

elderberries

Elderberry plants are tall shrubs with fast-growing, hollow, short-lived canes that produce white flowers in distinct clusters known as cymes (Figure 17). There are elderberry species that produce red fruit, yellow fruit, or fruit that ranges from blue to black in color, referred to here as “blue/black.” Only the species with blue/black fruit are edible. The species that produce blue/black fruit tend to have flat or slightly round cymes, whereas red elderberry species tend to have conical or pyramidal cymes. While some species of elderberries can grow twenty feet tall, the canes usually live only a few years, and new canes are constantly sprouting from the mother plant’s crown or spreading rhizomes. Red elderberries are native to Minnesota and found across the state, while the edible American elderberry’s historical natural range was just south of the Minnesota-Iowa border. Observations suggest the range may be moving north.

Elderberries are easy to grow, produce high yields, have few diseases, and are easy to harvest. Interest in elderberries for fruit and flower products has been rising rapidly since 2010 due to recently rediscovered health benefits.

The two main species of elderberry used in commercial elderberry production are the European elderberry, *Sambucus nigra* and the American elderberry, *Sambucus canadensis*. The American elderberry is found along the east coast from Florida to Quebec and west to Kansas and Nebraska. In the Midwest, the northern range of wild *S. canadensis* is close to the Iowa/Minnesota border. Both *Sambucus canadensis* and *Sambucus nigra* have dusky black fruit with a purplish cast that produces a dark purple juice. Some *S. nigra* cultivars are considered hardy to Zone 4 (-25°F). *S. canadensis* is considered hardy to Zone 3 and is currently being used for commercial production in Minnesota.



Figure 17. Elderflowers of an American elderberry

A third species, the blue elderberry *Sambucus caerulea*, is native to North America west of the continental divide from Montana to British Columbia to California. The blue elderberry is distinguished by a waxy coating on the fruit skin, giving the berry a light blue color. In spite of large, edible berries and cymes that can reach two feet in diameter, the blue elderberry has not been grown commercially to any extent. Blue elderberries ripen evenly within the cyme, making wild collection easy and could make the species desirable for commercial production. *S. caerulea* has never been domesticated. *S. caerulea* grows naturally in parts of Montana with a Zone 4 climate, but has not been tested in Minnesota.

In some books and articles, the three major species of blue and black-fruited elderberries are lumped into one species, *Sambucus nigra*, which would make the

American elderberry *S. nigra* subspecies *canadensis*. The aggressive lumping of different elderberry species into one species was due to the work of one taxonomist who did his work in the 1990s. His conclusions were not accepted by many scientists who studied elderberries and will not be used here. The two domesticated species of black elderberry have critical differences that influence how the crop is grown and processed. European elderberries only flower on second and third year canes, while many American elderberries can form flowers on first year canes in addition to older canes. Chemical differences between the fruit of the European and American elderberry species change how the fruit can be processed. Finally, the two species do not readily hybridize.

Elderberry canes leaf out early in the spring but do not bloom until June in Minnesota. As a result,

Table 9. Elderberry species names, common names, ranges, and important traits.			
Species	Common Name	Range	Important traits
<i>Sambucus nigra</i>	Black Elder	Europe, western Asia	Few rhizomes; tall, upright shrubs
<i>Sambucus canadensis</i>	American elderberry	East Coast to Great Plains	Produces fruit on first year canes, spreads by rhizomes
<i>Sambucus cearulea</i>	Blue elderberry	Rocky Mountains to Pacific Coast	Blue fruit ripens evenly in cyme, tall shrubs



Figure 18. Elderberry cyme with ripe fruit (photo courtesy of P. Otten, Natura Farms)

the leaves could be occasionally damaged by hard frosts if they sprout early. Frost injury to the blossoms is rare due to the summer bloom times. Elderflowers on second year canes will bloom for over a month, and many cultivars of *S. canadensis* will bloom on first year canes. In plants with new and old canes, bloom and harvest can last two months. Some cultivars that bear on first year canes are determinant, producing flowers at one time, while other cultivars are indeterminant and continue to produce flowers through fall.

Most cultivars of elderberries, whether *S. canadensis* or *S. nigra*, are selections of wild plants that have been propagated vegetatively. There are about 35 cultivars from both species. Several *S. nigra* cultivars

were selected for ornamental value with yellow leaves or purple flowers and edible fruit, but have productivity too low for commercial fruit production.

All the current *S. canadensis* cultivars available for the U.S. market come from breeding and selection programs in New York, Nova Scotia, and Missouri. The New York and Nova Scotia programs were active during mid twentieth century, while the Missouri program started in 1998. The only true breeding program was Nova Scotia, which used New York cultivars as parents. There are no known interspecific hybrids of elderberries between the European and American species. The Missouri program primarily uses wild selections from Missouri and will be releasing more new cultivars in the next few years.

Table 10. Zone 4 Elderberry cultivars				
Cultivar Name	Species	Origin	Characteristics	Yearly Mowing?
Samdal	<i>nigra</i>	Denmark	Vigorous, tall shoots, large cymes	No
Samyl	<i>nigra</i>	Denmark	Productive, good flowers, pollinates Samdal	No
Adams	<i>canadensis</i>	New York	tall shoots, upright canes	Yes
Bob Gordon	<i>canadensis</i>	Missouri	shorter, bending canes	Yes
Wyldeewood	<i>canadensis</i>	Missouri	shorter, bending canes, early ripening	Yes
Johns	<i>canadensis</i>	Nova Scotia	Large cymes, vigorous upright canes	Yes
York	<i>canadensis</i>	New York	Large berries, late ripening, shorter canes	Yes

HISTORY

Elderberry fruit have been used both in Europe and North America for millennia. In North America, all blue and black elderberry species were consumed by Native Americans. In arid valleys of the west, blue elderberries were the most common wild fruit available, and so became a critical part of the diet. In addition to the fruit, the leaves, flowers, and occasionally the roots have been used throughout the world to cure a variety of ailments. The hollow stems were used to make flutes.

Europeans and European settlers in North America collected wild fruit from plants growing in waste areas near roads and swamps to be used for jelly, juice, and wine. Because all edible species of elderberries are easily harvested from the wild, there was little interest in selecting cultivars and growing elderberries in commercial operations.

Interest in commercial elderberry production in the United States increased during the early 2000s as

the public started to show an interest in consuming elderberry products for their health benefits. At first, the health benefits attributed to elderberries were primarily rediscoveries of ancient knowledge. Since 2010, many scientists have been showing that the ancient uses of elderberries to cure diseases are based on solid science. As the demand for elderberries grew, processors wanted a more consistent supply and quality than can be acquired through wild plants. Researchers in Missouri began to release new, productive cultivars.

In the past decade, elderberry cooperatives have been established in seven different states, including Missouri, Iowa, New York, and Minnesota. Within each state a group of growers have organized to share knowledge on the best ways to grow and market the crop. Although elderberries are an old product, it is a new crop for fruit growers, and American scientists and producers are still developing new systems to grow the fruit profitably.

USES AND HEALTH BENEFITS

Fresh elderberries are not acceptable for fresh eating, due to low sugar content, bitter flavors and small levels of cyanide producing compounds (See Anthocyanins and Cyanogenic, below). When properly processed, elderberries have a unique flavor that most consumers find quite pleasing, along with a pleasant purplish color. Most elderberries are processed into jellies, syrups, sauces, juices, and wine. Elderberry juice is often mixed into other juices, such as apple or pear to give a unique flavor, a purple color, or to increase antioxidant levels of the product.

Elderberries have little natural pectin, and elderberry jelly does not jell easily. Use of a pectin that interacts with added calcium powder, such as Pomona's Universal Pectin²⁴, might be more successful than

the more commonly available pectins that interact with sugar. Elderberries are low in acid, so jelly or juice tastes better when lemons or another acidic fruit is added. Elderberry juice is fairly similar to chokecherry juice, which also jells poorly, so recipes for chokecherry jelly could be tried with elderberry juice. In the book, "Stalking the Wild Asparagus" Euell Gibbons promoted the idea of mixing elderberry juice with tea from the sumac fruit. Sumac tea is highly acidic, with a taste similar to lemonade, and it gives a nice zing to the elderberry juice.

Elderberry flowers or "elderflowers" are edible and have many healthy attributes. Elderflowers can be used to flavor wines and liquors, make syrup, make tea, or simply dipped in batter and fried.

²⁴ The Minnesota Institute for Sustainable Agriculture does not endorse particular commercial products, but is providing this product name because of its unusual properties that may make it suitable for use with low-pectin perennial fruits.

Elderberries and elderflowers are being incorporated into over-the-counter medicines. The Sambucol® brand includes many patented products made from elderberries that are being sold as a cure for colds and flu based on brand-funded research.

Elderberries are rich in essential nutrients and antioxidants and contain medicinal compounds. In addition to Vitamin C, elderberries are one of the few blue fruits with Vitamin A, and they even have Vitamin B6 and iron. Much of the current interest in elderberry production has been driven by potential health benefits from the medicinal compounds in all parts of the plant.

One of the first recorded uses of elder for health purposes comes from Hippocrates, circa 400 BC who referred to the elderberry bush as his medicine chest because of the wide variety of uses. Four hundred years later, the Roman physician Dioscorides and Pliny the Elder wrote about its widespread use. Some home remedies that include elderberries were written alongside cures that contain pig manure, which may not inspire confidence. However, the universal use of elderberries on all continents indicates many legitimate health benefits. Prior to the advent of modern medicine, all parts of the elderberry plant were used to treat a large variety of ailments. The leaves were used as a poultice to treat aches and speed up healing. The pith was used to cure diseases and ease the pain of childbirth. Many different parts of the plant, including the flowers, were used as a laxative.²⁵

Like all blue fruit, elderberries are rich in anthocyanins. Most anthocyanins are chemically unstable compounds that easily break down during processing. Food manufacturers have avoided using anthocyanins in food dyes because the blues or reds often disappear in cooking and storage. American elderberries have unusually stable anthocyanins called acylated anthocyanins, which

consists of a normal anthocyanin with a smaller molecule attached to it. The acylated anthocyanins give the juice of American elderberries stable purple color and high antioxidant levels that are retained even after extensive processing. The anthocyanins in European elderberries are the normal unstable types.²⁶

Both the flowers and fruit contain substances that appear to kill some types of bacteria and even help keep viruses from replicating, suggesting that elderberries can help cure the common cold.²⁷ Elderberries contain the active ingredients for an herbal medicine called Sambucol®, which people drink as a syrup to recover from colds. The fruit of some species contains valeric acid, which can help control asthma. Another substance in the fruit stimulates insulin secretion while enhancing glucose absorption, which suggests that it could be used in treating the symptoms of diabetes.



Figure 19. Elderberry cyme with ripe fruit

²⁵ Charlebois, D., P.L. Byers, C.E. Finn and A. L. Thomas. Elderberry, Botany, Horticulture, Potential. 2010. *Horticulture Reviews*. Volume 37, pp. 213- 280

²⁶ Bakowska-Barczak. 2005. Acylated anthocyanins as stable natural food colorants. A review. *Polish Journal of Food and Nutrition Sciences*. 14: 107-116

²⁷ Charlebois, D. et al. 2010; *ibid*.

ANTHOCYANINS AND CYANOGENIC

All types of fruit are extremely complex chemically, and sometimes very different chemical compounds in the fruit have similar names. The words *anthocyanin*, *cyanide*, and *cyanogenic* all sound similar, but the first word in some ways is the opposite of the second two words. The term “cyan” refers to a blue color, and cyanide was first isolated from blue-green algae, which are also called cyanobacteria.

Anthocyanins are chemical compounds that make fruit blue or red. Anthocyanins are beneficial with no harmful side effects.

Like many medicinal plants, elderberries can be toxic. Most parts of the plant contain cyanogenic glucosides that can release the poison hydrogen cyanide. Levels of the cyanogenic glucosides in the fruit vary greatly between cultivars, and some cultivars have none. As a general rule, raw elderberries can be eaten in small quantities. Stems have high levels of cyanide, and therefore during processing, berries should be removed from the cyme as much as possible. Although roots and stems have been used in traditional medicines, their consumption is not recommended due to high cyanide levels.

Cyanogenic glycosides are sugar compounds that contain cyanide, and are found in the tissues of about 2000 plant species from many different families. Cyanogenic glycosides are stable and harmless in living plant cells. Cyanides are released when the cell structure is broken down allowing cyanogenic glycosides in one part of the cell to

come into contact with enzymes from another part of the cell. The most common ways cell structure is broken down are when leaves are frozen and thawed, chewed, or ground up. Cyanide is an extremely toxic compound that plants use to discourage animals from eating certain parts of the plant. Cyanide can kill people if moderate amounts are eaten. Common plant tissues that have cyanide include cassava, sorghum leaves, stone fruit pits, and apple seeds. Among the emerging crops, elderberries, aronia, chokecherry, wild plums, and juneberries all contain cyanogenic compounds in seeds and leaves. A small amount of cyanide is harmless. Humans can absorb 50 to 60 ppm cyanide per hour with no consequences.²⁸ A person would have to eat and thoroughly chew at least 22 apple seeds in an hour to exceed 60 ppm cyanide and 143 apple seeds to reach harmful levels (calculated from Bolarinwa et al. 2015 using maximum cyanide levels).²⁹ Lethal doses occur at about 200 ppm per hour (Bolarinwa et al.) With stone fruit, the danger from cyanides is low, because the cyanogenic glucosides are in the pit and pits with high levels of cyanogenic glucosides are too bitter to eat. There are apricots with “sweet pits” that are edible and contain edible concentrations of cyanogenic glycosides. Almonds (a stone fruit closely related to peach and apricot) have been bred to contain low cyanide. Juneberries contain enough cyanogenic glycosides to give cooked products an almond flavor but not enough to harm anyone’s health.³⁰

²⁸ <http://extoxnet.orst.edu/faqs/natural/cya.htm>

²⁹ Bolarinwa, I.F., C. Orfila, and M.R. Morgan. 2015. Determination of amygdalin in apple seeds, fresh apples and processed apple juices. *Food Chem.* 170:437-442

³⁰ Vetter, J. 2000. Plant cyanogenic glycosides. *Toxicon* pp. 11-36.

PROPAGATION

Elderberries can be propagated by seeds, hardwood cuttings, rhizomes and simply by digging up and replanting whole dormant suckers. Seed propagation occurs wherever there are birds and elderberries, but seedlings vary in fruit quality, vigor and productivity. The variability due to seed propagation can be beneficial for people trying to find new cultivars suitable for various climates and soils. Plants started from seed take one or two years longer to come into production than plants started from cuttings.³¹

People who want to retain all the characteristics of the mother plant must use vegetative propagation. For those who want to make five or so plants, digging up dormant suckers works quite well. Growers who need many plants in a short period of time can use hardwood cuttings. Dormant first-year canes can be cut either at the beginning of winter and put in cold storage for the winter or taken at the end of the winter and planted directly in the

ground. Considering the potential for winter injury in Minnesota, cuttings probably should be taken in late November or early December and put in cold storage for two months or until the buds start swelling. The temperature in cold storage should be between 32° and 40°F, with high humidity. As soon as the buds swell, the cuttings should be put into soil and placed in full sunlight. Cut canes into sections containing two to three buds and place them in a propagation bed consisting of sand, peat, or good garden soil. Rooting hormones are advisable but not necessary. Cuttings can be put in a nursery bed outside, planted in pots in a greenhouse, or planted directly in the field in early spring. By planting in pots or an outside nursery bed, the field can be prepared or used for another crop the first year. Putting cuttings directly in the field avoids the extra step of transplanting, but the field must be kept weed free the first summer. Not all cuttings sprout, so be prepared to fill in spots the following year or in late summer if planting directly into the soil.

PLANTING AND CARE

Elderberries grow in a wide range of soils. In Missouri and other states elderberries commonly grow in ditches next to roads where the plants tolerate short term flooding. Depending on the species and cultivar, elderberries will grow in soils with a pH between 5.5 and 7.5, with some reports of berries growing in soils with a pH of 8.0. Elderberries are tolerant of soils fairly high in clay. In their native habitats, elderberries rarely grow in sandy soils. If growing elderberries in sandy soil, irrigation is necessary.

Elderberries should be planted further apart than other berries. Plant from two to four feet apart within the row for a hedge and further apart for individual shrubs. Rows should be at least ten feet apart. Once established, elderberry plants grow rapidly and can

spread easily, creating a thicket that is difficult to walk through. Growers who planted their rows too close together (eight feet) usually wished that they had planted their rows further apart. Plant spacing should be adjusted according to plant height.

Perennial weeds such as quackgrass and Canada thistle should be killed before planting elderberries. After becoming established, elderberries can outcompete weeds; but for the first two years, the plants should be kept completely weed free. Elderberries grow well when mulched the first two years after planting. Controlled studies that compared different types of mulch showed no difference in weed control or growth between wood chip mulch and plastic mulch. Durable landscape fabric and heavy plastic mulches that last more than

³¹ Byers, Patrick. *Elderberry Propagation*. University of Missouri Extension. <http://extension.missouri.edu/greene/documents/Horticulture/Elderberry/ElderberryPropagation.pdf>

two years should be avoided, because they inhibit new shoots from sprouting near the mother plant.

Elderberries can be grown on a one-year (annual) cane system, a two-year (biennial) cane system, or a three-year (perennial) cane system. In the one year or annual cane system, the canes are mowed to the ground every year. The annual system can only be used on selected *S. canadensis* cultivars which flower and fruit at the tip of first year canes. The biennial cane system can be used for both *S. canadensis* and *S. nigra* cultivars. Most European varieties only produce flowers on canes that have gone through one or more winters, which means that best yields are accomplished with a biennial or perennial cane system. In the perennial system, canes older than three or four years are pruned out each winter, which allows plants to grow 15 to 20 feet high. Berries on three- and four-year-old canes ripen unevenly within the cyme, while berries on second year canes ripen evenly within the cyme. Many European producers use a modified biennial system where plants are pruned every other year to a height of three feet, which means that most fruiting canes are in their second year.

American growers have had more success growing all of their elderberries on first year canes, although not all named cultivars or wild plants are suitable

for this practice. Each spring, the shrubs are mowed or cut to ground level, leaving no overwintering canes. The annual cane system is more suitable for mechanization, and the berries on cymes of first year canes ripen evenly. In Minnesota, growers using the annual cane system do not have to worry about losing a crop if the canes die from winter injury.

In a study conducted in Missouri, three cultivars of elderberries were grown with four different pruning systems: the annual cane system mowed every year, a biennial system where plants were mowed to the ground every other year, a system where the older canes were selectively removed, and plants that were never pruned. Plants of the cultivar 'Netzer' that were mowed every year had half the yield of those that were selectively pruned, while 'Adams II' yield in the annual system was nearly identical to other types of pruning. 'Bob Gordon' had the highest yields overall, and annual mowing reduced yields about 25% compared to biennial mowing or selective pruning. Cymes of 'Adams II' and 'Bob Gordon' in the annual system were nearly twice as big as cymes from other pruning systems. The larger cymes, increased harvest efficiency, and lower labor costs for 'Bob Gordon' with the annual system made up for the reduced yields.³²



Figure 20. Elderberries grown in the annual cane system in early June. (Photo courtesy of P. Otten)

³² Finn, C. E., A. L. Thomas and P.L. Byers. 2008. Evaluation of American (*Sambucus canadensis*) and European (*S. nigra*) elderberry genotypes grown in diverse environments and implications for cultivar development. *HortScience*. 43:1385-1391.

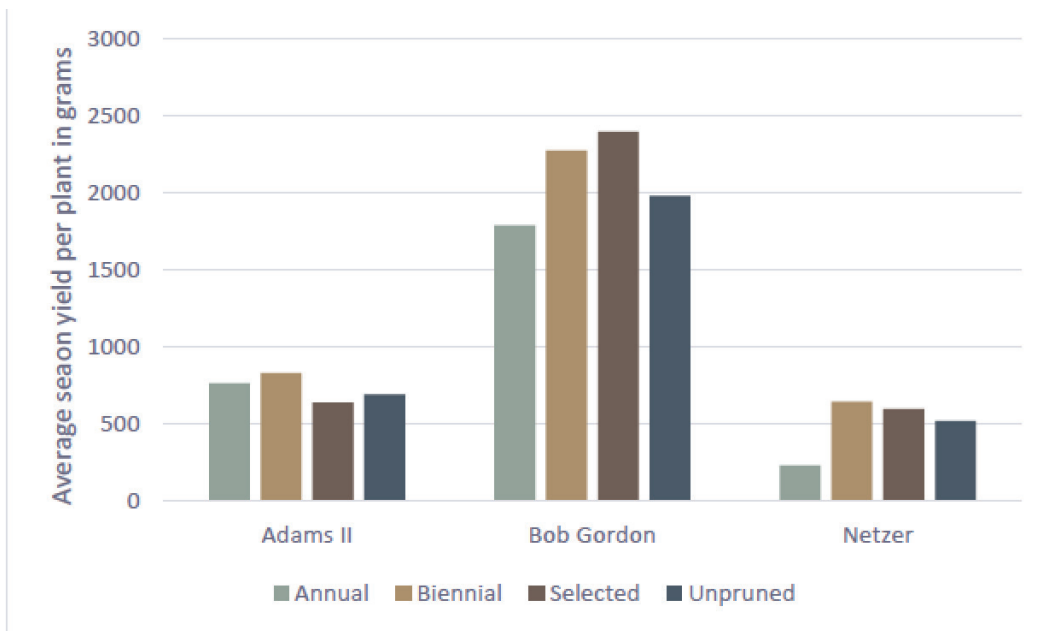
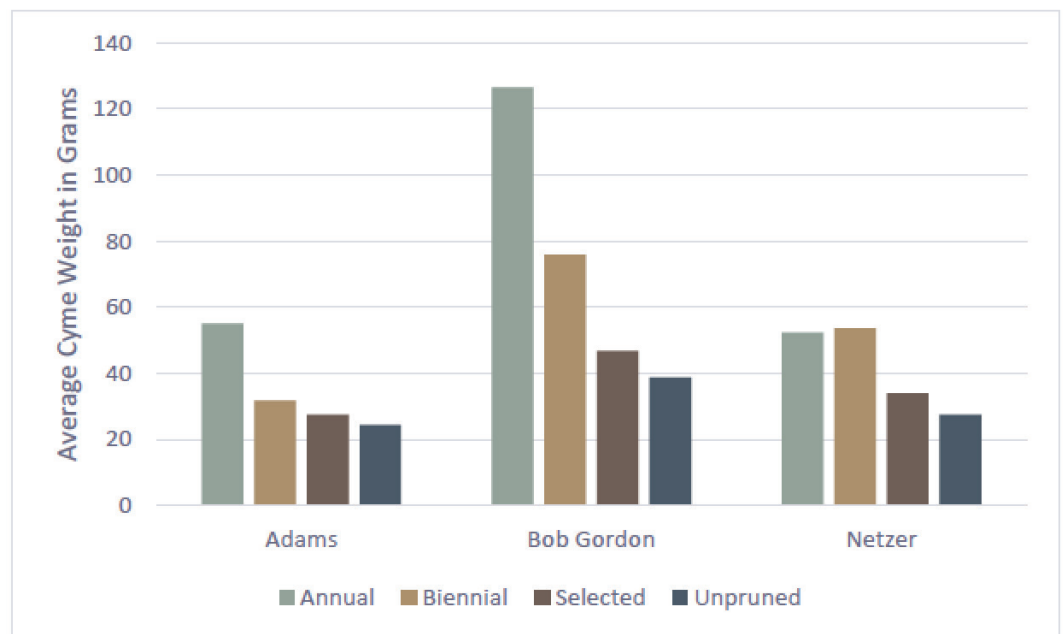


Figure 21. Average yield for three American elderberry cultivars that were either mowed every year, mowed every other year, selectively pruned or left unpruned. The berries were grown in two sites in Missouri from 2003 to 2007. Figure from Finn et al., 2008.

Figure 22. Cyme weight for three American elderberry cultivars that were either mowed every year, mowed every other year, selectively pruned or left unpruned. The plants were grown in two sites in Missouri from 2003 to 2007. Figure from Finn et al., 2008.



PRODUCTION PROBLEMS

Elderberries have few diseases or insect pests in most of Minnesota. Problems with elderberry rust, powdery mildew, and mites become more likely as you move south and east. Deer occasionally feed on elderberries, especially on young plants and succulent growth. The two biggest issues elderberry growers face are bird pressure and Spotted Wing Drosophila. Elderberries appear to be a preferred host for Spotted Wing Drosophila, a pest which showed up in the state in 2012. Currently, Minnesota elderberry growers are

still trying to figure out how to control Spotted Wing Drosophila. Spotted Wing Drosophila numbers appear to peak in late July and often drop to minimal levels by early September, so late ripening elderberries may escape severe infestations.

Some growers find it necessary to net their plants to protect their crop from birds, while others are able to harvest a crop with minor bird damage and no nets.

HARVESTING

Elderberries are typically harvested by cutting the cymes from the plant and separating the berries from the cyme after picking. Ladders are rarely used, because elderberries are typically trained to be 10 feet tall or

less. Removing berries from the cymes is usually the most labor-intensive step in harvesting elderberries, so most large processors have machines that shake the cymes and remove the berries.

EDIBLE LANDSCAPING

If properly pruned and maintained, any of the major cultivars of elderberry can be an attractive addition to a landscaped yard or the edge of a garden. All elderberries have flowers that bloom in early summer when few other flowers are open. Elderberries have long been a part of ornamental gardens in England as well as in the U.S. Several European cultivars have been selected as ornamentals yet still produce edible fruit. 'Black Beauty' has black

leaves, contrasting pink flowers, and produces black, edible fruit. 'Black Lace' also has deeply cut black leaves and edible fruit. 'Variegated' has variegated white and green leaves, but slower growth and lower productivity. The western species *Sambucus caerulea* has an upright growth habit, giving the plant good form, and has light blue fruit that stays on the plant for several months, adding an unusual blue color to the fall landscape.

COMMERCIAL POTENTIAL IN MINNESOTA

Although elderberries have been eaten in North America for thousands of years, most Americans have never heard of the crop. Even in parts of the U.S. where elderberries grow wild, only a fraction of the fruit is harvested and processed. In a 2011 survey, only 33% of consumers nationwide had heard of elderberries.³³ In Minnesota, that number is probably smaller because the state lies north of the natural range for the American elderberry, and there is no tradition of making elderberry wine or jelly among rural Minnesotans. In spite of the low visibility, demand is higher than supply, primarily from people who claim that a cold or flu was cured by elderberry tea, juice, or jelly.

The market for elderberries has huge potential, due to a combination of health benefits and good flavor. Elderberries have the benefit of edible flowers in addition to edible fruit, which can add a delicate flavor to fruit juices, cordials, wines and jellies. In some cultivars, the flowers can be harvested without a reduction in total yield, because canes will produce extra cymes.

The Minnesota Elderberry Cooperative (MEC) was started in 2012 to promote elderberry production and find uses for the product. The cooperative members changed the name to Midwest Elderberry Cooperative in 2016 (<http://www.midwest-elderberry.coop/>). Participating members are successfully growing, harvesting, and marketing local elderberries. Currently, Minnesotans are seeing the highest yields using *S. canadensis* varieties that flower and fruit on first year canes, rather than the biennial or selective pruning systems. Yields are likely high enough to support an elderberry industry.

Elderberries appear to be best suited for the southern third of the state. Experimental plots in Staples, Minnesota and Carrington, North Dakota have produced weak plants with poor yields. Growers in northern areas can either experiment with annual production or experiment with perennial culture using hardy *S. canadensis*, *S. nigra*, or even *S. caerulea* seedlings.

³³ Mohebalian, P.M. and F.X. Aguilar. 2013. Conjoint analysis of U.S. consumer's preference for elderberry jelly and juice products. *HortScience* 48:338-346.