

Raisin Grape Varieties

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'Thompson Seedless' is the dominant raisin variety grown in California because of its high productivity, wide soil adaptability, seedless fruit, and versatility for use in different grape and raisin products. About 95 percent of California raisins are currently produced from 'Thompson Seedless' grapes, followed by 'Fiesta' (3 percent) and 'Zante Currant' (1.5 percent). The remainder are produced from 'DOVine,' 'Muscat of Alexandria,' "Sultana" (false 'Sultanina'), 'Monukka,' 'Ruby Seedless,' 'Flame Seedless,' and 'Perlette.' 'Thompson Seedless' is also dominant in most commercial raisin-producing countries worldwide.

'Thompson Seedless' has not always been the foremost raisin variety in California plantings. 'Muscat of Alexandria' was the first raisin variety introduced into California, and it dominated for about 40 years until the early 1920s. In 1913, about 75 percent of California's raisins were 'Muscat of Alexandria' and only 14 percent were 'Thompson Seedless.' By 1925 the positions of the two varieties was reversed, with 'Thompson Seedless' constituting 80 percent and 'Muscat of Alexandria' 15 percent of California raisin production. This shift was in response to a rapidly growing preference for seedless raisins.

Historically, the raisin industry has relied almost entirely on Old World grape varieties. There was little interest in the development of new varieties until the breeding and introduction of 'Fiesta' by John Weinberger of the USDA Agricultural Research Service in 1973. The principal advantage of 'Fiesta' is that it typically ripens about 10 to 14 days ahead of 'Thompson Seedless' and has high-quality, meaty raisins. Its early ripening allows growers to begin harvesting earlier, and that reduces the risk of damage from early rainfall and extends the picking period for farm laborers. New plantings of 'Fiesta' were interrupted for a few years after the variety was introduced, due to concerns over the presence of seed traces in the berries. The perceived seed trace problem has since waned; 'Fiesta' raisins are now widely accepted by raisin packers and the variety has gradually grown in importance.

Interest in new varieties has increased as a result of the acceptability of 'Fiesta' and the recognized need for earlier-ripening, high-quality varieties. Seedlessness (seed traces of 'Thompson Seedless' size or smaller), early ripening, potential for drying on the vine (DOV), suitability for mechanized pruning or harvesting operations, and tolerance to important pests and diseases are other characteristics of interest to developers of new raisin varieties. 'DOVine' was introduced by USDA in 1995 because of its suitability for DOV with cane cutting. Its early ripening, adaptability for cane pruning, and high raisin quality characteristics give 'DOVine' the potential for earlier cane cutting for DOV with improved raisin quality. The future development of new varieties has the potential to revolutionize raisin production, drying, and harvesting practices.

'THOMPSON SEEDLESS'

Origin

'Thompson Seedless' (Plate 6.1) is thought to have originated in Persia in Asia Minor, in an area that now makes up parts of Iran and Turkey. Its use spread throughout Asia Minor, the Mediterranean, northern Africa, and then to Europe, and it was from Europe that it came to America, South Africa, and Australia. The variety was introduced into California in 1872 by William Thompson of Yuba City. Thompson acquired cuttings from the Elwanger and Barry nursery of Rochester, New York, which described the variety as a grape from Constantinople grown in English hothouses under the varietal name 'Lady De Coverly.' The variety was quickly accepted by local growers, who misnamed it 'Thompson Seedless,' an appellation that has remained with it throughout its development and use in California. The variety's most widely accepted name in the literature is 'Sultanina,' a derivation of 'Sultanieh,' believed by some to be a recognition of a sultan's

appreciation for or ownership of the grape, or of its possible origination in or near the town Soutlanieh, which is situated in Persia not far from the Caspian Sea. Other synonyms are 'Oval Kechmish' (Iran, Persia), 'Kouforrogo' (Greece), 'Tchekirdeksiz' (Turkey), and "Sultana" (Australia and South Africa).

Importance and Use

'Thompson Seedless' is by far the most widely planted grape variety in California, with 267,371 total acres (108,205 ha) reported in 1997. It is also the most versatile of grape varieties. While the largest proportion of its acreage is devoted to raisin production (about 70 percent), a substantial proportion is used for fresh table grapes (about 14.5 percent), crushing for wine, grape juice concentrate, and distillation products (about 14 percent), and canning (about 1.5 percent).

The versatility of 'Thompson Seedless' also extends to its use as raisins. While it is most widely known for production of natural sun-dried raisins (about 93 of the 'Thompson Seedless' raisin crop), about 7 percent of its raisin crop goes to commercial dehydrators to make golden seedless (about 4.5 percent) and dipped seedless (about 2.5 percent) products.

Physical Description

- *Clusters.* Large (average 1 pound [454 grams], typically ranging between 0.5 and 1.5 pounds [227 and 680 grams]); conical to shouldered, seldom winged; well-filled.
- *Berries.* Medium (average 1.8 grams, typically ranging between 1.5 and 2.5 grams); long oval; light green to light yellow; medium skin with light bloom; fleshy pulp; small seed traces (less than 1 mm wide and 1 mg dry weight); neutral flavor.
- *Raisins.* Medium (0.4 to 0.6 gram); bluish dark brown; medium wrinkles.
- *Leaves.* Large, medium green, glossy on upper side; rounded, tending to have three lobes; glabrous on both sides; lyre-shaped petiolar sinus with overlapping edges; teeth convex and average sized.
- *Shoots.* Long, straight shoots with medium to long internodes; light green to yellowish green when herbaceous; tips light green and shiny; lignification is light brown to brown.

Growth and Soil Adaptability

'Thompson Seedless' vines are vigorous and adapt to a wide range of soils, from loamy sands to loams. Roots show some tolerance to root knot nematodes by limit-

ing the pests' ability to penetrate root tips. 'Harmony' and 'Freedom' rootstocks are recommended in sandy to sandy loam soils with a history of nematode problems, especially when replanting grapes. The recommended vine spacing within rows is 7 or 8 feet (2.1 or 2.4 m).

Production

The industry average volume of production for a 'Thompson Seedless' vineyard is 2 tons of raisins per acre (4.5 metric tons per hectare [t/ha]), with individual vineyards mostly averaging between 1.5 and 3 tons per acre (3.4 and 6.7 t/ha).

Harvest

The 'Thompson Seedless' variety typically achieves approximately 21 °Brix by the first week in September. Peak harvest generally runs from August 25 to September 10, but may extend from August 20 to September 20, depending on the season and vineyard conditions. The variety's large clusters and medium-long peduncles, most of which are not lignified, make hand harvest comparatively easy. Raisin drying takes about 3 weeks, plus or minus 1 week, depending on drying conditions.

Training and Pruning

'Thompson Seedless' vines are head-trained and cane-pruned, leaving 4 to 8 canes of 12 to 15 nodes each. Successful spur pruning by hand has been achieved by leaving 20 to 25 five-node spurs per vine with cordon training. Machine hedge pruning with cordon training is possible by hedging to about 12 inches (30.5 cm) in all directions from the cordon. No hand follow-up pruning is needed except to remove long canes missed by the pruning machine. Minimal pruning (no hand pruning except to trim [*skirt*] the bottom growth to at least 2 feet [60 cm] from ground level) is *not* recommended for raisin production, since it encourages small clusters and berries and delays fruit maturation.

Special Insect and Disease Problems

Commercial 'Thompson Seedless' vineyards not planted with virus-free, certified nursery rootstock are known to carry virus diseases. Mostly only a mild form of leafroll virus is present, and this shows no leaf symptoms and may not affect yields by more than 5 to 10 percent. Certified virus-free planting stock such as performance-tested Clone 2A is recommended for new plantings. 'Thompson Seedless' is highly susceptible to phomopsis cane and leaf spot with spring rains in infected vineyards, and moderately susceptible to powdery mildew, black measles, and Pierce's disease.

Other Cultural Characteristics

'Thompson Seedless' is susceptible to *waterberry*, a disorder that interrupts berry ripening and leads to berry shrivel, mostly at the cluster tips. The cause of waterberry is unknown, but the vines' nitrogen status is known to be a contributing factor. A bud break disorder commonly called *delayed growth* can occur following winters with early cold weather. Dry soil conditions during the winter intensify the problem. *Bull vine* or *witches' broom* chimera (bud mutation) is a common phenomenon in older vineyards that leads to vigorous, unproductive growth; complete removal of abnormal growth with a pruning saw is necessary.

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'ZANTE CURRANT' ('BLACK CORINTH')

Origin

The "currant" is one of the oldest raisins known (the term *currant* is used to describe its small berry size, but it is a true grape [*Vitis vinifera*] and not a member of the *Ribes* species). As early as the year 75 A.D., Pliny writes of a tiny Greek grape, thin-skinned, juicy, and sweet, and with bunches exceedingly small. It then dropped out of written history until the eleventh century, when trade of this type of raisin between the Greek producers and the Venetians was recorded. From 1334 to 1377 they were reported as *Reysyns de Corauntz* in the English markets, and the name *raisins of Corinth* was used in the 1500s. The name *currant* gradually evolved from *Corinth*, the name of the port whence the early supplies of this fruit reached western Europe. However, by the early 1700s the trade in currants shifted toward the Ionian Islands of Greece, notably Zante—hence, the traditional commercial name for this variety, 'Zante Currant.'

'Black Corinth' (Plate 6.2) is considered the most correct name in the English literature. *Black* differentiates it from similar white- and red-fruited grape varieties, 'White Corinth' and 'Red (Rose) Corinth.' Synonyms include *Corinthe noir* (France), *Raisin de Corinthe* (Greece), and *Passolina* and *Passerina* (Italy).

Early introductions of 'Black Corinth' into the United States date back to 1854, but at first without successful distribution or establishment in California. In 1861, Colonel Agoston Haraszthy imported the 'White Corinth' and 'Red Corinth' varieties, and small though not commercially important plantings were established in different parts of California. The successful introduction and commercialization of 'Black Corinth' came with cuttings imported in 1901 by USDA. USDA's agricultural explorer David Fairchild had purchased the cuttings from the Greek village of Panariti, noted for its

production of quality 'Black Corinth' raisins. Interest in the variety was slow to develop, however, due both to limited knowledge of its culture and to the popularity of 'Thompson Seedless.' Acreage finally expanded significantly during the 1920s and 1930s in response to comparatively higher prices for 'Black Corinth' raisins and the adoption of improved cultural practices, notably vine girdling at bloom to improve fruit set and berry size. By 1936, plantings had reached 2,951 acres (1,194 ha), approximately its present level.

Importance and Use

Greece is still the major producer of 'Black Corinth' raisins—about 80 percent of the world production—with California, Australia, and South Africa producing much of the remainder. California plantings in 1997 were 2,633 acres (1,066 ha), up from a more historically typical 1,800 acres (728 ha). This increase was stimulated by a strengthened international market in response to declines in Greek production.

'Black Corinth' raisins are used mostly for cooking and baking because of their small size and tender skin. The fresh grapes are occasionally used by wineries for blending and color, depending on need and availability, such as during winery crush shortages and the 'Black Corinth' raisin surpluses of the 1970s and 1990s. They are also shipped fresh as 'Black Corinth' grapes for use as a culinary and beverage garnish.

Physical Description

- *Clusters*. Small (average 0.4 pound [182 grams], ranging between 0.2 and 0.6 pounds [91 and 272 grams]); cylindrical, prominently shouldered or, often, winged; well-filled to compact.
- *Berries*. Very small (0.35 to 0.6 gram); round, reddish black with light bloom; skin thin and tender; pulp juicy and soft; seed traces almost undetectable; occasional larger berries will contain hard seeds; flavor rich, sweet, and fruity when fully ripe.
- *Raisins*. Very small (0.09 to 0.14 gram); bluish dark brown to black; medium to fine wrinkles.
- *Leaves*. Medium-sized, oblong, cordiform, and five-lobed with deep, often overlapping sinuses; marginal serrations slightly convex in two series; petiolar sinus deep and narrow, usually overlapping; upper surface dark green with light-colored veins; lower surface lighter green, slightly pubescent; petiole medium-slender with a pink tinge.

- *Shoots.* Slender and trailing in growth habit; medium internodes and strong lateral branching; medium green with very light pink coloration when herbaceous; tips light green with slight bronzing and white pubescence; light brown to brown when mature.

Growth and Adaptability

'Black Corinth' vines are vigorous and well adapted to sandy loam and fine sandy loam soils; nematode-caused declines in vigor in sandy soils are more severe than for 'Thompson Seedless,' 'Harmony' and 'Freedom' rootstocks are recommended in sandy soils, especially in replant situations. Recommended in-row vine spacing is 7 or 8 feet (2.1 or 2.4 m).

Production

Typical 'Black Corinth' harvest tonnages are comparable to figures for 'Thompson Seedless' on similar soils except in older vineyards on sandy soils, which may only produce 1 to 1.5 tons per acre (2.2 to 3.4 t/ha).

Harvest

'Black Corinth' typically achieves 22 to 24 °Brix by August 15 to 20; readings in the 26 to 30 °Brix range are common, especially when there is some dehydration of berries on the vine. Harvest is made difficult by dense canopies and small clusters that juice very easily. Good harvest supervision is necessary to prevent juicing problems and uneven amounts of fruit on the drying trays. Drying on trays is rapid, taking only 10 to 14 days. 'Black Corinth' is suitable for drying on the vine with cane cutting, due to the variety's early ripening date and small berries, which dry in 4 to 6 weeks if left on the vine.

Training and Pruning

The 'Black Corinth' variety is fruitful with spur or cane pruning. Most commercial vineyards are head-trained and cane-pruned, leaving 5 to 8 canes of 12 to 18 nodes each. Spur pruning with bilateral or quadrilateral cordon training requires that 20 to 40 spurs of 2 to 3 nodes be left on each vine, due to the small clusters. Vine shape is hard to maintain under cordon training. Cane pruning is more difficult with this variety than with 'Thompson Seedless' because of the bushy growth, slender, irregular canes, and more numerous lateral shoots found in 'Black Corinth.'

Special Insect and Disease Problems

'Black Corinth' is very susceptible to powdery mildew, especially in vigorous vines; dense growth can interfere with fungicide application. Commercial vineyards not planted with certified, virus-free planting stock of this variety are known to carry virus disease, especially leafroll-related viruses. This may reduce vine yields and fruit maturation and color development. More severe latent virus problems have also been experienced with non-certified propagation material. Complete vine failure has occurred in some instances when scion wood collected from commercial 'Black Corinth' vineyards was grafted onto virus-free resistant rootstocks such as 'Freedom.' New plantings should only use certified virus-free planting stock of 'Black Corinth' Clone 2. Bunch rot can be a problem if the clusters are excessively tight; botrytis bunch rot can infect and mummify individual clusters. Grape leafhopper populations can be especially high at harvest.

Other Cultural Characteristics

Very few mineral nutritional problems have been identified for 'Black Corinth' besides excess nitrogen and its associated excess vigor in fertile soils; flower shelling at bloom and poor fruit set can result. A spray application of gibberellic acid (GA) between bloom and fruit set improves berry size and vine yields. The common practice is to apply 4 grams GA₃ per acre 3 to 5 days after full bloom. Full bloom comes at about 70 percent cap fall. Follow label directions for the GA, and adjust the application rate, based on vineyard experience, for the desired berry size and cluster density. Excessive application rates and delayed applications may contribute to excessively tight clusters and too-large berries.

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'MUSCAT OF ALEXANDRIA'

Origin

'Muscat of Alexandria' (Plate 6.3) probably originated in northern Africa, as indicated by its name and known early distribution. Records of its antiquity include a description in the French literature in the late 1700s, a long record of its cultivation in English hothouses, and historical planting in the Cape of Good Hope, South Africa, around 1650. There were several early introductions of this variety into California, beginning with Colonel Agoston Haraszthy in 1851. The first 'Muscat of Alexandria' raisin production in California was in the San Bernardino Valley, but plantings soon spread northward to the San Joaquin Valley where it became

the dominant raisin variety until the early 1920s. ‘Muscat of Alexandria’ is widely known as a multipurpose variety: it is used as a table grape in Spain, Italy, Japan, and South America; a dessert wine and blending variety in southern Europe, California, and Australia; a brandy (Pisco) variety in South America; and a raisin variety in the Old and New Worlds.

Synonyms include *Zibibbo* (Italy), *Moscatel Romano* (Spain), *Muscat D’Alexandrie* (France), *Iskendiriye Misketi* (Turkey), *White Hanepoot* (South Africa), and *Muscat Gordo Blanco* (Australia).

Importance and Use

‘Muscat of Alexandria’ acreage in California has gradually diminished due to the variety’s decline in importance for raisin and dessert wine production. In 1997, there were 5,230 total acres (2,117 ha), having declined from about 21,000 acres (8,499 ha) in the early 1960s. Annual muscat raisin production has averaged 187 tons in the 10 year period from 1988 to 1997, but with highs and lows of 534 and 41 tons in 1990 and 1992, respectively, reflecting its wide annual fluctuations in production. This erratic pattern of grape utilization for raisins is governed by the demand and price in the markets for this variety’s competing uses—wine and fresh shipment for home winemaking—which typically account for about 95 percent of its annual production.

Muscat raisins are almost exclusively marketed with their seeds removed. The sale of muscats as whole clusters of raisins with attached stems (*layers* or *clusters*) was discontinued in the 1970s.

Physical Description

- **Clusters.** Large (average 1 pound [454 grams], ranging between 0.25 and 2.2 pounds [114 and 999 grams]); conical, shouldered, winged; loose, often straggly.
- **Berries.** Very large (average 5.5 grams, ranging from 2.5 to 8.0 grams); dull green to light yellow with some ambering of exposed berries; flesh pulpy; thin to moderately tough skin with gray bloom; strong muscat flavor when fully ripe; seeds average 30 mg dry weight.
- **Raisins.** Very large (average 1.0 gram with seeds removed); bluish dark brown; medium to coarse wrinkles; muscat flavor.
- **Leaves.** Medium-sized; dark green; five clefts of medium depth; veins lightly tufted with hairs on

lower surface; marginal serrations very narrow in two series, pointed; petiolar sinus a narrow V, often closed; petiole long with some light pink color, especially at the leaf junction.

- **Shoots.** Shoot tips woolly, white; expanding leaves bronze-yellow, cobwebby; shoot green; light brown to brown when mature.

Growth and Soil Adaptability

‘Muscat of Alexandria’ vines are moderately vigorous to vigorous on medium- to fine-textured soils (sandy loam to loam), but weak on sandy soils. Recommended in-row vine spacing is 6 or 7 feet (1.8 or 2.1 m). The vine is highly susceptible to root knot nematodes. ‘Harmony’ or ‘Freedom’ rootstock is recommended when planting to sandy soils. Some incompatibility problems with ‘Ramsey’ (Salt Creek) rootstock have been reported in the literature, but experience with other rootstocks is insufficient to justify any further recommendations.

Production

The average production for ‘Muscat of Alexandria’ is 1.75 tons per acre (3.9 t/ha). A typical year’s harvest will be from 1.25 to 2.75 tons per acre (2.8 to 6.2 t/ha).

Harvest

‘Muscat of Alexandria’ typically achieves 21 °Brix by September 10. Peak harvest time is from September 5 to 20. Sometimes growers dry the raisins on wood trays because of rain risks associated with a later harvest date than for other varieties, and slower drying rate. ‘Muscat of Alexandria’ raisins take 3 to 4 weeks to dry.

Training and Pruning

‘Muscat of Alexandria’ vines are most commonly trained to a bilateral cordon and pruned to 12 to 18 spurs with two buds each. Cordons should be developed over a 2- to 3-year training period, taking care not to overcrop young vines. Practice shoot thinning for crop adjustment during the early years of cordon establishment. Head training is common in older vineyards: the vines are spur pruned to from 12 to 20 two-bud spurs, with spur numbers increasing with vine size.

Special Insect and Disease Problems

The ‘Muscat of Alexandria’ variety is susceptible to zinc deficiency, which results in poor fruit set and “shot” berries. This can be corrected with a foliar spray of neutral zinc or zinc oxide products before or during bloom. The vine foliage will commonly show characteristic symptoms of “muscat spot” in mid- to late summer. These appear as irregular, yellowish, chlorotic interveinal spots on the older leaves. Affected portions may also become necrotic or brown. This disorder is thought to be a genetic characteristic of some muscat varieties and is not related to any known disease, nutritional, or physiological problem. The variety is moderately susceptible to powdery mildew, black measles, Pierce’s disease, and phomopsis cane and leaf spot. Some commercial vineyards are known to carry leafroll virus. Certified virus-free Clones 2 and 3 are recommended for new plantings. Field trials have confirmed Clone 3’s high yield potential.

Other Cultural Characteristics

‘Muscat of Alexandria’ is somewhat susceptible to overcropping. Exceptionally large yields of 13 to 15 fresh tons per acre (29 to 34 t/ha) or more than 3 dry tons per acre (6.7 t/ha) will shorten the productive life of the vineyard, and particularly of young, cordon-trained vineyards. Exposed fruit are subject to sunburn injury, particularly during early summer hot spells. A foliage support trellis to shade fruit is recommended.

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‘FIESTA’

Origin

The ‘Fiesta’ variety (Plate 6.4) is the result of a complex cross (Figure 6.1) made in 1965 by John H. Weinberger of the USDA Agricultural Research Service at the U. S. Horticultural Field Station in Fresno. It was released for commercial production in December, 1973.

Importance and Use

‘Fiesta’ was selected for its ability to produce high-quality raisins and its early fruit ripening. Increases in ‘Fiesta’ plantings in California have been gradual since its introduction in 1973, however, with a total of 4,531 acres (1,834 ha) in 1997. This modest rate of expansion was influenced by industry concerns in the late 1970s over the seed trace content of ‘Fiesta’ raisins. These concerns were found to be exaggerated and the variety is now widely accepted by raisin packers. It is

not used as a table grape because of its sensitivity to gibberellic acid.

Physical Description

- *Clusters.* Large (average 1 pound [454 grams]); conical to shouldered, seldom winged; well-filled.
- *Berries.* Medium (average 2 grams); oval, more round than ‘Thompson Seedless;’ light green to light yellow; medium to tender skin with light bloom; fleshy pulp; small (or occasionally medium) seed traces, mostly averaging between 1 and 2 mg dry weight.
- *Raisins.* Medium (0.50 to 0.65 gram); bluish dark brown, slightly darker than ‘Thompson Seedless;’ medium to fine wrinkles, with a tendency to be more meaty than ‘Thompson Seedless.’
- *Leaves.* Medium large; medium green, slightly darker than ‘Thompson Seedless;’ glabrous; glossy on upper surface; primary and secondary veins somewhat prominent; rounded, with tendency to five-lobing; upper sinuses closed or overlapping; lower leaf sinuses often shallow; petiolar sinus wide and U-shaped; serrations medium and convex; petioles light green and pinkish with pink color extending slightly into primary veins; young, tender leaves tend to roll downward.
- *Shoots.* Shoot tips clear to light green; shoots green with medium internodes and diameter; typically smaller in diameter than ‘Thompson Seedless’ shoots and with a tendency for strong lateral shoots; light brown to brown when lignified.

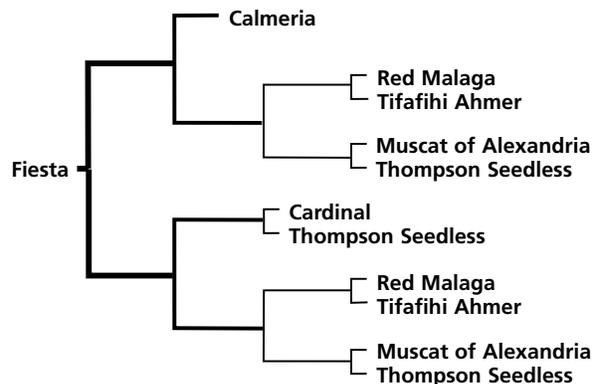


Figure 6.1 Pedigree of the ‘Fiesta’ variety

Growth and Soil Adaptability

'Fiesta' vines are vigorous and well adapted to soils ranging from sandy loam to loam. 'Harmony' and 'Freedom' rootstocks are recommended on loamy sands and sands, respectively, especially in replant situations. Recommended in-row vine spacing is 7 or 8 feet (2.1 or 2.4 m).

Production

Annual production for 'Fiesta' is comparable to or slightly higher than for 'Thompson Seedless' on similar soils.

Harvest

'Fiesta' grapes ripen 10 to 14 days ahead of 'Thompson Seedless'; the fruit are typically harvested at 21 to 22 °Brix in mid August. Hand harvest is similar to techniques used for 'Thompson Seedless,' except that 'Fiesta' requires that closer attention be paid to discarding clusters with rot and minimizing berry shatter. The drying fruit are very susceptible to caramelizing on the tray, which sometimes results in puffy, blackened raisins. Timely turning and rolling are critical to preventing the already dried fruit from "burning" on hot days. 'Fiesta' raisins dry more rapidly than 'Thompson Seedless,' typically 20 percent faster, even when both are harvested at the same date and the same fruit maturity. This is probably due to more rapid moisture loss through the thinner skin of 'Fiesta.'

Training and Pruning

The 'Fiesta' vine is head-trained and cane-pruned, leaving 4 to 8 canes of 12 to 15 nodes each. Bud fruitfulness characteristics are similar to those of 'Thompson Seedless,' with low cluster numbers from the basal three nodes of fruiting canes. Cane pruning requires additional supervision for the pruners, since 'Fiesta' has poorer and more irregular canes than 'Thompson Seedless.' Primary fruiting canes on 'Fiesta' are typically of smaller and more irregular in diameter, and sometimes have dominating laterals. It is often necessary to select the cane of a strong lateral shoot that is more developed than the primary shoot from which it originated.

Special Insect and Disease Problems

Some 'Fiesta' plantings include vines with fanleaf virus. These are the descendants of 'Fiesta' vines that were grafted onto infected mature vines. New plantings should use certified wood sources or vineyards with a clean wood source history. 'Fiesta' vines are highly sus-

ceptible to powdery mildew, phomopsis cane and leaf spot, and Pierce's disease.

Other Cultural Characteristics

Because of 'Fiesta's' potential for bunch rot, harvest should not be delayed once the fruit is mature. Its susceptibility is thought to be a result of the berries' thin skin.

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'DOVINE'

Origin

'DOVine' (Plate 6.5) was released by the USDA Agricultural Research Service in 1995 as an early ripening variety with potential to dry on the vine (DOV) when the canes are cut. It is the first variety released from the hybridization of two seedless grapes using embryo rescue techniques developed by David Ramming at the Horticultural Crops Research Laboratory in Fresno. 'DOVine' resulted from a cross of 79-101 × 'Fresno Seedless' made in 1983. 79-101 is a blue seedless grape of unknown parentage, probably bred by Elmer Snyder of USDA; 'Fresno Seedless' is a sibling of 'Flame Seedless' and resulted from the cross of ('Cardinal' × 'Thompson Seedless') × [('Red Malaga' × 'Tifafihi Ahmer') × ('Muscat of Alexandria' × 'Thompson Seedless')].

Importance and Use

Because of its recent release and limited grower experience with the variety, the degree of use for 'DOVine' over the long term is as yet unknown. It was selected primarily for its early ripening (2 to 3 weeks earlier than 'Thompson Seedless') and high raisin quality characteristics. Since it ripens earlier than 'Thompson Seedless,' 'DOVine' is ready for cane cutting for DOV at an earlier date and at higher fruit maturity than 'Thompson Seedless.' Fruitfulness is low at nodes 1 and 2 at the base of fruiting canes, ensuring that a minimal number of clusters will remain in a fresh state behind the severed canes during DOV. The variety's high vigor provides the potential for a large vine framework and canopy adapted to more expansive trellising and to the demands of cane renewal that characterize DOV.

The variety is not as well suited to conventional raisin farming practices as are 'Thompson Seedless' and 'Fiesta.' Its high vigor and dense canopy with standard trellising can contribute to fruit zone shading and more difficult powdery mildew control. Head training can be difficult to maintain because the renewal canes tend to originate toward the end of the previous year's

canes. A conventional tray drying system is recommended only where the vines are moderately vigorous, as in sandy soil or when grafted onto a medium-vigor root system.

Physical Description

- *Clusters.* Medium large (average 0.9 pound [408 grams]), and tending to be smaller and more loose than ‘Thompson Seedless’ and ‘Fiesta’ clusters; conical to shouldered, seldom winged; loose to well-filled.
- *Berries.* Medium (average 1.85 grams), with more variability than ‘Thompson Seedless’ and ‘Fiesta;’ oval to truncate; light green to yellow; medium to tender skin with light bloom; fleshy to firm pulp; very small seed traces (less than 1 mm wide and 1 mg dry weight); neutral flavor.
- *Raisins.* Medium (0.3 to 0.6 gram); bluish dark brown; medium to fine wrinkles; sweeter, less-acid flavor than ‘Thompson Seedless.’
- *Leaves.* Medium large; medium to dark green; glabrous on both sides and glossy on upper side; petiolar sinus narrow, lyre-shaped with slightly overlapping edges; five-lobed with shallow upper sinuses and moderately deep and overlapping lower sinuses; tips of lobes tend to be pointed, especially the apical lobe; serrations medium, convex; petioles light green with some light pink color; leaf surface often crinkled along the primary and secondary veins.
- *Shoots.* Shoot tips light green; shoots green with medium internodes and medium to large diameters; shoot growth tends to be upright with shorter internodes than ‘Thompson Seedless;’ numerous short to medium lateral shoots, sometimes at almost every node along a shoot; shoots mature exceptionally well; light brown to brown when lignified.

Growth and Soil Adaptability

‘DOVine’ vines grown on their own roots can be extremely vigorous when planted on fine sandy loam to loam soils. This can be a serious problem in vineyards with limited trellising, but can be managed with more extensive DOV trellising and with control of nitrogen fertilization and watering. Vigor is more moderate and manageable on sandier soils. Preliminary studies indicate that ‘DOVine’ may have a greater tolerance to root knot nematodes than other raisin varieties. The longevity of this tolerance and the susceptibility of this variety to other nematode species are as yet unknown.

Production

‘DOVine’ annual raisin production per acre with conventional trellising is comparable to or slightly higher than that of ‘Thompson Seedless;’ potential production for ‘DOVine’ grown on large trellises is high.

Harvest

‘DOVine’ fruit usually reach a maturity of about 22 °Brix by the first or second week of August in the Fresno area. Typically, ‘DOVine’ matures about 3 weeks before ‘Thompson Seedless’ with a comparable crop load. Hand harvest is somewhat more difficult than for ‘Thompson Seedless’ because of its more dense canopy, more numerous and slightly smaller clusters, and tendency toward more loose berries. The fruit darkens quickly with tray drying, minimizing the need for turning. Caramelizing during tray drying can be a problem because of the high drying temperatures that go along with early harvest.

Training and Pruning

This variety has not been grown long enough for us to develop anything beyond preliminary recommendations. Head training under standard trellising is only recommended with low-vigor to moderately vigorous vines. This is because renewal canes on vigorous vines tend to be produced near the ends of the previous year’s canes.

Bilateral and quadrilateral cordon training may be preferable for ‘DOVine’ because of the vine’s high vigor and the resultant ease of establishing a large, permanent framework. These training systems are well-suited to most dry-on-the-vine trellis arrangements.

Growers should practice only cane pruning, due to low fruitfulness at basal nodes 1 and 2. Greater numbers of canes should be left on ‘DOVine’ than on ‘Thompson Seedless,’ with 6 to 12 (typically 8 to 10 with high vigor) per vine recommended. Fifteen- to twenty-node canes are appropriate for vigorous vines.

Pruning is more labor-intensive for this variety due to the vines’ tendency to produce fewer canes in the center of the head, the greater number of canes to be retained, and the greater number of lateral shoots that must be trimmed off.

Special Insect and Disease Problems

‘DOVine’ is highly susceptible to powdery mildew and phomopsis cane and leaf spot diseases. The dense foliage canopy impedes good coverage with sprays and dusts.

New vineyards should not be propagated with wood from grafted vines. Most older vineyards from

non-certified wood sources carry virus diseases that will be transmitted to the scion and any wood produced from it. Wood sources should be certified virus-free or grown from own-rooted vines planted directly from USDA wood sources.

Other Cultural Characteristics

‘DOVine’ requires careful attention to irrigation and nitrogen fertilizer management due to its potential for excessive vigor. Otherwise, the vines tend to become vegetative, with lower fruit production and delayed fruit maturation.

The berries are susceptible to splitting during ripening if the vines are subjected to irregular or excessive irrigations. Overcropping, excessive vine vigor, and dense canopies may aggravate the problem.

The ‘DOVine’ vine’s upright growth characteristic favors good cane renewal, especially when trellised for DOV. However, this growth habit can contribute to excessive shading of raisin trays if trellis crossarms are wider than 24 inches on 12-foot rows.

The bloom period of ‘DOVine’ is similar to that of ‘Thompson Seedless.’

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“SULTANA”

The earliest introduction (mid-1800s) of this misnamed variety was by a Mr. West, a Stockton nurseryman. It was distributed as “Sultana” under the mistaken impression that it was the variety from which the ‘Sultana’ raisins of commerce were produced. Colonel Agoston Haraszthy also imported the same variety from Spain in 1861. It probably was introduced into Europe from Asia Minor. It is described under the name ‘Round Kishmish’ in French ampelographies, and should not be confused with the true ‘Sultanina’ (Sultana) that we know as ‘Thompson Seedless.’ It was California’s most important seedless raisin variety for a short period—until the introduction of ‘Thompson Seedless.’ “Sultana” production continued to increase until the mid-1920s (high of 29,750 tons in 1925), and then continually declined to a typical range of 125 to 319 tons annually as experienced in the 10 years from 1988 to 1997. In 1997, 183 acres were reported.

The “Sultana” vine is vigorous and productive under cane pruning. Its sugar accumulation is inferior to that of ‘Thompson Seedless,’ however; it produces a less meaty and more reddish colored raisin. The berries are round, light green to amber yellow, and have only a light bloom, which gives them a more transparent appearance than ‘Thompson Seedless.’ Seed traces are often larger than those in ‘Thompson Seedless.’ The clusters are very large, compact, cylindrical, and heav-

ily shouldered. Overall, as a raisin grape it is inferior to ‘Thompson Seedless’ and should not be planted.

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‘BLACK MONUKKA’

‘Black Monukka’ (Plate 6.6) was received by the USDA ca. 1910 from England, where it had been acquired from India. Its true origin is not known; its name is thought to have originated from that of a Persian elongated grape, ‘Munaqqa,’ the name of which means “raisin.” It has never been important in California’s traditional raisin markets due to its larger raisin size, darker color, and larger seed traces in comparison to ‘Thompson Seedless.’ It is mostly used in specialty markets such as health food stores for its unique qualities, including blackish color, tender skin, and characteristic rich flavor. The 1997 California acreage report listed 359 acres for ‘Black Monukka.’ Raisin production has averaged 751 tons annually in the 10 years from 1988 to 1997. It is sometimes used as a table grape for local markets, and its response to gibberellic acid is similar to that of ‘Thompson Seedless.’ Its susceptibility to berry shatter and its thin skin rule it out as a shipping table grape. It is popular for home garden use.

The vine is vigorous and productive under either spur or cane pruning. Most vineyards are cane pruned for better yields. The berries are large (average 3 grams), long oval to cylindroidal, red to reddish black when fully ripe, thin-skinned, and with firm pulp; they typically contain one or two seed traces of 2 to 4 mg dry weight. Clusters are very large, long, cylindrical, usually shouldered, well filled, and average 1.5 pounds (680 grams), with a range of 0.5 to 2.5 pounds (226 to 1,135 grams). The time of ripening is much influenced by the amount of crop; average crops will ripen a little ahead of ‘Thompson Seedless.’ Older plantings are known to carry leafroll-associated viruses, which reduce the red to black fruit color development, and result in highly variable (light to dark) grape and raisin color. New plantings should use only certified, virus-free propagating material.

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MISCELLANEOUS VARIETIES

‘Ruby Seedless,’ ‘Flame Seedless,’ and ‘Perlette’ are table grape varieties that are occasionally made into raisins. For the most part, raisin drying is a secondary use for unharvested strippings, a market for grapes from young vineyards coming into production, or an alternative market when table grape prices are low. In the San Joaquin Valley, these varieties are tray-dried. In the

Coachella Valley and other southern desert districts they are most often left on the vine to dry naturally. This is possible because of prolonged high summer temperatures. The dried raisins are harvested by hand in an operation referred to as *gunny sacking*. Other seedless table grape varieties can also be dried for raisins, but their use is too limited for discussion here. These miscellaneous raisin types are most commonly sold in generic packs, mixed fruit trays, fruit stand and grocery produce section packs, and bulk packs for restaurant and industrial uses.

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NEW VARIETIES

The USDA Agriculture Research Service has maintained an active breeding program for the development of new raisin varieties since the introduction of 'Fiesta.' The goal is to introduce varieties that are early ripening, seedless, have high raisin quality, are suitable for DOV, and are suitable for mechanized pruning and harvest. The rate of success has been greatly enhanced by the development of embryo culture, which allows the crossing of seedless × seedless selections and provides a much greater percentage of seedless progeny. Many promising seedlings are being tested by growers and University of California Cooperative Extension personnel; we expect some to be released within the next few years.

The University of California has carried on a program to evaluate potential varieties from foreign sources, including commercial varieties and those from breeding programs. Selections from many countries, including Australia, South Africa, Yugoslavia, Iran, Afghanistan, and Uzbekistan, have been studied. Of these, 'Merbein Seedless' from Australia's CSIRO breeding program has shown the most promise due to its high productivity and similarities to 'Thompson Seedless.' However, it tends to juice during harvest, and maintaining arm and renewal spur positions with head training is difficult; these factors have discouraged its use.

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