PRUNE VARIETIES AND THEIR ORIGINS

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One of the most important sources of commercial plum varieties is the species *Prunus domestica*, known commonly as the European plum. This species is thought to have originated in Western Asia, in the area east of the Caucasus Mountains and the Caspian Sea. The *domestica* plum, and especially the dried prune made from it, has been for centuries a staple product of the Mongols, Tartars, Turks and Huns. This dried product was a common commodity of trade and most likely a common provision during the migration of these peoples towards Eastern Europe. The first written record of this species in Europe was in the writings of Pliny the Elder in the first century A.D. The European plum has a history of cultivation in Europe for 2000 years, where it has become an important fruit crop. For many years the "prune" has been defined as a firm fleshed plum of the species *Prunus domestica*, that has a high sugar content and can be dried whole without fermentation at the pit. In recent years, there has been a change in preference of nomenclature, now identifying the dried product as a "dried plum" rather than as a "prune". By the time the *domestica* plum became known in Europe, it was represented by varieties that had well-flavored and large size fruit, an indication of the many years of cultivation before its arrival.

In North America, the European plum apparently did not arrive as early as other fruits such as apples, pears and peaches. References to Damson plums (*Prunus institia)* are present as early as 1629 in Massachusetts, but mention of *Prunus domestica* types does not seem to occur until about 1720. The early immigrants on the Atlantic coast preferred the large dessert type fruit rather than the smaller prune types. The drying of fruit in the humid, rainy weather of the eastern colonies was not easily accomplished.

On the Pacific coast, the first mission in California was established by the Spanish Franciscan Missionaries at San Diego in 1769, followed by an additional 20 Missions in the following 54 years. Records indicate that plums were planted at Missions San Buenaventura, Santa Barbara, San Gabriel, Santa Clara and San Luis Rey. The British explorer George Vancouver saw plums growing at Mission San Buenaventura as early as 1792. At Mission Santa Clara, a variety named the "Mission" prune was still growing in 1870, but it has since disappeared, with almost nothing known about it. Numerous plums and prunes of the *Prunus domestica* type were introduced into California during the early years from 1851 through the 1880's, but the most important introduction, that of the "Agen" or "French" prune, took place in 1856.

From the time of its introduction into California, the French prune has occupied a dominant position in the California prune industry. The regularity with which this variety bears abundant crops, the high percentage of sugars and solids in the fruit and the ability to hang on the tree well into maturity has, in the past, distinguished the French prune from most other prune type plums. Other non-French varieties developed substantial acreage in the early 1900's but over time, many have nearly disappeared from production. The California Agricultural Statistics Service (CASS) estimates the 2005 California prune acreage at 74,500 acres, with 67,000 acres bearing and 7,500 acres non-bearing. This represents an overall drop of over 30 percent in total prune acreage from the 109,000 acres reported in the ground in California in 1998. French type prunes

currently account for 95 percent of all prune acreage in the state. CASS reports all "other" (non-French) prune varieties together as a group with bearing and non-bearing plantings combined. As recently as 1999, **t**he only non-French varieties listed separately by CASS were Moyer at 772 acres, Imperial at 168 acres and Burton at 13 acres, with all "other" varieties at 306 acres. As we shall see, since the 1950's, there has been an interest in new varieties of the "French" type and in the evaluation of new French clones. A result of this interest and evaluation is that there has been some change in the specific definition of what is meant by " French Prune". "French" has become, or perhaps always has been, more a generic definition rather than a specific variety.

THE AGEN IN FRANCE

The origin of the "French" prune dates back to the thirteenth century. Traditional history indicates that Benedictine monks accompanying Crusaders in the vicinity of Turkey or Persia (Iran) brought back what was known in that region as the Date plum. This new acquisition was planted on the grounds of the Benedictine abbey near Bordeaux, France. The name "pruneau d'Agen" came into common usage in France because of the extensive plantings of this prune that developed in the region known as Agen near the town of the same name. Several names have come to be associated with this prune. These include Agen, Prune d'Agen, Petite Prune d'Agen, Petite Prune and the variety name in current usage in France, Prune d'Ente. The prune industry in France is historically associated with the Lot Valley where the Agen has been grown for nearly 500 years. Production peaked in the mid-1890's at a time when more than 5 million prune trees were in the ground with a production of 56,000 metric tons.

In modern times, evaluation of various clones of the Agen variety began in France in 1947. Dr. R. Bernhard at the Grande Ferrade Research Station near Bordeaux, France initiated a survey of the existing old plantings of Agen throughout France seeking naturally occurring mutations. His program had three specific objectives. These were the improvement of fruit size and productivity, the development of a regular bearing habit and the improvement of tree vigor. Over many years of culture in France, individual trees of the Agen had developed discernable differences. These included such characteristics as variability in the date of pollen shedding, date of leafing, fruit size, productivity, date of maturity, bearing habit and tree vigor. Most clones found during this survey period in France are thought to be the result of natural mutations. These mutations likely have occurred on the Agen variety over many years rather than developing from seedlings of Agen, because their differences are small compared to what would be expected from among seedling populations. From these old plantings, Bernhard selected 57 different clones of the Agen, each having at least one characteristic different from the general population. This collection of clones was evaluated at a research station at Bourran in the Lot and Garonne Valley. By the 1950's three improved clones of the Agen had been released to French growers. The selections were identified as Prune d'Ente 707, 698 and 626 or more simply as (Grande Ferrade) **GF 707, GF 698** and **GF 626.** All of these clones satisfied the goals of improved size, vigor and productivity over the general prune population but differed among themselves as to the degree of improvement. The GF 626 clone was less vigorous than the GF 707 and had substantial early fruit drop. In addition, the dried fruit quality was inferior to GF 707. The GF 698 clone was less vigorous than GF 707 but with equal fruit quality. The GF

698 also was less productive than GF 707 and harvested later than GF 707. Because of its high level of productivity, fruit quality and tree vigor, the GF 707 rapidly became the standard variety of the prune industry in France. After the removal of all significant viruses from the GF 707, the clone was re-identified as **GF 2733.**

(Photo of 2733 or 707)

Within a short time, however, it became apparent that a pollination problem existed with the new clone. In cool, wet years, pollen shedding occurred after the peak receptive period of the flower pistil, resulting in poor fruit set and reduced production. To remedy this situation, Bernhard released three additional clones in 1962 that were recommended for interplanting in GF 2733 orchards to enhance fruit set. The three were numbered **GF 303, GF 642** and **GF 652** and included both early and similar pollen shedding timing. Maturity differences between these selections were not so great that they would constitute a harvest problem when fruit was harvested from the ground. At present, the most common combination of clones for planting in France is the GF 2733 with the early pollen shedding GF 303 as pollinator.

PRUNE d'ENTE CLONES IN CALIFORNIA

In 1959 Professor C. Hansen at the University of California, Davis imported five clones of the Prune d'Ente into California for testing. Included among them were the GF 707, GF 698 and GF 626. Field trials beginning in 1960 and directed by David Chaney, who was then Farm Advisor in Sutter and Yuba Counties, produced the following information about the clones, reported by Chaney in 1981.

"GF 626 Flesh pressure softens earlier than French and there is usually appreciable fruit drop before desirable soluble solids are attained. Early harvest is usually required to avoid picking after heavy drop. Drying ratios of the fruit usually exceed those of French.

GF 698 Blooms 1 to 2 days later and harvests a few days later than French. Average fruit size has been slightly larger than French in mature trees. Dried fruit quality has been good. It has been grown only in field trials.

GF 707 Has consistently yielded crops as large as French and produced significantly larger fruit. It produces the largest fruit size of any of the numbered French clones and larger than any of the tested French clones selected from California prune orchards. The skin quality frequently is not as good as that of French. Soluble solids have averaged slightly lower and drying ratio slightly higher than French. It is grown commercially in a small amount."

As a result of the 1959 importation and subsequent evaluation, a small acreage of the Prune d'Ente clone GF 707 was planted in California. Soon after these early plantings began to bear, a problem began to appear with the variety. After dehydration and during processing, the GF 707 develops a slight skin peel that results in a dull, greyish appearance often referred to as a "mousey" color. In addition, in some locations,

the GF 707 was less productive than the California French prune. Further planting of GF 707 has been discouraged by fruit processors. By 1999, plantings of GF 707 in California had declined to 47 acres.

In 1985, four additional clones of the Prune d'Ente were imported into California by T.J. DeJong and J.F. Doyle of the UC Davis Pomology Department. These clones were established in a field trial at the University of California's Kearney Agricultural Center at Parlier in Fresno County. The Prune d'Ente clones included GF 642, GF 652, GF 303 and GF 2733. At six years of age, in a direct comparison with a standard commercial California French clone, all four Prune d'Ente clones were less productive. In addition, with some clones, various problems in adaptation to the hot California interior valley growing conditions became apparent.

GF 642 This clone was the best performing and closest in appearance to the California French clone. Tree form, vigor, bearing habit and date of maturity were all comparable to the standard. Fruit size was slightly larger than French but soluble solids content of the fruit was slightly less, resulting in slightly lower average count per pound. The most substantial limitation of this d'Ente clone was its reduced productivity. At six years of age the GF 642 had produced only a cumulative 66% crop of dried prunes in comparison with the standard French.

GF 652 The GF 652 is a spur type tree with moderate vigor, few strong upright scaffold limbs and a relatively dense spur and short lateral limb growth pattern. The tree can be pruned easily and quickly. This clone was one of the two lowest producers of all varieties in the test. At six years, the cumulative productivity was 45% of French. The low productivity of this clone has also been reported in France. The fruit of GF 652 does not hang well on the tree. Substantial drop usually occurs when the fruit pressure reaches 4 pounds. This rapid drop, also reported in France, necessitates early harvest of the crop at less than optimum soluble solid content. Fresh fruit size averages several grams larger than French but the need for early harvest results in lower soluble solids content and higher counts per pound than French. The clone is not at all suited to a shake-catch system of harvest.

GF 303 The GF 303 clone of the Prune d'Ente is the most popular pollinator variety interplanted in France along with the principal variety GF 2733 (GF 707). In the Kearney evaluation, it was similar in vigor, bearing habit and date of maturity to the California French but after six years, produced only 45 percent of the standard. This cultivar did not appear to be well suited to California interior valley growing conditions. In three consecutive years, towards the end of the growing season, approximately one third of the fruit darkened internally and began to shrivel prematurely on the tree. Much of this heat damaged fruit did not drop but remained on the tree and was harvested along with the sound fruit. Soluble solids accumulation was negatively impacted in the shriveled fruit. The presence of this damaged fruit in the bulk harvest produced the lowest soluble solids reading of any prune in the Kearney evaluation. This lack of heat tolerance and low productivity in the GF 303 indicates a major problem with adaptation in California.

GF 2733 As mentioned previously, the GF 2733 is the principal prune variety grown commercially in France. In the Kearney evaluation the tree was vigorous and very similar to the California French in tree form and bearing habit. Fruit size was large and produced a high quality dried product. Limited processing indicated a similar skin peel problem to that of the GF 707. Productivity was substantially less, at six years of age cumulatively only about 65 percent of the standard. Date of maturity varied from the same to a few days later than the California French.

At the same time that the four Prune d'Ente clones were being evaluated, another prune from France, the **GF 812** or **DOUBLE ROBE** was included in the test. In France it is sometimes identified as a sub-variety of the prune d'Ente. The variety originated in France. It was found in an orchard of Agen but is probably a seedling of Agen rather than a mutation. The tree form is distinctly different from that of the Agen, more open, less branched and with thicker limb caliper. The tree is highly vigorous but can be formed and pruned easily. Leaf size is larger and more rugose. Flower characteristics also vary from that of Agen. It appears to be self-fruitful. At Kearney, the fruit was larger than that of the California French, with a relatively small pit. The tree was productive, fully as productive as the standard. The fruit is lighter in color than the California French, of good quality and matures a few days later than the standard. The tree and flowers appear to have a relatively high chilling requirement. Due to the large fruit size, the fruit needs a longer drying time than average. It also tends to bleed, slab and stick somewhat to the drying trays. The light color of the fresh fruit produces a rather brown dried product. This variety is not widely cultivated in France.

THE AGEN IN CALIFORNIA

The Agen prune is reported to have been present on the East Coast of the United States as early as the 1830's. It was described by the horticulturist William Robert Prince in "The Pomological Manual or a Treatise on Fruit" published in New York in 1832. The Agen was also reportedly imported by the United States Patent Office in 1854. In that same year, however, the Highland Nursery of New Rochelle, New York and their agent nursery the Commercial Nurseries of Mission Dolores, San Francisco, California listed the Agen among the 132 plums offered for sale in their nursery catalog. It would seem that the Highland Nursery must have been propagating the Agen at least for several years previous to 1854. No record has been found that indicates any significant plantings of the Agen developed in California from this source although a small planting of Agen was established in 1850 by Jules Frosiere near Mission San Jose.

The credit for the importation of the Agen variety that would develop into one of the most important deciduous fruit tree varieties in California has been given to Louis Pellier. Born in 1817 in the Department of Charente Inferieure, France, Pellier at the age of 31 left his native country on an adventurous journey. Travelling from France to North Africa to Portugal he eventually arrived in South America. Early in 1849, Pellier considered taking up residence in Chile, but news of the discovery of gold in Northern California caused him to reconsider and to join the rush for riches. Several different accounts of Pellier's success in the California mines exist. One story indicates he did well in the mines of Trinity County, but the rigors of the cold winters drove him back to

the Bay area in the early 1850's. Another account attributes failure in his quest for gold as the reason for his return to San Francisco. Regardless of which was true, Pellier eventually turned his attention to the nursery business in San Jose. Pellier had been trained as a horticulturist since his youth and success as a nurseryman came quickly. In 1853, his brother Pierre Pellier joined him at Pellier's City Gardens in San Jose. The rest of the story has often been retold, of how Pierre returned to France to marry and how in 1856 he subsequently returned to California crossing the isthmus with his new bride, another brother Jean and his son and a brother-in-law. In addition, at the request of Louis Pellier, Pierre brought back from France a substantial collection of seeds, scions and cuttings of numerous tree fruit and grapes. Among the many varieties was one item of major significance, "la petite prune d'Agen".

The Pelliers shared some of these first scions of Agen with other orchardists, most notably George W. Tarleton and J.Q.A.Ballou of San Jose and another nurseryman B. Kemp. In fourteen years, from these first propagations, there were 650 acres of prune trees in California. About 300 of these acres were in Santa Clara County, with much of the rest in nearby locations. Undoubtedly, through the late 1800's, there were numerous subsequent importations of the Agen from various locations in France. These importations also undoubtedly resulted in the establishment of several strains of Agen from varying districts in France. By 1875, there was some concern about the authenticity of the Agen clone brought from France by the Pelliers. The dried fruit from California seemed to be smaller than fruit of the Agen imported from France. It was thought that clones called the "petite (small) prune d'Agen" might not have been the true prune of commerce in France. In 1878, William B. West, a Stockton nurseryman, traveled to France with the express purpose of determining whether the Pellier Agen was in fact the real Agen. Eventually the import was deemed correct. At about this same period of time a general shift began to occur in California away from the name Agen or prune d'Agen or petite prune d'Agen, to the simple designation of "French Prune" or "Petite Prune" (sometimes pronounced "petty prune"). U.P. Hedrick, writing in his definitive "Plums of New York" in 1911, makes note of this change. Hedrick relates the introduction of the Agen by Pellier and then states, "…it (the Agen) soon became and still is the leading plum, though with curious persistency the fruit-growers there (in California) call it the French Prune and the Petite Prune".

THE CALIFORNIA "IMPROVED FRENCH" PRUNE

Almost from the very beginning of the dried prune industry in California there has been an abiding interest in the development of new and improved varieties of prunes. This search, on one hand, has taken the form of the importation or development of completely new varieties, with the promise of a larger, more flavorful dried product or improvements in processing or horticultural characteristics. On the other hand, there has also been a continuing desire for improvement of the Agen or French prune itself. This search for improved clones of French or closely related seedling types has also been centered on improvements in horticultural or processing characteristics, but in addition has sought to preserve the basic identity of the French variety.

In November of 1898, Luther Burbank, the famous plant breeder of Santa Rosa, California, sold a prune variety he had named "Miller" to Leonard Coates, a nurseryman at Morgan Hill, California. The Miller had originated as an open-pollinated seedling of the Agen. After ten years of testing, in 1908, Coates began to sell the variety that he had by then re-named the **IMPROVED FRENCH**. The new variety was very similar to the original Agen except that it was reported to be somewhat larger and more uniform in fruit size. Leonard Coates was a long-time nurseryman in California, beginning at Napa from 1875 to 1905. He had a short residence at Fresno and then expanded to Morgan Hill about 1910 until his retirement at Clear Lake in 1920 after 42 years as a nurseryman. During his long career, Coates sought to improve the French prune by the selection of buds on full French trees or specific limbs of French trees that appeared to be superior in size, productivity or some other horticultural characteristic. By the re-propagation of these variants followed by rigorous evaluation, Coates worked to develop the ultimate in improvement of the French prune. In about 1910, E. J. Wickson addressed a meeting of the California Association of Nurserymen. Wickson, who had joined the University of California College of Agriculture about 1879, was also a long-time editor of the Pacific Rural Press/ California Farmer Magazine. He eventually served as Dean of the University of California College of Agriculture and the University of California Experiment Station. In a reference about Coates' work, Wickson stated, "Coates then practiced what he preached and was on the trail of improved varieties of the French prune and in such pursuit of the right line, that probably the best variety of French Prune that we now have, fifteen years after his initial proclamation, is one of his selections." Ten years later, in1920, Coates was propagating several French clones that were the result of natural mutation. In fact, many of the leading nurseries at that time were offering "improved" French prunes of one type or another. By then, Burbank's "Miller" AKA "Improved French" had undergone another name change to "Morganhill".

In 1904 a limb of a natural mutation was discovered in an Agen orchard at Saratoga. The fruit was reported as considerably larger and somewhat more oval shaped than the original Agen. It also was reported as highly productive, producing fruit of high quality. This limb sport was re-propagated by Leonard Coates in his nursery orchard at Morgan Hill. Eventually the sport received the name **COATES 1418.** At various times the mutation also received the names Cox, Double X, Date Prune, Saratoga and Saratoga XX. This clone produced large size fruit when the trees were young, but the fruit pits were larger in size than those of the standard French. As the trees became mature, however, the fruit size became similar to French. The variety was never widely planted in California, but in the 1960's was grown to a limited extent in the Willamette Valley of Oregon. No orchards are in existence in California today.

It is not clear whether the improved clone of French referred to by Wickson in his address of 1910 was Burbank's Improved French or Coates 1418 or some other clonal selection of the Agen. A.H. Hendrickson writing in his "Prune Culture in California" in March of 1930 states "Several so-called improved "strains" of the French prune have been introduced in the past few years. Some of these have much promise". Prior to the 1950's it does appear that there was consensus among some of the leading nurserymen of that era that a single clone of Improved French was the "French Prune" of preference.

(Photo of Improved French)

Since that time several large California nurseries have listed their French clone as "Improved French" or "French Improved". Long time nurserymen indicate that one of the primary forces in the selection of a "standard" Improved French in the late 1940's and early 1950's was the shift from harvesting off of the ground to the mechanical shake-catch system. This new system necessitated the use of a clone of French that was not only uniform in size but more importantly was also uniform in maturity. The Improved French in contrast to the clones of Agen is substantially more uniform in both of these regards. The specific origin of the present day Improved French is difficult to trace. It is also unclear whether only a single Improved French exists or whether it is a combination of improved clones of French. European researchers and nurserymen generally consider the Improved French grown in California as a single variety, distinctly different from the Agen or Prune d'Ente grown today in France, and credit the development of this variety to Luther Burbank. It is certainly reasonable to suggest that the bulk of the prune orchards grown in California today are made up of Improved French, not the Agen or "French Prune"of seventy-five or more years ago. For the curious, it may be left to DNA analysis to sort out whether "Improved French" is a single variety or a multiple clone and whether it is Burbank's seedling or some mutation of the original Agen.

As grown in California, the Improved French tree is upright growing and vigorous, with strong branches capable of successfully bearing heavy crops. The tree is self-fertile with average precocity, usually bearing some fruit at third leaf and, if long-pruned and well grown, produces substantial fruit in fourth leaf. The tree has a moderate tendency to alternate bear, especially after heavier than average crops. The blooming period is mid-season within the *P. domestica* species. Bloom is abundant and well distributed throughout the mature tree. Leaves are medium in size, medium to light green in color and moderately shiny. Fruit maturity is mid-season for the species.

The fruit is medium sized and usually matures rather uniformly throughout the tree. The fruit form is ovate, with a slight neck. Skin color can range from a reddish-purple to a full purple, covered with a light greyish bloom. The fruit flesh is yellow to amber in color and dense in texture. The fruit pit is small, generally oval in form, thin in thickness and with smooth overall surfaces. The pit is semi-free with fibers at times attached along the ventral surfaces of the pit. Fruit soluble solids often range from 22 to 24 degrees Brix and above with average crops. At that sugar level, fresh to dry (drying) ratios can commonly average 3 to 1.

In addition to its use for drying, large size Improved French fruit are packed and sold as fresh fruit. Much of the product is exported to Pacific rim countries. Over 238,000 packages of French prunes were shipped fresh in 2001 and 225,000 packages were shipped in 2002. Since that time, fresh production has generally declined. The California Tree Fruit Agreement reports 21,031 boxes of French packed in 2005 and an estimate of about 22,000 boxes to be packed in 2006. The volume of fresh fruit packed often depends on the crop load set throughout the various growing areas in California in

any specific year. Light sets increase the individual fruit size and the economic feasibility of picking for the fresh market.

MUTATIONS OF FRENCH IN CALIFORNIA

Since 1950 several mutations of the French prune have been discovered and planted in California. Over time, none have been particularly successful. Many have been planted only in small acreages.

GERRAN'S EARLY FRENCH

This mutation of the French prune was discovered in the late 1950s in the W.A Gerrans orchard in Colusa County, California. It was first commercially planted in 1961. The fruit generally resembles French Prune in form but is substantially smaller in size, slightly more narrow and slightly more necked than French. The Gerran's tree is also similar to French in form but as it grows to maturity is most often smaller in stature. The tree blooms a few days earlier than French and is self-fertile but with fruit maturing up to two weeks ahead of French. Cropping is somewhat erratic and often is light. Sugar in the Gerran's ranges from 2 to 3 degrees higher than French and drying ratios are very good, typically ranging from 2.50:1 to 2.75:1. Although initially widely planted, the variety has fallen out of favor due to the small fruit size and irregular yields. Very few acres have been planted since 1985 and by 1999 fewer than 400 acres remain in the ground.

(Photo of Gerran's)

FRIEDMAN

The Friedman French clone was introduced and patented by Martin Friedman of Gridley, Butte County, California. The original test planting was established in about 1972. Fruit form is similar to French but with a slightly more pronounced neck. The Friedman tree form is similar to French. The tree blooms a few days later than French and flowers are particularly abundant, more dense than French. The tree is apparently self-fertile. Fruit quality is good, essentially the same as French. Fruit production has been erratic in some locations. Very few trees have been planted since 1985 and about 300 acres of trees were left in the state by 1999.

VICTOR LARGE

The Victor Large Prune originated at Morgan Hill and was developed by Victor Locarnini. The first commercial plantings were made in California about 1970. The fruit is very similar in form and quality to French, but may be slightly larger when the tree is young and crops are light. As the tree matures, cropping is identical to French. The tree is vigorous and productive. The tree blooms at the same time as French and is self-fertile. Date of maturity is identical to French. Almost no orchards of this variety have been planted since 1985. Currently less than 300 acres remain under cultivation.

PUNIAN

The Punian prune was discovered in a Yuba City orchard as a mutation of French by Gurbachan Punian in the late 1960's. After re-propagation and evaluation, the prune was eventually patented and released in 1990. The tree is vigorous, similar to French in form but quite thorny. Fruit maturity is early, at least two weeks ahead of French. The fruit is generally similar to French but with a somewhat darker purple blush color and a more green ground color. The flesh color of the Punian is more green than French and upon drying turns rather dark. Sugar accumulation in the fruit is good with low drying ratios. The tree develops abundant bloom but it has been difficult to set. The tree does not appear to be self-fruitful. Use of various pollinators has not seemed to increase the reliability of set. Of the few orchards that were established, most have been removed.

"OTHER" PRUNE VARIETIES

During the early part of the twentieth century, non-French type prunes made up a substantial part of California prune acreage. Over the last fifty years, however, the productivity, consistent bearing habit and ease of handling of the French prune has eventually relegated most other non-French varieties to the pages of history. Varieties such as the Bulgarian, Wangenheim, Hungarian, St. Martin, Hungarian Date, St. Catherine, Golden and others listed in publications of the late 1890's are nowhere to be found in California today. Current California statistics set the acreage of non-French varieties at only 1,869 acres or 2.5% of the total prune acreage of 74,500 acres. When the comparison is made between current acreage and the 24,500 acres of non-French prunes growing in California in 1940 (16.7% of the total acreage) the downward trend is clear. With the prune crop now completely mechanically harvested, French, and particularly the Improved French with its uniform maturity, has demonstrated its supremacy over the old non-French types. The spread of maturity in many of the old, non-French prune varieties was substantial and the one-pick mechanical harvest reduced the quality of the total harvest. The superior durability of the skin and flesh of the French prune also gave it an advantage over the often soft flesh or delicate skin of the non-French types. Many of the old varieties had large, rough pits that were tightly attached to the fruit flesh. With a high percentage of today's dried prunes sold as pitted prunes, these large, tight, rough pits presented a difficult processing problem. Much of the non-French prune acreage today is represented by prune varieties grown only for the fresh market. The eight varieties described below, with the exception of the Moyer, are either now commercially extinct or will most likely be totally out of commercial production within the next ten years.

MOYER

The Moyer prune, sometimes referred to as Moyer Perfecto, was discovered as a seedling growing at Roseburg, Oregon in about 1925. The seed parent is thought to be Coe's Golden Drop, also know as the "Silver Prune". Originally selected in Oregon as a prune for drying, over the last 15 years it has become one of the primary fresh market shipping prunes in California. Statistics from the California Tree Fruit Agreement Annual Report indicate that 223,000 packages of Moyer were packed for fresh shipment from California in 2001 and 283,000 packages shipped in 2002. Total production has recently declined with 126,274 packages packed in 2005 and an estimate of about 135,000 predicted for 2006.

The tree is an upright grower with strong, thick limbs and smooth light grey bark. The tree is very vigorous and slow to come into bearing. After cropping commences, the tree can be distinctly alternate bearing. The fruit is substantially larger than French and production can be quite heavy in the "on" year. The fruit is generally oval and symmetrical, with a uniform blue to dark reddish blue coloration when fully ripe. The fruit is overlain with a heavy greyish and waxy bloom. Date of full bloom can vary from 2 or 3 days to as much as a week later than French. The tree is self- fertile. Fruit harvest is about ten days later than French.

The fruit is difficult to dry. The accumulation of sugar is lower than French and drying ratios are usually in the 4:1 range. The large fruit needs a longer drying time than French and it tends to slab out and bleed on the trays, making removal from the trays more difficult. The internal color of dried Moyers is somewhat orangish and the dried flavor is different from French. The pit is large and adheres substantially to the flesh. Most Moyers sent to the dehydrators are cull-outs from the fresh fruit packing lines and end up as a byproduct. Slightly less than 800 acres of Moyers were reported in the ground in 1999. A current estimate of Moyer plantings is about one thousand acres total, both bearing and non-bearing.

(Photo of Moyer)

IMPERIAL

The Imperial prune is a relatively old prune of French origin. Known in France as the Imperial Epineuse, it was discovered in 1870 as a chance seedling growing on the grounds of an abandoned monastery near the French town of Clairac. It was first imported into California in 1883 by the nursery pioneer Felix Gillett and grown at his Barren Hill Nursery at Nevada City, California. After several years of testing, Gillett first offered it for sale in 1893 under the name "Clairac Mammoth". Another nurseryman, John Rock of Niles, California also imported the Imperial in 1886. The two imports were perceived to be two different strains, with the Gillett strain more regular in bearing habit. In more recent years, several strains of varying size and quality have been selected in France (#449 and #851) but have not been tested in California.

The Imperial tree is vigorous with a more spreading growth habit than French. The tree is somewhat brittle and subject to early decay. The tree is often a shy bearer, but when heavy crops do occur, it becomes distinctly alternate bearing. In heavy crop years, the tree must be thinned to produce an acceptable dried product. The fruit is usually somewhat larger than French and oval in shape. Skin color can vary from a dark red to purple-red. The flesh color often has a greenish tint. The pit is somewhat larger than French and semi-free. The flesh color can darken and develop air pockets when temperatures are elevated near harvest time. Date of full bloom can vary from a few days ahead of French to fully overlapping the French full bloom. The Imperial flowers are self-incompatible and need a cross-pollinator. French, Burton and Sugar are all satisfactory. Fruit harvest date is about a week ahead of French depending on crop load.

Because of its size, the Imperial is difficult to dry. Drying times are substantially longer than for French. Sugar accumulation is not particularly high and drying ratios can approach 3.75:1 or higher. The fruit will slab out and bleed, sticking to the drying trays. In 1958, Imperials in California totaled 6,338 acres. By 1999, only 168 acres of Imperials were left in the ground in California.

BURTON

The Burton prune was developed by R.E. Burton of Vaca Valley in 1906. Burton had emigrated from England in 1874 and settled near the present day town of Vacaville. In 1886 he obtained trees of the Imperial from both Felix Gillett and John Rock. In 1906, Burton planted seed that had been produced on a limb of Tragedy plum grafted onto the Imperial tree that he had received from Rock. From this population of from 75 to 100 seedlings the Burton prune was eventually selected.

The tree is vigorous, upright in form and slightly thorny. The variety is only partially self-fertile and usually needs a pollinator to produce full commercial crops. Bloom of the Burton overlaps both French and Sugar in timing. The fruit is very large with a substantial neck. Skin color varies from a light purple to a darker blue and with a moderate amount of greyish bloom covering the fruit. The flesh color ranges from yellow to a darker yellow-gold. The flesh texture can be somewhat coarse and the pit is very large, semi-free and with a rough surface. Harvest date is about ten days later than French.

Harvesting and drying are difficult with this variety because of substantial variation in maturity within the tree, the thin skin of the variety and the very large size of the fruit. Drying times are greatly lengthened in comparison to French. Under standard drying circumstances the fruit slabs out and bleeds heavily producing a poor quality product. Under modified drying conditions, however, where temperatures are reduced and the fruit has attained a high level of maturity, the dried product can be excellent. Very few Burton orchards are left in California. Only 13 acres were listed as being in commercial production in 1999.

(Photo of Burton)

SUGAR

The Sugar prune was released by Luther Burbank in 1899. It is reported to be an open pollinated seedling of the Agen. The tree is upright in growth habit and can grow to be quite large. The tree is very brittle and the limbs break readily under heavy crop loads. The tree is fully self-fertile and can be very productive. Heavy crops need to be thinned to produce acceptable size dried fruit. The tree is extremely alternate bearing. Under normal crop loads the fruit is somewhat larger than French. The fruit is oval in form and dark red to purple-red in color. Flesh color is amber. Mature fruit can develop flesh pockets prior to harvest. The flesh texture is somewhat coarse and the pits are large with a rough pit surface. Many pits have a strong wing along the ventral suture that can crack off or separate from the main body of the pit causing the presence of pit fragments. Harvest date of the Sugar is from a week to ten days earlier than the French.

Although the sugar content is reasonably good, Sugar prunes need a longer drying time than French and have a relatively high drying ratio of 4:1. The fruit bleeds excessively under the normal drying temperature near 165 degrees F. The dried product is often of only fair quality, being rather coarse and stringy. Very few orchards of Sugar are left in California and those few that remain are usually shipped to the fresh market. In 2001, a little over 5,000 boxes were reported in the California Tree Fruit Agreement Annual Report to have been shipped fresh. In 2002 only 484 boxes were packed and shipped.

(Photo of Sugar)

ROBE DE SARGEANT

Of French origin, the Robe de Sargeant was grown in California to a moderate extent, with about 1300 acres reported in the ground in 1958. Today in 2003, the variety is very nearly commercially extinct. The fruit, when the tree is moderately cropped, can be somewhat larger than French. Shape of the fruit is oval and the fruit skin color is a deep purple, sometimes approaching black, and overlain with a thick grayish-blue waxy bloom. Fresh flavor of the fruit is sweet and rich, although occasionally with a lingering astringency. The flesh texture is juicier than French, green-yellow in color with a large, rough-surfaced stone that adheres to the flesh more so than French. Moderately cropped trees can develop soluble solids of 24 percent Brix or above, but the fruit begins to drop from the tree badly at pressures of 3.5 lbs or below. Drying ratios are higher than those for French and the fruit on drying trays has a tendency to slab, bleed and stick to the trays, a result of the excessive juiciness of the ripe fruit. The dried fruit is very black in external color and is of good quality when carefully dried. In the past, Sargeant dried fruit was sometimes blended with French. Trees of the Sargeant are self-sterile and need a pollenizer such as French or Sugar. This self-sterile characteristic can lead to irregular cropping in cool areas or in cool and wet years. The tree is an upright grower and has broad leaves that are large and dark glossy green in color. The tree is somewhat brittle. The variety is highly incompatible with peach rootstock.

Some confusion exists as to the origin of the Sargeant in France and as to its exact name. In 1911, U.P. Hedrick writing in his “Plums of New York” indicates that French growers at that time held Sargeant, Agen and Prunier Datte to all be the same variety. John Rock of Niles and W.B. West of Stockton, both early day nurserymen in California, imported the Sargeant into California prior to the 1890’s as a distinctly different variety from the Agen. Leonard Coates at Morgan Hill, who had imported the Prunier Datte into California, maintained that it was the same variety as Robe de Sargeant. In older literature (1892-1920), the variety can be found listed as Robe de Sergeant, Robe de Sargeant, Robe de Sergent and simply Sergeant or Sargeant.

ITALIAN

Although no longer grown in California, the Italian prune still remains an important variety in Oregon, where it has been dried, canned and sold fresh. This variety is known

by a number of names, Quetsche D'Italie in France, Prugna D'Italia in Italy and commonly as Fellenburg in other areas of Europe (especially Germany), where it took on the name of the man who first imported it to Germany from Italy. The variety originated in Italy around 1800, reputedly from the area around Lombardy. It was reported in the United States in 1831 and was listed in nursery catalogs in California by 1854. Initially, in California, the Italian prune was planted in the Santa Clara Valley, but has never been well adapted to the hot, dry interior valleys of California where both the tree and the fruit can suffer substantial heat damage. The medium vigor and open growing habit of the tree probably worsens the heat injury due to full exposure of both tree and fruit to the sun.

The fruit is oval in form, tapering somewhat towards the stem end. The fruit is usually larger than French and hangs well on the tree. Fruit color is dark blue to dark purple-black, often speckled with yellowish dots and covered with very thick, waxy bloom. The fresh flavor of the fruit, when well grown in adapted areas, can be quite rich and aromatic, with a higher level of acidity than French. The flesh is greenish-yellow and relatively firm. The stone is nearly free, although with roughened surfaces, a short tip and wings along the ventral edge of the stone. The tree is self-fertile. Dried Italian prunes are usually very dark in color. This variety does not attain as high of a sugar content as French but does have a higher acidity. Thus, the dried product can be quite tart.

Several early maturing "Early Italian" types have been grown in Oregon, such as Richards, Milton, Demaris, Reuter and Greata. All are similar in form to the standard Italian prune but can mature from 7 to 14 days earlier. The several varieties have not always been maintained as separate varieties but have been sold simply as "Early Italian".

GERMAN

Numerous strains of this old European prune exist, due to the long-standing practice of planting orchards of this variety from seed. Trees of the German prune produced from seed bear fruit with only moderate variability from tree to tree. The German prune was one of the most widespread varieties grown in Europe. The source of this variety is obscured by time, but may be similar to that of the Prune d'Agen, having been carried back to Europe from Asia by Crusaders. The German prune was grown in Hungary in the 16th Century, with the dried fruit commercialized into Italy, Switzerland and Germany. The variety then spread widely into Europe by the end of the 17th Century. The first clear mention of this variety in America was in 1832. One of the best of the many German prune strains, the Latz strain, entered the United States in 1850 from Prussia. In California, the German prune was listed by nurseryman A. P. Smith at Sacramento in his 1856 catalog. Production of the Latz strain of the German Prune occurred at Wright Station in Santa Cruz County, beginning about 1900. German prune production was never widespread in California, limited to specialty packs. Even surviving specimen trees of this old late-season variety are now hard to find in California.

The fresh fruit is generally small to medium in size, long and oval in form and slightly tapered at the apical end. Fruit color is a purplish-black with some basal speckling and heavy bloom. The stone is relatively free. The fruit flesh is firm, yellow-

green in color, moderately juicy and sweet with a mild, pleasant flavor. The tree is large, hardy, vigorous, a regular bearer and quite productive.

SILVER

The Silver prune, also known as the Golden Drop, was grown commercially in small acreage in the early 1900's, primarily in Santa Cruz County. The yellow colored fruit, when dried and sulfured, produced a high quality, light blond colored product that when large in size, brought excellent returns. The fruit was also shipped fresh into the San Francisco market.

This late season variety was developed in about 1809 by Jervaise Coe. Coe was a market gardener living at Bury St.Edmunds, in Suffolk, England. It was raised from a seed of Green Gage, that was thought to have been pollinated by the White Magnum Bonum plum (also know as Yellow Egg). The Golden Drop arrived in America in 1823, sent by the noted English pomologist Thomas A. Knight to John Lowell of Massachusetts. At one time on the Pacific coast, the Silver prune, as it was re-named there, was considered to be a seedling of Golden Drop that originated in Oregon. That theory has been discredited and the Silver Prune and Golden Drop are now considered to be the same variety. The Golden Drop was listed in the catalog of Warren and Sons Garden and Nursery at Sacramento as early as 1853.

The fruit is large, yellow in color, oval in form, with only a very slight neck. The flesh is firm, juicy and yellow in color. The stone is semi-free, somewhat rough surfaced and often with a conspicuous wing. The variety matures late in the season and seems to perform best in cooler areas of the Pacific Coast. The fresh fruit flavor, when grown in adapted areas, has been regarded as excellent, perhaps reflective of its Green Gage parentage. The dried product, when carefully processed, has also been considered as among the best in sweetness, size, appearance and flavor. The tree is hardy, but is a slow grower, neither highly precocious nor productive. The variety is not self-fertile. No commercial production of the Silver prune has occurred in California for many years.

PRUNE VARIETY DEVELOPMENT

THE FRENCH PROGRAMS

In addition to past efforts to improve prune varieties by selection of mutants of the Agen and the importation and evaluation of varieties that had been developed prior to the early part of the 20th Century, several prune breeding programs have been active in the modern era since the end of World War II and have released new varieties to the prune industry. The program of R. Bernhard at the Grande Ferrade Research Station near Bordeaux that was initiated in 1947 has been noted previously in relation to the selection of superior clones of the Prune d'Ente. In 1958, a second program at Grande Ferrade was initiated by R.Renaud with the goal of developing new prune varieties by means of hybridization between existing varieties. This hybridization program had three objectives. First, the development of new varieties with harvest dates both earlier and later than the Prune d'Ente, with the intention of spreading the timing of harvest and drying, thereby improving the efficiency of each of these operations. Secondly, to develop more precocious tree types and thirdly, to improve the technical quality of the fruit (lower

drying ratios, freestone fruit types, etc…). Several thousand hybrid seedlings were developed in 1962 and 1963, selected down to 60 by 1970 and down to a final 3 by 1982. These final selections were released to French growers and named Primacotes, Lorida and Tardicotes.

The **PRIMACOTES** prune is the result of a cross between a seedling of the Prune d'Ente and a clone of the Prune d'Ente. In France, the fruit is described as maturing 3 to 4 weeks ahead of the Prune d'Ente 707. It is medium to large in size and oblong in shape, slightly elongated at the stem end. External color of the fruit is a reddish-violet, with yellowish flesh and a medium sized semi-cling stone. The fruit is described as easy to dry and of good quality, considering its early season of maturity. The tree is described as of average vigor, slightly weeping in form, a regular bearer and productive. The tree is early blooming and self-fertile.

The **LORIDA** is a hybrid of the Prune d'Ente and the European plum variety Anna Spath. In France, it ripens at the same time as the d'Ente 707. The fruit is large in size, oblong in shape and rounded at both the apex and base. Skin color varies from red to violet and the flesh color ranges from yellow to orange. The stone is completely free. The fruit dries into a very high quality prune. The tree is of average vigor and upright in form. Full bloom is at the same time as full bloom of the Prune d'Ente and the tree is a productive and regular bearer. The Lorida is self-fertile.

The variety **TARDICOTES** resulted from a cross of the Prune d'Ente and the plum variety Grand Duke. In the Lot and Garonne Valleys of France, it ripens 8 to 10 days after the Prune D'Ente 707. The fruit is medium to large in size, oblong in form and somewhat elongated. Color of the skin is a blue-violet. The epidermis is quite resistant to cracking. Flesh color is yellow, with slight greenish tones, becoming more orange with advancing maturity. The stone of the Tardicotes is semi-free. The dried fruit quality is good with a low drying ratio. The Tardicotes tree is vigorous and very upright. The tree is early blooming, attaining full bloom at least 4 to 6 days ahead of the d'Ente 707. The tree is productive and a regular bearer. The variety is self-fertile.

PERFORMANCE OF THE FRENCH HYBRIDS IN CALIFORNIA

In 1985, shortly after their release, these three new hybrid varieties were imported into California and established in a comparative trial at the UC Kearney Agricultural Center, Parlier. In addition to the three new varieties listed above, this trial included four clones of the Prune d'Ente (previously discussed), an older variety from France called the Double Robe (GF 812) and the standard California Improved French as a comparison. Ten trees of each variety were established in a randomized and replicated planting. By the end of the 1989 crop year, it was clear that the **LORIDA** was not going to be successful in interior valley plantings in California. The Lorida fruit had cracked badly from the outset of testing, with from 85 to 90 percent of the fruit split, rotted and insect infested before attaining full maturity. The variety continued to perform this way under both light and heavy cropping situations and in 1990 was eliminated from the test plot as unsuited for California growing conditions. At the end of six years of testing (1991) the

following report on the performance of the remaining two hybrid varieties was made by DeJong and Doyle to the California Prune Board.

"PRIMACOTES:
The early date of maturity and large fruit size are positive characteristics of this new prune cultivar. Bearing characteristics, low productivity and difficulty in harvesting, however, are such negative factors that it is questionable if this prune can be used successfully by California growers. Production in 1990 and 1991 averaged only about 1.5 dry tons per acre in comparison with 4.5 dry tons for Improved French. In 1991, as in 1990, the primary fruit bearing area in the tree was at the end of shoots on one year wood. Very little fruit was borne on spurs formed on the scaffolds and older secondary limbs. Large areas of blank two year old wood were present. The major portion of the crop was borne in large drooping clusters of 20 to 50 fruit, far out on the terminal of the shoots. Shaker vibration is poorly transmitted to these high-inertia clusters, making fruit difficult to remove. If the long shoots are shortened at dormant pruning time, a much more detailed pruning job is necessary and the removal of terminal crop-bearing wood reduces yield. This type of bearing habit substantially limits the value of the Primacotes cultivar in a shake-catch type of harvesting system. The Primacotes produces a large, coarsely wrinkled prune with a more acidic flavor than Improved French. The dried exterior color is irregular with a more brownish cast than Improved French. Interior flesh color is a dark brown.

TARDICOTES:
This new prune cultivar from France is at the opposite end of the maturity spectrum from Primacotes, ripening 2 to 2-1/2 weeks later than Improved French. The cultivar is poorly adapted to hot interior valley conditions, producing large numbers of double fruit (20%) and exhibiting internal heat damage prior to harvest. The internal damage is characterized by darkening and/or drying of the flesh near the pit and by a substantial amount of pre-harvest drop even at flesh pressures above 3.0 pounds. The cultivar produces a dark, dull black prune. The prune flesh is extremely tough and fibrous and somewhat dark in color. The flavor of Tardicotes is more acidic than Improved French and lacks richness and balance. Lack of productivity and poor adaptation rules out the use of this cultivar in California."

DEVELOPMENT OF NEW VARIETIES BY MUTAGENISIS

SPURDENTE
In 1966 at Grande Ferrade, Dr. Renaud embarked upon a prune variety development program using artificial mutagenesis. Collecting from various clones of the Prune d'Ente, graftsticks were first irradiated and then budded onto rootstocks. Buds that survived and grew from this first propagation were then re-propagated and grown to fruiting age in the field. From an initial population of 1200 mutant buds, the Spurdente variety was selected and released by Renaud in 1986. The fruit of Spurdente is reported to be very similar in form and processing quality to that of the Prune d'Ente. It flowers about four days after the GF 2733, but ripens from 8 to 10 days ahead. The tree is a spur type tree with fewer vigorous upright shoots, but with a proliferation of fruiting spurs.

The tree is vigorous and easily pruned. Nurserymen from France have indicated that the Spurdente may produce smaller fruit size than the GF 2733 (d'Ente), but the variety has not been field tested under California growing conditions.

PRUNE VARIETY DEVELOPMENT AT UC DAVIS

EARLY RESEARCH

In 1975, a study was completed on the inheritance of ripening date, fruit size and soluble solids in *P. domestica* by C.O.Hesse of the Department of Pomology (UC Davis) and P.E.Hansche and V. Beres of the Departments of Pomology and Genetics at UC Davis. The study was based on measurements taken by Hesse and D.O.Walker from seedling populations developed from 1948 through 1966. Measurements taken from a second population during the 1973 and 1974 growing seasons were also included in the study. The results indicated that fruit size and ripening dates in *P. domestica* were very highly heritable, with percent soluble solids less so but still in the high heritability range. After an estimate of genetic and environmental components was made, the study concluded "…that inter-mating of parents selected on the basis of their own performance could be very effective and efficient in improving the genetic potential of such breeding stocks in bloom date, ripening date, fruit size and probably (though not certainly) soluble solids." Also "These results indicated that the rates of gain to be expected from mass selection on such populations are substantial."

Encouraged by these findings, Hansche and Beres initiated a prune variety development program in 1975. The immediate goal of this program was to develop a prune with all the cultural and processing traits of standard French, but ripening about two weeks ahead. Using quantitative genetics, the estimate was made that 13,000 seed of self-pollinated French would need to be grown and fruited to allow for enough recombination to occur so that a seedling (or seedlings) containing all the desired traits could be recovered. The 13,000 seed were processed, but only about 5,000 seedlings were developed. It rapidly became apparent that the French prune was not a good choice as a parent. Several cultural and genetic problems appeared. Self-pollinated seedlings of French prune had a long juvenile time period and were distinctly non-precocious. Even after nine years, many seedlings had never bloomed or fruited. Additionally, over sixty percent of the seedlings were so weak that they were very short lived or because of their vegetative form had no commercial potential. The trait of high fruit yield was found to have a low heritability and very few seedlings attained the productivity level of the French parent. Although two seedling selections achieved the goal of ripening two weeks ahead of French, both had severe upper stem cracks, weak growth habit and low levels of productivity. In fact, only one selection out of the 33 selections derived from the entire population had a production level equal to French. This productive selection unfortunately produced a weak tree, had extremely pear-shaped fruit and only fair processed fruit quality. Only 38 percent of the population estimated to be required for recovery of the desired seedling recombinant was developed, jeopardizing the chance of success. No varieties were released from this program.

THE CURRENT UC PROGRAM

Although unsuccessful in the development of new varieties, the early work of Hesse, Hansche and Beres provided substantial insight into potential gains and problems associated with variety improvement of *P. domestica*. As the initial breeding work was terminating, there remained a continuing interest in prune variety development within the prune industry. In response to this interest and encouragement, primarily by the California Prune Board, a second prune variety development program was begun in 1985. This program was initiated under the leadership of T.M. DeJong of the Department of Pomology at UC Davis, with field management of the program by J.F. Doyle at the UC Kearney Agricultural Center (KAC) at Parlier, CA. Initially the program focused on the importation and evaluation of the several Prune d'Ente clones and the new Primacotes, Lorida and Tardicotes varieties developed in France. As it became apparent that the new varieties from France were not adapted to California growing conditions and industry practices, more emphasis was placed upon development of new varieties with specific adaptation to growing conditions found in the interior valleys of California. The primary goal was the development of new prune varieties similar to French in appearance and processing ability, but maturing substantially earlier or later than Improved French. These new varieties would serve to improve the efficiency of both the harvesting and drying process by spreading out the short high peak volume of harvest and dehydration currently experienced by the exclusive use of only the French variety. Well aware of the limitations found with the exclusive use of French as a parent in the previous UC program, a new strategy was developed to overcome these limitations.

The first phase of the new strategy was to grow several hundred seedlings of each of the principal prune varieties adapted to California growing conditions and to progeny test for precocity, seedling vigor, spread of maturity (both early and late) and freedom from heat damage in both the fruit and tree. Selections from Phase 1 of the program would then be used as parents in Phases 2 and 3 hybridizations that followed. Traditional California varieties do not exhibit, however, a sufficiently wide range of variability in their seedling populations, so in Phase 2 a wider range of parental varieties were used, many not historically grown in California. The purpose of Phase 2 was to incorporate through hybridization, that wider range of diversity of desired traits not evident in California varieties, again emphasizing such characteristics as spread in dates of maturity, precocity, tree vigor, freedom from heat damage, fruit size, fruit color, freestone pit characteristic and other traits of commercial significance. Because of the diversity of parentage used in Phase 2 it was expected that advanced selections from this phase would, for the most part, not closely resemble French, except in cases where French or related varieties were used in the cross. A third phase was then initiated to use advanced selections from Phases 1 and 2 in a series of Phase 3 crosses. The Phase 3 crosses would hybridize these best selections with Improved French Prune to produce seedling populations that had at least a 50 percent "French" pedigree. The seedling populations in Phase 3 have a high potential for producing selections that closely resemble Improved French, but with fruit maturities in a broad range and with trees that are vigorous, productive and precocious. Two new prune varieties have recently been developed and released to California growers from Phase 2 crosses and one new variety from Phase 3.

SUTTER

The Sutter is a new prune variety developed for use in the dried fruit industry. It is the result of a hybridization made in 1987 between the prune variety Sugar as the seed parent and the prune variety Primacotes as the pollen parent. The seedling was first selected from among Phase 2 seedlings growing at Kearney in 1993. Testing of the variety began at both Kearney and in grower plots in 1994. Date of maturity of the Sutter can range from early to mid-August, about a week to ten days ahead of the Improved French growing in the same location. Fruit of Sutter usually develops at least 2 degrees soluble solids higher than Improved French at similar crop loads. The fruit is large, dark purple in color and covered with a medium waxy bloom. The new variety's fruit shape is similar but longer than the fruit of Improved French. Fruit flesh color is yellow-amber. The pit of Sutter is a smooth-sided freestone, oval in shape, slightly larger that the pit of Improved French and is easily mechanically removed. The tree is similar in form and vigor to Improved French and is equal in its precocity to bear fruit. Timing of bloom is nearly identical to Improved French in most locations. The variety is self-fertile and has produced average crops when protected from pollen of other *P.domestica* trees. The fruit hangs well on the tree with a minimum of pre-harvest drop. The new variety performs normally on both Marianna and Myrobalan rootstock. Peach rootstock or rootstock that is a peach hybrid is not recommended as a rootstock for Sutter because grafts had a high amount of scion breakage when propagated on this type of rootstock. Leaves of Sutter are similar in form but are less glossy than Improved French.

Fruit of the new variety dries into a very high quality prune. Average sizes run slightly larger than Improved French and drying ratios are in the 3: 1 range. Interior color is a golden-amber. Exterior appearance of the dried fruit is quite similar to that of Improved French but the dried flavor is lighter, with a more complex fruity flavor and a sweeter taste. The new variety was released to California growers in 2000. Commercial plantings of Sutter have come into bearing in 2006. Some growers are considering Sutter as a "dual purpose" variety that could be used to produce a high quality dried product and also could be shipped to the fresh market. Large size, early maturity, high soluble solids and dark skin color characteristics of the Sutter hold out the promise of success for the variety as a fresh market product. However, the Sutter has not been tested for this purpose and no fresh shipments have as yet been reported.

(Picture Sutter)

TULARE GIANT

The Tulare Giant is the result of a cross between the *P.domestica* plum variety Empress as the seed parent and the prune variety Primacotes as the pollen parent. The cross was made in 1987 and the seedling was first selected from among Phase 2 seedlings in 1991. Field testing of the selection began in 1993 both at Kearney and in grower trials. Date of maturity for fresh market in the central San Joaquin Valley usually begins in the first week of July. The new variety can mature as early as three to five weeks ahead of the Improved French growing in the same location. Fruit of Tulare Giant is large in size, substantially larger than fruit of Improved French. The fruit is oval in shape and somewhat tapered at both ends. Color of the fruit is a dark purple under a grey colored

and waxy epidermal bloom. At the stem end of the fruit, the color can be a lighter purple or show a small amount of yellowish ground coloration. Fruit flesh color is a very pale yellow with, at times shades of green, depending on the stage of maturity. Trees are vigorous, upright-spreading in form and highly precocious bearing fruit as early as their third year. Unlike many other *P. domestica* varieties, the Tulare Giant will produce many flowers and set numerous fruit from buds on one-year old wood, as well as on older spurs and branches. Flowers on the Tulare Giant are very abundant. The variety is early blooming, not self-fertile and requires a pollenizer to set adequate crops. It is very important to use another early blooming European plum as a pollenizer in order to set regular crops of adequate numbers. The new UC variety Muir Beauty blooms at approximately the same time and is recommended as the pollenizer of Tulare Giant.

The new variety, with its large size and good color, appears to be highly suited for shipping as a fresh market prune. In order to be successful, however, the tree must be well pruned and the crop usually needs to be well thinned for the fruit to develop adequate levels of sugar. Heavy crops usually have adequate size but will be low on sugar and bland in flavor if not carefully thinned. Brix levels of 18.0 and above produce the highest quality and most flavorful product. In 2002, total shipments of Tulare Giant numbered 9,200 packages. Plantings have increased since then with 2005 production at 89,199 boxes and an estimate of 2006 production of around 150,000 boxes.

The Tulare Giant could be used for drying in specialty packs, but the pit is quite large and is only semi-free from the flesh making it difficult to remove. At 3.0 lbs fruit pressure and with a moderate crop load, fruit soluble solids can approach 22 degrees Brix. Because of the large size of the fruit, drying time exceeds twenty hours and the fruit can bleed, slab and stick to the drying trays. The dried fruit color is a glossy black and quality of the dried flesh is good, but because of the above drying characteristics, utilization of the Tulare Giant as a dried product is not recommended.

(Picture Tulare Giant)

MUIR BEAUTY

A third prune developed from the UC breeding program was released to California prune growers in 2005. The new variety was tested as “D6N-72”. The variety was developed from a hybridization made in 1992 of Improved French as seed parent and Tulare Giant (3-6E-13) as pollen parent. It was selected from among Phase 3 seedlings growing at UC Davis in 1997. Testing of the selection began in 1998 at Kearney and at the UC Wolfskill Experimental Orchard at Winters, CA. The Muir Beauty matures approximately 10 to 15 days ahead of Improved French growing in the same location. The fruit is large, somewhat intermediate in size between the Tulare Giant and Improved French parents. The fruit form is oval with a purple-rose skin color covered with a grayish medium waxy bloom. Fruit flesh color ranges from a dark gold to a golden-orange. The tree is very vigorous, upright in form and very productive. The fruit is born on one-year-old shoots and older spurs similar to the fruiting habit of Tulare Giant. Test trees have been grown successfully on both Marianna and Myrobalan plum rootstock. The variety has been successfully grafted on to peach rootstock and early testing shows

good compatibility but peach rootstock is not recommended until long term testing has shown complete compatibility. The leaves are moderately large in size, deep green in color and relatively shiny. The tree is more precocious than Improved French, flowering and fruiting at an earlier age. The time of full bloom is 7-10 days before Improved French blooms. Muir Beauty bloom overlaps with the bloom of Tulare Giant very well. The tree is self-fruitful. The fruit hangs well on the tree with no more than normal pre-harvest drop. Limited mechanical tree-shaking tests have resulted in complete fruit removal. Muir Beauty fruit develops fruit soluble solids in the range of 21.0 to 24.0 Brix.

Dried fruit of the Muir Beauty is large, dark shiny black in color with larger but somewhat fewer wrinkles. Flesh color is a golden-orange. The pit of Muir Beauty is medium in size and varies somewhat from semi-free to completely free. Limited pitting tests have resulted in easy removal of the pit. The dried fruit is thick and meaty, with a very pleasant fruity flavor.

(Picture Muir Beauty)

NEW DIRECTIONS

Beginning in 1995, the prune variety development work at the University of California has made a transition from its original location at the UC Kearney Agricultural Center at Parlier to the Department of Plant Sciences pomology orchard research area located on the campus of UC Davis. Since 1995, all seedling blocks have been grown at Davis for the primary evaluation. The highest quality seedlings are selected and moved to orchard blocks located at Parlier and Winters for further evaluation. At the present time over 9,000 unselected hybrid seedlings are in the program along with 98 advanced selections that are in higher levels of evaluation. The program at Davis continues under the direction of T.M. DeJong with the breeding, selection, and field management of the program now carried out by C.J. DeBuse.

The program priorities have changed throughout the years to include new breeding objectives along with the primary objective of the program that was to extend the harvest with new varieties having maturity dates before or after Improved French. The new objectives include breeding for pest and disease tolerance, new specialty traits such as dried plums that have different colors and flavors, and improved fruit quality and fruit characteristics that increase efficiency and quality of drying and processing. This new direction will address the new objectives while continuing to broaden and strengthen the germplasm base. The breeding program has created and expanded the UC *Prunus domestica* germplasm into a strong and diverse collection of advanced items and a wealth of seedling families from which to select the next generation of California dried plum cultivars.

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