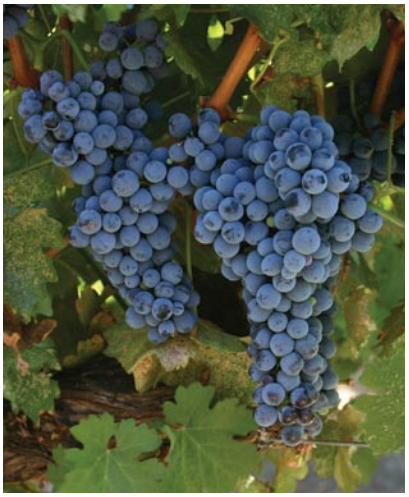

Cabernet Sauvignon at FPS

by Nancy Sweet, Foundation Plant Services

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

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

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

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

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

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

VARIETAL CHARACTERISTICS

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

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

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

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

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

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

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

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

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

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

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

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

PRE-PROHIBITION IN CALIFORNIA

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

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

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

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

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

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

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

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

POST-REPEAL UNIVERSITY EVALUATIONS

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

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

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

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

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

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

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

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

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

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

CABERNET SAUVIGNON ACREAGE

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

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

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

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

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

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

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

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

EARLY FPS SELECTIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Cabernet Sauvignon FPS 02 in the Foundation Vineyard at FPS.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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


Cabernet Sauvignon FPS 08

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

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

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

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

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

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

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

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

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

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

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

CABERNET SAUVIGNON HERITAGE SELECTIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

CLONAL MATERIAL FROM FRENCH SOURCES

In the mid-1980's the Oregon Winegrowers' Association and Oregon State University (OSU) collaborated on a project related to a mutual interest in European clonal material. The former OSU grape importation program was able to import French clonal material, which was later shared with the public collection at FPS in 1988-89. FPS refers to that material as generic French clones. This importation project preceded the official ENTAV-INRA® clone authorization program (2001), so the identity of the generic French clones cannot be guaranteed under that official program. Generic clones are "reported to be" the French clone number assigned at the time of the importation.

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

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

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

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

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

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

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

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

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

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

The *Etablissement National Technique pour l'Amelioration de la Viticulture* (ENTAV) is an official agency certified by the French Ministry of Agriculture and responsible for the management and coordination of the French national clonal selection program. ENTAV maintains the French national repository of accredited clones and has created an ENTAV-INRA® authorized clone trademark to identify its official clonal materials internationally. The trademark is a good indication that the clonal identity of a vine is correct. Trademarked importations come directly from official French source vines. ENTAV retains the exclusive rights to control the distribution and propagation of its trademarked materials, which are only available to the public from nurseries licensed by ENTAV.

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

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

Italian selections

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

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

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

CLONAL EVALUATIONS

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

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

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

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

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

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

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

Lodi-Woodbridge Trial

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

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

Mondavi Trial

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

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

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

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

Beaulieu Trial

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

Lake County Trial

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

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

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

Fresno Trial

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

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

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

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

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Summary of FPS Cabernet Sauvignon Selections

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

Summary of FPS Cabernet Sauvignon Selections (cont.)

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