

FPS GRAPE PROGRAM NEWSLETTER

fps.ucdavis.edu

OCTOBER 2012

From the Director: A Fruitful Year of Expansion

by Deborah Golino

On May 4, 2012, Foundation Plant Services supporters celebrated the dedication of the Trinchero Family Estates Building. We greatly enjoyed having so many stakeholders join us for this special event. Dean Neal Van Alfen welcomed our guests; among them were Bob and Roger Trinchero representing the Trinchero family, donor Francis Mahoney, and the family of Pete Christensen, late Viticulture Specialist in the Department of Viticulture and Enology. Having this event timed between the National Clean Plant Network Tier II Grapes annual meeting and Rose Day allowed many distant guests to attend, including State and Federal regulatory officials, scientists from around the country, and many of our client nurseries. Photos of the event are on the back page.

The Trinchero Family Estates Building site is immediately south of the main FPS facility on Straloch Road. Its 7,580 energy-efficient square feet will include a spacious room for FPS industry meetings as well as much needed space for our expanding programs and technology.

In August, the cold shell of the building was completed. In moving forward with the first stage of the building, we were able to take advantage of a very favorable contractor bidding climate and realized significant savings. Our next challenge is to raise \$1.6 million in order to complete the construction, finish the tenant improvements (interior walls, doors, electrical and plumbing), and begin using the new space.

The shell is very impressive with its clean lines and striking profile. I invite all of you to come by to walk through the building with me. Having the building so nearly completed is a little like the anticipation of a present under a Christmas tree!



In Progress: Trinchero Family Estates Building at FPS
Photo by Justin Jacobs

An ongoing major initiative for the FPS grapevine program is the new Foundation Vineyard at Russell Ranch. On page 14, Mike Cunningham details the vineyard preparations, vine training and impressive numbers of qualified grapevines added in 2012. Such progress attests to the close cooperation of each person at FPS across every function. Funding for this

Foundation Vineyard was provided by the National Clean Plant Network, a major new USDA program that benefits clean plant centers for specialty crops at public institutions. This is the final year of NCPN funding from the current farm bill. We hope that this program will continue to back us up as we fulfill our role as the foundation of registered grapevines for growers and nurseries.

It is a busy time for FPS, and a very busy time for our grape nurseries as we move into an upswing in the vineyard planting cycle. As always, we are thankful for the support we have received and anticipate a new year of providing the best possible grapevines to all our growers.



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DORMANT ORDER DEADLINE: November 15

2012-13 Season Orders

FPS is now accepting orders for the 2012-13 season. To request unrooted, ungrafted dormant cuttings for delivery in January-March 2013 or green mist-propagated plants (MPPs) for 2013 delivery, submit your order by November 15, 2012. 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 trpinkerton@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

**Current Issues in Vineyard Health, UC Davis**

Extension class. November 28, 2012, 9:00 am–4:00 pm at the DaVinci building in Davis. Registration and information are at www.extension.ucdavis.edu

2013 Unified Wine and Grape Symposium to be held January 29–31 at the Sacramento Convention Center, 1400 J Street, Sacramento, California. For more information, go to www.unifiedsymposium.org

FPS Annual Meeting: February 20, 2013 at the ARC Ballroom A & B, UC Davis. **Advance registration required;** online form and details posted at ucanr.org/sites/FPSevent or phone Olivia at (530) 754-9104.

Current Wine and Wine Grape Research

February 21, 2013 at Freeborn Hall, UC Davis. Register through www.extension.ucdavis.edu.

National Conference of the American Society for Enology and Viticulture June 24–28, 2013 in Monterey, CA. Details available at www.asev.org



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New FPS Public Grape Varieties and Selections

by Nancy Sweet

MANY NEW WINE GRAPE VARIETIES (domestic and imported) have been released at Foundation Plant Services (FPS) in 2012. These newly-available Provisional selections have been added to 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. The selection names that contain a '.1' suffix are planted in the new Russell Ranch Foundation Vineyard.

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.

Mist propagated plants (MPPs) may be ordered for summer 2013 delivery (actual dates subject to change depending on demand). Dormant cuttings may also be ordered, but normally take 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'.

GERMANY, AUSTRIA AND ITALY

Grüner Veltliner is the most commonly planted variety in Austria. This white wine variety is becoming increasingly popular throughout the world. Grüner Veltliner can produce wines that are dry, full bodied, peppery or spicy. *Robinson, 2006*.

Grüner Veltliner 02 was donated to the FPS public grapevine collection in 2008 as part of a varietal exchange with Riversun Nursery, Ltd., in New Zealand. The original material is vineyard selection GV 4/13, which reportedly originated from the Burgenland Nursery Association in eastern Austria. Grüner Veltliner 02 was released from quarantine to the FPS Classic Foundation Vineyard in 2012.

Grüner Veltliner 03 was imported in 2003 from Höhere Bundeslehranstalt für Wein und Obstbau, Klosterneuberg, Austria, in a varietal exchange for the FPS foundation collection. Documents accompanying the plant material indicate that the selection is clone LA 7-44. The original plant material underwent microshoot tip tissue culture therapy at FPS in 2008. Grüner Velt-

liner 03 successfully completed disease testing in 2012 and was released to the Classic Foundation Vineyard. The selection will be proprietary until 2015, after which it becomes available to the public.

Affenthaler is a black wine grape from Germany. Affenthaler wine, from the village of Affenthal, near Buhl, in Baden, is reportedly a thick, strong, and much-prized red wine.

Affenthaler 01.1 came to FPS in 2007 from the National Clonal Germplasm Repository (NCGR), Davis (DVIT 618). The plant material was donated to the NCGR in 1983 by Dr. Harold Olmo, former Professor in the Department of Viticulture & Enology, UC Davis. Old vineyard maps and planting plans show that an Affenthaler selection was planted in 1910 in the original Department vineyard in Davis. Affenthaler 01.1 underwent microshoot tip tissue culture therapy after it came to FPS in 2007. This selection has qualified for the new Russell Ranch Foundation Vineyard, where it was planted in 2012.

Lagrein, Catarratto and Vermentino are Italian varieties. Lagrein is a black wine grape grown in Alto Adige, Trentino, in Italy. Lagrein is valued for both tannins and color. DNA analysis has revealed that the parents of Lagrein are Schiava Gentile and Teroldego. *Robinson, 2006*.

Lagrein 04 was imported to FPS as part of a varietal exchange from Riversun Nursery, Ltd., New Zealand. The selection did not undergo treatment at FPS and is planted in the Classic Foundation Vineyard.

Catarratto is a Sicilian white grape variety that is the second most widely planted grape variety in Italy. *Robinson, 2006*.

Catarratto 01.1 came to FPS in 2007 from the NCGR-Davis (DVIT 2058). A card in a file maintained by Dr. Harold Olmo while he was a Professor of Viticulture and Enology at UC Davis indicates that the source of this Catarratto selection was 'Lanza.' Horace O. Lanza, California Grape Products, in Delano, California, was the source of several Italian wine grape varieties that were planted in the Department vineyard at UC Davis after Prohibition. Lanza had purchased the large Secundo Guasti grape collection (Italian Vineyard Co.) during World War II. The Guasti/Lanza selections at UCD (including the clone that became DVIT 2058) were donated to the NCGR in 1983. The plant material underwent microshoot tip tissue culture disease elimination therapy at FPS in 2008. Catarratto 01.1 was planted in the Russell Ranch Foundation Vineyard in 2012.

Vermentino is an aromatic white grape variety from Italy and is identical to the Ligurian Pigato and Piedmont variety Favorita. Some believe that Vermentino may be related to the Malvasia family. *Robinson, 2006.*

Vermentino 01.1 and Vermentino 02 came to FPS from the NCGR-Davis, where the variety is known by the synonym name Vermentino Favorita (DVIT 545 and DVIT 1002). The original plant material for these selections was donated to the NCGR in 1983 by Harold Olmo. Both selections can be traced to the same source vine (D7: 19-21) in the old Department vineyard at UC Davis. Vermentino 01.1 and Vermentino 02 underwent microshoot tip tissue culture therapy. Vermentino 01.1 qualified for the Russell Ranch Foundation Vineyard. Vermentino 02 tests positive for Rupestris stem pitting (RSP) virus and is planted in the Classic Foundation Vineyard.

CULTIVARS FROM EASTERN EUROPE

The Hungarian black wine grape variety Cserszegi Fűszeres is a hybrid between Irsai Olivér and Red Traminer. In Hungary, the variety ripens late in September. The small rose berries have acidity and an aromatic flavor. *Bakonyi, 2003.*

Cserszegi Fűszeres 01.1 was imported to FPS in 2004 by Dr. László Kocsis of the University of Veszprem, Hungary. The original plant material underwent microshoot tip tissue culture disease elimination therapy in 2007. The selection has qualified for planting in the Russell Ranch Foundation Vineyard.

Vranac is a black grape variety from Montenegro. Vranac wines are deeply colored and respond well to oak ageing. *Robinson, 2006.* There may be a parent-offspring relationship between Vranac and Zinfandel. *Calò et al., 2008.*

Vranac 01 was imported to Davis from the University of Ljubljana in Montenegro (then Yugoslavia) in 1971. It was maintained in the NCGR vineyard (DVIT 2091) and came to FPS in 2007. The selection underwent microshoot tip tissue culture therapy in 2008 but remains RSP+. Vranac 01 was planted in the Classic Foundation Vineyard in 2012.

In 2002, scientists at UC Davis, in collaboration with scientists at the University of Zagreb in Croatia, were able to confirm that grapevines in Croatia shared a DNA profile with California's Zinfandel. Two varieties in Croatia, Crljenak kaštelski and Pribidrag, matched that Zinfandel profile. Cuttings from the two Croatian varieties were sent to FPS in 2002 (Crljenak) and 2005 (Pribidrag). The Croatian material will be released at FPS under the name Zinfandel, since that is the name by which this variety is known most commonly in the United States.

All of the Croatian material underwent microshoot tip tissue culture therapy at FPS and will be planted in the new Russell Ranch Foundation Vineyard. The Crljenak kaštelski clone was released in 2012 as **Zinfandel 42.1** (proprietary until 2014). The Pribidrag clones were released as **Zinfandel 43.1 and Zinfandel 44.1**. For a complete review of these clones and other Croatian varieties in the pipeline at FPS, please see 'New Croatian Wine-grape Varieties at FPS' on page 8.

Zinfandel 41 is a proprietary selection from Grey Creek Viticultural Services. Many vineyards in the Rockpile Appellation of Sonoma County are planted with this selection; for that reason, Chris Lindelof and Ulises Valdez chose the name 'Rockpile selection' for Zinfandel 41. Lindelof reports that the selection has been distributed throughout California with excellent results. Zinfandel 41 is available via Grey Creek in cooperation with Valdez and Novavine Nursery (Sonoma County).

NEW TABLAS CREEK RHÔNE VARIETIES

A large collection of Rhône wine grape varieties has come to FPS on two occasions through the efforts of Tablas Creek Vineyards in Paso Robles, California.

The first shipment of Tablas Creek varieties in 2004 contained several lesser known Rhône wine grapes used in Châteauneuf-du-Pape wine. Those varieties were imported as the result of a cooperative effort between FPS/UC Davis, the General Partners of Tablas Creek Vineyards, Robert Haas and the Perrin family in France. Cuttings were taken by selection massale from the best performing vines at Château de Beaucastel (the Perrin estate) in Châteauneuf-du-Pape in southern France and were sent directly to FPS.

Clairette blanche, Picardan, Picpoul blanc and Terret noir selections were released in 2009 and 2010 and were described in the 2010 FPS Grape Program Newsletter. Three new varieties from that 2004 importation – Bourboulenc, Cinsaut, and Vaccarèse – were released in 2012.

Bouboulenc is a late budding variety. This Châteauneuf-du-Pape white grape is a possible source for floral character, freshness and acid to blend with wines from white Rhône varieties that tend toward high sugars, such as Viognier, Roussanne, and Grenache blanc. *Haas, 2005.*

Bouboulenc 01.1 underwent microshoot tip tissue culture disease elimination therapy at FPS in 2005, after testing positive for leafroll virus 2. The selection has now qualified by successful completion of 2010 Protocol testing for planting in the new Russell Ranch Foundation Vineyard, where it was planted in 2012.

Cinsaut is a black grape variety from southern France, often used for softness in blends of quality red table wines; Cinsaut was formerly known as Black Malvoisie in California. Cinsaut adapts to warm-to-hot climates, typically with light-colored red wines; cooler climates result in acceptable red wine color. *Bettiga et al., 2003*. **Cinsaut 04** underwent microshoot tip tissue culture therapy in 2007 and is now planted in FPS' Classic Foundation Vineyard.

The black grape Vaccarèse is a possible source for floral character, freshness and acid to blend in red wines that tend toward high alcohol levels, such as Grenache noir, Syrah, and Petite Sirah. *Haas, 2012*. The prime name in France for Vaccarèse is Brun Argenté, which produces a relatively light red wine. The original plant material for **Vaccarèse 01.1** underwent microshoot tip tissue culture therapy at FPS in 2007. The selection has successfully completed all testing to qualify it for the Russell Ranch Foundation Vineyard, where it was planted in 2012.

The second group of Tablas Creek Rhône varieties came to FPS in 2010. The original material for this group of clones was imported from France through the Geneva, New York, quarantine program in the 1980's. Mother plants were later maintained at Novavine Nursery in Santa Rosa, California. In 2010, Robert Haas sent cuttings to FPS from the mother plants of Grenache noir, Gros Manseng, Mourvèdre, Petit Manseng, Picpoul blanc, Roussanne, Syrah, and Tannat. All of these Tablas Creek selections originated from separate and unique vine sources in France.

Syrah, Grenache noir and Mourvèdre have been grown with success in California, and the more common white Rhône varieties such as Roussanne are well known to Rhône enthusiasts. Grenache noir (known in Spain as Garnacha tinta) is widely planted throughout the world. In the southern Rhône Valley, Grenache and Syrah are blended with other varieties to produce common red table wines (Cotes-du-Rhône) and the highly regarded Châteauneuf-du-Pape. Mourvèdre originated in Spain and is used to make fruity rosés and wines with strong tannic structure. *Bettiga et al., 2003, p. 71*.

Three new selections of Grenache noir were released in 2012—**Grenache noir 06, 07 and 08**. Three new selections of Syrah were also released—**Syrah 23, 24, and 25**—along with **Mourvèdre 05 and 06**. None of these selections underwent treatment at FPS, and all are planted in FPS' Classic Foundation Vineyard.

Gros Manseng is a Basque white grape grown in southwest France to produce dry wines. It looks similar to, but is a different variety from, Petit Manseng. Petit Manseng

is also from southwest France but has smaller berries and is more suitable for sweeter wines. *Robinson, 2006*. **Gros Manseng 02** and **Petit Manseng 01** successfully completed testing and were planted in the Classic Foundation Vineyard in 2012. Neither selection underwent treatment.

Picpoul (Piquepoul) blanc is an ancient white wine grape associated with the Languedoc region of France. Piquepoul means 'lip stinger', referring to the high acidity of the must. Picpoul and Clairette are the basis of Picardan wine. *Robinson, 2006*. Picpoul blanc 01 was released in 2010; that selection was from the Perrin vineyard at Château de Beaucastel. **Picpoul blanc 02** is not from that same vineyard but rather from a different unique source in France. Unlike Picpoul blanc 01, Picpoul blanc 02 did not undergo tissue culture therapy treatment. Picpoul blanc 02 successfully completed testing in 2012 and was planted in the Classic Foundation Vineyard.

Roussanne originated in the Rhône Valley of France. This white wine grape variety has a unique floral aroma and an acidity that allows for 'graceful' aging. Roussanne and Marsanne are often blended in France. *Robinson, 2006*; *Bettiga et al., 2003, p. 125*. Two Roussanne selections from the Tablas Creek material were released in 2012.

Roussanne 04 and **Roussanne 05** were from unique source vines and were not required to undergo treatment at FPS. They completed testing and were planted in the Classic Foundation Vineyard.

Tannat is a black wine grape used for quality red table wines, mostly in blends for color, acidity and tannin. It adapts to cool and warm regions. *Bettiga et al., 2003, p. 173*. **Tannat 04** did not undergo treatment at FPS and was released to the foundation vineyard in 2012.

The Tablas Creek selections will remain proprietary to Tablas Creek for three years after successful completion of testing and release, after which the material will become available in the FPS public grapevine collection. The selections released in 2012 will become available to the public in 2015. Until that time, inquiries about plant material should be directed to Novavine Grapevine Nursery in Sonoma County.

OTHER FRENCH CULTIVARS

Four new official French clones from the Institut Français de la Vigne et du Vin (IFV) were released from quarantine at FPS in 2012. IFV (formerly ENTAV) has brought to the United States new Chardonnay, Pinot noir and Syrah clones for distribution by the ENTAV licensees. **Chardonnay**

ENTAV-INRA® 1066 has small clusters that exhibit millenderage (hens and chicks). This is an early clone and produces low yields. The wines made from clone 1066 are aromatic and well-structured. *IFV Catalogue, 2006*.

Manseng noir is a native of vineyards of the western Pyrenees near the Atlantic Ocean. **Manseng ENTAV-INRA® 897** is a black wine grape originally collected in the Jurançon. The wines are very colored, astringent, and acid but fine, with aging qualities. *IFV Catalogue, 2006*.

Pinot noir ENTAV-INRA® 828.1 is French clone 828 from Burgundy. The plant material underwent microshoot tip tissue culture therapy at FPS and qualified for planting in the Russell Ranch Foundation Vineyard.

Syrah ENTAV-INRA® 524.1 is French clone 524 from the Languedoc region of the Rhône Valley. This selection also underwent microshoot tip tissue culture therapy and is planted in the Russell Ranch Vineyard.

Chenin blanc is a versatile white wine grape that originated long ago in France's Loire Valley, where it is made into a fine sweet white wine. In that region, the cultivar is known as Pineau or Pineau de la Loire. Substantial acreage is now also planted in South Africa (Steen) and California. Chenin blanc has a natural high acidity and can be used as a component of dry, sweet, fortified and sparkling wines. *Robinson, 2006*. **Chenin blanc 06** was donated to the FPS public foundation collection in 2010 by Duarte Nursery in Hughson, California. The plant material originated from a California vineyard and was chosen because it seems more resistant to rot than other Chenin blanc clones. *Russell, 2012*. Chenin blanc 06 did not undergo treatment and was released in 2012 to be planted in the Classic Foundation Vineyard.

Négrette is a black wine grape variety from southwest France. Négrette wine is sometimes described as having a 'slightly animal, or violet, flavor'. *Robinson, 2006*. Other sources suggest that Négrette is a direct descendant of the Mavro grape from Cyprus. In California, the variety is known as Pinot St. George and was planted in old Zinfandel blocks to provide color and good yields. *Walker, 2012*.

Négrette 01.1 was initially donated to FPS in 1977 by Paul Truel from Domaine du Chapitre, near Montpellier, France. The selection was planted and maintained in both FPS quarantine vineyard GQ1 and the Department of Viticulture & Enology Tyree Vineyard beginning in 1983. Négrette 01 was never qualified for the FPS foundation vineyard. Négrette 01 had tested positive for Rupestris stem pitting virus and underwent microshoot tip tissue culture therapy in 2010. After successful completion of 2010 Protocol testing, the tissue culture version of this plant material was renamed Négrette 01.1 and was planted in the Russell Ranch Foundation Vineyard in 2012.

Three newly released selections are familiar Bordeaux winegrape varieties. **Cabernet franc 16.1** is #2 in the Vincent series, which is from an anonymous and well re-

spected producer of French wine near Bordeaux, France. FPS has already released Cabernet franc clone #1 from the Vincent series (Cabernet franc 15) and has many Cabernet Sauvignon clones from the Vincent series in the FPS collection. Cabernet franc 16.1 underwent microshoot tip tissue culture therapy in 2008 and was released in 2012. It is planted in the Russell Ranch Foundation Vineyard. The selection is proprietary to the owner until 2014, after which it will become available to the public.

Jorge Boehm, Viveiros Plansel, S.A., Portugal, donated two Bordeaux wine grapes to the FPS public collection.

Cabernet Sauvignon 64 and **Sauvignon blanc 33.1** are clones from the Boehm collection and are now part of the foundation collection at FPS. Both selections underwent microshoot tip tissue culture therapy prior to release.

ADDITIONAL GREEK SELECTIONS

A number of Greek varieties were released to the FPS foundation vineyard in 2011. In 2012, five additional Greek wine grape selections successfully completed testing at FPS: Mavron (2 clones), Roditis, Thiakon, and Xynisteri.

Mavro means 'black' in Greek, and is the common name of the dominant black wine grape on the island of Cyprus. *Robinson, 2006*. FPS received plant material named 'Mavron' from four separate vine sources in Cyprus in 2008.

Mavron 01 and **Mavron 02** are two of the four selections, received from the Department of Agriculture, Viticulture & Oenology Section, Limassol, Cyprus. Mavron 01 and Mavron 02 successfully completed disease testing in 2012 and were released from quarantine at that time; the remaining two Mavron selections (FPS groups 8558 and 8559) are still in the disease testing process. Mavron 01 underwent microshoot tip tissue culture disease elimination therapy. Both Mavron 01 and 02 are RSP+ and are planted in the Classic Foundation Vineyard. They will become available to the public in 2013.

Xynisteri is the most common white grape variety grown on Cyprus. It is used for the island's most distinctive wine, a rich fortified wine called Commandaria. *Robinson, 2006*. This wine grape is also known as Aspro on Cyprus.

Xynisteri 01.1 was imported to FPS in 2008 by Fr. Christopher Flesoras, St. Anna Greek Orthodox Church, Roseville, California, from the Viticulture & Oenology Section of the Cyprus Department of Agriculture. The selection underwent microshoot tip tissue culture therapy at FPS in 2008. Xynisteri has qualified for the Russell Ranch vineyard and was planted there in 2012.

Dr. Harold Olmo collected the Greek varieties Roditis and Thiakon while on a trip to Greece in 1948. He maintained both selections in the Department of Viticulture

and Enology vineyard on the UC Davis campus and eventually donated them to the NCGR-Davis in 1983.

Roditis is one of the oldest and most common white grapes in Greece grown primarily as a wine grape. The Greek word Rodítis ('rose') is a reference to the pink skin of the berries. The cultivar reportedly makes the best wine when the grapes are grown at higher altitudes with a northern exposure. *Robinson, 2006; Boutaris, 2000*. The original plant material for **Roditis 01.1** came to FPS from the NCGR (Rodites - DVIT 609) in 2007. The material underwent microshoot tip tissue culture therapy in 2008. Roditis 01.1 successfully completed disease testing in 2012 and was released to the Russell Ranch Foundation Vineyard under the name 'Roditis', which is the preferred Greek spelling for this variety.

Thiakon is a synonym name for the Greek wine grape with the prime name Thiakò. Thiakò is normally a red wine grape grown on the island of Ithaca and Cephalonia, but a white clone is found on the island of Lefkada. Thiakò is blended for 'robola' wines. *Boutaris, 2000*. The Thiakon clone that Olmo donated to the NCGR in 1983 was the white clone. (DVIT 981; PI 171232).

Thiakon 01.1 came to FPS from the NCGR in 2007, where it underwent microshoot tip tissue culture disease elimination therapy. Thiakon 01.1 qualified for planting in the Russell Ranch Foundation Vineyard in 2012.

SPANISH AND PORTUGUESE CLONES

Malvasia fina (syn. Boal or Boal Cachudo) is an ancient white grape variety that probably originated in Eastern Europe. It is grown primarily in the Dão and Douro regions in Portugal. *Böhm, 2011*. Wine from this variety can add crispness to white port wine. *Robinson, 2006*. Harold Olmo imported **Malvasia fina 02** to FPS in 1981 under the name Tinta Santarém from the Cockburn Co., Tua (Douro) Oporto, Portugal. The selection has undergone heat treatment (1982) and microshoot tip tissue culture therapy (2000). DNA testing in 2009 revealed that the plant material was Malvasia fina, and the name of this selection was changed in 2010. Malvasia fina 02 was released in 2012 and planted in the Classic Foundation Vineyard.

Rufete (syn. Tinta Pinheira) is a red variety that originated on the Iberian Peninsula. Rufete is used for fruity red wines and light port wines and has a bright ruby coloration and floral aroma. *Böhm, 2011; Robinson, 2006*.

Rufete 01.1 was imported to Davis in 1984 by Harold Olmo from the Regua Agricultural Station in the Douro region of Portugal. After undergoing microshoot tip tissue culture disease elimination therapy in 2007, Rufete 01.1 was qualified for planting in the Russell Ranch Foundation Vineyard in 2012.

Alvarinho 03 and **Verdelho 11** are Portuguese white wine varieties that were donated to the FPS public foundation vineyard collection by Jorge Boehm of Viveiros Plansel, S.A., in Portugal. Boehm also donated a Spanish black wine grape, **Garnacha 02** (known in France as Grenache noir), to the public collection. All three selections were planted in the Classic Foundation Vineyard in 2012.

Arinto, Prieto Picudo and Touriga Franca are well known Portuguese wine grape varieties of proven high quality. *Böhm, 2011*. Jorge Boehm imported these three varieties to the United States as proprietary material for Viveiros Plansel, S.A. **Arinto PLANSEL® 635, Prieto Picudo PLANSEL® 584**, and **Touriga Franca PLANSEL® 313** have successfully completed testing and were planted in the FPS foundation vineyard in 2012. The three selections may be purchased from PLANSEL licensees.

Additional Information on these Selections

For more detailed information on these and all the selections ('clones') in the FPS foundation vineyards, see the Variety and Clone pages in the National Grape Registry website, www.ngr.ucdavis.edu.

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New Croatian Winegrape Varieties at FPS

by Goran Zdunić, Institute for Adriatic Crops and Karst Reclamation, Split, Croatia and Josh Chase, Foundation Plant Services, University of California, Davis, CA

VITICULTURE HAS A LONG HISTORY IN CROATIA dating back to the civilizations of the Phoenicians, Greeks, and Romans. Grape and wine production still plays an important role in the economy of Croatia; the industry is based on fewer than 15 native varieties. Several significant native Croatian varieties have been imported to California for the public foundation collection at Foundation Plant Services.

Wine made in the region now known as Croatia was recognized for its quality before the Christian Era. Many Croatian place names are derived from Greek and Latin; Greeks established the first colonies on the Adriatic coast. The Croatian town of Trogir and the islands of Korčula, Hvar, and Vis are from the Greek words Tragurioum, Korkyra, Pharos, and Issa. These Dalmatian locations had prominent, well-developed viticulture and winemaking industries in ancient times. In a document from the second century B.C., the Greek writer Agatarchida praises wine made on the island of Issa (now Vis) in the Adriatic Sea as being superior to all other wines.

Recent genetic analysis using DNA markers has revealed the identity of many of the ancient Croatian varieties that are present today in commercial vineyards. A good example demonstrating the high quality of Croatian grape germplasm was the discovery of Zinfandel's possible origin. Crljenak kaštelski, also known in Croatia by the synonym Pribidrag, has a long history in the Croatian grape gene pool in the Dalmatia region. Scientists from Zagreb University (Croatia) and UC Davis collaborated to solve the mystery of the identity of this ancient variety. DNA analysis eventually revealed that Crljenak kaštelski shares a DNA profile with California's Zinfandel and Italy's Primitivo (Maletić *et al.*, 2004).

Another important genetic discovery relates to the most important red wine grape on the Dalmatian coast, Plavac mali. Genetic analysis indicates that the parents of Plavac mali are Crljenak kaštelski and Dobričić.

It is believed that Croatian varieties growing in various California microclimates may produce qualities that will enrich California wines. The challenge for California winemakers and viticulturists will be to identify suitable microclimates within which to grow the Croatian varieties in order to develop any unique new qualities.

From 2002 to 2010, twenty Croatian grape varieties were imported to Foundation Plant Services (FPS) at the University of California, Davis. These varieties will eventually become a part of the public foundation collection. All twenty selections tested positive

for virus, which initially prevented release from federal quarantine. Almost all of the selections have undergone microshoot tip culture therapy to propagate them without the viruses.



CROATIAN 'ZINFANDEL' CLONES

The first two Croatian selections to come to FPS were **Crljenak kaštelski** and **Pribidrag**, two sub-varieties (clones) of the grape known in the United States as Zinfandel. The genetic value of the Croatian vines for this ancient variety could prove to be highly significant. The Croatian plant material represents an old genetic source of the variety that has developed over time apart from the California Zinfandel clones. This Croatian plant material has been exposed to particular selection pressures different from the California Zinfandels.

The Crljenak grapevines in Croatia exhibit common varietal characteristics with some California Zinfandel clones that FPS sent to Croatia for comparison. At the same time, some of the Crljenak and Pribidrag selections display slightly distinct traits that are noted below.

Crljenak kaštelski was imported to Davis and arrived at FPS in 2002. Upon arrival at FPS, the Crljenak kaštelski material tested positive for virus and underwent microshoot tip tissue culture therapy. After successful completion of testing, the selection was released from quarantine in 2012.

This Crljenak selection also qualified for planting at the new Russell Ranch Foundation Vineyard, where it was planted under the name Zinfandel. The Croatian clonal material will be included in the FPS foundation collection under the name Zinfandel, as that is the popular name for the cultivar in the United States. This selection will be available to the public in 2014.

Preliminary field trials of Crljenak kaštelski, Zinfandel and Primitivo selections in Croatia suggest that the Crljenak selections have earlier fruit maturity than Zinfandel and are similar to Primitivo based on fruit composition. The first mono-varietal wine of Crljenak kaštelski showed that the wines mature quickly, with soft tannins and fruity aromas, and are ready for bottling and drinking in the year of vintage.



Babić vines growing in a Croatian vineyard.

Three **Pribidrag** clones were imported to Davis in 2005. Pribidrag is the synonym name by which the Crjenak kaštelanski/Zinfandel cultivar is known in the Dalmatian region of Croatia. Two of the Pribidrag clones have been released from quarantine and one remains in the testing process at FPS.

Pribidrag clone VV-079 is described as having loose, cylindrical clusters and a crisp aromatic flavor. After undergoing microshoot tip tissue culture therapy and successfully completing testing, this Pribidrag clone was released from quarantine and planted in the FPS Foundation Vineyard in 2011.

In 2012, Pribidrag clone VV-079 qualified for planting in the new foundation vineyard at Russell Ranch after it successfully completed testing under the '2010 Protocol'. Vines were planted in that vineyard in 2012 under the name Zinfandel. This selection will be released to the public in the summer of 2013.

A second Pribidrag clone (clone VV-101) has qualified for and been planted in the Russell Ranch Foundation Vineyard. This Pribidrag clone has small, short clusters with larger berries. It will become available to the public in 2014.

A third Pribidrag clone is currently in the pipeline (testing and treatment) at FPS. Clone VV-134 has loose clusters and intense fruity aromatics. It is estimated that this Pribidrag selection will be released from quarantine in 2015.

On previous page: The Plavac mali "Gray" or "gris" clone, believed to be a mutation similar to that of the Pinot gris clones. Estimated release is 2016.

OTHER CROATIAN VARIETIES IN THE FPS PIPELINE

The remaining Croatian varieties are undergoing the testing and treatment processes at FPS. Their profiles and estimated release dates are described below.

Babić is a black Croatian variety which can be found in most areas of northern Dalmatia, with the most substantial plantings being in the Primošten region. This variety shares part of its genome with the grape variety Dobričić suggesting a possible parent-offspring relationship. In North Dalmatia, the clusters are large, conical and loose with medium round, very juicy berries. Fruit ripening is middle late (late September in the Primošten region). The fruit exhibits superior compositional balance—high °Brix, high to medium TA and low to medium pH. Babić gives wines of a good bright color, balanced body with soft tannins, good acidity, and distinctive varietal character. Lack of intensity results if the vines are heavily cropped or grown in unsuitable conditions. It is estimated that this selection will be released in 2015.

Babica is a minor variety in the areas of Split and Kaštela. This black variety shares part of its genome with Plavac mali. Clusters are medium in size, conical in shape, and medium compact. Berries are medium, round and have blue-black skin. Maturity is medium late, often being harvested in late September or early October in the Kaštela region. Wines made from Babica are medium in alcohol, acid and tannin, and are traditionally blended with other native Dalmatian cultivars grown in the Kaštela region. Less favorable sites can produce softer wines with lower tannin levels. It is not known when this selection will be eligible for release from quarantine.



Babica vines growing in a Croatian vineyard.

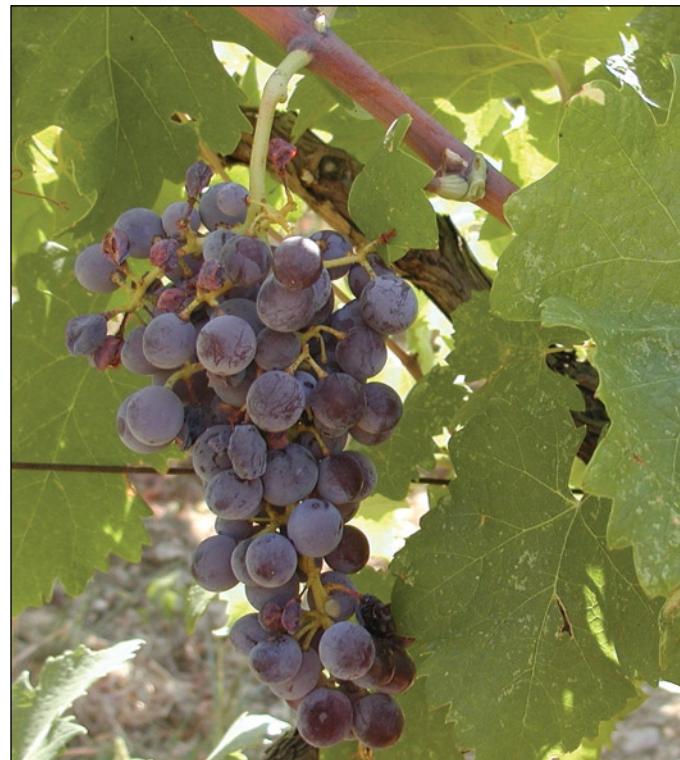
Debit is a medium late ripening white wine grape variety from the hinterland of northern Dalmatia. The most substantial plantings are in Šibenik and Drniš region. Debit is a productive and fairly vigorous variety. Clusters are medium large, conical and have medium density. Berries are medium sized and round, have juicy flesh, and are golden in color and neutral in flavor. By itself, Debit makes wines which have light body, good balance, and low to medium alcohol concentrations. The estimated quarantine release date is 2016.



Debit cluster in Croatia.

Dobričić is an old native Croatian grapevine variety. DNA testing has revealed that Croatia's most widely grown red wine grape, Plavac mali, resulted from a cross between Zinfandel/Crljenak and Dobričić. Dobričić is grown in the Dalmatian coastal region and islands in southern Croatia. Currently the variety is not widely grown, but the greatest number of Dobričić old vine representatives are found on the island of Šolta. Clusters are small to medium, conical, sometimes loose and may have one wing. The berries are small and round. Fruit ripening is medium (mid September in island of Šolta). Dobričić produces table wines with intense color and high tannins requiring long ageing. The dominating sensory attributes are berry fruits (blackberry, black currant, and cherry). Vegetative aromas (stemmy and bell pepper) may also be present. The quarantine release date for this cultivar is 2015.

Glavinuša, also called Okatac in the Omiš region, is considered one of the better varieties in Croatia, especially for dessert-type wines. This red variety is not as widely grown as Plavac mali or Babić. Sequencing shows that it shares part of its genome with Plavac mali. Clusters are rather small, generally conical, and loose with small, oval red berries. The fruit ripens early there (the beginning of September in Kaštela region), where it attains a high sugar concentration with low acidity. Glavinuša does not provide much color in the wine but gives excellent fruity aromas under most Dalmatian conditions (Kaštela and Omiš regions). The variety is best suited for blending to increase fruity aromas. The projected release date is uncertain.



A loose Glavinuša cluster starting to raisin in Croatia.



Dobričić vines growing in Croatia.

Kamenina is minor Croatian variety, mostly grown on the island of Krk and neighboring islands. This black grape variety has slightly loose clusters with healthy grapes and modest yields in Croatia. Medium late ripening, small to medium, loose clusters, medium to big, round berries. The estimated release date for this cultivar is 2016.

Malvasia dubrovačka is likely a native of Greece. Malvasia dubrovačka has been cultivated since ancient times on the south Dalmatian coast (Dubrovnik area), as well as in a few limited locations of the Mediterranean Sea. In Spain, this white variety is known as Malvasia de Sitges. In Italy, the cultivar is called Malvasia delle Lipari (Crespan *et al.*, 2006). Interest in this variety has recently increased in Croatia. Clusters are medium sized, long, cylindrical, and loose. The berries are small, round, and yellow when ripe. Malvasia dubrovačka produces highly flavored wines of excellent quality and is also used for premium Croatian dessert wines called Prošek. The estimated release date of this selection is not known.

The highly regarded **Plavac mali** is the leading red wine grape of Croatia, grown mainly in Dalmatia. DNA analysis revealed that it is a cross between Prividrag and Dobričić. In general, Plavac mali is a fairly vigorous variety. Clusters are medium size, broad shouldered, well filled to compact, with berries quite variable in size and color at the time of full maturity. The berries have a firm texture and are not easily split by rain when ripe. Recently, a clonal selection program for Plavac mali was begun in Croatia using clones from the grape collection at the Institute for Adriatic Crops and Karst Reclamation in Split. Five of those selections (taken from five separate vines in that vineyard) were donated to FPS. Unique clones were selected which possess slightly different characteristics compared to the majority of individuals in the Croatian population. Some of the clones have small berries, loose clusters, and (in one instance) pink or grey skin color.



Plavac mali clusters near harvest time in Croatia.

The five clones donated to FPS have performed as follows in Croatia:

Plavac mali clone OB100 exhibits average cluster characteristics and yields compared to the general population of vines growing in Croatia. The estimated release date is 2016.

Plavac mali clone OB219 reportedly has small clusters and berries, low yields and early ripening compared to the general population. The estimated release date is 2016.

Plavac mali clone OB073 is described as having small clusters, medium size berries and early ripening. The estimated release date is 2016.

Plavac mali clone OB095 has large clusters and berries, ripens late, has high yields and pronounced acids and pH values. The estimated release date is 2016.

Plavac mali clone Gray/Gris has a mutation making the berry skin pink instead of dark blue. In Croatia, Plavac mali gris is used to make white wines. The estimated release date is 2016.

Sansigot is minor Croatian black variety, exclusively grown on the island of Susak. This high-yielding cultivar has big dense clusters that ripen late. Despite the cluster density, there is a high tolerance to Botrytis. The berries produce high intensity color for the wines and moderate Brix levels. The estimated release date is 2015.

Škrlet is mostly grown in the Moslavina region (near Zagreb). This medium-late ripening white cultivar has medium, conical clusters. The yields are usually moderate, and Škrlet is tolerant of biotic and abiotic stresses. The berries usually have high quality potential, moderate sugar, high acids level. There it gives fresh and elegant wines with a distinct aroma. The yields are moderate to high. In comparison with all other cultivars introduced to FPS, Škrlet is the only one grown in cool climates. Estimated release date is 2015.

Vugava is an old white grape cultivar restricted to central Dalmatia. In the appellation of the island of Vis, Vugava is made into a dry white wine with fruity floral flavors. There the vines express medium vigor. Clusters are medium in size, very dense, conical, sometimes winged and sensitive to bunch rot. The medium size berries are oval and become gold when ripe; at that time, they produce a distinctive varietal aroma. Vugava ripens early which is late August on the island of Vis. The estimated release date is 2015.

The white cultivar **Žlahtina** is found mainly in the island of Krk. There the variety is fairly vigorous. The clusters are medium to large in size, well filled, with medium, round, green berries. Varietal wine made from only Žlahtina grapes is likely to be light in body, with a pleasant varietal character. The estimated release date is unknown at this time.



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Notice of Release of Table Grape C51-63

Excerpted from the signed notice by the United States Department of Agriculture, Agricultural Research Service, issued July 5, 2012

The United States Department of Agriculture, Agricultural Research Service, announces the release for propagation of the new red seedless *Vitis vinifera* L. table grape cultivar C51-63. This red seedless grape ripens in the late season and has medium-large, sweet, firm berries with a neutral flavor. C51-63 resulted from the cross C66-144 X Crimson Seedless made in 1988. C66-144 and Crimson Seedless are complex hybrids whose parents include Blackrose, Cardinal, Divizich Early, Maraville, Muscat of Alexandria, Sultanina, and Tafafih Ahmur. The original vine was planted in 1989 in cooperation with California State University, Fresno, and selected in 1991 by David W. Ramming and Ronald Tarailo. C51-63 has been tested in the San Joaquin Valley of California.

C51-63 ripens with Crimson Seedless and is harvested the last week of October to the first week of November. The fruit averages 20 to 21 percent soluble solids and 5.9 to 7.7 g acid per liter juice at maturity. Red skin color development is enhanced by pulling leaves and the application of Ethrel. The clusters are large in size (1.5 to 2.0 pounds) and length. They are conical and uniform in shape with average berry set.

The natural berry is oval to elliptical in shape and averages 1.8 cm diameter, 2.5 cm long and weighs 4.7 to 5.3 grams. Berries from girdled vines averaged 1.95 cm diameter, 2.6 to 2.8 cm long, and weigh 5.7 to 6.6 grams. The flavor is sweet and neutral but becomes astringent when fully ripe. Girdling appears to increase astringency and heat damage. The skin of C51-63 is thick and adheres to the flesh. Flesh texture is firm and meaty. Berries contain very small aborted seeds which are not noticeable when eaten. Fruit retains its firmness during cold storage. Berry attachment to the pedicel is very good and very little postharvest shatter occurs. The rachis has average thickness.

C51-63 is medium to high vigor. Production is very good and averaged over 60 pounds per vine on fourth leaf vines. C51-63 was indexed by Foundation Plant Services, University of California, Davis, CA 95616 and found to qualify for the California Registration and Certification Program for grapevines.

Genetic material of this release will be deposited in the National Plant Germplasm System, where it will be available for research purposes including development and commercialization of new cultivars. It is requested that appropriate recognition be made if this germplasm contributes to the development of a new breeding line or cultivar. The Agricultural Research Service has no plants of C51-63 available for distribution.

Inquiries regarding availability of C51-63 should be addressed to David W. Ramming, USDA Agricultural Research Service, 9611 South Riverbend Avenue, Parlier, CA 93648, or email david.ramming@ars.usda.gov. 

Detection of a Novel Grapevine Vitivirus in California

by Maher Al Rwahnih and Adib Rowhani

GRAPEVINE VIRUSES ARE KNOWN to affect plant performance and cause considerable losses in crop yield and product quality. Grapevine hosts at least 63 different virus species, many of which could spread in the field either by propagation from virus-infected vines or by different biological vectors. Advancement of new technologies helps scientists to discover new viruses which may or may not have pathogenic character. Development of sensitive detection methods enables us to better understand vineyard disease problems and help in vineyard management.

Groups of viruses belong to different virus families, and some genera have been reported to be associated with different diseases in grapevines. One of these genera is the genus *Vitivirus*, which includes *Grapevine virus A* (GVA), *Grapevine virus B* (GVB), *Grapevine virus D* (GVD) and *Grapevine virus E* (GVE).

The *Vitivirus* group of viruses is easily transmitted by vegetative propagation in nurseries and in the field. These viruses are also reported to be transmitted in the field by several species of mealybug and scale insect e.g., *Pseudococcus*, *Planococcus*, *Heliothrips*, *Neopulvinaria*, *Parthenolecanium*, *Cavariella* and *Ovatus*. Experimental evidence showed that GVA was transmitted by the scale insect *Parthenolecanium corni* in association with *Grapevine leafroll associated virus 1* (GLRaV-1). The co-transmission indicated a possible interaction of these viruses during transmission (Preez *et al.*, 2011).

The presence of grapevine vitiviruses has been reported in all major grapevine-producing regions of the world. These viruses are associated with the diseases in the rugose wood (RW) complex. RW includes several important woody cylinder disease complexes, including Kober stem grooving, corky bark, stem pitting and LN33 stem grooving caused by GVA, GVB, GRSPaV and an unknown cause, respectively (Fig.1). In general, these viruses produce pits and grooves on the woody cylinder of the susceptible grape cultivars and hybrid rootstocks and, in severe cases, may kill the plant. However, not much information is available on the synergistic effects of these viruses on grapevines.

The impact of GVA infection on some grapevine cultivars has been evaluated in many different countries. In Germany, a study indicated that GVA infection had a very low impact on the growth of vines despite a high incidence (46.9%) of infection (Preez *et al.*, 2011).

Another report from Australia indicates that GVA remains asymptomatic in a number of grapevine varieties, although it is destructive on own-rooted Shiraz, Merlot, Malbec, Ruby Cabernet and possibly Chardonnay. The symptoms observed there included delayed budburst, stunted zig-zag growth, reddened leaves curling downward (in red berry varieties), unlignified canes late in the season and die-back or decline. In Italy, GVA caused harvest losses of up to 22% in wine grape varieties. Reports from South Africa suggested that Shiraz disease is caused by a co-infection of GVA and GLRaV-3.

Additional research shows damage or potential damage from vitiviruses other than GVA. GVB is usually symptomless when Kober 5BB and St. George are used as virus-disease indicators. However, research data indicates that in some grapevine cultivars it causes growth retardation at leaf burst, die back, the same cane and leaf symptoms as described for GVA, and delay in leaf abscission. GVD was also detected in a grapevine that exhibited corky rugose wood symptoms. There has to date been no report of the association of GVE with any disease symptoms; however, its structure and genetic profile are closely related to other members of *Vitivirus* genus.

Grapevine viruses in the genus *Vitivirus* may also be associated with graft incompatibility in plants grafted on certain rootstocks. Our observations in California have shown that Cabernet franc plants propagated on Freedom, 420A, 3309C or 101-14 rootstocks died within 1-2 years when inoculated with virus source LR1-V19-20 infected with GLRaV-1 and GVA. This is the first time that we have observed 4 different rootstocks react similarly to a mixed infection made of viruses from different families (GLRaV-1 and GVA).

Figure 1

A: Corky bark symptoms on LN33 indicator



B: Kober stem grooving symptoms on Kober 5BB.



In an attempt to characterize the viruses responsible for the graft incompatibility in these Cabernet franc plants, we subjected the LR1-V19-20 virus source to high throughput sequencing. The sequencing data confirmed the presence of multiple strains of GLRaV-1 and GVA. But it also revealed the presence of an entirely novel vitivirus which was tentatively named **Grapevine virus F (GVF)**. The genome of this novel virus was 7,539 nucleotides long and was polyadenylated at its 3' end. The genomic organization of the virus was similar to that of GVA. The two more conserved genes of the virus, polymerase and coat protein genes, shared 31 to 49% nucleotide and 40 to 70% amino acid sequence identities, respectively, with other grapevine vitiviruses.

We have developed molecular techniques for the specific detection of GVF. We are performing a limited survey of different commercial vineyards using these molecular techniques to evaluate the extent of the spread of GVF in a real-world environment. A new grant from the Fruit Tree, Nut Tree, and Grapevine Improvement Advisory Board has made it possible for us to investigate the extent to which the combination of viruses and virus strains, such as those present in the LR1-V19-20, can lead to incompatibilities and/or vine death. 

Literature Cited:

Preez, J.D., Stephan, D., Mawassi, M., Burger, J.T. (2011). The grapevine-infecting vitiviruses, with particular reference to grapevine virus A. *Archives of Virology*, 156:1495–1503.

Russell Ranch Vineyard: 2012 Update

During the fall of 2011 and the spring and summer of 2012, several improvements were made to the Foundation Plant Services farm at Russell Ranch, increasing the size and scope of the grapevine collection being established at that location.

Previous National Clean Plant Network funds, allocated in the years 2009-2011, have been used to create the infrastructure for the Russell Ranch Vineyard including land preparation, soil fumigation, installation of a well and water pump, underground irrigation lines, security fencing, and a trellis system. Twenty-five of the 100 total acres that have been assigned to FPS by University officials was prepared for planting. The initial planting, consisting of approximately 400 scion and 160 rootstock grapevines, was completed in June of 2011. These vines qualified for planting at the Russell Ranch site in that they were created using micro shoot-tip tissue culture procedures for disease elimination and they met the stringent testing standards established by the NCPN participating nurseries, qualifications now referred to as “Protocol 2010.”

In the spring of 2012, suckering and training by the FPS field crew has been accomplished for the majority of the 2011 vines being established on the trellis system, with two cordon arms as the basis for the growth of saleable budwood as early as the dormant season of 2013-14.

In the most recent cycle of NCPN-funded work at Russell Ranch, 540 scion vines—representing 211 selections—and 50 vines of rootstock—representing 15 new selections—were added to the collection.

Also this summer, an additional 10 acres of land was prepared for planting and fumigated with methyl bromide/chloropicrin. The existing lyre-style trellis system was extended to the new 10 acres of prepared ground, so that the Russell Ranch vineyard now contains 20 trellised acres for scion varieties and 10 acres of land set aside for rootstock varieties. FPS staff determines the number of vines of each grapevine selection in the vineyard based upon historical sales figures and perceived interest in the variety.

Concurrent with the improvements to the Russell Ranch Vineyard itself, many hundreds of new releases from the FPS importation and quarantine program have been processed through the department greenhouse and screenhouse facilities, and have reached the size and maturity needed for successful planting in the spring of 2013. A list of selections that are in the FPS “pipeline,” on their way to the Russell Ranch Vineyard, can be found at: <http://ngr.ucdavis.edu/inprogresslist.cfm>. 

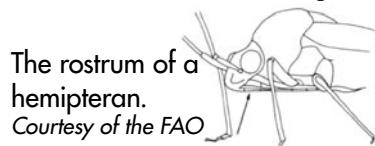
The Bagrada Bug, *Bagrada hilaris* Burmester 1835

Order Hemiptera; family Pentatomidae

By Richard Hoenisch, National Plant Diagnostic Network Training and Education Director

Bagrada hilaris is a species of shield bug known by the common names Bagrada bug, painted bug, and harlequin bug. It is native to much of eastern and southern Africa and parts of southern Europe and Asia. It is now known in California and Arizona, where it was first reported in 2008.

The Bagrada bug is a very dangerous insect pest. The adult and nymph of the species suck sap from the leaves of the plants, causing wilting, yellowing, and stunting of growth. Damage is inflicted on host plants when adults and nymphs insert their needle-like mouth parts, called the rostrum, and suck juices from the plant. Feeding results in large stippled or wilted areas on leaves and damaged meristems. Often the growth of newly formed central shoots or heads of plants become stunted.



The rostrum of a hemipteran.
Courtesy of the FAO



Right: Bagrada bug feeding
Photo by Delbert Crawford

A Bagrada bug is only $\frac{1}{4}$ " (5-7 mm) in length. This photo shows adult Bagrada bugs and Convergent lady beetles,



Hippodamia convergens, the most common lady beetle in the US. When the bugs were first noticed in Los Angeles County in 2008, the owner of the property thought that he had discovered a new, exotic species of lady beetle.

The Bagrada bug is primarily associated with *Brassica oleracea* crops, including cabbage, kale, cauliflower, Brussels sprouts, and broccoli, and related crucifers such as turnips, rape, and mustard. In addition, the bugs have been found on papaya, sorghum, maize, potato, cotton, caper, pearl millet, and some legumes.

The host range in the United States is being monitored to see what other crops and plants may be affected by the Bagrada bug. Observers in Orange County, California, note that the pest moves to non-Brassicaceae plants when there are no longer any Brassicaceae hosts available.

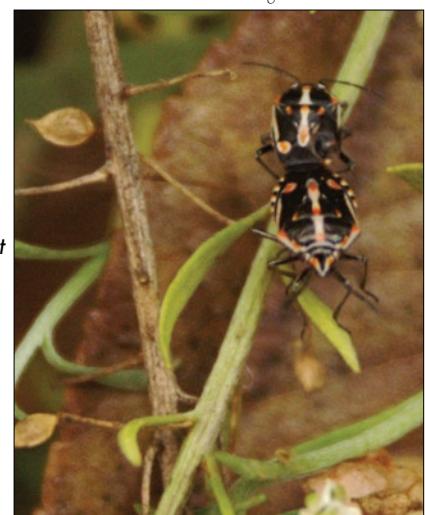


Bagrada bug on finger.
Used with permission by Joyce Thompson, bugyou.blogspot.com

Populations of this pest can build up quickly, reaching damaging densities that require control. Heaviest infestations are typically observed in organic farms, community gardens, and residential vegetable gardens where little or no pesticides are used. The bug lives and breeds in the cracks and crevices of the soil and can be very difficult to control.

The Bagrada bug has begun to spread geographically within the United States. Initially, the pest was present in all of the southern California counties south of the Tehachapi Mountains, as well as in the Yuma area of Arizona. In 2010, a report of a Bagrada sighting came from Amargosa Valley in Nye County, Nevada, and shortly after that more samples were submitted from Las Vegas and Overton in Clark County. New Mexico reported the Bagrada bug in the southern part of the state in 2010, and then in the Albuquerque area in 2011.

For more information, there is a Bagrada Bug presentation (www.wpdn.org/webfm_send/236) on the WPDN First Detector webpage. This presentation was composed with the help of Dr. Gevork Arakelian, an entomologist for the Los Angeles County Ag Commissioner's office, and Dr. John Palumbo, an entomologist with the University of Arizona at the Yuma Agricultural Center. (See *The Bagrada Bug in Arizona*, cals.arizona.edu/crops/vegetables/advisories/docs/SWAS_BagradaBug2010VEGIPM15.pdf). The Spanish-language version *La Chinche Bagrada* (www.wpdn.org/webfm_send/240) is also on the WPDN training site.



Bagrada bugs mating on sweet allysum.
Photo used with permission by Joyce Thompson.
The Bagrada Bug blog post can be viewed at bugyou.blogspot.com/2008/11/new-bagrada.html

Hosting the 17th Meeting of the ICVG

From October 7 to 11, 2012 FPS had the great pleasure and honor to host over 130 colleagues and friends from around the world to the University of California, Davis for the 17th Congress of the International Council for the Study of Virus and Virus-like Diseases of the Grapevine (ICVG). ICVG had not met in Davis since 1965, during the early years of the organization. This meeting celebrated 50 years of progress for ICVG. There were nine scientific sessions focused on different topics in grapevine virology including: Diagnostics; Leafroll and related viruses; New Viruses, Diseases of Unknown Etiology and Viroids, Virus Effects; and Grapevine Certification and Clean Stock. More information and extended abstracts are available at www.icvg.ch and ucanr.org/sites/ICVG.

Attendees toured FPS, Adib Rowhani's leafroll vineyard, Russell Ranch, the Wolfskill USDA Clonal Germplasm Repository, and Martinez Orchards in Winters. Keeping with the theme of 50 years of Progress, there was a banquet and dancing featuring hits from the 1950s to today.



After the conference there was a 3-day tour of the Central Valley, Sonoma and Napa Counties, visiting Duarte Nursery, vineyards in the Lodi area, the Lodi Wine Grower's Visitor Center, Kundee Estates Winery, Ridge Winery in Healdsburg, the Oakville Experiment Station, the Mondavi research block including Kai Blaisdell and Kent Daane's mealybug trials, and Opus One Winery.

We are very grateful for the support of all our sponsors; this was one of the most memorable ICVG meetings due in great part to their help. Our sponsors were: Agri-Analysis, Agritest, AL&L Crop Solutions, American Vineyard Foundation, Bioreba, California Seed and Plant Labs, Concannon, Duarte Nursery, E&J Gallo Winery, Eurofins STA Laboratories, and the UC Davis College of Agricultural and Environmental Sciences. Thank you for helping us show the beauty and bounty of our wonderful wine industry in our great State of California! 

UC scientists presented 15 papers, posters or lectures at the ICVG XVII conference:

Almeida, Rodrigo. *Transmission biology of the leafroll viruses.* (Invited Lecture).

Al Rwahnih, Maher, Dave M. Anderson, J.K. Uyemoto, and M.R. Sudarshana. *Association of a circular DNA virus in grapevines affected by Red Blotch Disease in California.*

Al Rwahnih, Maher. *Grapevine virus analysis and what's next with Next Generation Sequencing* (Invited lecture).

Al Rwahnih, Maher, M.R. Sudarshana, J.K. Uyemoto, and Adib Rowhani. *Complete genome sequence of a novel vitivirus isolated from grapevine.*

Arnold, Kari, D.A. Golino, and N. McRoberts. *Analysis of subjectivities about leafroll disease management among Napa grape growers and winemakers.*

Arnold, K., D.A. Golino, and N. McRoberts. *Statistical parameters of spatial patterns of spread for leafroll disease.*

Blaisdell, G. Kai, Siming Zhang, Kent Daane, and Rodrigo Almeida. *Patterns of virus transmission from hosts with mixed infections.*

Gergerich, Rose C., Ken C. Eastwell, Deborah A. Golino, Robert R. Martin, Gary McAninch, Georgios Vidalakis, Ruth A. Welliver, and Ioannis E. *Harmonization of certification standards for National Clean Plant Network commodities.*

Klaassen, Vicki, Deborah Golino and Adib Rowhani. *Diagnostic performance of Foundation Plant Service assays.*

McRoberts, N. *Spatial patterns and temporal dynamics in the spread of visual leafroll symptoms through vine blocks.* (Invited lecture).

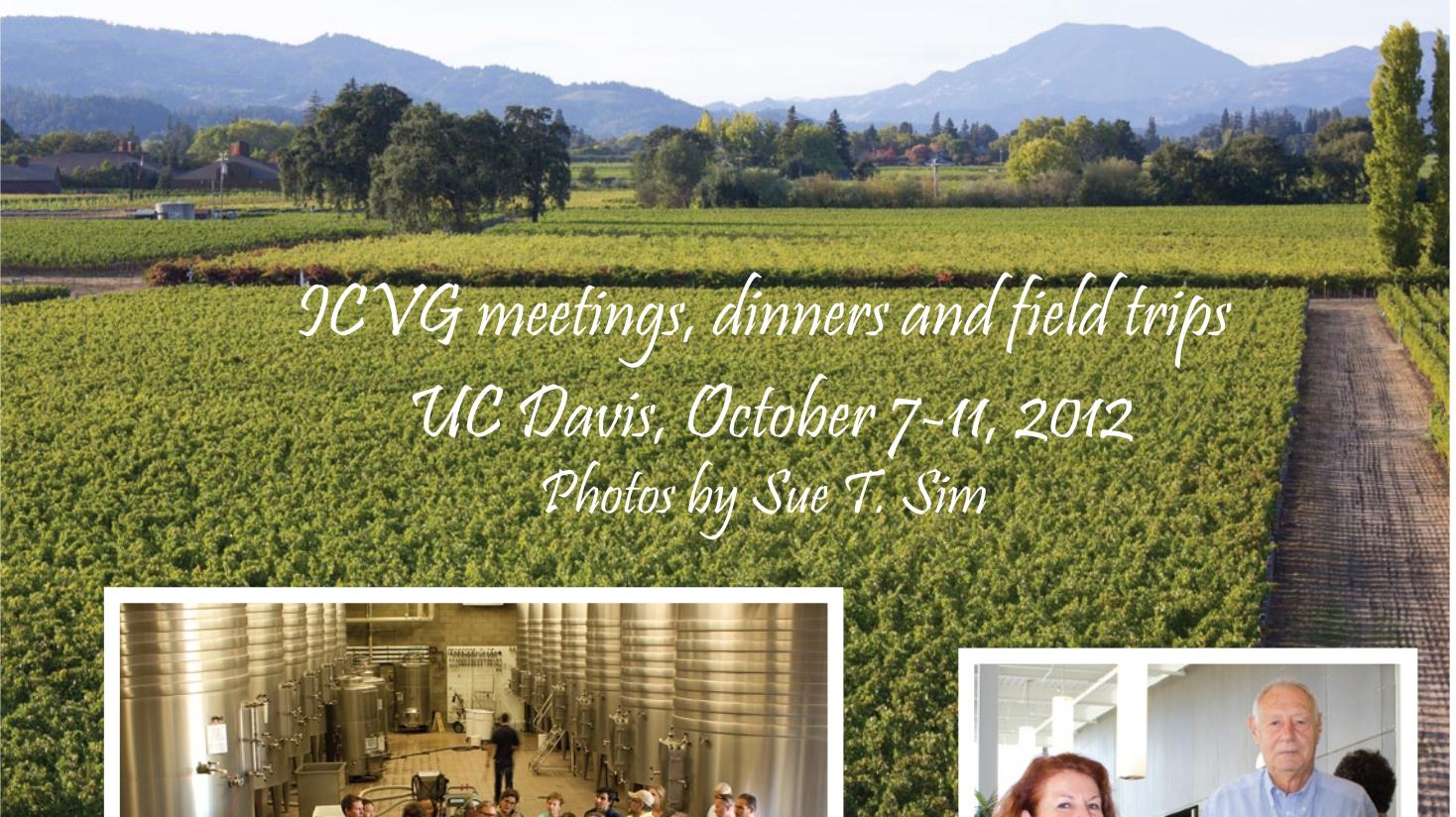
Osman, Fatima, Alicja Omanska-Klusek, Tammi Olineka, Emir Hodzic and Adib Rowhani. *Development and validation of a multiplex quantitative PCR assay for the rapid detection of Grapevine Vitivirus A, B and D.*

Osman, Fatima, Tammi Olineka, Emir Hodzic, Deborah Golino, and Adib Rowhani. *Comparative procedures for sample processing and quantitative PCR detection of grapevine viruses.*

Sim, Susan T., Maher Al Rwahnih, Adib Rowhani, and Deborah Golino. *Virus elimination from grape selections using tissue culture at Foundation Plant Services, University of California, Davis*

Smith, Rhonda J. and John R. Yeo. *Virus effects on vine growth and fruit composition of selected Zinfandel field selections.*

Rowhani, Adib, Deborah A. Golino, Sue T. Sim and Maher Al Rwahnih. *Grapevine leafroll-associated viruses effects on yield, vine performance and grape quality.*



ICVG meetings, dinners and field trips
UC Davis, October 7-11, 2012
Photos by Sue T. Sim



Malbec and Cot: From France to FPS

by Nancy Sweet, Foundation Plant Services

A CLASS OF BLACK WINE GRAPES known as 'Cots Rouges' is grown in southwest France. In the Middle Ages, powerful, dark wines made from black grapes grown in Cahors in the Valley of the Lot River were called 'black wine' or 'the black wine of Lot' by the English. The dominant grape cultivar in the 'black wine of Lot' was one of the Cots Rouge cultivars called Cot or Malbec, which was grown in the rugged limestone vineyards of Cahors. *Mount, 2012, p. 220; Robinson, 2006, p. 421; Baudel, 1977, p. 102; Viala et Vermorel, 1905, pp. 6-7.*

Many historical references associate the 'black wines' with medieval clergy and royalty. Wine from Cahors was reputedly served at the 1152 wedding of Eleanor of Aquitaine and Henry II of England. In 1225, Henry III of England forbade Bordeaux authorities from stopping or taxing wines sent by Cahors merchants who were under his protection. Pope John XXII, who was born in Cahors in the 14th century, used vintages from that area as sacramental wines at Avignon. François I liked the wine from Cahors so much that he installed grapevines from that Quercy district in the vineyard at Fontainebleau in about 1531. Tsar Peter the Great preferred Cahors wine because he could tolerate it with his ulcerated stomach. *Mount, 2012, p. 220; Capdeville, 1999, p. 47; Baudel, 1977, pp. 17-18, 30.*

The wine grape cultivar known alternatively as Cot (France) and Malbec (New World) was present in University of California vineyards in the 1880's. The cultivar was important at that time as a blending variety in Bordeaux-style wines.

Malbec has been developed into a successful varietal wine in its own right, most notably in Argentina. Recent plantings in the United States demonstrate increased interest in the cultivar in this country. This article profiles the current Malbec/Cot selections in the Foundation Plant Services vineyard collection at the University of California, Davis.

The origin and parentage of Malbec

The cultivar now known most commonly as Malbec was given many different names in central and southwestern France. French ampelographer Pierre Galet has amassed more than 1,000 synonyms for the grape cultivar he calls Cot. *Mount, 2012, p. 220.* The grape is known as Cot in the Loire Valley, Pressac in the Libournais area of Bordeaux, Malbec or Malbeck doux in the Gironde, Luckens or Lutkens in the Médoc or Graves, Coté rouge in Entre deux Mers and Lot-et-Garonne, and Auxerrois or Cot noir in the Cahors area of Quercy.

The geographical origin of Malbec is not known with certainty. Multiple theories have proposed alternatives that include Hungary, Germany and regions all over France. The confusion is compounded by the numerous synonyms used for the cultivar throughout France. Results of a DNA analysis published in 2009 clarified the issue. It now appears that the best candidate for the geographical origin of Malbec is southwestern France – in the Gironde, Charentes or the Lot Valley.

Theories on the geographical origin of the cultivar were initially built from the various names and synonyms by which the cultivar was known in France. Names used for Malbec in the Médoc and Graves areas in the 18th century were *Estrangey, Etrangey or Etranger* (foreigner), hinting that the original home of the cultivar was other than the Gironde region. *Galet, 1998, p. 82.* One ampelographer specializing in German grapevines, Jean Louis Stoltz, speculated that the cultivar came from the banks of the Rhine under the name *Agreste*. *Galet, 1998, p. 82; Viala et Vermorel, 1905, p. 7.*

Some of the names attached to the cultivar in southwest France were adopted from the name of the person who introduced the grape to a particular area. A M. de Lutkins, who was a doctor in Bordeaux, planted the cultivar in Camblanes in the Gironde in the 18th century; the synonym name Luckens or Lutkens is thus used for Malbec in the Médoc and Graves area. *Viala et Vermorel, 1905, p. 7.* A man named Pressac brought the cultivar to the Libournais area near St. Émilion; Malbec is known as Pressac or Noir Pressac in that region of Bordeaux. *Robinson, 2006, p. 545; Galet, 1998.*



The medieval Pont Valentré spans the Lot River in Cahors in southwest France. Photo courtesy of 'Cambridge2000'

The name Malbec first became associated with the cultivar as a result of another independent introduction. Oral history in Bordeaux holds that a Hungarian viticulturist named Malbeck or Malbek brought the grape to the Médoc/Gironde in the Left Bank region of Bordeaux, where the winemakers blended it into claret for the dark juice quality. *Mount, 2012; Leclair, 1995; Viala et Vermorel, 1905, p. 7.*

Most sources concluded that the origin of the Malbec cultivar was the vineyards surrounding the Lot River in southwest France near the town of Cahors. Cahors is about 70 miles north of Toulouse in the Quercy region. The cultivar was once known there as Cot or Cot noir. Galet explains the Cahors theory on the name 'Cot' being a progressive transformation of the name of the town Cahors – illustrated by the following names that are also used in the region: Côte rouge, Costo roujo and Cot. *Galet, 1998, p. 82.*

At one time, a few authors proposed a Burgundian theory of origin for the cultivar, which has also been known for many years in the Cahors area by the name Auxerrois. *Robinson, 2006.* Some authors, including French ampelographer Louis Levadoux, concluded that use of the synonym name Auxerrois meant that Cot originated near the town of Auxerre in the département of Yonne in Burgundy. Speculation continued that the cultivar then migrated from Yonne to southwest France via the Loire Valley, where it received the name Côte in Poitou and Touraine. This theory assumes that the people in southwestern France did not recognize a long 'o' and mispronounced the name 'Côte' as 'Cot' once it got to the Cahors area. *Galet, 1990, p. 104.*

The Burgundian theory was rejected by Galet, noting that the Malbec cultivar was not historically grown in vineyards in Yonne except for a few acres in a town called Jоigny. The presence of the cultivar in the Yonne region of Burgundy was explained by Galet as the result of growers in Cahors sending cuttings to the area around Auxerre by order of the King (who had also requested that vines be planted in the nearby Château of Fontainebleau). The reasoning went that growers in Cahors named the cultivar Auxerrois after it was sent to Auxerre, Burgundy. *Galet, 1990, p.105.*

Use of the synonym Auxerrois causes confusion in another fashion. Auxerrois is also the name of a Burgundian white grape cultivar that is a full sibling to Chardonnay, whose parents were Pinot and Gouais blanc. Recent DNA results show that the parents of Malbec were not Pinot and Gouais blanc. *Bowers et al., 1999.*

DNA results reported in 2009 clarify the possible geographical origin of the Malbec grape. Malbec and Merlot

share the same female parent, a long forgotten cultivar recently renamed Magdeleine Noire des Charentes. The male parent of Malbec is Prunelard, an old, endangered cultivar from southwest France. *Boursiquot et al., 2009.*

The plant material recently named Magdeleine Noire des Charentes was introduced into the INRA grape germplasm repository of Domaine de Vassal (Montpellier, France) for the first time in 1996. The cuttings for the accession were taken from an abandoned grapevine growing on a hill in northern Brittany; the cultivar was known to be growing in that area in the second half of the 15th century during the Middle Ages. Additional cuttings were retrieved by the researchers in 2004-2007 from four different villages in Charentes in central-western France —400 km from Brittany and adjacent to the Loire Valley. *Boursiquot et al., 2009.*

The name Magdeleine Noire des Charentes was developed from the local names used by the growers in the villages in Charentes. Magdeleine Noire de Charentes had for unknown reasons escaped notice of ampelographers when French grape cultivars were described and referenced in the 19th century.

The paper that reveals the parentage for Malbec identifies its geographical origin through an analysis of five progeny cultivars of Magdeleine Noire des Charentes. The five cultivars (including Malbec) have five different fathers. Based on descriptions in the classic ampelographical work of *Viala et Vermorel* and the locations from which the five progeny cultivars were collected prior to introduction into the Domaine de Vassal repository, the researchers placed the 'supposed geographical origins' of all five progeny cultivars in southwestern France. In so doing, they include Charentes (home of one of the progeny cultivars) within the designation 'southwestern France'. *Viala et Vermorel, 1905, p. 7.*

The conclusion that Malbec originated in southwest France is qualified a bit by the reference to *Viala et Vermorel*. That work suggests two possible origins for Malbec, only one of which is considered 'southwest France': (1) Quercy (Cahors) in southwest France and (2) Touraine, which is in the Loire Valley. Nevertheless, a strong inference can be drawn in favor of an origin in southwest France for Malbec, given that its male parent Prunelard had a known presence in that region. No mention is made of Prunelard in the Loire Valley. *Boursiquot et al., 2009; Viala et Vermorel, 1905, p. 7.*

Malbec was widely planted in Bordeaux and was important in winemaking there prior to the 19th century. During the 19th century, the style of Bordeaux wines underwent a major change from Malbec to Cabernet Sauvignon and Merlot due in part to the failure of the Malbec crop for several consecutive years of bad weather. At

the same time, a naval blockade during the Napoleonic Wars (~1811) caused a switch from the milder Baltic oak barrels in which the Malbec-Verdot blends matured to barrels made of French oak, which had a greater affect on the wine and became the preferred oak for the Cabernet Sauvignon and Merlot blends. *Asher, 2002, p. 66.*

Several other forces negatively impacted Malbec acreage in Bordeaux. The 19th century phylloxera epidemic and a 1956 killer frost in southwest France contributed to reduced acreage. *Mount, 2012, p. 221.* Finally, the cultivar reportedly fell out of favor because of poor fruit set (excessive number of abscised berries) which was attributed to virus infection in the 1950's. *Leclair, 1995.*

After the 1956 frost, Cahors became France's main producer of Malbec, which is appreciated there for the color, aromas, tannins and acidity that it gives the wines. *Attia et al., 2007.* Cahors was awarded full Appellation Contrôlée status in 1971; appellation rules provide that the Malbec cultivar, known in Cahors as Auxerrois or Cot, must be at least 70% of the wine, blended with Tannat or Merlot. *Robinson, 2006, p. 122.* The clones contained within the vineyards of Cahors (French Cot clones 42, 46, 594, 595, 596, 597 and 598) date from the 1970's. *Anonymous, 2010.*

Today, Malbec is a minor variety in France and is produced in Bordeaux and the Loire Valley, in addition to Cahors. *Mount, 2012, p. 221; Grimshaw, 2010; Christensen et al., 2003.* Clonal selection programs in Bordeaux have reportedly eliminated grower concern about Malbec's fruit set problems there. *Leclair, 1995.* Malbec remains one of the six permissible grape varieties allowed in red Bordeaux wine, where it is used primarily as a blender in small amounts with Cabernet Sauvignon, Merlot, Cabernet franc, Carménère, and Petit Verdot.

Success in Argentina

A recent book by Ian Mount, *The Vineyard at the End of the World: Maverick Winemakers and the Rebirth of Malbec*, thoroughly chronicles the history and development of Malbec in Argentina. Argentina became a wine powerhouse in the last decades of the 19th century, becoming the world's fifth-largest producer of wine by 1915. Ultimately, winemakers in that country developed a fine varietal wine from what Mount refers to as 'an unloved grape with unlovely name: Malbec'. *Mount, 2012, pp. 25, 70; Robinson, 2006, p. 29.*

Vitis vinifera plant material was introduced into Argentina starting in the 1550's directly from Spain and via other



Malbec 10 is reportedly French Cot clone 46 from Cahors. Clone 46 has average to superior production levels in France.

Photo by Justin Jacobs

South American regions. Grapes, primarily Cereza and Criolla, have been grown in the eastern foothills of the Andes, including the area around Mendoza, since that time. *Robinson, 2006, p. 29.*

A more significant importation of *vinifera* occurred much later, in the 19th century. A colorful personality from Tours named Michel Aimé Pouget emigrated from France to Chile around 1850 when Louis Napoléon declared himself Emperor of France. Pouget was a successful agronomist and took with him cuttings of classic French grapes, including Malbec, which was at the time important in Bordeaux.

In 1853, Pouget was ultimately persuaded to move to the Mendoza area in Argentina to operate a government model farm. He brought with him knowledge of modern agricultural and winemaking techniques, as well as cuttings of Malbec and other classic French grapes, which were thereafter planted along the desert region of western Argentina. *Mount, 2012, pp. 41-44.*

The wine industry was developed slowly in those early centuries. In the late 19th century, improved irrigation techniques and an influx of European immigrants familiar with viticulture and wine-making facilitated the improvement of the industry and influenced tastes. Eventually, Mendoza became the largest and arguably most important wine-growing province in Argentina. *Robinson, 2006, p. 31.*

Malbec thrives in the climate and geography of western Argentina, particularly in the arid high-altitude valleys. Growers have observed that older Malbec vines in Mendoza's higher altitude areas produce Malbec grapes with intense color, flavor and structure. Malbec is a thin-skinned grape that is susceptible to cold and disease. The cultivar thrives in the hot sun in Mendoza, most likely because of its high vigor and dense leaf cover. That warm evening temperatures contribute to reduction of grape acids, so that Malbec in Argentina is not as acidic as that in France. *Mount, 2012, pp. 221-233; Walker, 2012.*

Malbec acreage in Argentina increased until it peaked at 120,000 acres in the 1960's. From 1970 through 1990, Malbec acreage decreased to 25,000 acres and prices became depressed. Vineyards with gnarled old Malbec vines were pulled in favor of other varieties that produced high yields for bulk wines. Additionally, those Argentinian winemakers who chose to compete internationally with fine wines favored other more traditional red *vinifera* varieties at first.

It was not until the mid 1990's that high quality Malbec was produced as a varietal wine. Malbec grower/

winemaker *bodegueros* such as Domingo Catena saw the potential for Malbec as a fine wine. His son, Nicolas, eventually gambled on that potential and, Bodega Catena Zapata led the movement toward fine Malbec wines when he produced them beginning in 1994. *Mount, 2012.*

The grapes that were used for those wines were selected in Mendoza from the successor vines of Argentinian grapes planted in the mid-19th century, as well as from grapevine material brought anew from Cahors. *Mount, 2012, p. 233; Catena Zapata.* The goal of the selection program was development of the best clones for each altitude, favoring healthy looking grapes with small berries and clusters, lower yields and fewer shot berries to produce concentrated flavors. *Cutler, 2007.* The ultimate formula for production of fine Malbec wine in Argentina has been described as: material from old, carefully selected vines; grown for low yields, at high altitudes in intense sun and rocky soil; with the use of new wine production technologies. *Mount, 2012, pp. 233-271.*

By 2011, Malbec acreage in Argentina rebounded to ~77,000 acres, 85% of which are in Mendoza. *Apstein, 2011.* Malbec's popularity as a fine varietal wine caused exports to increase. The Wine Market Council and Nielsen reported that Argentina and New Zealand were leaders in table wine import growth in the United States in 2011, with Moscato, Pinot noir and Malbec as the top three varieties. *Korman, 2012.* Jancis Robinson refers to Malbec as 'Argentina's most important serious wine grape' that has become 'Argentina's vinous trademark'. *Robinson, 2006, pp. 32, 421.*

Malbec in California

Documentation on the first importation of Malbec into California is sparse. What is known is that in the 1850's several French immigrants saw the need for higher quality wine grapes in the state and brought cultivars from Bordeaux to California. *Hilgard, 1892, p.31.*

Jean-Louis Vigne in Southern California was the first immigrant to import varieties from Bordeaux in 1833, however, records of what varieties he established and whether they survived do not exist. *Walker, 2000; Pinney, 1989, pp. 246-248.*

Red wine varieties used to make 'claret' were first brought to Northern California from France's Bordeaux region in the 1850's by Santa Clara Valley Frenchmen Antoine Delmas, Pierre Pellier and Charles Lefranc. *Sullivan, 2008, p. 136.* Although Delmas imported thousands of cuttings from France in 1854, available authorities do not specifically state that Cot or Malbec was among them. The date and cultivar list for the early Pellier importation are similarly vague. *Sullivan, 1982, p. 21.*

There is authority indicating that Charles Lefranc imported Malbec from France to California either in 1857 or 1858. Lefranc was a French immigrant who established the New Almaden Vineyard near San Jose in the Santa Clara Valley. In 1857–1858, he imported cuttings of important wine grapes, including Malbec, to plant in his vineyard and sell commercially. *Sullivan, 2008, p. 136; Christensen et al., 2003; Sullivan, 1998, p. 188.*

In his 1861 trip to Europe, Colonel Agostin Haraszthy reportedly brought from France all grape cultivars used to make Bordeaux clarets. The catalogue of cultivars imported during that trip includes Malbec, which was supposedly thereafter planted in his vineyard at Buena Vista Ranch in Sonoma County but probably not widely distributed otherwise. *Sullivan, 2003, pp. 56-57; Wetmore, 1881, Appendix I, p. 184.*

Charles Wetmore was the Chief Executive Viticultural Officer of the Board of State Viticultural Examiners at that time. He wrote in the section 'Classification of California Wines' in the First Annual Report of the Chief Viticultural Officer (1881): 'I have yet failed to find good reasons, excepting the scarcity and high price of cuttings, for the neglect to sufficiently cultivate in all the Sonoma and Napa vineyards, which can nearest approach the Bordeaux, the varieties which give character to the finest Bordeaux red wines. The Carbenet [sic.] Sauvignon and the Malbec have been too long ignored.' *Wetmore, 1881, pp. 65-66.*

Wetmore reported that Lefranc's old Malbec vines were the only large planting of good red Bordeaux vines in California prior to the 1880's. *Wetmore, 1884, Part V (Ampelography).* University of California's Professor of Agriculture Eugene Hilgard recognized Lefranc's Malbec block at New Almaden as 'the largest area of Malbeck in the State thus far' (1884). *Hilgard, 1886, p. 83.* The Santa Clara plantings were not large enough to satisfy the demand of the market.

Small lots of wine containing Malbec and other Bordeaux varieties were produced in California between 1860 and 1880. Charles Lefranc was a winemaker in addition to a viticulturist. He made the first commercially successful California 'Médoc' in the 1860's, which he called 'Cabernet-Malbeck.' Wetmore observed that the 'Cabernets and Malbecs' were mixed in Lefranc's vineyards. *Sullivan, 2008, p. 136; Wetmore, 1881, p. xxxii.*

The 'Malbecks' and claret (blended with Cabernet Sauvignon) wines made in the 1860's and 1870's were highly regarded by Wetmore and Hilgard for the color, bouquet and general character. *Sullivan, 1982, pp. 24-26; Wetmore, 1884, p. 40 and Part V (Ampelography).* Hilgard wrote of

Lefranc's 'Malbeck' of 1881 and several other 1870's Santa Clara 'Malbecks': '[they] prove irrefragably the excellent keeping power of the color of that wine, and a beautifully rounded mellowness in their taste.' *Hilgard, 1886, pp. 83-84.*

Malbec and other Bordeaux varieties began to appear in vineyards outside Santa Clara County around this time. Glen Ellen's J.H. Drummond planted the first plot of useful Bordeaux vines in the North Coast in 1878. He was soon followed by Napa's H.W. Crabb. By 1885 virtually every major producer who was interested in fine claret had Cabernet Sauvignon, and many also grew blending cultivars such as Malbec. Crabb favored Malbec at first but then turned to Cabernet franc to use as a blender. Gustav Niebaum first used Merlot and Verdot for blending, but cellar records indicate that he later favored Malbec. *Sullivan, 2008, p. 136.* Other notable plantings of Malbec were by the Natoma Land and Water Company in Folsom and by Charles Wetmore himself in Livermore. *Wetmore, 1884.*

Wetmore authored an important document in 1884 entitled *Ampelography*, in which he reviewed the winegrape varieties then being grown in California and recommended what he saw as appropriate quality cultivars for use in varietals or blends. He initially identified 'the proper Malbeck' (*Cot de Bordeaux*) as one of several varieties generally classed under the name *Cot*. *Wetmore, 1884, Part V (Ampelography).* Wetmore highly valued Malbec wine and recommended the cultivar for use in California clarets. He ultimately opined that Malbeck would be appropriate for planting in the coastal regions of California and did not believe the cultivar would succeed in areas of great heat and sudden extremes of temperature. *Wetmore, 1884, Part V (Ampelography).*

The University of California began evaluating appropriate grapes and wines for California in the 1870's. Malbec was one of the cultivars included in the early plantings in the university experiment station system.

The College of Agriculture of the University of California was established in Berkeley in 1870. Eugene W. Hilgard was chosen Professor of Agriculture in 1874. Grapevines were planted at a vineyard in Berkeley in 1875. In 1878 experimental work in viticulture and wine making was begun as a special discipline with a cellar and laboratory located at Berkeley. *Hilgard, 1890.* The Division of Viticulture (later Department of Viticulture & Enology) was initiated at UC Berkeley in 1880. *Walker, 2000.* Adequate funding to perform the work was a constant problem in those early years, as was funding to support production of regular reports.

Hilgard began lobbying the Regents in 1879 for funding to establish an experiment station system within the

university 'to resolve practical questions'. *Hilgard, 1879*. He argued that such a system would facilitate 'small culture experiments' to evaluate particular regions where wine grape cultivars were suitable and adaptable. *Hilgard, 1892, p.31*.

A Viticulture Experiment Station was authorized by the Legislature in 1880 in the same act that created the State Viticultural Commission. The Central Station (including cellar and laboratory) was established at Berkeley in that year. *Hilgard, 1896^a, pp. 13-15; Hilgard, 1896b*. However, creation of additional stations within the university was delayed for many more years by lack of funds.

The university proceeded with the evaluation of grape varieties beginning in 1878 despite the lack of funding for additional university stations. Hilgard explained that the mission was to select proper varieties for California that were 'best calculated to bring the pure wines of California into use as table wines, instead of numerous artificial compounds now dispensed as 'table clarets' under French labels.' *Hilgard, 1880, p. 88*.

The lack of funding for university stations in the early 1880's forced Hilgard to arrange for privately funded sources of grapes and wine to assist with university viticulture work. Donated samples used in university research included Hilgard's own vineyard at Mission San Jose, Crabb and Krug in Napa, Drummond and Gundlach in Sonoma, Lefranc and others in Santa Clara, the Natoma Water and Mining Co. in Folsom, George West in Stockton, and Professor Eisen in Fresno. 'Malbeck' grapes and wine samples were sent to the university for analysis from Crabb, John Doyle, Lefranc, Wetmore, and M. Keatinge in Lower Lake County. The Natoma Water and Mining Co. in Folsom imported 40 cultivars from Europe and planted them in 1883. Natoma donated sample lots of wines of 40 cultivars (including Malbec) to the university lab for analysis in 1884 and 1885. *Hilgard, 1886^a, p. 54-83; Hilgard, 1886b, p.67; Hilgard, 1884, pp. 9, 13; Hilgard, 1880, pp.88-89*.

Hilgard believed that Malbec had potential for California wines and from the outset included it in the grapes that were studied by the university. *Hilgard, 1886^a, p. 83*. He wrote that, 'although California growers and winemakers were familiar with Malbeck by that time [1884], the cultivar had not previously been more widely cultivated in the state due to its tendency to light bearing.' *Hilgard, 1886^a, p. 83-84*.

"Although California growers and winemakers were familiar with Malbeck... the cultivar had not previously been more widely cultivated in the state due to its tendency to light bearing."

~Hilgard, 1886

In 1884, a close friend of Hilgard's named John T. Doyle assigned to the university some of his property in Cupertino for use as an experiment station vineyard. The two-year old vines on the property consisted of forty varieties from around the state including 'Malbeck'. That privately-funded station became known as the West Side Santa Clara Valley Station in Cupertino. *Hilgard, 1886^a, p. 160; Hilgard, 1886b, p. 124*.

Hilgard's vision for a complete university experiment station system was realized in 1888. The final piece of the puzzle was put into place that year when Hatch Act funding was provided to the university to fund outlying general culture stations under the auspices of the university for the purpose of conducting extension work. *Hilgard, 1891*.

Ultimately five general culture stations were established within the university: the Central Station at Berkeley (in operation since ~1880), the Sierra Foothill Station near Jackson in Amador County, The South Coast Station near Paso Robles in San Luis Obispo County, The San Joaquin Valley Station in Tulare County, and the South California Station in Pomona. Viticultural work also continued at the three special (privately owned) stations at Cupertino, Mission San Jose and Fresno. *Hilgard, 1891*.

Evaluation of appropriate grape varieties for California continued in the new university experiment station system. Grapes were grown at each of the five general culture stations, as well as the three private viticultural stations. Malbec and other Bordeaux type grapes were grown in the experiment station vineyards, i.e., Berkeley, Jackson, Paso Robles, Tulare, and at the private stations in Cupertino and Mission San Jose. No source information for the Malbec at the four general culture stations was given. There was no Malbec in the southern California station at Pomona. *Hilgard, 1890, Appendix No. 4, p. 197*.

In 1892, Hilgard concluded that Malbec was shown to be early maturing but a low producer. Small wine lots were made. Except for wines from very young and short pruned vines, Malbeck maintained its character in terms of high sugar and alcohol content, heavy body, deep color, high tannin and low acid from old vines with well-matured fruit. However, the researchers had great difficulty in maturing the wines 'without their acquiring the lactic taint', which Hilgard attributed to samples that were badly couloured (failure to set fruit or fruit drop). *Hilgard, 1892, p. 38*. He concluded that more reliable and abundant bearers should be used for blending with Cabernets. *Hilgard, 1892, p. 38*.

In 1896, in a summary of the results of years of testing and observation, Hilgard observed that Malbeck showed poor yields and serious coulure at all the experiment stations. However, it seemed best adapted at Paso Robles. Hilgard concluded that Malbeck was completely ill suited for conditions such as those in Tulare and the San Joaquin Valley. Malbec was not recommended, even as a blender with Cabernet Sauvignon. *Hilgard, 1892, p. 31; Hilgard, 1896.*

University observations in the 20th century

Malbec did not receive more favorable reviews in university publications in the first half of the 20th century. Frederic T. Bioletti was a university graduate who began his career as Foreman of the University Cellar, then became the university's first Professor of Viticulture in 1898. In 1913, Bioletti became head of the Division of Viticulture.

Malbec was not recommended for commercial planting in California in Bioletti's 1907 Experiment Station Bulletin entitled 'The Best Wine Grapes for California' (Bulletin no. 193), even as a blender for Cabernet Sauvignon. However, Malbec was among the varieties included in selection blocks and the variety collection when Bioletti planned the new vineyards for the Division of Viticulture at the University Farm in Davis in 1910. One of the FPS Malbec selections came from that early vineyard at Davis.

Bioletti did not mention Malbec in the chapter 'The Grape Varieties in California', a 1929 Extension Circular that reviewed the merits of California red and white wine grapes. *Bioletti, 1929, rev. 1934, p. 26.*

During the period of Prohibition, very little research on wine grapes was done at the university, although some of the better vineyards were maintained in the state.

U.C. Professors Maynard Amerine and Albert Winkler mentioned Malbec only in passing in their 1944 *Hilgardia* magazine review of wine grapes in California. The cultivar was not tested in the coastal counties in the research described in that article. Planting of Malbec in California vineyards was not recommended at that time on the basis that 'other varieties have equal or greater potentialities'. Further study of the acidity of the Malbec in cooler growing regions such as the coastal counties was suggested as a possibility. *Ough and Alley, undated; Amerine and Winkler, 1944, pp. 663-664.*

Amerine and Winkler issued another comprehensive set of recommendations on California Wine Grapes in 1963. Malbec was again not recommended for California vineyards. The research showed that Malbec production levels were moderate and irregular, and malic acid levels were low. The authors concluded that it was a poor grape for California region IV (interior Central Valley with marine

influence) and of 'doubtful utility for the cooler regions'. They thought that the cultivar's 'slight Cabernet-like aroma' could make it useful in blends if it were fermented with another variety. *Amerine and Winkler, 1963.*

Malbec Plantings in the United States

Malbec was quite popular in northern California before 1900 as a variety used to blend with Cabernet Sauvignon. *Sullivan, 1998, p. 199.* But California grapevine acreage declined sharply in the late 1800's due to phylloxera. Malbec was planted little thereafter in the phylloxera-devastated vineyards until recently. *Christensen et al., 2003; Sullivan, 1998, p. 199.*

Malbec did not have a 'commercial presence' in California in 1964, but was part of the University of California plantings. *Olmo, 1964.* Malbec began appearing by name in California state statistics after five acres were planted in Napa in 1976. The total number of Malbec acres in the state in 1978 was estimated at 134 (bearing and non-bearing). *California Grape Acreage 1978, California Crop and Livestock Reporting Service.* Acceptance of Malbec by growers was traditionally limited by the fact that the cultivar is subject to poor fruit set. *Christensen et al., 2003; Sullivan, 1998, p. 199.*

Total Malbec acreage in California increased slowly and steadily during the latter part of the 20th century. In the period between 2009 and 2011, Malbec increased rapidly to a total of 2,041 acres (1,611 bearing and 430 non-bearing) in the state. *California Grape Acreage Report, 2011 Summary, United States Department of Agriculture, National Agricultural Statistics Service, March 30, 2012.*

The increased interest in Malbec after 2000 was attributable in part to California growers and winemakers searching for different and interesting grape cultivars for winemaking. Some planted what they called a 'Meritage scheme', a blended group of Bordeaux cultivars adopted as an alternative to pure varietal wines. Those cultivars included Cabernet Sauvignon, Cabernet franc, Petit Verdot and Malbec, which were planted in Napa and other areas of the state for use in wines sold as 'Meritage' blends. *Sullivan, 2008, p. 386; Robinson, 2006, p. 437; Pinney, 2005.* Additional interest was sparked by the success of Malbec as a varietal wine in Argentina.

Foundation Plant Services at the University of California, Davis, maintains a virus-tested foundation vineyard containing 19 public and proprietary Malbec/Cot selections. Ungrafted cuttings from those vines, as well as mist-propagated plants on their own roots, are distributed to grapevine nurseries that are members of the California Grapevine Registration & Certification Program, grape growers and winemakers, and researchers throughout the United States. FPS first released Malbec material in 1988;

in 1988, 1989 and 1990, 400-500 cuttings were distributed per year. Sales of the cultivar then declined and remained steady, except for spikes of 400-500 cuttings annually in 1996, 1997 and 2011.

Two large nurseries in the California R&C Program saw increases in their sales of Malbec material in 2000-2001, 2007 and most significantly in 2009-2011. *Duarte Nursery, 2012; Vintage Nursery, 2012*. It is noteworthy that Duarte Nursery located in Hughson, California, distributed 270,874 and 193,152 grafted Malbec vines in 2010 and 2011, respectively. Approximately 350,000 of those grafted vines were distributed to growers and wineries in Merced, San Joaquin and southern Sacramento Counties. John Duarte indicates that there is currently 'a lot of demand for Malbec, which has been used as a blender, but now is often marketed as a varietal wine'. *Franson, 2012*.

Malbec has become popular in the State of Washington within the past ten years. Sales of the cultivar in one nursery began to increase prior to 2009 (to a total of ~88,000 vines sold annually) and have now levelled out. *Judkins, 2012*. There are over 300 acres planted to Malbec in the state. The cultivar has produced well in clonal evaluation studies in southwestern Idaho and eastern Washington. *Shellie, 2007*. In 2009, *Seattle Magazine* selected Malbec as the 'Best Emerging Varietal' in their Best of Washington Wine Awards because of its ability to grow well in the hot days and cool nights of eastern Washington. *Seattle Magazine, 2009*.

Malbec distribution in the eastern United States has increased in recent years and there are small plantings in many states, including New York, Pennsylvania, Virginia and Maryland. The cultivar has been grown on Long Island for more than 20 years and has been made into successful varietal wines at several wineries in the east. *Chien, 2012; Wise, 2012*. The two large grapevine nurseries in New York State report increased sales of the cultivar in recent years. *Rak, 2012; Amberg, 2012*. Grower interest in Malbec is evidenced by its inclusion in the national grapevine variety trials currently being conducted by university extension services. *NE 1020: Multi-state Evaluation of Winegrape Cultivars and Clones*.

The recent popularity of Malbec wine, especially among younger wine drinkers, has been attributed to the 'big, ripe fruit and nice structure Malbec delivers at a very affordable price.' *Zimmerman, 2010*.

Viticultural Characteristics

Malbec is a black grape variety that is sensitive to coulure and temperature extremes. The cultivar is not always easy to grow, requiring sunny and dry weather conditions. *Robinson, 2006, p. 421; Christensen et al., 2003; Galet, 1998; Wetmore, 1884, Part V (Ampelography)*.

If grown in favorable conditions, Malbec is a vigorous variety adaptable to a wide range of soil types. It has large leaves and unusually strong lateral shoot growth leading to a dense canopy in the fruit zone that might interfere with grape maturation. Coulure (poor fruit set or shatter) occurs particularly with high vigor or cool weather during bloom; it can lead to particularly low yields of 1 to 3 tons per acre. If set is good, production levels are moderate to high. *Christensen et al., 2003, pp. 75-76*.

Although the skins are thin, the grapes do not spoil easily. The clusters are medium-sized and the berries loosely set. *Galet, 1998; Amerine and Winkler, 1944, p. 664*. It is reported that the clones selected and developed in Argentina have smaller leaves, smaller and tighter clusters, and smaller berries than the clones from France. *Mount, 2012, pp. 234-236*.

MALBEC & COT SELECTIONS AT FPS

The public selections for this cultivar at FPS are named Malbec because that is the name by which the cultivar is most popularly known throughout the world. The proprietary French clones at FPS are named Cot by request of the owner.

Malbec 04

Malbec FPS 03 and Malbec FPS 04 originated from the same source vine in the 'Old Foundation' (O.F.) vineyard at the University of California, Davis. That vineyard is located in the 'Armstrong' or 'West Armstrong' tract at Davis. The source vine for these two selections was planted at location 'O.FA r9 v3' in that vineyard in 1955 under the name 'Cot (Malbec)'. The plant material at O.FA r9v3 was one of the early clones identified by Dr. Harold Olmo (U.C. Department of Viticulture & Enology) in a systematic effort to acquire European grape cultivars for the grape and wine industry.



Clonal selection is important for Malbec to minimize the risk of coulure. Malbec 04 can be prone to poor fruit set and low yields. *Photo by Justin Jacobs*

In 1934, plant pathologist William B. Hewitt was hired by the University of California to deal with the Pierce's Disease problem throughout the state. Eventually, both Hewitt and Olmo (who was at the time working on breeding P.D. resistant grapevines) expanded their work to deal with grapevine viruses, particularly leafroll and fanleaf. *Alley et al., November 2000 and January 2001.*

Stricter plant quarantine regulations were established around 1948 by the USDA, ending 'uncontrolled importation of clonal plant materials' and requiring a permit for importation of any *Vitis* spp. into the United States. The regulations provided that imported grapevine material could not be released until it was tested for viruses, thus necessitating plant quarantine facilities. In 1950, no one knew how to test for grape viruses, so the USDA quarantine greenhouses in Maryland were overflowing with untested cuttings, which would either die or be in very poor shape by the time of their release many years later. Olmo and Hewitt worked to establish a quarantine facility at Davis, so that upon arrival in the U.S. vines could be shipped directly to that facility and be supervised there during the quarantine testing process. *Alley et al., November 2000 and January 2001.* Early efforts to that effect in 1952 eventually resulted in the Foundation Plant Services facility at UC Davis in 1958.

At the same time, there was much interest in improved grapevine material. Prohibition (1920-1933) had decimated the California vineyards that contained high quality wine grape cultivars. Harold Olmo convinced industry members that a concerted effort should be undertaken to import known grape cultivars from the areas in which they had thrived. In 1951, the California Wine Institute funded a trip to Europe for Olmo, who sent back suitable wine grape clones for the California grape and wine industry. *Alley et al., April 2001.* It appears that Olmo collected the plant material that eventually became Malbec 03 and 04 on that 1951 trip.

Tracking the original material for Malbec 03 and 04 requires explanation of a three-digit numbering system apparently adopted by Harold Olmo to label his 'finds' during the plant exploration trips. Records of importations maintained by Olmo at the Department of Viticulture show that unique three-digit numbers preceded by Olmo's name were assigned to many of the cultivars that Olmo personally collected around the world. Those numbers included 550's through 900's. The numbers from Olmo's 1949 trip to Greece and Afghanistan are illustrative. Olmo collected Assirtico from Greece in 1949. The entry in his import records gives the USDA P.I. number (PI 171194) and the variety name (Assirtico) followed by 'Olmo 667'. Another 1949 selection from Afghanistan

shows PI 171069, Kishmishi - Olmo 569. The 'sender' of the cultivars was in both cases 'H.P.O.'

Those three digit numbers which no one can explain are frequently attached to grapevine selections in the FPS database and grape indexing binders that were maintained by U.S.D.A. Plant Pathologist Austin Goheen to document disease testing at FPS. Those same numbers remain attached to some of the selections through variety trials that Olmo conducted, most notably exemplified by Chardonnay (which uses 800 numbers). Those unique numbers were clearly used in the early days to identify and track the new selections through the various processes at UCD. The three-digit numbering system becomes significant for the Malbec selections because the material that ultimately became Malbec 03 and 04 was initially identified and tracked by 'number 808' from its first appearance in UCD and FPS records.

Many of the old records documenting these early grape importations to Davis, including 'number 808', are contained in the files at Foundation Plant Services. For example, a very old binder labelled '805-1305, Hewitt's Introductions' contains important information for the grape importations to Davis beginning in 1951; the Hewitt binder documents the date of arrival of the grape cultivar in the United States, source of the cultivars, dates of planting at Davis and release dates. For the grape cultivars that were imported in 1951, there is a column containing an 'introduction number', which for some of the 1951 imports does not coincide with the USDA Plant Introduction number. The 'introduction numbers' for some of the French imports sent by Harold Olmo in 1951 were three-digit numbers beginning with an 8.

The Hewitt binder shows that cuttings for 'Introduction number 808' with the variety name 'Cot (Malbec) R15G3' were sent to the U.S. from France by Olmo in October, 1951. There is no indication in any of the records as to the meaning of 'R15G3'. It has been suggested by a knowledgeable source that this could be a reference (with a typographical error) to a vine location – the correct reference could be a vine location in French: Rang (row) 15, Souche (vine) 3.

For introduction 808, there is a notation in the 'Remarks' section of the Hewitt binder that the material is a 'Hybrid between Cot and Merlot'. The notation 'Cot x Merlot' also appears in the Goheen indexing binder for the Malbec selection associated with number 808.

Notations in the FPS indexing records and Olmo's file show that the original source of the grapevine material for introduction number 808-1 was Grand Ferrade in Bordeaux, France. There is a grapevine variety collection

near Bordeaux at the research station of Grande Ferrade à Villanave d'Ornon, which is part of INRA's Centre de Bordeaux-Aquitaine. In an FPS record for a Malbec clonal trial in Oakville, FPS program manager Curtis Alley refers to Malbec 04 as 'Olmo's Cot' and 'Olmo-Bordeaux'.

The Hewitt binder indicates that the 'number 808' plant material was 'released' at UC Davis in 1954. It was planted in 1955 at 'O.F. (Block A) r9 v3', which is a location in the Old Foundation vineyard at West Armstrong or Armstrong tract. The selection name and number of the new planting were 'Cot (Malbec) 1'. The plant material at O.F. r9v3 began index testing under the number 808-1, beginning in 1958.

After the original material successfully completed the first round of index testing in 1961, it was planted in location C2 v 1-12 in the new FPS foundation vineyard west of Hopkins Road. Material from these vines was thereafter subjected to two different heat treatments (96 days and 103 days) in 1964-65 and eventually became Malbec FPS 03 and FPS 04, respectively. After successful completion of index testing, the heat-treated selections were planted in 1966 in the FPS foundation vineyard at locations FV E2v2 (Malbec 03) and FV E2v3 (Malbec 04).

Any doubt that the material received in 1951 is pure Malbec (rather than Cot x Merlot) was resolved by professional identification of the vines at FPS. Malbec 03 and 04 were identified as Malbec by ampelographers Jean-Michel Boursiquot (1996) and M. Andrew Walker (1998).

Finally, FPS scientist Gerald Dangl performed DNA analysis on Malbec 04, and its profile matched references for the Malbec/Cot cultivar. *Dangl, 2012*.

Malbec 03/04 has been the second most-widely distributed Malbec 'clone' at FPS, second only to Malbec FPS 09.

Malbec 06 came from the original UC Viticulture Department vineyard planted in 1910 in Davis.
Photo by Justin Jacobs



Malbec 06

The official source vine for Malbec 06 in the FPS database and other records is 'Viticulture K129 v1', which was a location in the 'Wine Grape Production' block K planted in the Department of Viticulture's vineyard in the Armstrong tract in 1949. It is probable that the Malbec vine in Block K is a successor vine several generations removed from the first vineyards installed by the Department on the UC Davis campus beginning in 1910.

Frederic T. Bioletti, the university's first Professor and Chair of the Department of Viticulture, planned the new vineyards that were installed at the University Farm at Davis. Those vineyard plans, drawings and plant lists are in his notebook written around 1910 that is now housed as part of the Olmo collection (D-280) in Special Collections at Shields Library at U.C. Davis. *Bioletti, 'Davis: Vineyard, Maps and Plans', Olmo D-280, Box 2, folder 11*.

The early vineyards planted at Davis were given numbers. The initial vineyard in the Bioletti notebook is Vineyard #1. Blocks A and B of that vineyard were designated 'Selection Plots' which were planted beginning in 1910. *Olmo D-280, Box 23, folders 22-23*. Malbec was planted in both Block A, row 35 v 1-24 and Block B, row 35 v 1-24. Notes on the map indicate that the plant material in those locations was from the university experiment station in Tulare. *Hilgard, 1890, pp. 135-136*. A list of vines 'growing at Davis in December, 1913' shows Malbec only in Vineyard #1, Blocks A35 and B35, at that time.

Plot D of Vineyard #1 is described beginning on page 10 of Bioletti's notebook. Plot D is designated the 'Collection of Vinifera Varieties', with vine planting lists shown initially through row 39. Those vines appear to have been planted around 1910 or 1911. Source information for

those vines was usually noted, either individually or for a group of vines. Plantings in these lower rows were usually from the Tulare Station. Malbec was not planted in the Plot D variety collection until row 46.

After the list of vines planted in Plot D in 1911, there are in the notebook several lists that describe cuttings needed in 1911-1912 for future plantings for Plot D. There are lists of cuttings to be brought from several different locations, e.g., Woodland, Pomona, Tulare. One list is entitled "Cuttings Needed from Miscellaneous (B, FG, F) – Berkeley, Fountain Grove, Fresno. Malbec is one of the cultivars on this 'Miscellaneous' list and the source for that cultivar is noted as Fountain Grove, Santa Rosa. Malbec is not included on any of the lists of needed vines for future plantings except the Miscellaneous List. The desired sources for the Miscellaneous List are noted in Bioletti's handwriting. He also wanted Chenin blanc, Clairette blanche, Chardonnay, Grand noir, Listan, and Limberger from Fountain Grove.

There is reason to believe that Frederic Bioletti was familiar with the grapevine material at Fountain Grove in Sonoma since he was acquainted with the owner of the property. The settlement at Fountain Grove was originally established in 1875 by Thomas Lake Harris, a minister and poet who founded the utopian 'Brotherhood of the New Life' in upstate New York. He moved to the hills near Santa Rosa in 1875 and established a new settlement of around 2,000 acres, much of which was covered by vineyards. The vineyards grew good varieties such as Cabernet and Zinfandel, and red table wine was the staple product. Harris was a colorful and controversial character who believed in a philosophical mix of socialism and mysticism and espoused unusual ideas about sex. Eventually he left Fountain Grove in 1892 and deeded the Fountain Grove property to his adopted son, Kanawe Nagasawa. Nagasawa became a respected grape grower and wine maker. He became friends with Bioletti in the process. Pinney, 1989, pp. 332-335; Anonymous, *Pacific Wine & Spirit Review*, 1900.

In the records at Shields Library is a notebook titled 'RESISTANT VINES, Notes on Fountain Grove Vineyard, Santa Rosa, Sonoma County, 1910', in which the Fountain Grove cultivars named above all have individual pages. The notes taken on each cultivar appear to be in the handwriting of Frederic Bioletti. He observed Malbec on 'Chas. x Ber.' Rootstock [41-B]. The plants appeared to be 'doing well', although the crop was light. The berries were of irregular size, blue in color and sweet. Many of the berries were seedless. There was no graft enlargement at the union of scion and stock.

It appears that the Malbec from Fountain Grove, Santa Rosa was ultimately planted in the Variety Collection at UCD in Vineyard #1, Block (Plot) D, row 46 vines 21-24. A document in the Olmo files entitled 'Summary of Davis Vineyard #1, July 19, 1916' designates Block D as a collection of *vinifera* varieties and shows Malbec plantings at locations in Block A, Block B and Block D (D46 v 21-24). *Olmo D-280, Box 3, folder 46*.

Tracing the source material for Malbec 06 becomes problematic by the relocation of Vineyard #1 (including Blocks A, B and D) to several new locations at the University Farm in the 1920's. The source material for Malbec 06 can be tracked in FPS files back to a Malbec vine at location B8 in the newly relocated vineyards. Reference is also made to Malbec 06 as being from 'the old variety collection'. Alley, 1978. Old vineyard maps for the Department, indexing records at FPS and variety notes maintained by Dr. Olmo show the successive locations for Malbec 06 as follows:

B8 → E104:1 (1940) → K129:1 → Malbec 06 (Hopkins FV C6:11 (1964) and E2:1 (1967)).

An ambiguity arises when the identity of the plant material at location B8 is investigated. A small hardbacked book named 'Vine Collection Davis 1932' contains drawings of the 'new' vineyards, with lists of vines and locations. A map shows a diagram for 'new' Vineyard VI (Blocks A and B) and Vineyard VIII (Blocks A through C) next to Hutchison Road where the campus is now in Davis. Malbec was planted in Block B of both Vineyard VI and Vineyard VIII. *Olmo D-280, Box 77, folder 17 (Vine Collection Davis 1932)*.

Malbec was planted in B6 in Vineyard VIII. Vineyard VIII, Block B, rows 1-9 were intended to be a 'Wine grape variety collection' and were planted beginning in 1924. Malbec was planted in that new Wine grape variety location at B6 v11-12. *Olmo D-280, Box 9, folder 11*. A logical inference might be made that the Fountain Grove Malbec from the original Variety Collection in Vineyard #1 was moved to this location.

Malbec was also planted in Vineyard VI at location B8. The materials available in the files at Shields Library lack details about the purpose of the new Vineyard VI. The records and vineyard maps at FPS do show that Malbec was installed in Vineyard VI sometime after 1925 in Block B8, vines 1-35. There is no source information in the old maps for this planting at B8. The old records at FPS (which probably came from oral history on campus) indicate that Malbec 06 (and therefore B8) was from the 'old variety collection'. This reference could also be evidence of the Fountain Grove Malbec. Alley C.J., 1978.

The bottom line is: the most that can be stated with any confidence is that the planting in B8 was probably from the Fountain Grove Malbec from Vineyard #1, Block D, or the Malbec from the Tulare Station that had been planted in Vineyard #1, Blocks A and B, in 1910. There is no information in the files at FPS or in the Olmo collection files at Shields Library that a third source of Malbec was present in the vineyards at Davis during the 1920's.

Plant material from vine K129:1 (successor to B8) initially came to FPS for index testing starting in 1956. This selection was one of the early plantings in the new FPS foundation vineyard west of Hopkins Road in 1962 (location C2 v13-16). The selection was assigned the name Malbec-2 (on the list of FPS foundation vines) and also Malbec 5 (in the Goheen indexing binder), although neither of those names was ever entered in the FPS database.

Plant material from the same source vine K129:1 underwent heat treatment therapy for 63 days in 1962. It is not clear from the records whether the material that underwent heat treatment was taken from the original source vine (K129:1) or the vines in foundation vineyard location C2 v13-16 named Malbec 2/Malbec 5. However, both sources go back to vine K129:1. After successful completion of index testing, the heat treated selection was planted in 1964 in the FPS foundation vineyard west of Hopkins Road as Malbec 06.

Malbec 08/Malbec 12

The plant material for this selection arrived in California in March, 1966, and was sent to UC Davis by C.R.A.S.O. (Centre Recherches Agronomiques Sud-Ouest) in Pont-de-la-Maye in Gironde, France (USDA Plant Introduction number 312798). The import was labelled with the name 'Malbec 1056'. The full name of 'Malbec 1056' (also known as Cot) was 'INRA-Bx 1056' which originated in the Lot region of France in Cahors vineyards. Bx 1056 was later certified as French Cot 46 in 1971.

Upon arrival at Davis, the plant material was installed for a time at location K2v58 in the Old Foundation (West Armstrong) vineyard and began the index testing process at FPS. The decision was made to subject the selection to heat treatment therapy for 60 days, which it underwent in 1969. After successful completion of index testing, the new heat-treated material was given the selection number Malbec FPS 08 and planted in 1975 in the FPS foundation vineyard west of Hopkins Road at location L5 v9-10.

In 1997, Malbec 08 underwent microshoot tip tissue culture disease elimination therapy to eliminate *Rupestris* stem pitting virus. The new material received the selection name Malbec FPS 12 and was planted in the Classic Foundation Vineyard in 2005. The selection was identi-



Malbec 12 originated from Cahors in the Lot region of France.
Photo by Justin Jacobs

fied using DNA technology in 2010. Malbec FPS 12 has also qualified for the new Russell Ranch Foundation Vineyard, where it was planted in 2011.

Malbec 09, Malbec 10 and Malbec 11

The plant material that became Malbec 09, Malbec 10 and Malbec 11 was imported to Davis from France in 1989. The shipment was part of a project sponsored by Winegrowers of California to bring important French clones to California to improve the wine industry. This effort antedated the establishment in 1997 of the ENTAU-INRA® trademark program for certified French clonal material.

In the mid-1980's, the Oregon Winegrower Association and Oregon State University (OSU) collaborated on a project related to a mutual interest in European clonal material. David Adelsheim of Adelsheim Vineyard in Oregon and Ron Cameron at OSU worked together and successfully established relationships with viticulturists in public programs in France. The OSU program (which at that time had a permit to import grapevine materials from abroad) was able to import many varieties and clones from French vineyards. Mr. Adelsheim appeared in California at a 1985 meeting of university and grape industry members and explained the OSU importation project. In response to interest from the California grape and wine industry, OSU agreed to make some of the clones available for the public collection at FPS in 1987-88. When Dr. Cameron retired from OSU, he made a special effort to ensure that FPS received all the clones from OSU.

Later, FPS was able to arrange for direct shipment of additional clones from France to FPS as part of this project, which was then sponsored by Winegrowers of California. Two Cot (Malbec) clones were sent to FPS in 1989 in one of the direct shipments sponsored by the California group. That material was the source of Malbec 09, Malbec 10 and Malbec 11.



Malbec 09 is reported to be French Cot clone 180 from Bordeaux. Photo by Justin Jacobs

FPS uses the words 'generic French clones' for French clonal material that was sent to the United States prior to the establishment of the official ENTAV-INRA® trademark program. 'Generic clones' are publicly available and are assigned an FPS selection number that is different from the reported French clone number. The source for generic French clones is indicated on the FPS database using the following language: 'reported to be French clone xxx'. This language is used to distinguish the generic clonal material from trademarked clones that are certified by ENTAV (now IFV) and sent from the official French vineyards. There is no guarantee of authenticity for generic clones.

In 1989, FPS received two Malbec clones that were reported to be French Cot clones 46 and 180. The clones were sent from INRA's Chambre d'Agriculture de la Gironde in Aquitaine, France. The Chambre d'Agriculture is a type of semi-governmental agency that exists in France in each geographical area. These agencies frequently work on clonal selection and extension work. The agency in the Gironde was one of those that performed clonal evaluation work.

The material that is reported to be French Cot clone 180 eventually became Malbec 09 at FPS. Cot 180 was from Bordeaux vineyards in the Gironde area. *Institut Français de la Vigne et du Vin, 2006.*

The material went through index testing in 1989-90 and did not receive any disease therapy or treatment. After successful completion of testing, Malbec 09 was planted in the Classic Foundation Vineyard in 1992. This selection has been the most widely-distributed Malbec selection at FPS.

Malbec 10 and Malbec 11 are reported to be French Cot clone 46, which originated from Cahors vineyards in the region of southwest France near the Lot River. *Institut Français de la Vigne et du Vin, 2006.* Both of these FPS

selections underwent microshoot tip tissue culture disease elimination therapy prior to 2000. After successful completion of disease testing, Malbec 10 and Malbec 11 were planted in the Classic Foundation Vineyard in 1999 and 2000, respectively. Both selections also qualified for planting in the new Russell Ranch Foundation Vineyard, where they were planted in 2012.

In France, Cot clone 46 has superior fertility and an average-to-superior level of production and sugar content. Cot clone 180 has inferior fertility and inferior-to-average level of production. *Institut Français de la Vigne et du Vin, 2006.*

Malbec 22/Malbec 22.1

Malbec FPS 22 has had a long and confusing history at Foundation Plant Services. The plant material arrived in Davis in March, 1962, from the Station de Recherches Viticoles d'Arboriculture Frutiere, C.R.A.S.O., in Pont-de-la-Maye, Gironde, France. The name on the imported material was 'Cabernet Savagnin, CL 1563' (USDA Plant Introduction no. 279498).

FPS began disease testing the material in 1968-69, initially as Cabernet Sauvignon. The material underwent heat treatment therapy in 1966 for 105 days. Sometime during the subsequent disease testing process, the name of the plant material was changed to Merlot. After the final test results were recorded in 1968, the selection was planted in 1970 in the FPS foundation vineyard as Merlot 07.

As evidenced by a note entered in the Goheen indexing binder prior to Goheen's retirement in 1986, someone suspected that the selection was possibly Malbec. DNA testing revealed in 2000 that the selection was, in fact, Malbec. *Meredith, 2000.*

In 2006, this selection underwent microshoot tip tissue culture disease elimination therapy to clean up leafroll virus. In November of 2010, FPS changed the name of this selection to Malbec 22. Malbec 22 successfully completed 2010 Protocol disease testing necessary for qualification for the Russell Ranch Foundation Vineyard, where it was planted in 2012. The name was then changed to Malbec 22.1. The selection currently has Provisional status.

Consultant and viticulturist Phil Freese was a Vice-President at Mondavi Winery in the 1990's when he identified the pre-tissue culture version of what is now known as Malbec 22 for use in Mondavi and Opus One wines. Mondavi realized that the cultivar was Malbec, not Merlot, and ensured that the selection was correctly identified as such. They preferred this clone to other Malbec selections and used it at Mondavi Winery. There is still a block planted with the pre-tissue culture, Malbec 22 material at the To Kalon vineyard in Oakville (to the west of the north field station). *Bosch, email 2012.*

Michael Silacci, Winemaker and Director of Viticulture at Opus One, confirms that Opus One has used the pre-tissue culture version of what is now the Malbec 22 selection in every Opus wine since 1994. They recognized the clone as Malbec (and not Merlot) using a visual identification. The Malbec clone constitutes about 1% of the Opus vineyard acreage and is only a small percentage of the Opus wine. *Silacci, personal communication, 2012.*

Cot ENTAV-INRA® 596 and Cot ENTAV-INRA® 598

There are two official, certified French clones for the Malbec/Cot cultivar at Foundation Plant Services. That proprietary clonal material is distributed through IFV (formerly ENTAV-INRA) licensees in the United States.

The agency formerly known as The Etablissement National Technique pour l'Amelioration de la Viticulture (ENTAV) was an official agency certified by the French Ministry of Agriculture and was responsible for the management and coordination of the French national clonal selection program.

ENTAV recently merged with ITV France; the new entity is called the Institut Français de la Vigne et du Vin (IFV). IFV continues with the responsibilities formerly administered by ENTAV, including maintenance of the French national repository of accredited clones and ENTAV-INRA® authorized clone trademark to protect the official French clones internationally. The trademark is a good indication that the clonal identity of a vine is correct. Trademarked importations come directly from official French source vines. IFV retains the exclusive rights to control the distribution and propagation of its trademarked materials which are only available to the public from nurseries licensed by IFV.

In the French system, clonal material is subjected to extensive testing and certification. There are now 16 Cot (Malbec) clones that are certified by the French Department of Agriculture and Fisheries. Cot 596 and Cot 598 are both from Cahors vineyards in the region of southwest France near the Lot River. The IFV catalogue states that these clones are valued for their agronomic characteristics and the quality of wines produced from the grapes. *Institut Français de la Vigne et du Vin, 2006.*

Cot ENTAV-INRA® 596 came to FPS in 2000. It successfully completed disease testing and was planted in the Classic Foundation Vineyard in 2003.

Cot ENTAV-INRA® 598 also came to FPS in 2000. It was planted in the Classic Foundation Vineyard in 2002 after successful completion of disease testing. This selection also underwent microshoot tip tissue culture therapy to qualify by the 2010 Protocol for planting in the Russell

Ranch Foundation Vineyard. The tissue culture version of this selection successfully completed disease testing and was planted in Russell Ranch in 2012 as Cot ENTAV-INRA® 598.1.

These proprietary selections may be obtained through IFV licensees who sell ENTAV-INRA® grapevine material in the United States.

Argentinian Malbecs at FPS

The FPS foundation vineyard currently contains many Malbec selections that originated from Argentina. Argentine Malbec clones reportedly differ in appearance from the clones from France. Some of the Argentine clones used in the fine Malbec wines were specifically selected and developed to have small berries and bunches for concentrated flavors. *Mount, 2012, p.235.*

All the existing FPS Malbec clones where the plant material originated in Argentina are proprietary clones that are not available for distribution to the public, either directly from FPS or through a nursery. Malbec 13-17 are owned by an Argentine winery. Malbec 20 and 21 are owned by a U.S. winery. It is possible that Malbec 20 and 21 might become available to the public around 2020 if they appear to be unique in some fashion.

MALBEC IN THE PIPELINE AT FPS

There are several Malbec/Cot selections currently in processing at FPS undergoing disease testing and/or tissue culture therapy.

Malbec plant material came to FPS from Mendoza, Argentina, in 2010. The original vines are currently undergoing disease testing at FPS. If all goes well, the tests could be completed in late winter or early spring, 2013. It is not certain yet whether the material will remain proprietary or be made available to the public.

Duarte Nursery sent to FPS a Malbec selection taken from a California vineyard in 2011. That selection is undergoing disease testing and could be available to the public as soon as 2014.

IFV brought another of the official French clones, Cot ENTAV-INRA® 595, to FPS in 2012. Clone 595 is from the region of southwest France near the Lot River. If disease testing results are all negative, the selection should be available in 2014 or 2015.

Finally, two popular FPS Malbec selections (Malbec 04 and 09) underwent microshoot tip tissue culture therapy in 2011 in order to qualify by the 2010 Protocol for planting in the Russell Ranch Foundation Vineyard. Those selections are currently undergoing disease testing.

UC VARIETY AND CLONAL ASSESSMENTS

The University of California began evaluating appropriate grapes and wines for California in the 1870's. Malbec was one of the cultivars included in the early studies because the Bordeaux cultivars were some of the first imports to the state. Clonal evaluations conducted by the university between 1966 and 2010 built upon those early observations and assessments reported by Hilgard, Amerine and Winkler.

Ough and Alley, 1966

U.C. Davis Professor Cornelius Ough and Extension Specialist Curtis Alley reviewed the data on Malbec based on the work done by Hilgard, Amerine and Winkler plus their own unpublished data from research in the coastal regions of California on the Cabernet varieties (Malbec, Cabernet franc, Cabernet Sauvignon, Ruby Cabernet, Pfeffer, and Merlot). The evaluation was limited to performance in California regions I and II (primarily coastal climates). They noted that Malbec wines that underwent malolactic fermentations suffered a deficiency in acid, an excessively high pH level and deterioration in quality. They did not recommend Malbec for planting at that time, but pointed to a newly acquired Malbec clone at FPS (Malbec 08/12) that promised a heavier production level that possibly could solve the pH problem. *Ough and Alley, 1966.*

UCD Clonal Trial Oakville, 1978-80

A clonal trial was conducted by Cornelius Ough and Curtis Alley on three FPS Malbec selections at U.C.'s Oakville Station in Napa County between 1978 and 1980. The Jaeger Family Foundation of St. Helena sponsored the clonal evaluation with the goal of locating a 'superior clone of Malbec that will do well in....the North Coast area'.

The clonal material was planted at Oakville in 1976 and 1977. The budwood used in the trial was from Malbec 04, 06 and 08, and from two other non-certified clones that never entered the FPS program. In 1978 and 1979, Malbec 08 was by far the best producer in terms of tons/acre (2.83 and 4.0). In 1980, there were no significant differences in yield for the three clones, but FPS 08 had a larger-sized cluster (mean cluster weight). The researchers observed that many clusters had a large percentage of small shot berries which reduced yield, which the researchers attributed to extensive virus acquired from the rootstock used in the trial. *Alley, C.J., 1980; Alley C.J., 1978^a.*

UCD Clonal Trial Oakville Station, 1997-2000

University researchers studied the same three clones again at Oakville, in 1997-2000. Malbec FPS 04, 06 and

08 were grafted onto rootstocks 110R and Teleki 5C and planted in 1992. Four years of data were taken.

Malbec 08 (now Malbec 12) averaged the highest yield for all yield components over the four year period – 10.5 kg/vine total yield and 1.80 kg cluster weight. Malbec 04 was intermediate and Malbec 06 was the lowest. Yearly variation in yield occurred for all selections and was largely dependent on berries per cluster. Differences in clusters per shoot were significant and were correlated with yield. The researchers concluded that Malbec 08, although not consistent from year to year, produced enough fruit even in poor-crop years to be the most commercially viable. The ultimate recommendation was that growers plant Malbec 08, regardless of possible canopy manipulation that could make Malbec 04 and 06 perform with higher yields.

Consistent with yield results, Malbec 06 had the highest pruning and shoot weights, and Malbec 08 had the lowest. There were no differences between rootstocks in average vegetative growth, but there was a significant rootstock-clone interaction for Malbec 06. Rootstock 110R had increased yield in high crop years but did not prevent poor fruit set in low crop years.

Malbec 06 had the highest average soluble solids (23.5) and pH (3.48) at harvest, while Malbec 08 had the lowest (22.1 and 3.36). Malbec 08 averaged the lowest titratable acidities (6.9), while Malbec 04 had the highest TA (7.5). The advantage of any of the three selections regarding Brix was 'very dependent on yield'. *Benz et al., 2007.*

Wine Grape Varieties in California, 2003

A publication produced by the University of California, Division of Agriculture and Natural Resources, in 2003 contains a report on the performance of the Malbec clones that were in the FPS collection at that time. The variety profiles were written by university viticulture extension specialists and underwent peer review by scientists and other qualified professionals. In the book, former Napa Viticulture Extension Specialist Edward Weber wrote that clonal selection is important for Malbec to minimize the risk of coulure. He indicates that Malbec 04 and 06 were particularly prone to poor fruit set and low yields. Malbec 08 (now Malbec 12) was consistently higher yielding but moderate in production. He wrote that Malbec 09 (French Cot 180) and 10 (French Cot 46) showed potential for a more consistent crop set. *Christensen et al., 2003, p. 76.*

UCD Clonal Trial at Kearney Agricultural Center, 2007-2010

UC Davis Cooperative Extension Viticulture Specialist Dr. Jim Wolpert and associate Mike Anderson have complet-

ed phase 1 of field trials at UC's Kearney Agricultural Research and Extension Center (KAREC) in Fresno County. The purpose of the trials was to evaluate viticultural characteristics (color, tannin, acid and sugar) and identify new cultivars that might grow well as varietal wines in the southern Central Valley. The trials were funded by the American Vineyard Foundation (AVF).

Phase 1 of the trials was planted in 2003 with 1103P rootstock. Malbec FPS 06 was one of the red cultivars included in this phase. Viticultural data were collected for the seasons 2007 through 2010. The commercial viability level for growers was set at yields of 8 tons per acre. Wines were made by Constellation.

Dr. Wolpert reported the following to the American Vineyard Foundation in 2011:

'Malbec is considered sensitive to cool temperatures at bloom that lead to poor berry set. Malbec 06 set fruit better than did Malbec 04 in a previous trial at Oakville. Using Malbec 06 in this trial seemed reasonable, especially considering that weather in the Fresno-area during fruit set is likely to be much warmer than in the north coast. However, the yield of Malbec 06 in this trial was too low – 6.5 tons/acre attributable to too few berries per cluster. The yield in the cool year of 2010 was so much lower that it reduced the average yield by almost one ton per acre. The good vegetative growth (1.4 kg/m) and very low yield-to-pruning weight ratio (3:8) indicate that it could have been cropped more heavily in all years.'

'The harvest composition was not the best with Malbec 06 pH creeping up close to 4, even at relatively low Brix (<23). The low rot and good color in the wine make it a cultivar that has some promise if the yield could be improved. Industry members present at the wine tasting evaluations did not like the wine quality of Malbec at Kearney as much as they did from cooler production areas.'

'Malbec is not recommended for planting in the southern Central Valley at this time, but a clonal trial might provide a more attractive selection in terms of identifying selections that could increase yield. Better fruit set should be a consideration in any future clonal trial.' *Wolpert, 2012.*

In summary, the major theme of university research and observations of the Malbec grape from Hilgard's time to the present is that the cultivar has potential in California and is worthy of further study.

CONCLUSION

Malbec continues to attract winemakers as both a blending and varietal wine. Acreage for the cultivar in the United States is increasing in several major wine-producing regions. Foundation Plant Services offers many healthy Malbec selections from which to choose for new plantings.

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UC Integrated Viticulture Online iv.ucdavis.edu - A compilation of viticultural information, resources from UC and around the country, current UC research and articles on every related topic.

National Grapevine Registry ngr.ucdavis.edu - Descriptions of grape cultivars, many of which have photographs, and information on suppliers and nurseries.

UCDavis Extension www.extension.ucdavis.edu - Offers classes on vineyard management, grapevine diseases, winemaking and much more.



*Dedication at FPS for the
Trinchero Family Estates Building
May 4, 2012*

