

Grape Varieties for Indiana

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Selection of the proper variety is a major factor for successful grape production in Indiana. Properly matching the variety to the climate of the vineyard site is necessary for consistent production of high quality grapes. Grape varieties fall into one of three groups: American, French-American hybrids, and European. Within each group are types suited for juice and wine or for fresh consumption. American and French-American hybrid varieties are suitable for production in Indiana. The European, or *vinifera* varieties, generally lack the necessary cold hardiness to be successfully grown in Indiana except on the very best sites.

The first section of this publication discusses American, French-American hybrids, and European varieties of wine grapes. The second section discusses seeded and seedless table grape varieties. Included are tables on the best adapted varieties for Indiana and their relative cold hardiness and disease susceptibility.

Wine Grape Varieties

Leading American Varieties

Concord is grown on a greater variety of soils and under a wider range of climatic conditions than any other variety of American grape. Its vine is vigorous and productive, ripening in mid to late September in Indiana. Concord's versatility gives it a large market potential. It is the most important variety for sweet juice, jelly, and preserves, and it is also used in quantity for wine production and fresh market sales.

Concord produces medium-sized clusters bearing large, blue-black berries. It is typical of the American *V. labrusca*-derived grapes in having a tough skin that separates readily from the pulpy flesh (slipskin). The pronounced fruity, "labrusca", or American, flavor of Concord makes it a desirable dessert grape. Skin cracking and excessive postharvest shelling, however, as well as the presence of seeds, limit its use for this purpose. Relative characteristics of Concord and other varieties are listed in Tables 1 and 2.

Catawba, developed in the early 1800s, is a spicy-flavored, slipskin grape with a pronounced labrusca flavor and aroma. The vines are vigorous, hardy, and productive, but the foliage is somewhat more susceptible to

fungal diseases than that of Concord (Table 1). Catawba also experiences foliar injury where ozone pollution occurs. This grape is used primarily in white or pink dessert wines, but it is also used for juice production and fresh market sales. This grape was widely grown in the Cincinnati area during the mid-1800's.

Niagara is a floral, strongly labrusca flavored white grape used for juice, wine, and fresh consumption. It ranks below Concord in cold hardiness and ripens somewhat earlier. On favorable sites, yields can equal or surpass those of Concord. Acidity is lower than for most other American varieties.

Other American Varieties

Delaware is an early-ripening red variety with small berries, small clusters, and a mild American flavor. It is an important dessert variety in Japan but is used primarily for juice and white wine in the US. Rain during harvest season may cause the tender skins to crack. Delaware requires a deep, fertile, well-drained soil for satisfactory vine growth; on such soils, with good management, its yields may be as high as those of Concord. On all but the most favorable soils, Delaware should be grafted on a phylloxera-resistant rootstock to ensure vigorous growth. Delaware is very sensitive to drift of 2,4-D and related herbicides which may limit its production in Indiana. Once prized for champagne production in New York, Delaware is now being replaced by several interspecific hybrid and vinifera varieties. It remains, however, one of the highest quality American varieties for wine.

Fredonia is a blue-black, Concord-type grape with very large berries that ripen about two weeks before Concord. Although Fredonia lacks the flavor associated with Concord, which is usually desired for juice and jelly, it is used for both juice production and roadside table grape sales. With careful pruning, its vigor and production may approach that of Concord. The fruit clusters are susceptible to downy mildew and Phomopsis cane and leaf spot.

Moore's Diamond has fruit reminiscent of Niagara and a vine like Concord. It is one of the few white American varieties that have been used to produce dry table wine. It is also desirable as a table grape, but the skins may crack during wet seasons.

French-American and Other Interspecific Varieties

The introduction of the North American pests phylloxera (*Daktulosphaira vitifoliae*) and downy mildew (*Plasmopara viticola*) into Europe in the mid-1800s was devastating to grape-growing enterprises. French hybridizers responded by developing new interspecific varieties using wild American species resistant to phylloxera, downy and powdery mildew, and other diseases, to cross with the *Vitis vinifera* varieties of Europe. Breeders rushed to market the results of their crosses in an effort to solve the crisis. These selections were usually identified with the name of the originator plus a number. Many have been named since their initial release.

The first products of these programs (developed by breeders and nurserymen such as Seibel, Couderc, Kuhlmann, and Bertille Seyve) were planted widely in Europe, but wine quality was disappointing compared with the traditional varieties. Additional time was required to hybridize and select improved types. Initial crosses used low-quality *V. vinifera* grapes, such as Aramon, as parents. Aramon is grown widely in Europe for bulk, but not quality, wine production. Later products of French breeding programs descended from *V. vinifera* parents known for high-quality wines. Wines made from these more recent hybrids, such as Vidal blanc and Vignoles, have received acclaim.

V. labrusca was rarely used in the development of the French-American hybrids so as not to impart its strong flavor to the new selections. Many other wild American species were used, especially *V. aestivalis lincecumii* (the Post Oak Grape), *V. rupestris* (the Sand Grape), and *V. riparia* (the River Bank or Frost Grape). The flavors of the French-American group are variable but much more subtle than those of many varieties derived from *V. labrusca*.

More recent introductions from North American breeding programs have been based on further crosses using French-American hybrids, native American species, and *V. vinifera* varieties. It was only coincidental that some of the varieties bred in France were adapted to conditions in the eastern and midwestern U.S. Varieties produced by North American breeding programs have been selected specifically for their adaptation to local conditions.

Several interspecific varieties, such as Cascade, Baco noir, De Chaunac, Ventura, and Vidal blanc, are sensitive to soilborne virus diseases of the ringspot complex. These varieties should be grafted onto virus-resistant rootstocks in areas known to have a high population of dagger nematodes. The virus is endemic in the north-eastern and midwestern U.S. and infects a wide range of deciduous fruit crops and weeds.

Interspecific Varieties for Red Wine Production

Baco noir (Baco No. 1) is an extremely vigorous variety that is best grown on heavy soils. Excessive vigor often occurs on light soils, increasing the risk of winter injury. Early budbreak increases the probability of spring frost damage. The variety is sensitive to soilborne virus diseases. The fruit is usually high in acid and produces wines of good quality that are normally deeply pigmented but low in tannin content. This variety is very susceptible to black rot.

Chambourcin (Joannes-Seyve 26-205) is a late-ripening grape that may produce a highly rated red wine when the fruit fully matures. It requires a long growing season and a site less subject to low winter temperatures. The large, moderately loose bunches set medium-sized blue berries. The vine is very productive, and cluster thinning is required. The foliage is resistant to downy mildew, but moderately susceptible to powdery mildew. Wines from this grape are higher in tannins than other French-American hybrids.

Chancellor (Seibel 7053) was once planted widely in France for table wine production. It is cold hardy and productive but requires cluster thinning. Early budbreak increases the risk of spring frost damage. Chancellor's wine quality is among the better of the French-American varieties. It is very susceptible to downy mildew and moderately susceptible to powdery mildew.

Chelois (Seibel 10878) wine quality ranks highly among the French-American hybrids. Vines are healthy, vigorous, and productive but require cluster thinning to prevent overcropping. Berry splitting and subsequent bunch rots may be severe in some years. Because it is susceptible to winter damage, Chelois should be planted on better sites. Small, blue-black berries are borne on compact, medium-sized clusters. It is most often used for blending with other red hybrids.

De Chaunac (Seibel 9549) is a very cold hardy, productive, and vigorous variety. Cluster thinning is required to maintain yield and fruit quality. The clusters are large and loose, resulting in few problems with bunch rots at harvest. Wine is only fair in quality, and the vine is susceptible to soilborne viruses.

Léon Millot (Kuhlmann 194-2) is an early-ripening black grape produced from the same cross as Maréchal Foch. The wines are similar, with distinct berry aromas. Vine characteristics tend to be similar as well, although Léon Millot is usually more vigorous and productive.

Maréchal Foch (Kuhlmann 188-2), usually referred to as simply Foch, is a early ripening black grape with small berries and clusters. The vines are hardy and medium in vigor and production. Grafted vines are recommended to

improve vigor, especially on heavy soils. Birds are attracted to the small, black berries. This is one of the most popular red wine grapes grown in Indiana. Wine styles can range from fruity, light red table wines, to hearty, full bodied reds.

Rougeon (Seibel 5898) is hardy and very productive but sometimes bears biennially. The wine is of high color and is used primarily for blending.

Villard noir (Seyve-Villard 18-315) is a late-ripening, productive variety that produces good-quality red wine when grown on favorable sites. For best performance, choose a site with moderate winter temperatures and a long growing season. Grafted vines are recommended to improve vigor, especially on heavy soils. Cluster thinning is also necessary to prevent overcropping.

Vincent was released in 1967 by the Horticultural Research Institute of Ontario (HRIO) at Vineland, Canada. The vine is medium in vigor, very productive, and ripens late. This dark blue grape produces a very dark juice that is useful for blending with varieties that have low pigment content. Care must be taken to control powdery mildew.

Interspecific Varieties for White Wine Production

Aurore (Seibel 5279) is early ripening, productive, vigorous, and produces large bunches of amber-colored berries. Bird damage and fruit rot often occur. Wine quality is fair, and this grape is being replaced by interspecific varieties of higher quality. Its major use has been for bulk wine production, frequently blended with *V. labrusca* varieties.

Cayuga White, named at Geneva in 1972, is one of the most productive and disease-resistant varieties grown in the eastern U.S. Its wine, which has medium body and good balance, has been rated highly. This versatile grape can be made into a semisweet wine which brings out the fruit aromas, or, using oak aging, into a dry, less fruity wine. When harvested early, it may produce a very attractive sparkling wine with good acidity, good structure, and pleasant aromas. When overripe, however, it can develop strong hybrid aromas with slight American overtones. Its excellent cultural characteristics and high wine quality make it a promising variety for the future.

Ravat 34 is a selection of the French hybridizer, J. F. Ravat. It ripens early and is moderately vigorous, productive, and winter hardy. Berries are pink to red at maturity and borne in loose clusters. Fruit rots have not been a problem. Wine quality is good.

Seyval (Seyve-Villard 5-276) is one of the most widely planted hybrid grapes east of the Rocky Mountains. When grapes are harvested at optimal maturity, wines

have attractive aromas of grass, hay, and melon. The body tends to be thin, and either malolactic fermentation or barrel fermentation followed by oak aging will enhance quality. The vine tends to overbear and must be cluster and shoot thinned to ensure proper ripening and maintain vine size. Grafting is recommended on all but the most fertile sites. Fruit clusters are very susceptible to *Botrytis* bunch rot.

Ventura was developed in Ontario, Canada, in 1974. A cross of Chelois and Elvira, it is a very productive, cold-hardy, crack-resistant replacement for Elvira. The berries are high in sugar and acidity and ripen at the same time as Concord. Although the grape is considered a hybrid, the wine has a pronounced labrusca aroma and flavor. The vine is susceptible to tomato ringspot virus and may require grafting on virus-infected sites.

Vidal blanc (Vidal 256) is a heavily productive white grape that produces good-quality wine when the fruit reaches maturity. It requires sites with long growing seasons and moderate winter temperatures. Small berries are borne on very large, compact, tapering clusters. Cluster thinning is sometimes required to prevent overcropping. Berries have thick skins, and *Botrytis* bunch rot has not been a problem.

Vignoles (Ravat 51) produces excellent wines of many different styles. It is favored for dessert wines, especially when picked late in the season. The fruit can develop high sugar content while retaining high acidity. Vines are hardy with moderate vigor and productivity. Budbreak is late, reducing the risk of spring freeze injury. Clusters are small, very compact, and highly susceptible to *Botrytis* bunch rot.

Villard blanc (Seyve-Villard 12-375) is a very productive, late-ripening grape that produces large, loose clusters of oval berries. It performs best on sites with long growing seasons. Wine quality is average, so it is often used in blending. The fruit may be sold as a dessert grape when it is fully ripe.

Recently Introduced Interspecific Hybrids

Chardone1 (Plant patent 7860) was released by Cornell University scientists in 1990 because of superior performance in Michigan and Arkansas. Its cold hardiness has been nearly as good as for Seyval, but good locations with long growing seasons are required to ripen the fruit. This cross of Seyval and Chardonnay produces an excellent wine when mature fruit are used, with aromas characteristic of both parents. Its potential for sparkling wine production appears to be good.

Horizon, developed at Cornell University in 1982, is suitable for production of bulk white wine. Its low acidity makes it useful in blending. Wines have been described as neutral and free of labrusca and hybrid flavors, but

some taste panelists have noted labrusca and hybrid aromas. The vine is very productive and winter hardy, but *Botrytis* bunch rot is a problem in some years.

Melody (Plant patent 6159) was introduced by Cornell University in 1985. The young wine is fruity, with hints of apricot and floral aromas. Its quality is among the better of the white hybrids. The vine is moderately disease resistant (Table 1), very productive, and vigorous. Selection of well-exposed canes when pruning will ensure an adequate crop each year. No cluster thinning is required.

Cold-Hardy Varieties Developed by Elmer Swenson, Osceola, Wisconsin

Several wine and table grape varieties have been developed through the private breeding efforts of Elmer Swenson and are described below. All have been bred for high levels of cold hardiness and should do well in eastern and midwestern U.S. areas typified by cold winters and short growing seasons.

Esprit (Plant patent 5716), a seedling of Villard blanc, is very productive, with large clusters and large, white berries. The variety is consumed fresh or fermented into wine but is hardy enough only for good sites in southwestern Wisconsin; it is one of the least hardy of this group.

LaCrosse (Plant patent 5588) is a fruity, white wine grape derived from Seyval. Compared to Seyval, the vine is more cold hardy, the fruit ripens slightly earlier, and the wine is somewhat fruitier. This variety has performed very well in Indiana.

St. Croix (Plant patent 4928) bears medium-sized blue berries on medium clusters. The vine is very hardy, vigorous, and disease resistant and is very precocious in bearing. Cluster thinning may be required.

St. Pepin (Plant patent 5771) is a sibling of LaCrosse, but it ripens earlier and makes a very fruity white wine. Winter hardiness ranks with Esprit. It must be planted near other grape varieties, because it is pistillate and requires cross-pollination.

European (*Vitis vinifera*) Wine Grape Varieties

The first colonists attempted to grow European grapes but failed, as did all successive attempts until the 1960s. Invariably, the failed vineyards succumbed to winter cold injury, and several underlying factors contributed to the failure to achieve satisfactory cold hardiness. The major reason is that *V. vinifera* vines generally are less cold hardy than the American grape species used to produce interspecific hybrids. Another important reason, how-

ever, these grapes failed is that they have little or no inherent resistance to several pests and diseases native to the eastern and midwestern U.S. These include the grape root aphid, phylloxera, and several fungal diseases (powdery mildew, black rot, and downy mildew). It was not until satisfactory phylloxera-resistant rootstocks were identified and modern fungicides developed that even the limited potential cold hardiness of these varieties could be attained in the field. Recently it has been found that *V. vinifera* varieties will not succeed in soils traditionally used to grow American varieties unless the soil pH is raised to about 6.5.

Another important factor that limited the success of these old varieties was the health of the nursery stock from which they were produced. During the many centuries of culture, certain virus and virus-like diseases have become widespread in *V. vinifera*. In regions with less stringent climates, such as California, these diseases may have only marginal impact on yield or grape quality. It has been suggested that the vines may even benefit from a dwarfing effect. In eastern and midwestern climates, however, anything that detracts from normal vine function is likely to reduce winter cold tolerance. Certified planting stock that has been tested for known virus pathogens is now available.

It is important to recognize the vulnerability of European grape varieties. Only sites that do not place extra restrictions on vine function, such as poor soil or air drainage, excessive or inadequate fertility, or local restrictions on length of growing season, should be used for *V. vinifera*. In addition, growers must use stringent measures to control diseases and insects, superior pruning and training methods, and canopy management techniques such as leaf removal that will enhance wood maturity and minimize disease. In many parts of Indiana, cane burial is required to prevent winter injury.

Leading *Vitis vinifera* White Wine Varieties

Chardonnay is the most widely planted *V. vinifera* variety in the eastern U.S. Relative to other *V. vinifera* varieties, it is cold hardy, but not as hardy as White Riesling or Cabernet franc. Its advantages include very high quality of both still and sparkling table wines, early and reliable fruit and wood maturity, and moderate vigor. Its primary disadvantage is its relatively high susceptibility to *Botrytis* bunch rot. For that reason, vertical training combined with summer pruning and leaf removal have often produced superior results. Of the several clones tested at the Geneva station in New York, it has been found that the locally available New York clone is superior to those from Foundation Plant Materials Service of California. Those clones tend to set excessive crops of very compact clusters that rot easily and do not ripen reliably. Their vegetative growth is excessive, often leading to winter cold injury.

White Riesling is also planted widely because of its high relative cold hardiness and the excellent quality of still and sparkling wines made from its fruit. The major disadvantage is the susceptibility of its fruit to *Botrytis* bunch rot and the relatively late harvest date. Its susceptibility to bunch rot suggests that additional canopy management techniques such as leaf removal and extra sprays to combat bunch rot may be advantageous. Several excellent clones are available, but older ones that have not been tested for freedom from viruses should be avoided because they have reduced production potential compared to certified clones.

Other *Vitis vinifera* White Wine Varieties of Interest

Pinot blanc, a white-fruited form of Pinot noir, is an important white wine variety in Germany, Alsace, and the Loire Valley of France. This grape's adaptability to eastern and midwestern growing conditions is similar to Chardonnay, and it has more resistance to bunch rot. It seems worthy of more extensive culture in cool climate districts.

Pinot gris is the "gray" (light red) form of Pinot noir. The clone tested in New York is not as cold hardy as the Pinot blanc clone but is as hardy as the better Pinot noir clones tested. It also appears to resist bunch rot. Pinot gris makes a fuller-bodied white wine than does Pinot blanc. Both the blanc and gris forms add to the quality of sparkling wine cuvées and make interesting still wines. They have the potential to offer an interesting alternative to Chardonnay or White Riesling for high-quality wine production.

Leading *Vitis vinifera* Red Wine Varieties

Cabernet Sauvignon is one of the most cold hardy and disease-resistant *V. vinifera* varieties. Although it ripens late, satisfactory levels of sugar are usually attained. Sugar alone, however, does not determine wine quality, and consistently superior wines have been produced only in the warmer production areas.

Cabernet franc should be considered an alternative or a supplement to Cabernet Sauvignon. It is the most cold hardy *V. vinifera* variety tested in New York and Michigan. The fruit ripens earlier and has produced good-quality wines more consistently than has Cabernet Sauvignon.

Pinot noir is one of the world's great red wine varieties. When fully mature, it produces superior red table wines. Excellent white sparkling wines can be produced as well. These may be made from Pinot noir alone or by blending

with other traditional sparkling wine varieties. Because it ripens early relative to other classic red *V. vinifera* varieties and is reasonably cold hardy, Pinot noir is an attractive choice for the cooler production areas. The variety has two important defects, however. It tends to produce very compact clusters of thin-skinned fruit that are highly susceptible to *Botrytis* infection and subsequent bunch rot. Wines tend to be deficient in color, especially when the fruit is harvested early to avoid bunch rot. When used for sparkling wine production the fruit are harvested before bunch rot becomes a problem.

Many clones of Pinot noir are being tested in New York and Michigan and there are great differences among them. The following are listed primarily because of their general availability. **Pinot noir "Mariafeld"** ("Klevner Mariafeld") originated in Switzerland. It has the greatest resistance to bunch rot of any Pinot noir clone tested in New York. It tends to have high yield, large berry size, and relatively low winter cold tolerance. Normally these factors should discourage planting, but because harvest can be delayed until full maturity, the clone often produces wines superior to those made from clones with potentially higher quality that must be harvested early to avoid bunch rot. The wines are high in color and tannin relative to other clones. "Mariafeld" is recommended for planting as one of a mix of clones when red Pinot noir wines are desired. Information on the origin of Pinot noir "**Geneva**" has been lost. Relative to other clones it has good winter cold hardiness but low resistance to bunch rot. Pinot noir "**Gamay Beaujolais**" is another variety whose moderate wine quality is enhanced because bunch rot tolerance allows harvest to be delayed until fruit are fully mature. Other promising clones are currently being tested. Before making planting decisions, growers should check current information on suitability and availability of alternative Pinot Noir clones.

Other *Vitis vinifera* Red Wine Varieties

Merlot has produced superior wines in New York. It has a very long vegetative growth cycle, however, and tends to produce dense, shaded canopies, leading to bunch rot and reduced winter cold tolerance. It is recommended for only the most favored sites in cool climate regions.

Limberger is grown under several different names in the northern production areas of Europe (e.g., Lemberger, Blaufränkisch). It has not been widely tested commercially, but results to date have been favorable in New York. Cold hardiness appears acceptable, and *Botrytis* resistance is good. The clusters are large and yield potential is high, which may dictate the need for crop control in some years. Wines have been rated highly; they have deep red color and rich tannins.

Table Grape Varieties for Indiana

Seeded and seedless table grapes are preferred by many consumers for fresh eating and for making jams, jellies and pies. Production of table grape requires more attention to detail than production of wine or juice grapes, because clusters must be well-filled with large berries, and the fruit must be free from rot and insect damage in order to meet consumer demands. Cane girdling, application of gibberellic acid, and cluster thinning are often required to produce high quality table grapes. Table grapes are best suited for local markets and pick-your-own sales.

Seeded Grapes

Alden is a reddish-blue variety with very large clusters and large berries. Cluster thinning is necessary to increase cluster compactness and to permit uniform ripening. Berries have firm texture and an adherent skin with a mild labrusca and muscat flavor.

Buffalo produces medium-sized, loose bunches of blue grapes with a fruity labrusca flavor. The vines are hardy and vigorous but susceptible to powdery mildew. Brittleness of cluster rachises can be also a problem.

Edelweiss produces early-ripening fruit similar to that of its parent, Ontario, but the vine is much more winter hardy.

Golden Muscat produces very large clusters of large, oval, amber berries. The late-ripening fruit may be high in acid if not fully ripened. Full maturity is not reached reliably except in locations with long growing seasons. Clusters are susceptible to bunch rot. The flavor is a rich combination of muscat and labrusca. The vine is moderately hardy and productive.

Kay Gray (Plant patent 4943), released from a private breeding program in Wisconsin operated by Elmer Swenson, is listed as one of the hardiest grapes grown in the upper Midwest. The golden fruit ripens very early, and the vine is quite disease resistant. Clusters and berries are small.

New York Muscat is a reddish-blue grape with a rich muscat-labrusca flavor. The vines are moderately vigorous and produce medium-sized, loosely filled clusters.

Ontario is a full-flavored American white grape that ripens early. Vines are vigorous, productive, and easy to grow.

Price is a very early ripening Concord-type grape developed at the Virginia Polytechnic Institute and State University (VPI). Clusters are small to medium sized with large berries. The skin is thinner than on most labrusca-

type grapes.

Sheridan produces large, compact clusters with large, black, Concord-type berries that ripen very late in the season. The vine is productive, vigorous, hardy, and easy to grow.

Steuben is a bluish-black grape that produces long, tapering, compact clusters that are among the most attractive of all dessert cultivars. The flavor is sweet with a spicy tang. The vines are hardy, vigorous, productive, and easily grown by home gardeners. Clusters thinning is usually required. Steuben is also grown commercially for wine production.

Swenson Red produces large bunches with large red berries that may turn reddish-blue if allowed to remain on the vine. Hardiness in Minnesota is marginal, but the variety easily withstands the winters in most parts of the Midwest. The berries are medium to large, firm in texture, and have an adherent skin. The flavor is mildly fruity and pleasant. Downy mildew can be severe. This variety was released jointly by the University of Minnesota and Elmer Swenson, Osceola, Wisconsin, in 1980.

Van Buren is an early-ripening, Concord-type grape. Vines are hardy but somewhat susceptible to downy mildew, especially at bloom. Clusters are somewhat smaller and the fruit more prone to cracking than Price, which ripens at about the same time.

Yates is a hardy, late-ripening red grape with juicy, sweet flesh, moderate labrusca flavor, and tough skin. Vines are very productive and may require moderate cluster thinning. The fruit keeps well in cold storage.

Seedless Grapes

Grape breeders have responded to consumer preferences for seedless grapes with the development of numerous improved varieties. The seedless trait in grapes was originally derived from cultivars of ancient origin such as Thompson seedless and Black Monukka. Most seedless grapes suitable for the eastern and midwestern United States are descended from crosses with these two cultivars. Because the trait originated in cultivars not suitable for surviving the cold temperatures of midwestern winters, many seedless varieties are not winter hardy (Table 3), although they are much hardier than their seedless parents. More recently named seedless cultivars (Canadice, Einset Seedless, Mars, Reliance, and Vanessa) represent a distinct improvement in cold hardiness. Breeding programs in New York, Ontario, Arkansas, and elsewhere continue to produce seedless selections with improved hardiness and quality.

The degree of seedlessness varies greatly among seedless grape varieties. Most seedless grapes have vestigial seed traces that range in size from very small to large and noticeable. Seed traces in berries of the same

variety may vary greatly in size and in the hardness of their seed coats. Climate is known to affect trace size. Occasionally the seed traces in some seedless grapes are large enough to be bothersome to consumers. Notes on seed remnant sizes are given for varieties in which problems exist.

Canadice is one of the more winter hardy seedless grapes, although trunk injury has occurred on some sites. It produces medium clusters with small red berries that are similar to Delaware in flavor and appearance. With cordon training systems and careful management, Canadice clusters may average 0.5 lb., and the vines can be extremely productive. Fruit rot is a problem in wet years because the clusters are compact.

Einset Seedless (Plant patent 6160) is a winter-hardy, red seedless grape with a unique, strawberry-like flavor. The medium-sized clusters produce bright red berries that have good storage potential. The clusters respond well to gibberellic acid or cane girdling to improve cluster compactness and berry size. The skin is slightly tough and adheres to the flesh. Cultural problems include susceptibility to fungal diseases and a seed remnant is occasionally noticeable.

Himrod, was released from the Cornell University grape breeding program (1952). It produces large bunches of white seedless grapes with excellent, honey-like flavor and melting, juicy texture. The clusters are loosely filled, but cane girdling, gibberellic acid treatments, or thinning may be used to increase cluster compactness and improve berry size. The brittle rachis may break when handled, and the berries may shell in storage. Vines are moderately cold hardy.

Interlaken Seedless is an early-ripening seedless grape with a strong, American flavor. The clusters are medium sized and compact with small, white berries that ripen very early. This cultivar was derived from the same cross as Himrod. Birds often cause crop loss. Vines are only moderately cold hardy.

Lakemont was also produced from the same cross as Himrod but has a milder flavor and more compact clusters of small to medium-sized berries. Cluster thinning prevents overcropping. Bunch rot is often a problem. Vines are moderately cold hardy.

Mars (Plant patent 5680), a release from the University of Arkansas, is a vigorous, blue seedless grape. The flavor is mildly labrusca, and the berries are slipskin. Clusters are medium sized, cylindrical, and well filled. Cold hardiness has been very good in Indiana, and the vines are resistant to several major diseases. Vines may bear fruit precociously, and production should be con-

trolled on young vines to prevent delays in establishment. Mars has been recommended as a home garden grape, but has shown potential for commercial marketing. It makes excellent pies and preserves

Reliance (Plant patent 5174), also from the University of Arkansas, produces large clusters of round, red, medium-sized berries. The skins are tender and the flesh is melting in texture, with a sweet labrusca flavor. Coloring may be poor in some years, and fruit often crack in wet seasons. Cold hardiness is among the highest of the seedless varieties. Downy mildew must be controlled for best results.

Remilly Seedless, developed by the New York State Agricultural Experiment Station, produces large clusters of oval seedless berries with firm texture. The flavor is neutral and mildly fruity. The clusters are very attractive in appearance but are subject to bronzing where exposed to sunlight. The vines are only moderately hardy.

Saturn (Plant patent 6703), another University of Arkansas release, produces large, crisp berries on medium-large conical clusters. The berries are bright red with adherent skins and a mild flavor. Vines are precocious but only moderately hardy. Cluster thinning may be necessary. In some years the seed remnants can be noticeable. Saturn has good storage potential and may be processed into an acceptable blending wine.

Suffolk Red produces medium to large clusters of mild-flavored red berries. The clusters are loose but may be made more compact with the use of gibberellic acid or cane girdling. Cold hardiness is only moderate. Excessive vine vigor may occur following poor crops and winter bud damage.

Vanessa was developed by HRIO, Canada, and is a red grape of excellent quality. The vine is moderately vigorous and hardy. Grafting may be desirable on many sites to increase vine size. Vigorous vines have shown poor fruit set and loosely filled clusters, but cane girdling, gibberellic acid treatments, or thinning may be used to increase cluster compactness and improve berry size. The seed remnant is usually large and soft; when noticeable it is sometimes a cause for limited marketability. Berries are medium in size on medium clusters. Storage potential is good. The flavor is mild and fruity, and berry texture is firm to crisp. The fruit quality is among the best of the red seedless types.

Venus, also from the University of Arkansas, is a vigorous and productive blue-black seedless grape. The medium-large clusters ripen early, producing large berries with mild labrusca flavors. Seed remnants are often hard and noticeable, and fruit rot can be a problem at harvest. Vines are only moderately cold hardy.

Table 1. Relative susceptibility of wine and juice grape varieties to low-temperature injury, disease, and sensitivity to sulfur applications.

Variety	WH ¹	BR ²	DM	PM	BOT	PHOM	EU	CG	ALS	Sulfur
Aurore	4	+++ ³	++	+++	+++	+	++	++	+++	No
Baco noir	3	+++	+	++	+	+	++	+++	++	No
Cabernet franc	3	+++	+++	+++	+	?	+++	+++	?	No
Cabernet Sauvignon	2	+++	+++	+++	+	+++	+++	+++	?	No
Catawba	5	+++	+++	++	+	+++	+	+	+	No
Cayuga White	4	+	++	+	+	+	+	?	++	No
Chambourcin	3	+++	++	+	++	?	?	++	?	Yes
Chancellor	5	+	+++	+++	+	+++	+	++	+++	Yes
Chardonel	4	?	++	+++	++	?	?	++	++	No
Chardonnay	2	++	+++	+++	+++	+++	++	+++	++	No
Chelois	4	+	+	+++	+	+++	+++	?	+++	No
Concord	5	+++	+	++	+	+++	+++	+	++	Yes
De Chaunac	5	+	++	+++	+	++	+++	++	+++	Yes
Delaware	5	++	+++	++	++	+++	+	+	+	No
Esprit	5	?	++	+++	++	?	?	?	?	?
Fredonia	5	+	+++	++	+	?	?	+	+	No
Horizon	5	?	+	+++	++	?	?	+	+++	No
LaCrosse	6	+++	+	++	+++	?	?	?	?	?
Léon Millot	6	?	+	++	+++	?	?	+	?	?
Limberger	2	+++	+++	+++	+	?	+++	+++	?	No
Maréchal Foch	6	++	+	++	+	?	+++	?	+	Yes
Melody	4	+++	++	+	+	?	?	?	++	No
Merlot	1	++	+++	+++	+++	+++	+++	+++	?	No
Moore's Diamond	4	+++	+	+++	++	?	++	?	?	No
Niagara	4	+++	+++	++	+	+++	+	++	+	No
Pinot blanc	2	+++	+++	+++	++	?	+++	+++	?	No
Pinot gris	2	+++	+++	+++	++	?	+++	+++	?	No
Pinot noir	2	+++	+++	+++	varies	?	+++	+++	+	No
Ravat 34	4	?	+	++	+	?	?	+	++	No
Rougeon	4	++	+++	+++	++	+++	+	?	+++	Yes
Saint Croix	6	?	++	++	++	?	?	?	?	?
Saint Pepin	5	?	+	+++	++	?	?	?	?	?
Seyval	5	+++	++	+++	+++	+	+	+++	++	No
Ventura	6	++	++	+++	+	?	?	+	+++	No
Vidal blanc	3	+	++	+++	+	+	+	+++	+	No
Vignoles	5	+	++	+++	+++	++	++	+++	++	No
Villard blanc	3	?	++	+++	+	?	?	?	?	?
Villard noir	4	?	+	+++	+	?	?	?	?	?
Vincent	4	?	+	++	+	?	?	?	?	?
White Riesling	3	+++	+++	+++	+++	++	++	+++	+	No

¹WH = Winter hardiness, 1 = too tender for all but a few select sites, 2 = tender, 3 = slightly hardy, may be grown on better sites, 4 = moderately hardy, 5 = hardy, and 6 = very hardy, worthy of trial on cold sites.

²BR = Black rot, DM = Downy mildew, PM = Powdery mildew, Bot = Botrytis, Phom = Phomopsis, Eu = Eutypa, CG = Crown gall, ALS = Angular leaf scorch, Sulfur = sensitivity to sulfur spray injury.

³Disease categories are rated as follows: + = slightly susceptible or sensitive, ++ = moderately susceptible or sensitive, +++ = highly susceptible or sensitive, ? = relative susceptibility or sensitivity not established.

Table 2. Season of maturity of wine and juice grape varieties in Indiana.¹

	Early	Midseason	Late
White Wine	Aurore (h) ²	Cayuga White (h)	Catawba (a)
	LaCrosse (h)	Chardonnay (v)	Chardonel (h)
	Ravat 34 (h)	Delaware (a)	Vidal blanc (h)
	Saint Pepin (h)	Esprit (a)	Villard blanc (h)
		Horizon (a)	White Riesling (v)
		Melody (h)	
		Moore's Diamond (a)	
		Niagara (a)	
		Pinot blanc (v)	
		Pinot gris (v)	
		Seyval (h)	
		Ventura (a)	
		Vignoles (h)	
	Red Wine	Cascade (h)	Baco noir (h)
Léon Millot (h)		Chelois (h)	Cabernet franc (v)
Maréchal Foch (h)		Concord (a)	Chambourcin (h)
Saint Croix (a)		De Chaunac (h)	Chancellor (h)
		Limberger (v)	Merlot (v)
		Pinot noir (v)	Villard noir (h)
		Rougeon (h)	Vincent (h)

¹In Indiana, early varieties ripen between late July and mid-August; mid-season varieties ripen between late August and mid-September; late varieties mature after the third week in September.

² a = American type, derived from *Vitis labrusca*
h = Interspecific hybrid, without dominant *labrusca* characteristics
v = *Vitis vinifera*

Table 3. Relative susceptibility of table grape varieties to low-temperature injury, disease, and leaf damage resulting from sulfur applications.

Variety	WH ¹	BR ²	DM	PM	BOT	PHOM	EU	CG	ALS	Sulfur
Alden	4	? ³	+	++	++	?	?	+	++	No
Buffalo	4	?	++	+++	++	?	?	+	?	NO
Canadice	4	+++	+	+	++	?	?	++	++	No
Edelweiss	5	?	+	++	++	?	?	+	++	?
Einset	4	+++	++	+++	+	?	?	+	++	?
Seedless										
Golden	4	?	++	++	+++	?	?	+	?	No
Muscat										
Himrod	4	+++	+	++	+	?	?	+	+	No
Interlaken	3	+++	+	++	++	?	?	+	+	No
Seedless										
Kay Gray	6	+	+	+	+	?	?	+	?	?
Lakemont	3	++	+	++	++	?	?	+	++	No
Mars	4	+	+	+	+	?	?	+	++	No
New York	4	?	+	+++	++	?	?	+	+	Yes
Muscat										
Ontario	4	?	+	++	++	?	?	+	+	Yes
Price	3	?	+	+	++	?	?	++	++	Yes
Reliance	4	+++	++	++	+++	?	?	+	+++	?
Remaily	3	+++	++	++	+	?	++	?	+	?
Seedless										
Saturn	2	++	++	+++	++	?	?	++	?	?
Sheridan	5	?	+	++	+	?	?	+	?	?
Steuben	5	++	+	+	+	?	?	+	++	No
Suffolk Red	3	?	+	++	++	?	?	++	++	Yes
Swenson Red	5	?	+++	++	++	?	?	+	?	?
Van Buren	5	?	+++	+	+	?	?	+	?	Yes
Vanessa	4	+++	++	++	+	+	?+	++	?	?
Venus	4	+	+	+	+++	?	?	+	+	?
Yates	4	++	+	++	+	?	?	+	?	No

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For more information on the subject discussed in this publication, consult your local office of the Purdue University Cooperative Extension Service.