Rose Honey' from China was perhaps not a solid reference for the Centinela Adobe Vine, but the match was extremely strong evidence that the mystery vine was a true named cultivar and therefore we had a chance of finding its true identity.

The hits kept coming; the same profile showed up in 2005 from a vine growing at an old house in Sebastopol, California, and in 2007 from a vine in Moab, Utah. This latter sample was called 'Utah Black.' More recently, the profile showed up at the USDA/ARS National Clonal Germplasm Repositories at Davis, California, and Geneva, New York. The Davis accession was named 'Thelma', while the two at Geneva were called 'Alexander' and 'Isabella.' From having no name, the mystery grape from Centinela now had five to choose from. Which was the right one?

Unlike the genetic profile, a popular grape cultivar can and often does change its name as it spreads to new areas or the original name is forgotten over time. The Centinela vine was obviously old. It was also obvious that to have spread to places as diverse as California, Utah and China, it had to have been widely distributed and planted at one time. This opened the possibility that it would be mentioned—under some name, perhaps the original—in descriptions of grape cultivars from that period.

'Isabella' grapevine, seen here in the FPS Foundation Vineyard, exemplifies naming challenges of widely spread, old cultivars. *Photo by Susan T. Sim*

'Utah Black' was obviously a local name. The name of the Davis accession, 'Thelma,' had no history and was likely provided by the person who donated the vine. Perhaps Thelma was the name of his mother or sweetheart. The 'Alexander' accession at Geneva was donated by a hobbyist; the identification was his with no provenance. In his 1908 book "The Grapes of New York" Hedrick states, "'Alexander' is now a grape of the past". Though it was a widespread cultivar as early as the 1700's, Hedrick's description of the grape flavor in particular is inconsistent with descriptions of 'Rose Honey' in China. That left 'Isabella.'

The 'Isabella' accession has been in the Geneva collection and its predecessors for so long the records are unclear. Passed from one researcher or curator to the next for decades, there has never been any reason to question the identification of the accession. Hedrick describes 'Isabella' as a wild selection made in South Carolina in 1816. It became the primary grape planted in the North Atlantic and New England states until it was supplanted by 'Concord' in the late 1800s. This 'Isabella' was widespread in the right time and place to have ended up at Centinela in the mid-1800s and to have been imported to China by French missionaries.

So what is the proper name for the Centinela vine? If its ampelography matches the historical descriptions of 'Isabella' (a comparison that has not yet been done), it would appear that an almost 200-year-old cultivar has come back from near-extinction. However, it is unclear whether it will continue forward under its original name. Perhaps the name under which it is now being commercially grown in China, 'Rose Honey,' will be the one that sticks. After all, California vintners still proudly call their vines and wines 'Zinfandel' rather than using the older name 'Crljenek kastelanski.' Perhaps a bottle of 'Rose Honey' by any name would smell as sweet as 'Isabella.'

Piecing together the history of an old grape cultivar like 'Isabella' requires the same mixture of patience, luck and attention to detail that the cold case detective in Arizona demonstrated. As more profiles are added to the database, some of the old samples that could not be identified will be, and may turn out to have an interesting history.

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A Social Look at Leafroll: A New Approach

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Some of the best photos taken of vineyards are red leaves splashed against yellows and greens, with bluish purple berries peppered against bright green berries in the same cluster. But this is precisely what many knowledgeable growers don't want. They know that the beautiful fall foliage goes with irregular ripening, poor sugar, reduced color, and poor yields.

Leafroll disease is a term used to describe a complex pathogen group. There are multiple strains of leafroll virus known as *Grapevine leafroll-associated virus*, or GLRaV, numbered GLRaV-1,-2,-3,-4,-5,-6,-7, and -9. GLRaV-1, -3, and -5 are separate mealybug-transmitted species, while GLRaV-4, -6, and -9 are tentative species (Fauquet*et al.*, 2005; Alkowni *et al.*, 2004; Martelli *et al.*, 2002). Recently, rapid field spread has been observed in California, frustrating growers looking for long term control of the disease (Golino *et al.*, 2002).

There is no cure for leafroll. Upon finding leafroll in a vine, a grower has a difficult choice: keep the vine or destroy it. Before a grower decides, certain questions must be answered. Are the negative effects of the virus on this vine severe enough to make removing it, replanting, and losing several years of production economically practical? How much of the vineyard is affected? Is it better to remove individual vines and replant (with the resulting management difficulties of having vines at different ages in the field) or wait until the problem warrants removal of the entire vineyard? If new vines are planted, will they stay clean? The grower may also test the vine to see which strain of virus is present; this will help decide future measures based on whether the virus is known to be insect transmissible in the vineyard. New planting material should be certified clean stock. Infected rootstocks and/or scion wood cannot be reused.

Further complicating decision making are some wide-spread opinions about viruses in grapes, about leafroll disease in particular, and the value of certain clones of important grape varietals. Getting unified action on leafroll disease is made more difficult by the inconsistent attitudes of grape growers and winemakers. Some wineries turn the grapes away, while others desire them. Some wineries insist on growers planting a clone known to be infested with leafroll—and pay more for the grapes. Some clones are not available without leafroll, and some winemakers want "a little bit of leafroll." So how does the grape industry act to get rid of something that the marketing experts would prefer to disregard? And, where do we begin in implementing meaningful control strategies?

A new study has begun, using some Social Networking concepts, to understand possible solutions to this issue. The initial focus will be on the opinions and attitudes of grape growers. We are asking them questions about leafroll, their perceptions and economics, and plans for future planting. At UC Davis, Neil McRoberts, plant pathology epidemiologist, Deborah Golino, director, Foundation Plant Services, and Kari Arnold have teamed up to look at leafroll from the industry's point of view, and industry has responded generously to the initial survey.

This project uses a special approach to see how industry views leafroll and where pockets of like-mindedness exist. The mode driving this experiment is called Q-methodology, which provides a foundation for the systematic study of subjectivity, such as a person's viewpoint, opinion, beliefs, and attitude.(Brown 1993). Surveys given to growers and winemakers had open ended questions about leafroll. Their statements were analyzed, and 47 were chosen for the Q-sort. These were printed on cards that are then sorted by participants on a board, like a game, based on how the statement fits their point of view. These individual meetings are referred to as an interview.

After the interviews are completed, a table of data is compiled with respondents as rows and Q-sort statements as columns. One can think of each row as a kind of bar coding or profile for each person. The data is subjected to a Factor Analysis to group people who have similar codings for the data items, so that groups of similar individuals are associated with different sets of data items. This should show which attitudes about leafroll and collective actions exist within the sample of participants. This will help us tailor our efforts. Feedback sessions will be organized to explain and interpret the results. We'll look to pull out deeper insights from the respondents. The intention is to give each respondent individual feedback that will allow him or her to place him/herself in the different clusters. Although kept lighthearted, it will focus on the real lessons to be learned from the analysis. This project is still underway, and if you would like to participate, contact Kari Arnold via email at *klarnold@ucdavis.edu*. We hope to hear from you!

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Barbera Finds a Second Home in California

by Nancy Sweet, Foundation Plant Services, UC Davis

Barbera… 'the Italian variety that best reproduces its characteristics in California.' — Guido Rossati, 1900

'Uva Barbera', *Pomona Italiana*, Giorgio Gallesio, Special Collections, Shields Library, University of California, Davis

Vitis vinifera 'Barbera' has been described as a high-quality Italian red wine cultivar that is adaptable to different climates and soils, amenable to multiple management techniques and demonstrably fertile. *Mannini, 2004.* The characteristics of the grape allow for multiple wine styles. As a result, this versatile cultivar flourishes throughout Italy, as well as in several other regions of the world including North and South America.

Barbera is an ancient cultivar that is believed to be native to Italy. A common theme in the works of ampelographers and historians who have written of Barbera is that nothing can be said definitively about its age or origin. Many of those works refer to documents and texts from as early as the 13th century to define the time and place of the cultivar's origin.

Barbera produced popular wines in Italy prior to the Renaissance and was known as the 'people's wine'. *Gily, 2001.* Wine writer Burton Anderson refers to the cultivar as '…a vine that had ranked for ages as a commoner, a *bourgeois,…* [prior to a renaissance of its own in Italy in the 20th century]'. *Anderson, 2000, page 5.* Notwithstanding its popular roots, documentary evidence (described below) shows that Barbera was also known to the upper classes in Italy where it was served at the curial and royal tables in important cities.

Early references to the Barbera grape were oblique. In the 13th century, Casale Monferrato was the capital city of the Marquisato of Monferrato in the province of Alessandria, Piemonte region, in northwest Italy. The archives of the cathedral chapter of Casale Monferrato reportedly contain contracts covering the period 1246 to 1277 requiring the lessees of church vineyard lands to plant and maintain vines of 'de bonis vitibus barbexinis'. *Gily, 2001; Robinson, 2006, page 62.* It has been suggested that the Latin 'barbexinis' refers to the grapevine 'Barbesina', an ancient synonym for the Barbera grape. *Busso, 2000, page 25.*

During Medieval times, it was customary for families in the Piemonte region of Italy to take their names from the grapevines which were common in the territory, from botanical sources or from the type of agricultural activities in which they engaged. The family names *Barbieri*, later modified to *Barbero* and then *Barberis*, date from this period and suggest a linguistic connection to the vines of the region. *Busso, 2000, page 25.*

An Italian jurist by the name of Pier de' Crescenzi (1230-1320) wrote a treatise on agriculture in 1303 that included a section about viticulture. In that treatise, de' Crescenzi referred to a grape variety by the name 'Grisa' or 'Grisola' (which signifies either 'crispness' or 'grey' in Italian). The inference was drawn in one recent source that de' Crescenzi referred to Barbera when he mentioned 'Grisola', making an analogy to *Uva Spina* (gooseberry with a sharp taste) and the acidity or sharpness of both the *Uva Spina* and Barbera. *Calò et al., 2001, page 176.*

It is not clear whether or not de' Crescenzi was referring to the Barbera cultivar by the reference to 'Grisa' or 'Grisola' in his 14th century text. *Uva Spina* is the analogy cited by the above secondary source and is translated in Italian to 'gooseberry', which is included in genus *Ribes (Grossulariaceae)*. However, that same secondary source also mentioned the name *Berberis (Berberidaceae)* in con-

nection with the analogy to Barbera. *Berberis* is a plant genus that includes the very tart barberry species, which has red berries. Early names for Barbera included 'Barberi' and 'Barberis', names similar to *Berberis*. *Busso, page 25.* Regardless of any taxonomic confusion, both gooseberry and barberry exhibit spines and a sharp taste. *Brennan, 1992; Ahrendt, 1961.*

A prominent Italian viticulture professor and grape breeder, Dr. Giovanni Dalmasso, did not make the same analogy from *Uva Spina* to Barbera. Dalmasso wrote in the early 1960's that no historical allusion to the Barbera variety appeared in the writings of Pier de' Crescenzi. Dalmasso indicated that de' Crescenzi lived in Asti for 30 years and would not have overlooked such an important variety if Barbera were being cultivated there at that time. *Dalmasso et al., 1960-61, Ch. II, page III.*

Dalmasso further noted that a second author, Giovanni Battista Croce, jeweler to the House of Savoy, similarly made no reference to Barbera in his 1606 work on the 'Excellence and Diversity' of wines made in the hills of Torino. *Schneider, 1992; Dalmasso et al., 1960-61, Ch. II, page III.* This latter omission might be explained by the fact that conditions in Torino are too cold for Barbera to achieve much success.

Other references from the Renaissance era specifically name the cultivar. The varietal name 'Barbera' appeared in less formal contexts in the 16th century. One of the earliest written references to the cultivar by the name 'Barbera' appeared in 1514 on a cadastral map (public register of land ownership) of Chieri, a town east of Torino. *Gily, 2001.*

The cultivar name 'Barbera' is again mentioned in 1609 in a letter in the communal archives of Nizza Monferrato, a municipality in the province of Asti in the Piemonte region. The letter was sent to officials in Nizza Monferrato (aka Nizza della Paglia) from the influential Dukes of Mantova in nearby Lombardia and requests that envoys be received to 'taste the wines of the vineyards [of] Nizza Monferrato and, in particular, the Barbera'. *Garoglio, 1973, page 245.*

A note in 1685 in the personal diary of Count Francesco Cotti of the Langa (Langhe) region in Piemonte shows that he ordered cuttings from various cultivars common to the Asti region, including Barbera. *Busso, 2000, page 26.*

Several sources indicate that the first 'official' mention of the name Barbera was in a 1799 paper on the cultivation of the vine entitled 'Istruzione letta dal Conte Nuvolone'. Nuvolone was the Vice Director of the Agricultural Society of Torino. *Dalmasso et al., 1960-61, Ch.II, page III; Robinson, 2006, page 62.* Conte Nuvolone's 'Istruzione' on cultivation of vines and wine-making mentioned Barbera by name. He described two types of Barbera grown in the Asti area near Alessandria: (1) Barbera with large oblong berries; and (2) Barbera with smaller berries and tighter clusters. Nuvolone stated that the second grape type made better wine. Dalmasso speculated that Barbera was a spontaneous product of some of the more ancient local vines, resulting in good cultural and productive characteristics which found favor with growers in the area. *Dalmasso et al.,1960-61, Ch.II, page III.*

Although nothing has been established definitively, the conclusion of a majority of Italian ampelographers, viticulturists and historians is that the ancient grape Barbera originated in the Piemonte region of northwestern Italy near the area known as Monferrato. *Robinson, 2006, page 62; Schneider et al., 2003; Dalmasso et al., 1960-61, Ch.II, page III.* Dalmasso wrote that everything pointed to a homeland in the Marquesato, later the Duchy, of Monferrato. Barbera is the principal vine in the Monferrato region in Piemonte, where it has been planted and grown widely for centuries. *Schneider et al., 2003.* In the 1960's when Dalmasso published his work, Barbera was vinified as a single varietal only in the Piemonte region. *Dalmasso et al.,1960-62, Ch.II page XII.* A Monferrato origin is further supported by 'Pomona Italiana' (1839) by Italian botanist Giorgio Gallesio and 'Remembrances' (1839) from Abbot Milano, both of which refer to the Barbera cultivar as *Vitis vinifera montisferratensis. Calò et al., 2001; Dalmasso et al., 1960-61, Ch.II, page III.*

There is an alternate theory for the area of origin of Barbera. In his 1909 *Ampélographie*, French ampelographer Pierre Viala proposes the Oltrepò Pavese as Barbera's original home. *Robinson, 2006; Viala et Vermorel, 1909, page 38.* The name Oltrepò Pavese means 'Pavia across the Po [River]' and refers to an area bordering Piemonte in the Province of Pavia to the south of the Po River. Oltrepò Pavese was formerly a part of Piemonte and was known as 'Old (Antico) Piemonte'. When Italy was unified in the 19th century, the region became part of Lombardia. *Viala et Vermorel, 1909, page 38.* Viala observes that Barbera has been important in the culture of the Province of Pavia. The cultivar has had a major presence in the Oltrepò region since 1820, where it thrives on the mountain slopes in deep clay soils. *Dalmasso et al., 1960-61, Ch.II, page XII.*

The effort to determine the parentage of Barbera has been as problematic as has determination of its time and area of origin. Despite efforts by Italian scientists to identify the parentage using DNA technology, Barbera's parentage remains uncertain. Scientists who studied the genetic relationships among grape cultivars from northwestern Italy reported in 2003 that Barbera was the variety most

frequently excluded from possible parental relationships with other varieties from that area. The results caused the scientists to surmise that either Barbera was introduced to Italy relatively recently (16th century or later) or that Barbera is more closely related to the local wild grape *Vitis vinifera* subsp. *silvestris* than to other cultivated grapevines. *Schneider et al., 2003.*

Barbera, or Barbera nera, is the preferred prime name for the cultivar. There are no official synonyms for the grape. Qualifying adjectives or descriptive modifiers were used in connection with the prime name, e.g., Barbera fina, Barbera grossa, Barbera dolce, Barbera forte, Barbera piccolo. *Viala et Vermorel , 1909, page 38; Calò et al., 2001, page 176.* Additionally, Italian geographical names are used on occasion to qualify the cultivar's name for wines made from Barbera, e.g., Barbera d'Asti, Barbera d'Alba, or Barbera del Monferrato.

Barbera is the second most widely planted red winegrape cultivar in Italy. The regions that favor the cultivar are Piemonte, the Emilia-Romagna and Lombardia. Barbera is the most widely cultivated variety in the Piemonte region (34% of the vineyards). *Ferrandino et al., 2007; Schneider, 1992.* Piemonte is a mountainous region with a continental climate. Viticulture in the region is unirrigated, and vineyards are typically located on hillsides with an average elevation of 400 meters (~1300 feet) above sea level. *Mannini et al., 1997.*

Notable Characteristics of Barbera in Italy

In a 1992 interview with FPS Grape Program Manager Susan Nelson-Kluk, Italian ampelographer Anna Schneider described Barbera as 'very adaptable and a good bearer'. The cultivar's adaptability allows for planting in almost all regions in Italy. *Schneider, 1992.* Barbera is easy to grow and exhibits medium-high vigor, good productivity and good basal fertility. *Mannini, 2004; Viala et Vermorel, 1909, page 38.*

Barbera clusters are typically medium sized and well-filled to compact. The berries are ovular and dark purple-black, producing juice with good color and relatively high acidity at maturity. Most sources report that the variety has long, green peduncles that make hand harvesting easy. *Christensen, 2003, pages 25-26; Dalmasso et al., 1960-61.* Anecdotal reports for observations of current Barbera grapevines in both Italy and California suggest that the predominant peduncle color is green, with perhaps a partial or complete browning as the grapes mature or a browning as a result of stressful environmental conditions.

Notwithstanding the references to long green peduncles, two ampelographers of the 19th century describe a 'Barbera fina' grape cultivar with long reddish-brown or wine-colored peduncles, without mention of green peduncles. *Odart, 1854; Gallesio, 1817-39.* The Italian grape reference book *Vitigni d'Italia* refers to 'peduncolo abbastanza lungo, bruno rossiccio' (peduncle rather long, reddish brown). *Calò et al., 2001.* The discrepancy in the descriptions of peduncle color could suggest multiple clones; however, no literature on clonal variation for that characteristic was discovered.

The Barbera grape characteristically produces full-bodied wines with good alcohol and color and high natural juice acidity. *Dalmasso; Viala; Mannini, 2004.* Good endowment of anthocyanins results in juice with deep color and polyphenolic character. Low tannin levels make the wines apt for wood ageing. *Lanati, 2000, page 11*; *Mannini, 1997.*

The first appellations of origin for the Barbera cultivar were in Italy. Barbera gave its name to the three initial DOC (Denominazione d'Origine Controllata) areas, which are in the Piemonte region: Barbera d'Asti (including sub-area Nizza Monferrato), Barbera d'Alba and Barbera del Monferrato. DOC is an indication of the viticultural area from where the grapes originate and according to which the wine is made. The first official production figures for Barbera in the appellations of origin were in 1971. *Robinson, 2006, page 62.*

In the late 20th century and despite a 1986 methanol scandal, a growing number of Piemontese winemakers saw Barbera as 'the start of the future ….[showing] extraordinary promise and potential for quality and a large production capacity.' *Anderson, 2000, page 5.* The cultivar can be incorporated into wine both on its own as a varietal and in mixtures. The wine is often used in blends due to its acidity and good color. The more traditional, less expensive varietal wine style exhibits a medium to light body with pleasant fruit and berry flavors but often a tart finish due to high acidity. *Anderson, 2000, pages 5-7; Gily, 2000, page 13.* Its acidity and low tannin levels make Barbera suitable for different wine styles, which may vary from wine that is sold quite young to wine that has undergone lengthy aging in barrel or bottle. *Robinson, 2006, page 62; Lanati, 2000, page 11; Gily, 2000, page 15; Anderson, 1980, page 65.* The enological characteristics of the cultivar suggest a high potential as a single varietal wine. *Mannini, 2004.*

Experts familiar with the evolution of Barbera wine styles in Italy opine that a prerequisite for making a quality Barbera varietal wine is production of grapes under specific unique conditions, i.e., the particular *terroir* in Piemonte. The most favorable site for production of quality grapes is described as a hillside vineyard (up to ~300 meters)

with ample sunshine and heat on well-drained soil. The optimum protocol for managing the grapevines speaks in terms of limiting yields. *Anderson, 2000, page 8; Gily, 2000, page 14-15.* The quality of wine may be impaired (overly acidic) if vines are allowed to overproduce or environmental conditions do not produce full ripening. *Mannini, 1997.*

Some say Giacomo Bologna in Rocchetta Tanaro, province of Asti in Piemonte, was the first to really appreciate the possibilities of Barbera as a varietal in producing an important wine in that area. His wine was made from a single vineyard of Barbera grapes from the Bologna estate, 'Braida'. Bologna believed that Barbera could mature very successfully in *barriques,* which are small French oak barrels. In the 1980's, he combined lower crop levels, malolactic fermentation and aging in new wood to create three well-regarded wines: Bricco dell'Uccellone, Bricco della Bigotta and Ai Suma (from late harvest grapes). Bologna's work showed that Barbera could be a wine that would impress the world market. In Bologna's wines, the variety revealed its many facets when its profile changed from a high acid, sharp thin wine to a richer, smoother and sweeter wine that is full-bodied and wood-tannin enhanced. *Anderson, 2000, pages 7-9; Lanati, 2000, pages 11-12.*

Barbera 04 is a popular clone in Italy.

Barbera outside of Italy

The tendency of Barbera to produce good yields of fruit with relatively high acidity has helped establish it as an important cultivar in several countries other than Italy, including the United States, Argentina, Australia and South Africa. *Fidelibus et al., 2009; Robinson, 2006, page 62; Christensen, 2003.*

In the United States, Barbera has a small but dedicated community of growers on the East Coast in the warmer regions of Virginia, Maryland, and Pennsylvania. Barboursville Vineyards near Charlottesville, Virginia, has been growing Barbera since 1976, and their first varietal wine was produced in 1991. *Paschina, 2011.* There are about 15,000 young vines planted in Maryland's Eastern and Southern Shore. Growers in the region attribute high fruit acidity retention for the popularity of the cultivar. *Fiola, 2011.*

Barbera also has a small presence in the States of Oregon and Washington on the West Coast. However, the cultivar has had by far its largest presence and longest tenure in the United States in the State of California, where friendly climatic conditions and *terroir* have enabled Barbera to thrive as both a blending wine and a quality varietal.

The Early Years of Barbera in California

The California wine industry began to emerge as a future competitor for European wines in the late 19th century. Influential viticulturists and nurserymen were eager to diversify California cultivars beyond the Mission grape and the few *Vitis vinifera* cultivars present in the state. Serious efforts to expand the number and quality of European wine grape cultivars were begun between 1860 and 1880. *Pinney, 1989, page 347.*

Agoston Haraszthy, a vineyard owner in Sonoma, campaigned to upgrade the varieties planted in California and lobbied the government for assistance. In 1861, he was appointed by Governor J.G. Downey as a 'commissioner' to study ways to improve the grapevine culture in California. Haraszthy ultimately received state 'sponsorship' (but not financing) for his 1861 trip Europe, where he acquired about 300 mostly *Vitis vinifera* grape varieties for import to California. *Sullivan, 1998, page 147.* Barbera was not included among those varieties.

U.C. Experiment Station Work

The California grape and wine industry became more institutionalized in the latter part of the 19th century. The State Board of Viticultural Commissioners was created by act of the legislature in 1880, as were the University of California's Department of Viticulture and Viticulture Experiment Station system. *Pinney, 1989, pages 342, 350;*

Hilgard, 1886[a]. The university began a systematic program to analyze the grapes then being grown within the state, as well as the resulting wines which were made therefrom, in a new wine cellar at U.C. Berkeley.

The Experiment Station system was tasked with developing sites in various locations throughout California to determine suitable grape varieties to be grown in the various regions. The Central Station at Berkeley was established first, and four other substations were created in Chino Valley, Paso Robles, Tulare (San Joaquin Valley Substation) and the Sierra Foothills in Amador County (Foothill Experiment Station). Two other stations under private auspices were developed in 1883 at Cupertino (West Side Santa Clara Valley Station) and Mission San José (East Side Santa Clara Valley Station). *Hilgard and Paparelli, 1892; Bioletti et al., 1896.*

Charles Wetmore was a real estate promoter and journalist who was appointed to be the first Chief Executive Viticultural Officer of the California Board of State Viticultural Commissioners. Eugene W. Hilgard, Dean of the College Agriculture at the University of California, was designated Director of the U.C. Agricultural Experiment Station system. The two men would have an acrimonious relationship, but the ultimate result of their respective efforts was positive for the California grape and wine industry.

In 1884, in his capacity as Chief Executive Officer, Wetmore wrote a report on the state of California's vineyards and the varieties known to be in the state at the time, which did not include Barbera. In his *Ampelography*, Wetmore lamented the lack of systematic planting in the state of varieties necessary to reproduce quality European wines and encouraged the import of those European grapes to improve California viticulture. *Wetmore, 1884.*

It was not for lack of awareness of the cultivar that Barbera had not been imported to California by the early 1880's. Beginning in the mid-19th century, Italian immigrants had begun to move into the areas that would become home to the California grape and wine industry. Additionally, the university meant to include grape varieties from the Italian region of Piemonte in its work, but Barbera had not yet been included in the 'early' university importations to California. *Hilgard and Paparelli, 1892.*

The first to import Barbera to California was neither an Italian immigrant nor a U.C. Experiment Station viticulturist. John T. Doyle was a noted trial lawyer, scholar and important leader in the California wine industry in the 19th century. In the 1880's, he purchased land near what later became Cupertino on the Peninsula in the California Bay Area and founded a winery. He was also a member of the State Board of Viticultural Commissioners. Doyle was a close associate of Eugene Hilgard, to the extent that in 1883 Doyle donated a parcel of land to U.C. Berkeley for the U.C. Experiment Station system. *Sullivan, 1998, page 91.* Doyle imported a large number of European wine grape varieties to California directly from Italy. Among his first imports in the early 1880's were Nebbiolo and Barbera, 'which [he felt] held in northern Italy the place that the Cabernets held in the Bordeaux region'. *Hilgard and Paparelli, 1892, page 118; Sullivan, 1998, page 19.*

The new U.C. Experiment Station system evaluated the performance of the Barbera grape over a period of time between 1884 through 1893. The variety was planted and/or evaluated at the Experiment Stations in Cupertino, Tulare and Amador County. Those findings in the late 19th century were consistent with the findings of Piemontese viticulturists that Barbera requires elevated temperatures at a constant level in order to thrive.

Doyle and Hilgard experimented with the Italian varieties (including Barbera) early on in Cupertino and Mission San José. In a report written for the 1883-84 season, Hilgard notes that Doyle's Barbera vines in the experiment plot in Cupertino were probably the only vines of that variety in the state at that time. *Hilgard, 1886, page 111.* Following three years of evaluation, the researchers concluded in 1886 that the reportedly productive and vigorous Barbera was not a very strong grower in Cupertino and did not show the early and profuse bearing attributed to it in Italy. Hilgard did note that the wine produced from the Cupertino vines exhibited very high acid, as well as beautiful and deep color. *Hilgard, 1886[a], page 85.*

A new source of the Barbera grape arrived in California in 1886. An important collection of valuable Italian grape varieties (including Barbera) was imported by the University to California 'through the kindness of Count G. [Giuseppe] di Rovasenda of Turin, the well-known Italian ampelographer'. Count Rovasenda maintained a grape collection in Italy containing approximately 4,000 varieties, which still exists at Gruliasco. Hilgard noted that the Italian grapes were very valuable to California, 'whose climate is so similar to that of Italy', for their remarkably high acidity along with a good proportion of sugar and good color. *Hilgard and Paparelli, 1892, page 118; DiRicaldone, 1974.*

The first draft of the U.C. Experiment Station Viticulture Report for Season 1887-1889 continued the evaluation of Barbera grapes and wines in the Experiment Station system, but that study was still limited to the Cupertino and Mission San José stations. That initial report, authored by Viticulture Instructor Louis Paparelli under the direction of Dr. Hilgard and issued in 1889, concluded that Barbera

was a good but uneven and irregular bearer in Cupertino (3.5 to 6 tons) and Mission San José (3 tons). The grapes achieved high sugar levels along with high acidity, a result the researchers noted could be of special importance for warm locations in the state. *Hilgard and Paparelli, 1892, page 142.*

Fermentation experiments led the U.C. researchers to conclude that satisfactory Barbera wines could be vinified in warm as well as cool locations. They recommended that the wine be bottled later than other wines because it seemed to them that Barbera required a longer time to age to lose some of the high acidity and astringency and acquire an agreeable bouquet and flavor reminiscent of Bordeaux wines. *Hilgard and Paparelli, 1892, page 144.* Paparelli and Hilgard concluded that the Barbera wines produced in California had good keeping qualities and could be aged to reduce astringency to be very delicate. They predicted that Barbera would be one of the most important of the Italian varieties that would thrive in the California conditions to produce a 'first-class dry wine of excellent keeping quality'. *Hilgard and Paparelli, 1892, page 118, 144.*

By 1893, Barbera had been installed as well at the U.C. Experiment Stations in Tulare and the Sierra Foothills in Amador County.

One Barbera selection planted at the Foothill Experiment Station (Amador County) in 1889 was named 'Barbera fina' and was obtained from the Central Station at Berkeley (Block D r1 v 1-14, Block N r1 v 1-13). John Doyle had a Barbera cultivar with the name 'Barbera fina' at his Cupertino vineyard [the remainder of his Barbera vines were named simply 'Barbera']. *Hilgard and Paparelli, 1892, pages 134-144.* There is no further source information indicating whether or not the 'Barbera fina' at the Foothill Experiment station originated at Doyle's vineyard in Cupertino or was plant material obtained by Rovasenda from Italy. Nothing in the files at FPS or on the old maps of the Department of Viticulture & Enology vineyards suggest that the 'Barbera fina' from the Foothill Experiment Station was ever planted in the Department vineyards on the Davis campus. Nothing in the FPS records shows that a selection named 'Barbera fina' from the Amador Station was ever processed through FPS.

Barbera seemed 'particularly well suited' to the Tulare (Fresno) Station area where it produced strong and healthy growth (5 tons per acre) in the sandy soils. The grapes ripened well without losing acid, and, due to a low tannin level, the resulting wines needed blending to make a good commercial wine. *Bioletti, 1896, pages 136-137.*

Frederic Bioletti , then Foreman of the University cellar, prepared the final report for Experiment Station Viticultural Work for 1887-93, in which he incorporated final data from the 1887-89 season and added comments from the years 1889 through 1993. Bioletti modified slightly the previous conclusions on the North Italian grapes with which the Experiment Station system had worked in Tulare, Asti (Sonoma County), Cupertino and San José. No grapes from the Foothill Experiment Station in Amador County were included in the evaluation.

The North Italian grapes were praised for their high acid and high sugar content and durable and prolific grape production. The researchers noted that Barbera produced good dry, red wines when grown in the hot climate of the San Joaquin Valley but would probably not succeed well in coastal counties except for some 'extra hot location'. *Bioletti, 1896, page 134.* Barbera was recommended for blending with other varieties whose acid content falls low. Bioletti concluded that the Northern Italian grapes (particularly Refosco, Fresa [sic.] and Barbera) had maintained their characteristics remarkably in California, showing their special adaptation to California conditions. *Bioletti, 1896, page 12.*

Italian Swiss Agricultural Colony

Barbera was imported to California in the late 19th century also by some of the Italian immigrants who settled in the counties that later became synonymous with quality wine. In 1881, a former Genoan named Andrea Sbarboro and some associates formed a cooperative grape-growing business in a village they named Asti near Cloverdale in Sonoma County, California. The cooperative was formed with idea of helping Italian immigrants become self-sufficient. The Italian Swiss Agricultural Colony (ISC) began planting vines in 1882. *Pinney, 1989, page 327.*

The absence of Italian varieties in the initial plantings motivated Italian Swiss Colony to seek the assistance of Dr. Giuseppe Ollino, one of its directors, who imported cuttings of leading Piemontese varieties to Asti, California, in 1885. Barbera was included among those varieties, although Sangiovese would later become ISC's most important varietal. *Hilgard and Paparelli, 1892, page 118; Florence, 1999, page 49.*

The ISC winery was constructed in the late 1880's. In 1888, Sbarbono hired Pietro Carlo Rossi, who had a degree in agricultural chemistry from the University of Torino, to be the winemaker. The quality of the wine thereafter made a dramatic improvement. *Florence, 1999, page 53; Sullivan, 1998, page 161.* In the 1890's, several of ISC's successful red table wines contained Barbera, which contributed deep color, brilliant tartness, and sharp tannins and astringency. *Sullivan,1998.*

Pietro Rossi's son, Edmund A. Rossi, later became President of Italian Swiss Colony. He wrote in a 1941 letter to Dr. Harold Olmo (Professor of Viticulture & Enology, U.C. Davis):

> 'Some of the earliest plantings of vineyards at Asti in the 1880's had beginnings in importations of grapevines selected on a trip to Italy by Dr. G. Ollino ….Of course, there were imported the Italian varieties that went into Chianti wine such as San Giovese, Lambrusca, and Albana. Then, there was the Barbera of which we had about 25 acres …. Of course, the Barbera and Chianti varieties have been maintained at Asti as they give not only a fair crop but very fine quality.'
> —*Rossi letter to Olmo, 1941.*

Professor Guido Rossati was an enologist sent to the United States by the Italian Ministry of Agriculture in the late 19th century for the purpose of investigating the state of wine-making in the United States. He visited the major localities where wine grapes were grown on both coasts in the United States. *Rossati, 1900, page 324; Sbarboro, 1900.*

In travelling through Sonoma County, Rossati observed that Barbera was a wine grape of special importance in Italian Swiss Colony plantings in Asti. Rossati reported that Barbera 'succeeds well in the warm locations on the slopes in Sonoma, Napa, Santa Clara and in the internal valleys of San Joaquin and Sacramento' but not so well in the counties on the coast. He saw that the variety gave 'an abundant harvest (5 tons per acre)' in California, even in the sandy alkaline soil of Tulare. It was Rossati's opinion that Barbera 'is the Italian variety that best reproduces its characteristics in California'. *Rossati, 1900, page 162.* He reported that the Barbera wine in California was good, less acidic and aromatic than that of Italy, but 'eminently drinkable'. *Rossati, 1900, page 300.*

In a report to the Italian government in 1900, Rossati stated that wine could be made in several states, but that 'fine wine in inexhaustible quantities could be produced only in the State of California, where, on account of the similarity of the soil and climate to that of the wine-growing countries of the world, the *vitae vinifera* ….thrives as well as and produces larger crops than it does it Europe'. *Sbarboro, 1900 .*

Barbera was also planted in the 19th century in small amounts by other Italian-American winegrowers in Sonoma County, including Louis Martini (Monte Rosso Vineyard), Eduardo Seghesio, and Samuele Sebastiani. *McGourty, 2011; Sullivan, 1998, pages 203, 321-322, 324.* The Sebastianis were still winning awards for their Barbera in the 1930's, with a deep flavored, well-aged, dry yet fruity red wine. *Adams, 1973, page 187.*

Barbera in California in the 20th Century

After twenty years of observation and evaluation by scientists in the university Experiment Station system, the University of California in 1907 issued a recommended list of grape varieties appropriate for planting in the various regions of California. By this time, Frederic Bioletti had become the university's first Professor of Viticulture. *Alley and Golino, 2000.* Barbera was included on the list of red wine grapes for dry wine appropriate for growing in the interior valleys of California (San Joaquin, Central, and Sacramento Valleys). Barbera was omitted from the recommended list of 'quality grapes' for vineyards in the coastal counties or the coast ranges. *Bioletti, 1907.* By the start of Prohibition (1919), there were approximately 5,000 acres of Barbera planted in California. *McGourty, 2011.*

Bioletti, who had become the Chair of the U.C. Department of Viticulture in 1916, produced a publication in 1929 (revised 1934) on 'The Elements of Grape Growing in California', in which he included a section describing the grape varieties then being grown in California. Barbera was included on the list of 'varieties of merit but not largely planted'. He indicated that Barbera 'bears well in good, heavy soil in California where it has been tried in the North Coast region, and makes an excellent wine'. *Bioletti, 1929, rev. 1934, page 34.*

When winemaking investigations were initiated on the U.C. Davis campus in 1935 following repeal of Prohibition (1933), it became necessary to establish production blocks of the leading wine varieties. The Department of Viticulture (which became the Department of Viticulture & Enology in 1948) initiated experiments on clonal selection. The first mother vine selections were made in 1937 and a number assigned to each. In 1937, Bioletti began progeny tests at U.C. Davis on Barbera vines from Italian Swiss Colony vineyards in Asti, Sonoma County. *Olmo, H.P., undated.* It appears as though no data on the results of such clonal work were ever published.

U.C. Davis Professor of Viticulture Albert J. Winkler indicated that, in the 1930's, the university provided California growers throughout the state with cuttings or rootings of cultivars of interest, and those growers grew them out and in turn provided the university with grapes for the wine-making evaluations. *Winkler, 1973, pages 23-24.* Those growers were the source of the some of the vines in the Department vineyard in Davis.

In addition to the Italian Swiss Colony Barbera vines, two other clones of the cultivar planted in these early years in the Department of Viticulture's Armstrong vineyard at U.C. Davis were Horace Lanza and Secundo Guasti. The source information for one of the Barbera clones in the

university vineyard was listed as 'Lanza', who was Horace O. Lanza (California Grape Products) in Delano, California (UCD Department of Viticulture vineyard, Block E76).

A second Barbera selection whose source designation was 'Guasti' came from a vineyard that once belonged to Secundo Guasti of the Italian Vineyard Company in Guasti (near present day Cucamonga) in Southern California. The Guasti clone was was donated to the Department collection prior to 1939 (UCD Department of Viticulture vineyard, Block E10, v 9-10). *Winkler, 1973, pages 23-24; Olmo, Harold, notes on grape selections used in research blocks, index cards maintained in FPS files.* Horace Lanza bought the Italian Vineyard Co. during World War II to gain control of the huge Guasti grape crop. *Adams, 1973, page 283.* The Lanza and Guasti clones were donated to the U.S.D.A. National Clonal Germplasm Repository at Davis in 1983 (DVIT numbers 648 and 649).

Dr. Olmo also imported a Barbera selection from Italy in 1949, sent by Luigi Pirovano, Viticultural and Horticultural Establishment in Milan (USDA P.I. number 173259).

It appears that some or all of the Barbera clones in the Department of Viticulture's vineyard still existed in the Department's collection until at least the 1980's. The first Barbera clone processed through Foundation Plant Services was Barbera FPS 01; FPS records show that plant material from Barbera 01 vines was first distributed to nurseries and the public in 1966. Old FPS distribution cards show that orders from throughout California requesting the Barbera cultivar were filled by FPS from the Department of Viticulture and Enology vines in the 1950's and 1960's. Unfortunately, the source information indicating from which Department vines the orders were filled is incomplete and unspecific.

Prohibition severely impacted Barbera acreage in California. After Repeal (1933), the variety did not immediately regain the popularity it had previously enjoyed prior to 1919. *Sullivan, 1998.* In 1968 the total Barbera acreage in the state was reported by the California Agricultural Statistics Service to be 1,214 bearing acres. *California Grape Acreage - 1968, California Crop and Livestock Reporting Service, Sacramento, California, 1969.*

In 1944, U.C. Enology and Viticulture Professors Maynard Amerine and A.J. Winkler published the comprehensive review of the performance of grape cultivars in California and defined the five climate zones that are referred to as the 'Winkler regions'. Those five regions are based on heat summation calculations of the number of degree days above 50° F.between April and October . *Amerine and Winkler, 1944, page 505.* The Winkler regions can be characterized generally as: I – cool; II – moderately cool; III – intermediate or warm; IV – moderately hot; V – hot.

In the 1944 publication, Amerine and Winkler reviewed the prior Experiment Station work on winegrape growing and wine making, beginning with Eugene Hilgard's reports in the 19th century. Each Winkler region (I-V) is featured with a discussion of the appropriate wine grape varieties to be grown therein.

Region I, Region II and cool areas of Region III

The university researchers concluded that all their years of research and observation showed that Barbera needs some heat to do well. They stated that the cultivar did not ripen normally year after year in the cool Winkler region I, represented by the primarily-hillside areas within North Coast counties. Amerine and Winkler concluded that the same would be true to a degree in region II, the moderately cool areas in the valley floors and hillsides of North and Central Coast counties, and in all but the warmer areas of region III. Barbera was excessively acidic even when it matured in those areas. *Amerine and Winkler, 1944, pages 505, 517-533, 552-553.*

Warm Region III and Region IV

The U.C. Professors saw Barbera as a promising red wine variety for standard, quality or blended table wines for the warmer areas in regions III and for the moderately-hot region IV. In the climates of those regions, the cultivar appeared to be productive and ripened sufficiently.

Region III includes the Livermore Valley in Alameda County, Mendocino County (Hopland, Ukiah), Calistoga, San Luis Obispo and parts of Sonoma County (Alexander Valley, Asti and Cloverdale). *Amerine and Winkler, 1944, pages 505, 552-553.* Most of the vineyards are reportedly on 'fairly flat land', although some of the soils are rocky. *Amerine and Winkler, 1944, page 533.* Amerine and Winkler believed that the Barbera wines from region III were the most balanced in character, although they indicated that 'it is a mistake to hope for dry wines of the finest quality' in this region.

Region IV includes the Sierra Foothills, parts of northern San Joaquin Valley, and Davis in Yolo County. The soils in the valley floors of region IV are usually fertile.

In 1944, the U.C. Professors were pessimistic about whether the 'low-producing vineyards' in the foothills in the Sacramento and San Joaquin Valleys should be planted to grapes at all. *Amerine and Winkler, 1944, page 540.* However, by the time of the 1970's, the Barbera grape was rediscovered in several regions in California, including the inland coastal and foothill areas, where acreage increased substantially. *Adams, 1973, page 180.* The warmer

temperatures, low hills and well drained soils approximate those conditions described as ideal for Barbera in the hills of the Piemonte. *Gily, 2000, page 15.* The growers in those areas sought to develop Barbera as a quality varietal wine grape. *McGourty, 2011; Christensen, 2003.*

Winemaker Cary Gott planted the first Barbera at Monteviña in Amador County in the Sierra Foothills in 1971, at Sacramento wine merchant Darrell Corti's suggestion. The first Barbera wine produced from that area was Monteviña Barbera 1974. *Clarke, 1998.* By 2010, there were approximately 300 total acres planted in the Sierra Foothill region (Amador, Calaveras, El Dorado, Nevada and Placer Counties). *California Grape Acreage Report, 2010 Crop.* One wine writer has referred to the increase in interest in Amador County to 'a small Barbera revival taking place'. *Sullivan, 1998, page 19.*

The Central and North Coast regions accounted for 97 acres and 178 acres of Barbera, respectively, in 2010.

Glenn McGourty, Winegrowing and Plant Science Advisor, University of California Cooperative Extension, included Barbera in a Mediterranean wine grape cultivar trial in the Red Hills, a sub-appellation of Lake County, which is a warm Winkler region III area. The research was conducted between 1998 and 2000. Fruit yields averaged 3.2 kg/meter of cordon for three years. Fruit chemistry results showed average titratable acidity at 10.3, % Brix at 25.9 and pH at 3.13. McGourty agreed that the best Barbera wines (good fruit, dark color, good tannic structure) have been produced outside of the San Joaquin Valley. However, when grown in moderately cropped vineyards in the Northern San Joaquin Valley (Winkler region IV), and carefully vinified, Barbera has also made very good quality wines in recent years. *McGourty, 2011.*

Other U.C. researchers concur and report that, in cooler regions in California [Winkler regions III and IV] and at lower yields, Barbera produces a quality varietal wine. *Christensen, 2003, page 27.*

Region V

In their publication in 1944, Amerine and Winkler concluded that Barbera was a suitable planting for the hot, fertile irrigated valleys of Winkler region V, which includes Fresno, Madera, Merced and Tulare Counties. *Amerine and Winkler, 1944.* They indicated that '[Barbera] is among the best varieties tested for the production of average and above average quality dry table wines in region V, but its planting is less well indicated for that region than for III and IV'. *Anerine and Winkler, 1944, page 553.* The Professors opined that wines from the 'warmer regions (IV, and more particularly V)' were less delicate, heavier and generally lower in quality. *Amerine and Winkler, 1944, page 552.* The typical product of region V was described by them as bulk quality red table wine produced from the higher acid varieties.

A truly impressive increase in acreage occurred in the Central and San Joaquin Valley regions in the 1970's, where Barbera became a prominent red wine variety. Julio Gallo encouraged planting in California's warmer regions recognizing that Barbera's high acidity would make it highly desirable for blending. Barbera was used to raise the quality of inexpensive red table wines by its contribution of acid and color. *Sullivan, 1998, page 19; Adams, 1973, page 180.*

The cultivar achieved its peak acreage in California in 1980 at about 21,000 total acres, most of which was located in California's warm interior valleys. By 2010, however, the total for the entire state had declined to approximately 6800 acres, 6200 of which were in the large counties in the southern Central Valley. *McGourty, 2011; California Grape Acreage Report – 2010 Crop; Christensen, 2003.*

Barbera's characteristics in California

A general explanation on how Barbera performs in California was included in the section of the 1944 Amerine and Winkler publication in 'Notes on Recommended Red Varieties'. The Professors indicated that Barbera is well above average in vigor and produces moderately well in California. *Amerine and Winkler, 1944, page 552.* A more recent report from U.C. researchers has quantified production. Vines usually bear 6 to 9 tons per acre, except on hillsides and non-irrigated sites where lower yields are normal. Yields have also been lower in the Sierra foothills (3-5 tons per acre), even if irrigated. *Christensen, 2003, page 26.*

Barbera is adaptable to many soil types but may show a lower tolerance for alkaline soils. *Christensen, 2003, page 25; Hilgard, 1886.* The vines leaf out relatively late, and Barbera is usually harvested 'midseason' (mid-September to early October) in the state. *Christensen, 2003, page 25; Amerine and Winkler, 1944, page 552.* Barbera adapts to various rootstocks, and there are no known incompatibilities. *Christensen, 2003, page 26; Kasimatis, 1980.*

The Barbera grapes grown in California consistently maintain high fruit acidity retention. U.C. researchers saw that the degree of acidity in the musts appeared to be affected less by maturity and by region of production than in most varieties. The wines produced were distinctive in aroma and flavor, fruity, medium to high in acidity, heavy or full-bodied and usually good in color and finish. None of the wines were above normal in tannin content. *Christensen, 2003, page 25; Amerine and Winkler,*

1944, page 552. Amerine and Winkler concluded that the characteristic heavy body, high acidity and average tannin level meant that Barbera would require and greatly profit by aging. *Amerine and Winkler, 1944, page 552.*

BARBERA SELECTIONS AT FPS

Foundation Plant Services never received any of the Barbera clones mentioned earlier in this article directly from the vineyards maintained by the Department of Viticulture & Enology on the U.C. Davis campus. The first Barbera selection came to FPS around 1959 or 1960 from a California vineyard. It is possible that that first selection originated indirectly from the Department collection, but there is no documented chain of evidence leading to that conclusion.

Barbera FPS 01/ Barbera FPS 06

The plant material that became Barbera FPS 01 came to Foundation Plant Services around 1959 or 1960 from a California vineyard – Marshall 32v7. The FPS files give no additional identifying information about the 'Marshall vineyard'. One educated guess is that the Barbera vine came to FPS from the vineyards maintained by L.K. Marshall in Lodi, California.

Lawrence K. Marshall moved to Lodi, California, in 1917, where he established a vineyard and began clonal experimentation and wine making with various grape cultivars. He was a prominent member of the California grape and wine community in the 1930's. *Winkler, 1957.*

After Prohibition was repealed, Marshall established a wine cooperative in Lodi in 1934 called the Bear Creek Vineyard Association, and East-Side Winery. Bear Creek and other wineries joined in the Wine Growers Guild, a federated cooperative, in 1937. Marshall became the first Chair of the Research Committee of the Wine Institute in 1934. *Winkler, 1957.*

Following World War II, Marshall was one of the first in the industry to recognize the seriousness of the virus threat to the grape industry. He helped form the California Grape Certification Association, an organization to produce grape planting stock that could be certified free of known viruses and true to variety name. *Winkler, 1957.*

Wine writer Charles Sullivan describes L.K. Marshall as follows: 'A power in the twentieth century development of winegrowing in the Lodi area and a founder of Guild Wineries. André Tchelistcheff considered him, along with Louis M. Martini and Herman Wente, one of the three 'apostles of the modern California wine industry'." *Sullivan, 1998, page 201.*

U.C. Davis Viticulture Professor Winkler and L.K. Marshall were close friends. Marshall was one of the growers to which the university provided grape plant material for use in the university wine-making evaluations. Marshall's vineyard in Lodi had 30-40 different varieties which the university could access for grapes. *Winkler, 1973, pages 11-12, 22-24, 50, 85.* The old FPS grape distribution records show that FPS program technician Curtis Alley exchanged grape cuttings with L.K. Marshall in 1956 and 1957. It is known that Barbera was being grown in the Lodi area in the 1930's. *Wines & Vines, 1938.* A reasonable inference can be drawn that the 'Marshall' referenced in the FPS database as the source of Barbera FPS 01 was L.K. Marshall of Lodi.

Assuming that the plant material that became Barbera FPS 01 did come from L.K. Marshall's vineyard in Lodi, it is not clear whether or not that material had previously been provided by the university to Marshall for planting in his variety blocks or whether Marshall had obtained the material from another source prior to involvement with the university program. In either case, there is no definitive source information for Barbera 01 that precedes the reference to the Marshall vineyard.

The Marshall Barbera selection underwent heat treatment for 119 days and tested negative for disease in the 1960's and 1970's. Barbera 01 (also assigned the superclone number 115 by USDA Plant Pathologist Dr. Austin Goheen) was planted in the foundation vineyard in 1964 and again in 1965. The selection first appeared on the list of registered vines in the California Registration & Certification Program in 1970.

University of California Extension Viticulturist Peter Christensen recalls that most of the Barbera plantings in California in the 1970's and 1980's were in the San Joaquin Valley where the variety was used mostly for blending because of its relatively high acidity. When Barbera 01 was first released, most of the existing Barbera vines in California were infected with leafroll virus, resulting in less fruit color and sugar. *Kasimatis et al., 1980.* Christensen stated that, by contrast, the own-rooted Barbera 01 material was clean and vigorous and proved to be a productive source of wood. *Christensen e-mail, 2008.*

In 1980, FPS began using a new Cabernet franc index test that was designed to detect 'mild forms' of leafroll virus. It was thought that the Cabernet franc index would be an improvement over the prior Mission index. Dr. Goheen reindexed 81 selections of 20 important FPS registered grape scion varieties in 1981-82. *Minutes of the Grape Growers Meeting* held *April 27, 1982, FPS Grape Growers' Newsletter, no. 2, August, 1982.* The Barbera 01 vines in the foundation vineyard tested positive for 'mild leafroll'

in 1982. Barbera 01 was removed from the Registration & Certification Program in 1984.

Meanwhile, Christensen had conducted a clonal trial of Barbera 01 vis à vis the plant material that later became Barbera 02 (Rauscedo clone 6) at Kearney Agricultural Center in the San Joaquin Valley. He was impressed with the performance of Barbera 01 in that trial. Christensen reported in 1995 that Barbera 01 produced smaller berries and clusters of earlier maturation. Barbera 02 yielded larger clusters and berries but matured later and suffered more rot. Christensen concluded that Barbera 01 should be preserved in the FPS collection after undergoing disease elimination therapy. *Fidelibus et al., 2009; L.P. Christensen, unpublished data, 1995.*

In a 1995 letter to FPS, Christensen recommended that Barbera 01 (the Marshall clone) be scheduled for virus elimination therapy because: 'The Marshall clone represents the best planting material used by the industry during the cultivar's more extensive planting from the mid 1970's to the early 1980's. Additionally, it exhibits good fruit characteristics for wine making, increases the diversity of clonal material available to our industry, and adds to the base of future clonal testing and importation of this important cultivar.' *Christensen letter to Golino, April 11, 1995.*

FPS was thereafter able to locate a source for Barbera 01 that did not appear to have symptoms of leafroll virus. In February of 1996, plant material for that selection was retrieved from a private increase block managed by John Gist in south Davis. The Gist Barbera 01 plant material underwent reindexing and tested negative for virus. The newly-tested plant material was renamed Barbera 06, which first appeared on the list of registered vines in the California Grapevine R&C Program in 2000-2001. A new selection number was given because the plant material had been outside the control of FPS for a period of time, and FPS could not guarantee that the selection was from the original FPS vines of Barbera 01.

While the original Gist plant material was undergoing retesting and reindexing, FPS also subjected tissue from that Barbera 01 plant material to microshoot tip tissue culture disease elimination therapy. The resulting plant was maintained in the FPS foundation vineyard from 2000 to 2010 as a backup plant to Barbera 06. In 2010, the new National Clean Plant Network for Grapes established a more rigorous standard for grapevine material associated with the network. FPS, as the headquarters for the NCPN for Grapes, was granted land on the U.C. Davis campus to establish a new foundation vineyard that incorporates the stricter standard. In order to qualify for the new foundation vineyard at Russell Ranch, grapevine material must undergo microshoot tip tissue culture therapy and test negative for an extensive list of pathogens that are listed in the '2010 Protocol'. The backup plant for Barbera 06 has met both of those criteria and will be planted in the foundation vineyard at Russell Ranch in 2011 under the new name Barbera FPS 6.1.

Barbera 06 was included in a clonal trial managed by U.C. Extension Viticulturist Matthew Fidelibus in Parlier, California, between 2003 and 2006. The other Barbera selections in the trial were Barbera 02, 03, 04, and 05. Dr. Fidelibus found that Barbera 06 produced lower yields than many other selections but suggested that the selection might nevertheless be desirable for growers in warm climates. The berries were fewer and smaller; the clusters were less susceptible to sour rot; and the fruit composition was comparable to most selections. Over the course of the study, the fruit of Barbera 06 had similar or greater soluble solids at harvest than the fruit of the other clones, even in the year in which FPS 06 was the last to begin ripening but the first (by a week) to be harvested. Juices from Barbera 06 generally had similar or lower titratable acidity than juices from other selections. *Fidelibus et al., 2009.*

The Marshall clone has less rot and is suitable for warmer climates.

Barbera 02

Dr. Austin Goheen imported the plant material that became Barbera 02 to FPS from Italy for evaluation in February of 1983. The supplier of Rauscedo clone 6 was Rauscedo Grapevine Nursery. Rauscedo clone 06 never appeared on the approved registry of Italian clones and was removed from the Rauscedo selection program prior to microvinification. Barbera FPS 02 is not a proprietary selection at FPS.

Barbera 02 tested negative for viruses at FPS and did not undergo treatment. The selection was planted in the foundation vineyard in 1986 and first appeared on the list of registered vines in the California Registration & Certification Program in 1988-89.

In 1995, Peter Christensen summarized his findings for four years of data for Barbera 02 as follows: 'Results to date have shown [Barbera 02] to be more fruitful and to produce heavier berries and clusters, as well as higher yield, as compared to [Barbera 01]. However, [Barbera 02's] fruit maturation is 7 to 10 days later and shows high bunch rot potential. Wine color also tends to be lower with [Barbera 02]. This is probably due to the greater pulp to skin ratio of [Barbera 02], as the skin anthocyanin contents are similar.' *Christensen letter to Golino, 1995*. Christensen felt at that point that Barbera 02 had potential in the industry due to its production capacity.

Dr. Fidelibus also evaluated Barbera 02 based on four years of data (2003-2006). He concluded that Barbera FPS 02 was the least desirable selection because of large berries and high rot potential. He cited prior research that Barbera's large berries can cause clusters to become compacted and susceptible to rot. In Fidelibus' trial, Barbera 02 consistently had the largest berries and was most susceptible to sour rot. *Fidelibus et al., 2009*.

Barbera 02 has heavier berries and larger clusters than other FPS clones.

Barbera 03 and 05

Barbera FPS 03 and Barbera FPS 05 are both clone CVT AT 171 from the Centro di Studio per il Miglioramento Genetico della Vite (CVT) , CNR (Grapevine Breeding Center), in Torino, Italy. The CVT-CNR center is involved in research regarding grapevines and cooperates with viticulturists at the University of Torino. Viticulturists Anna Schneider and Franco Mannini are experts in clonal selection and ampelography at the center.

CVT AT 171 was evaluated in Italy with the following results: medium-high vigor, high yield, medium-large cluster, and medium wine quality. *Mannini, 1995*. Ampelographer Anna Schneider commented that the clone is phenologically a bit earlier (bud break, veraison and fruit ripening) than the average Barbera population. She stated that the large clusters have small berries with moderate acidity, suitable for young wines. *Schneider, 1997*. The clone was selected in the Piemonte region and first registered in Italy in 1990.

CVT AT 171 came to FPS in 1993 and was first offered for sale by FPS in 1997 with Provisional status. Selections 03 and 05 first appeared on the list of registered vines in 1999-2000 and 2000-2001, respectively.

At the time of the release of Barbera 03 and 05, the policy of issuing 'duplicate releases' of FPS plant material was explained in the FPS newsletter. More than one selection from a single source or single European clone was on occasion processed through the FPS program. 'Duplicate selection' sometimes signified that the two selections originated from different source vines for the same clone in Europe or that multiple selections from the same source vine underwent different heat treatments at FPS. Maintaining duplicate selections was one way to insure that materials that were true to variety and clone were

eventually included in the FPS collection. Barbera CVT 171 was cited as an example for which there were two FPS selections, 03 and 05. *See FPMS 1997 Grape Program Newsletter.* The FPS newsletter article did not clarify whether Barbera 03 and 05 were from the same or separate source vines in Italy, only that they were the same Italian clone.

Barbera 05 is clone CVT 171 from Italy.

In his clonal evaluation, Dr. Fidelibus found that the two selections were almost identical with respect to every variable measured, regardless of year. Berries of selections 03, 04 and 05 were less heavy than Barbera 02 and heavier than Barbera 06. In every year, Barbera 03 and 05 produced 20 to 30 % more fruit, by weight, than Barbera 06. In two of the four years, the two produced 20% more fruit than Barbera 04. The higher yields for Barbera 03 and 05 were attributable either to production of more clusters or to heavier clusters, while the greater cluster weights of the two selections was attributable to those selections having more berries per cluster. *Fidelibus et al., 2009.*

Barbera FPS 04

Barbera FPS 04 was imported to Foundation Plant Services in 1993 from CVT-CNR in Torino, Italy. The plant material is clone AT 84, which was selected in Piemonte by CVT and first registered in Italy in 1980.

The clonal performance in Italy indicates medium vigor and yield, small clusters, high wine quality, moderate acidity, and suitability both for early consumption and aging. *Mannini, 1995.* Anna Schneider commented that this clone was usually less affected by grey rot than the average Barbera clone. She agreed that the wine produced from the clone is high quality and suitable for aging. *Schneider, 1997.*

Diego Barison, director of field operations and customer relations for Novavine Grapevine Nursery, spoke at Foothill Grape Day 2011 'Focus on Barbera' and discussed clonal and wine trials of Barbera clones he has done in Italy and California. He indicated that Barbera FPS 04 (AT 84) is a popular clone in Italy which exhibits small-to-medium clusters and berries and early-to-medium budbreak and maturity. *Barison, 2011.*

Barbera FPS 04 received no treatment and first appeared on the list of registered selections at FPS in 2000.

Barbera FPS 07

Barbera FPS 07 was imported to Davis in 1998 by Novavine Grapevine Nursery from Vivai Cooperativi Rauscedo in Italy. The selection is a proprietary clone to Novavine.

The Italian clonal designation for FPS 07 is VCR 19. Diego Barison characterized this clone as one of the most suitable for producing wine through aging, given its good body, color and structure. The clusters are smaller and have higher fertility than average. This clone may be planted in rocky, dry soils. *Barison, 2011.*

Barbera FPS 07 received no treatment at FPS and appears on the list of registered vines in the California R&C Program.

Barbera FPS 08

Barbera FPS 08 was imported to Davis in 1998 by Novavine Grapevine Nursery from Vivai Cooperativi Rauscedo in Italy. The selection is also proprietary to Novavine Grapevine Nursery.

The Italian clonal designation is VCR 15. Barison states that the clone produces small to medium clusters of lower than average weight and small berries. The vine exhibits medium vigor and yields a consistent production. The wine is 'nice and strong and a deep ruby red, if the canopy is managed properly'. Wine from this clone is also suitable for a long period of aging. *Barison, 2011.*

Barbera 08 received no treatment at FPS and has registered status in the California R&C Program.

CONCLUSION

Barbera was one of the early European grape cultivars imported for the emerging California wine industry. The versatility of the cultivar enabled it to thrive through various eras of California wine making and wine styles. The FPS collection contains Barbera selections that are suitable for winegrowers in all appropriate regions of California and elsewhere.

ACKNOWLEDGEMENTS

With the exception of the 'Uva Barbera' plate on the first page, all photos were taken by Deborah Lamoreux.

I am extremely grateful to wine merchant Darrell Corti of Sacramento for his invaluable assistance in the writing of this article. Mr. Corti devoted many hours to educating me on Italian wines, to translating the Italian texts cited in the article and to reviewing my text and offering pertinent comments. Axel Borg, wine bibliographer and reference librarian in the Viticulture & Enology section of Shields Library at U.C. Davis, provided significant assistance in regard to the university publications and citations.

I would also like to express my appreciation to University of California Viticulture Extension Specialists Dr. Matthew Fidelibus and Dr. Glenn McGourty for taking time to review and comment on the article and to Dr. Diego Barison of Novavine Grapevine Nursery for assistance with questions about Barbera.

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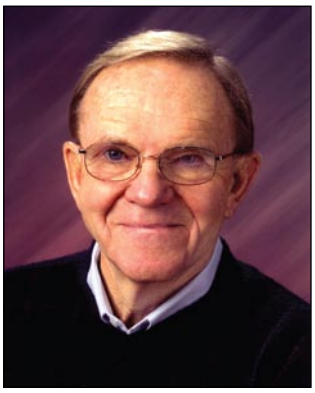
In Memory

L. Peter Christensen



L. Peter Christensen passed away peacefully at Hinds Hospice in Fresno, on Sunday, September 25, 2011. Born in Selma, California, on November 1, 1934, he was the grandson of Danish immigrants. Both his grandfather and father were grape growers in Selma. Peter wed Eleanor K. Honzik in 1960, with whom he was married for 51 years and raised three sons in Fresno, California.

Having grown up working in his parents' vineyard, Peter became an internationally renowned viticulture scientist, and was widely considered the world's leading authority on grapevine nutrition and fertility management. He received his BS in Viticulture from California State University, Fresno, in 1956, followed by an MS in Viticulture from the University of California, Davis, in 1959. Following his graduation from UC Davis, he joined UC Cooperative Extension as a Farm Advisor in Fresno County, where he spent 23 years working with the local grape industries. In 1984 he advanced to the position of Viticulture Specialist in the Department of Viticulture and Enology, stationed at the UC Kearney Agricultural Center in Parlier, where he retired in 1999.

Working closely with colleagues in academia and industry, he conducted practical research on a broad range of topics. Much of this work had immediate and long-lasting impact.

For example, the mineral nutrition and diagnostic and fertilizer recommendations for California vineyards are largely based on his research and extension activities. He authored or co-authored over 250 technical papers and research articles during his career, including several seminal publications on grapevine nutrition and the statewide UC production manuals on raisin production, wine grape varieties and grape pest and disease management.

He received the Best Research Paper Award from the American Journal of Enology and Viticulture in 1986 and 1990, and also served as the President of the American Society for Enology and Viticulture in 1991-1992. In 1997 he was presented the James H. Meyer Outstanding Career Achievement Award from UC Davis, and in 2004 he was given the Merit Award of the American Society for Enology and Viticulture. The latter is the highest honor given to a grape research scientist in the USA. In recognition of his outstanding contributions to the California raisin industry, the newly developed raisin grape variety "Selma Pete" was named in his honor in 2002.

In addition to his outstanding research contributions, Peter was a gifted, thoughtful and generous extension educator and mentor to young scientists. He presented hundreds of technical talks to Central Valley grape growers, and also trained many UC Farm Advisors during his career. His impact extended far beyond California, and he visited many different countries on sabbatical leaves and technical trips, including Australia, New Zealand, South Africa, Greece, Italy, Chile, Mexico, Japan, Canada, Uzbekistan and 11 States in the USA.

Peter is remembered by his family, friends and colleagues, and by grape growers throughout the Central Valley and beyond, for his unfailing readiness to help and serve, for his humility, and for his good nature and sense of humor. He was a faithful member of the St. Peter the Apostle Serbian Orthodox Church in Fresno, where he was actively involved in the landscaping and maintenance of the church property. For many years he farmed the family vineyards that he inherited along with his sister. His interests included traveling, writing, cooking (including gourmet meals), gardening, boating, fishing and scuba diving. Family closeness was very important to him, and he frequently arranged family get-togethers and vacations in various parts of the state and in countries throughout the world. After a battle with cancer, he ended his earthly life with his characteristic positive attitude, saying that he could not have asked for anything more in life, that he had no complaints, and that he was deeply thankful to God for everything.

Peter is preceded by John L. Christensen and Florence M. (née Andersen) Christensen. He is survived by his wife, Eleanor; his sons, John (Fr. Damascene), Robert and Scott; his daughters-in-law, Bonnie and Lorraine; his grandchildren, Jonathan, Emily and Melina; his sister, Jane Hildebrand; and his godparents, Ron and Radmila Tarailo.

Contributions in Peter's name may be sent to the St. Herman of Alaska Monastery, P.O. Box 70, Platina, Ca, 96076. Condolences may be offered by visiting *www.stephenandbean.com*

Brown Marmorated Stink Bug (BMSB)

Halyomorpha halys Stål, 1855, order Hemiptera, family Pentatomidae

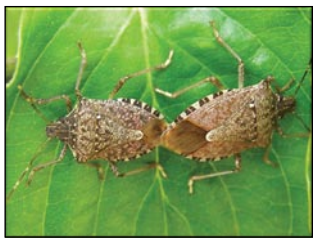
Richard W. Hoenisch, National Plant Diagnostic Network Training and Education Director

The name "marmorated" is from the Latin word for marble, "marmor." The back of the adult has a marble-like pattern, hence the name. The mouthparts, typical of the Hemiptera (true bug) order, are modified for piercing and sucking in order to penetrate and feed on plant tissue. BMSB is native to China, Japan, Korea and Taiwan. It may have been introduced to the US by way of cargo shipments from Asia. It is considered a major economic pest in Asia attacking a variety of high value crops, including tree fruit. This insect has made its presence known by causing losses in eastern stone fruit and apples and by becoming a late season pest in urban areas. The devastating potential of this insect has triggered a flurry of activity by state and federal agricultural researchers. They have initiated standardized sampling studies to determine best traps, lures, their placement and timing.

The first discovery of Brown Marmorated Stink Bug (BMSB) in the US was in Allentown, PA where it quickly spread to other Mid-Atlantic states. It is now found in 29 states across the US. Although there are no confirmed detections in WA, BMSB appears to now be resident in northwest OR (Portland south to Corvallis and east to Hood River). It was intercepted by the California Department of Food and Agriculture (CDFA) in a storage facility in Vallejo, CA in March 2005. A family had just moved to Vallejo from Allentown PA. BMSB was first found established in California in 2006. It is currently only known to be established in Los Angeles County, specifically in the cities of Pasadena (2006), San Marino (2006), Alhambra (2007), Los Angeles (2008), and Temple City (2008). The area in Los Angeles County where it is known to occur is highly urbanized.

Recently, a pest control operator (PCO) turned in a specimen reportedly found outdoors in northern Monterey County, but the PCO could not remember the locality.

BMSB eggs hatching on underside of leaf
Photo by David R. Lance



BMSB mating
Photo by Yurika Alexander

BMSB has been turned in by residents or collected by agricultural inspectors 14 times in nine other counties (Alameda, Contra Costa, Riverside, Sacramento, San Diego, San Francisco, San Joaquin, Santa Clara, and Solano) from 2002 to 2010, associated with articles or vehicles that had recently been in infested areas in the eastern U.S. However, it is unknown whether or not any of these introductions have resulted in new establishments.

The CDFA border stations on major highways into the state have intercepted BMSB 24 times from 2006 to 2010 in vehicles coming from the eastern U.S.

BMSB currently has a pest rating of B, which means that nursery stock found infested must be cleaned before it can be sold, and our border stations can require treatment or reject shipments which are infested. However, CDFA has not enacted any additional quarantine regulations for BMSB.

As for damage, Gevork Arakelian, the Los Angeles County entomologist has reported that in infested areas some discoloration and pitting has been observed on peach, nectarine, fig and apple fruit and also on the leaves of these trees. This damage was noticeable only when large congregations of nymphs were present.

BMSB may affect wine quality. BMSB does feed grapes. In an August 2011 interview by *Wines & Vines* with Dr. Joseph A. Fiola, extension specialist in viticulture and small fruit at Western Maryland Research and Education Center in Keedysville, Md., it reports that he did some testing in the past several weeks to determine how many bugs it takes per lug to affect the aromas and flavors in juice samples. He added controlled numbers of the BMSB to juice from 25-pound lugs of grapes and then evaluated the aroma of the juice. "The smell added by the stink bugs is a crushed cilantro smell," Fiola told *Wines & Vines*. "I could detect it at five bugs per lug; and at 10 bugs per lug, there was no doubt about the off-aroma." Other descriptors used for the stink bug taint are "skunky," "citrusy" and "piney." The odor from the BMSB is due to trans-2-decenal and trans-2-octenal. At low levels, these aromas may not make the resulting wine unusable, but they may reduce a wine's varietal character sufficiently that the wine would have to be used in a blend rather than bottled as a varietal wine [1] .Read more at: *http://www.winesandvines.com/template.cfm?section=news&content=79437&htitle=How%20Many%20Stink%20Bugs%20to%20Ruin%20Wine%3F*

See also Joseph A. Fiola's 2010 articles on BMSB in the vineyard in the University of Maryland Extension newsletter *http://www.grapesandfruit.umd.edu/TimelyVit2/TimelyVitBMSB1.pdf and http://www.grapesandfruit.umd.edu/TimelyVit2/TimelyVitBMSB2.pdf*. A delightful and informative video on BMSB is available on this Rutgers site at *http://ncsmallfruitsipm.blogspot.com/201%2/brown-marmorated-stink-bug.html*

Tracy Leskey's BMSB presentation at Foundation Plant Services can be viewed at: *http://stream.ucanr.org/fps_stinkbug/index.html*

POPULATION BIOLOGY OF THE BMSB

Most members of the Pentatomidae family mate only once a year. The BMSB mates continually throughout the spring, summer, and early fall. Populations build up very quickly.

Elliptical eggs are laid in clusters, often on the underside of leaves. Five instars (nymphal stages) take about a week each; the nymphs typically being brightly colored with red and black. Hemiptera undergoes incomplete metamorphosis.

In PA, the BMSB has only one generation a year, like in the northern part of its native range. However, in southern China up to five generations occur each year, and the same pattern can be expected as the bug spreads south. The adults mate in the spring about two weeks after emerging from diapause or the resting phase. The females soon begin laying egg masses (at weekly intervals); a female lays about 400 eggs in her lifetime. In PA, the egg-laying was observed from June to September, so different instars can be present on the same plant. Eggs hatch after 4-5 days. Nymphs are solitary feeders, but occasionally aggregate between overlapping leaves or leaf folds Adults are sexually mature two weeks after the final molt.

USDA-ARS researchers in WV have observed that there are two full generations of BMSB beginning with the previous year's overwintered adults in the spring. These become active, move into orchards and start to feed and mate. Egg masses are laid with nymphs hatching soon afterwards. The nymphs feed voraciously while undergoing five nymphal stages before developing into adults, ending the first cycle of the year. By September the second generation of adults is present and may begin to leave the orchard to overwinter.

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From the Director's Desk…continued from front page

under a Memorandum of Understanding between USDA's three participating agencies: APHIS, ARS, and NIFA. Now in the third year, this funding was allocated to be spent over 4 years by a competitive grants process overseen by USDA-APHIS. We received $1,141,438 in this year's funding budget from our USDA Governing Board. With all of the other financial bad news of the last few years, the NCPN funding has been essential to FPS.

With support from NCPN, we have modernized our laboratory equipment; refurbished growth chambers and greenhouses; largely expanded our grape importation, quarantine and therapy programs; increased pathogen testing for tree and grape collections; organized and hosted NCPN stakeholder meetings; and initiated work on a new grape Foundation standard. And, perhaps most important, we have made the Grape Foundation Vineyard at Russell Ranch a reality. You can read more about the vineyard and our first planting on the back page.

Varied sources of income support FPS: the list includes sales of plant materials; custom lab services; funds from the Fruit Tree, Nut Tree, and Grapevine Improvement Advisory Board (IAB); grape user fees, gifts, and grants. Research grants support our scientists and staff. It may be a surprise that only a small portion of our funding comes from the University of California; UC supports two faculty positions (Dr. Adib Rowhani and I), but all other positions rely on income from our self-supporting projects.

Research grant funding has taken a big hit.The Viticulture Consortium West (VCW) received no federal funding, and the California state legislature withdrew funding from the California Competitive Grant Program for Research in Viticulture and Enology (CCGPVE). Many research groups on campus scrambled to find alternate funding or new jobs.

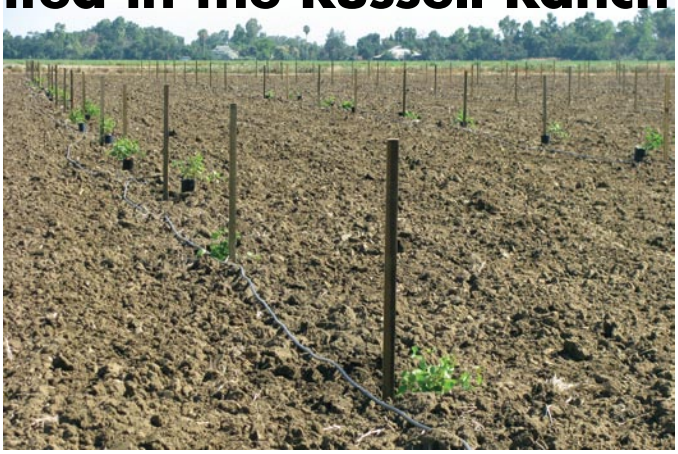
At the same time, income from the IAB and our FPS grape user fees have declined. The IAB is funded by an industry assessment of 1% of gross sales on all deciduous pome and stone fruit trees, nut trees, and grapevines including seeds, seedlings, rootstocks and topstock. This funding is key to the nursery services at CDFA, and FPS, each essential to the Registration and Certification programs for these crops. IAB funding for research projects was likewise reduced due to the economic downturn.

The net result was the loss of some permanent FPS staff positions. It has been hard to say "good-bye" to people who have done excellent work, but we are pleased that there are good jobs for scientific staff at UC Davis and in the private sector, making this transition easier to bear.

Thank you to all who make our grape program possible and work to keep our funding secure. We couldn't do it without you, and look forward to further improvements.

First Vines Have Been Planted in the Russell Ranch Foundation Vineyard

Mike Cunningham, FPS Production Manager



MUCH HAS BEEN ACCOMPLISHED with regard to preparation and planting of the Protocol 2010 qualified vineyard at Russell Ranch in the past year.

Twenty acres of land was plowed, deep chiseled, disked, and prepared for fumigation. In October 2010, 20 acres was fumigated with a 98% methyl bromide, 2% chloropicrin concentrate and covered with a high barrier plastic film tarp, in order to control fungal pathogens, to eliminate nematode populations, and to kill most weed seeds. In order to revitalize the soil after the virtual sterilization with methyl bromide, oat seed was sown onto the fumigated land, and the grain grew through the winter before being chopped and disked into the ground, providing organic matter to enhance the soil fertility.

The new well has been completed and is capped off, ready for use. The bore is approximately 160 feet deep and the water quality is good. The well pump has been installed, electrical hookups have been made, and a cement pad to accommodate the various panels and filters has been poured. A 3,000 gallon steel pressure tank, required to ameliorate the high water pressure coming from the well before it enters the underground irrigation lines, has been delivered. The tank's installation is expected in late October 2011. Meanwhile, irrigation water is provided from an existing domestic well—a temporary solution—but workable.

The 10-acre trellis system, necessary for proper growth, training, and sun exposure of the fruiting grape varieties, is nearly complete. The large lyre-shaped structure is needed at the Russell Ranch site to take advantage of the vigorous growth expected from the vines, and to maximize the quality and quantity of propagation material that will be harvested and distributed.

Underground main lines and tributaries, manifolds, and pressure valves for the drip irrigation system have been purchased and installed.

Roadway improvements to the site from the surrounding county roads have been completed. The dirt entranceway has been laser leveled, creating a slight drop towards a gulley area which will direct rain water off roads and fields alike. The roadway has been compacted and covered with 3 inches of road rock to allow entry to the site regardless of weather conditions.

A contract has been signed and construction started for installation of a 4-foot high wire mesh fence, topped with two strands of barbed wire, to enclose the entire 100 acres of FPS land assignment. The perimeter fence will include three 24-foot gates to allow for entry of large farm equipment, and 4 smaller gates to be used as walk- in entrances, the latter being spaced at various points along the fence line.

FPS staff installed the above ground irrigation lines and drippers in early July, and on Thursday, July 8, 2011, the first vines were planted in the Russell Ranch vineyard site. 260 grape rootstock vines were planted at 24' x 24' spacing. A celebration of this planting and an acknowledgement of the efforts made by literally all FPS staff included coffee, pastries and fruit. Almost a week later, on July 14, approximately 350 scion grapevines were planted in the trellised portion of the vineyard.

Additional grape plants are being produced by FPS laboratory and greenhouse personnel, and by spring 2012 there will be several hundred additional vines ready for planting at the Russell Ranch Foundation Vineyard.