

# Temperate Berry Crops

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Wherever humans have lived, they have made berries a part of their diet. Most of these have never been developed beyond local markets but some have become economically important crops. In this paper, the berry crops have been divided into four groups based on their current international popularity and potential future value. An overview of the status of development, current production, and future potential for these crops is presented with an American perspective. The discussion is limited to temperate “berry” crops that are produced on a shrub, a perennial herbaceous plant, or a vine, which excludes many of the cherry/plum (*Prunus* sp., Rosaceae) relatives; jujube (*Ziziphus jujuba* Mill., Rhamnaceae); *Cornus* sp. Cornaceae; *Sorbus* sp., Rosaceae; and many other tree fruit.

## MAJOR BERRY CROPS

The most economically important and best described berry crops worldwide include strawberry (*Fragaria ×ananassa* Duch., Rosaceae) (Galletta and Bringhurst 1990; Hancock et al. 1996); blueberry (*Vaccinium corymbosum* L., *V. angustifolium* Ait., *V. ashei* Reade, Ericaceae) (Eck et al. 1990; Pritts et al. 1992; Galletta and Ballington 1996); cranberry (*V. macrocarpon* Ait., Ericaceae) (Dana 1990; Eck 1990; Roper and Vorsa 1997); black currant (*Ribes nigrum* L., Grossulariaceae) (Harmat et al. 1990; Brennan 1996); table and wine grapes (*Vitis* spp., Vitaceae) (Ahmedullah and Himelrick 1990); raspberry (*Rubus idaeus* L., Rosaceae) (Jennings 1988; Crandall and Daubeny 1990; Pritts and Handley 1989; Daubeny 1996); and blackberry (*Rubus* sp., Rosaceae) (Pritts and Handley 1989; Hall 1990; Moore and Skirvin 1990; Crandall 1995). These need no further discussion as information is widely available on each.

Other major berry crops have large production areas worldwide but for a variety of reasons have not reached the stature and importance of the above. These include the hybrid berries such as ‘Logan’ and ‘Boysen’ (*Rubus* sp., Rosaceae); black raspberry (*R. occidentalis* L., Rosaceae); lingonberry (*Vaccinium vitis-idaea* L., Ericaceae); gooseberry (*Ribes uva-crispa* L. Grossulariaceae); and red currant (*Ribes rubrum* L., Grossulariaceae). These will be discussed in turn below.

## Hybridberries

‘Logan’ is a result of cross between red raspberry (*R. idaeus* L.) and a blackberry (*R. ursinus* Cham. & Schldl., Rosaceae derivative) (Logan 1909; Brown 1916; Logan 1955; Jennings 1980). ‘Logan’ fruit are similar in color and appearance to red raspberry but the torus remains with the fruit like a blackberry and they have a distinctive flavor. The fruit are excellent for processing and are dried, juiced, and canned. In the late 1800s to mid 1900s, ‘Logan’ was planted on thousands of hectares and accounted for millions of dollars in sales. Today approximately 40 ha remain in commercial production in Oregon. Many factors have led to ‘Logan’s’ decline in popularity including: the difficulty of picking the fruit especially with a mechanical harvester, relatively low yields, and a decline in popularity in a younger generation of consumers.

‘Boysen’ was discovered on Rudolph Boysen’s farm in California. This red raspberry (or ‘Logan’) × blackberry hybrid was the basis for the initial development of the Knott’s Berry Farm fruit and entertainment empire. ‘Boysen’ has the growth habit of trailing blackberry and the fruit are similar in appearance, larger on average, with larger drupelets, and a purple fruit color. ‘Boysen’ was widely produced in California, Oregon, and New Zealand into the 1980s. Currently, a few thousand hectares of ‘Boysen’ are grown in Oregon and New Zealand but California production has largely disappeared. The market for ‘Boysen’ remains strong.

‘Logan’ and ‘Boysen’ can be grown wherever trailing blackberries such as ‘Marion’ can be grown. Information is available on cultural practices at the Northwest Berry and Grape Infonet (<http://osu.orst.edu/dept/infonet/>).

## Lingonberry

Stang et al. (1990) specifically addressed lingonberries (*Vaccinium vitis-idaea* L., Ericaceae) at the First New Crops Symposium in 1988. Lingonberry continues to be largely a European crop. However, the Pacific

Northwest has seen a substantial increase in plantings the last 3 years. Lingonberry is harvested from native stands in northeast China and in some localities a substantial quantity of juice is produced. Lingonberry is found natively on acidic soils in northern temperate zones and can range to near the Arctic Circle, but in many of these northern areas they are protected by snow cover. In addition to Stang et al. (1990), St.-Pierre (1996) has published production information. Since lingonberry is largely a processed crop, either better cultivars or better machines must be developed that will make mechanical harvest viable.

### **Black Raspberry**

Black raspberry (*Rubus occidentalis* L., Rosaceae) production is concentrated in Oregon where 400–600 ha are harvested for processing into juice and jam. Ohio growers are planning on doubling their crop area to 250 ha in the next few years (J. Scheerens, pers. commun.). The juice is valuable as a natural colorant. In other regions, particularly regions of Ohio and Pennsylvania, black raspberry is harvested fresh as a pick-your-own crop. ‘Munger’ is the most important cultivar worldwide. Black raspberries are relatively easy to grow, however, they are short-lived. Plantings often last only 2–3 harvest seasons due to virus and disease infestation. Poor pollination from rain during bloom can limit the crop. The plants are trellised in the eastern US for fresh harvest but in the western US the plants are “hedged” at about 1 m for mechanical harvesting and processing. The biggest challenge with large-scale production is the fluctuation in fruit price. In 1997, the fruit sold for \$US 4.18/kg whereas the price in 1995 had only been \$US 1.32/kg (USDA-NASS-ERS 1998). Black raspberries can be established relatively quickly and cheaply so growers are constantly getting into and out of production in response to the fruit price.

### **Gooseberry and Red Currant**

These two members of the *Ribes* have a long history of cultivation. They are widely adapted to temperate regions and many soil types. While they are popular in Europe as a fresh market and processed product, they have had limited success in the US, in part due to white pine blister rust (*Cronartium ribicola* Fisher) restrictions. Both are grown throughout the eastern US primarily as a fresh market crop for local sales. In the Pacific Northwest, they are grown and shipped nationally on the fresh market and Washington has about 40 ha in production. Both of these crops are primarily processed into pies or preserves in the case of gooseberries, and juice or jelly in the case of red currants. Since 1966, when federal legislation was deregulated, 17 states in the US continue to restrict the production of some or all of the *Ribes* species because they are a cohost for white pine blister rust. Some of these states are considering repealing their restrictions so that *Ribes* can be grown. Some *Ribes* genotypes are resistant to this disease and some are immune (Hummer and Finn 1998b). Gooseberry production in the US is often limited by powdery mildew (*Sphaerotheca mors-uvae* [Schwein.] Berk. & Curt), which can regularly cause defoliation in plants. While the primary cultivars grown in the US have been ‘Oregon Champion’, ‘Poorman’, and ‘Pixwell’ due to their reliable production, other cultivars are suitable and are mildew resistant (Hummer and Finn 1998a). The main limitation to these crops appears to be consumer education and acceptance. A number of hybrids between gooseberry and black currant are larger fruited and milder flavored than black currant; ‘Josta’ is the best known example (Reich 1991). While not widely planted, there are some very small commercial plantings and market development seems to be the biggest drawback to further expansion.

### **NEGLECTED BERRIES**

Neglected berries include those that are regionally important such as elderberry (*Sambucus canadensis* L., Caprifoliaceae); aronia (*Aronia melanocarpa* [Michx.] Elliott, Rosaceae); cloudberry (*R. chamaemorus* L., Rosaceae); arctic raspberry (*R. arcticus* L., *R. stellatus* Sm., and their hybrids, Rosaceae); mora (*R. glaucus* Benth., Rosaceae); alpine strawberry (*F. vesca* L., Rosaceae); muscadine grape (*Vitis rotundifolia* Michx., Vitaceae); Juneberry/saskatoon (*Amelanchier* sp., Rosaceae); hardy kiwi (*Actinidia arguta* [Siebold & Zucc.] Planch. ex Miq., Actinidiaceae); edible honeysuckle (*Lonicera caerulea* L., Caprifoliaceae); sea buckthorn (*Hippophae rhamnoides* L., Elaeagnaceae); and schisandra (*Schisandra chinensis* [Turcz.] Baill., Schisandraceae).

## Elderberry

The juice and preserves of *Sambucus canadensis* L., native to eastern North America, and *S. nigra* L., native to Europe, have often been mainstays of rural pantries and Native Americans and early settlers used them as a dried and medicinal crop. Elderberry was seldom cultivated because it was so common in fence rows and along roadsides. While limited, information is available on commercial production (Way 1981; Stang 1990). Selections of superior plants from the wild have traditionally been used locally but high quality cultivars were developed from *S. canadensis* by breeding programs in New York, Pennsylvania, and Nova Scotia (Ritter and McKee 1964; Way 1964; Craig 1966; Darrow 1975). Pennsylvania and Oregon have a few fairly large plantings, Kansas has a small elderberry wine industry and the Austrians have substantial plantings. 'Haschberg', a wild selection of *S. nigra* from near Vienna, is the main European cultivar (R. Wrolstad pers. commun.). The fruit is in demand for processing in preserves, as a natural colorant, and for wine making. In Europe, a company has just released an anthocyanin/flavonoid enriched extract primarily from elderberry for colorant and nutraceutical use. While the crop would benefit from further breeding, it is generally adapted to most locations although viruses can be a problem in the northwestern US. Incorporating the desirable acylated anthocyanin pigments of *S. canadensis* into *S. nigra* and improving pigment stability in processed products (R. Wrolstad pers. commun.) are improvements desired by processors.

## Baby Kiwi, Hardy Kiwi, Tara, Wild Fig, Wee-kee

*Actinidia arguta* (Siebold & Zucc.) Planch. ex Miq., a smooth-skinned, winter tolerant relative of the kiwifruit (*A. chinensis* Planch./ *A. deliciosa* [A. Chev.] C. F. Liang & A. R. Ferguson, Actinidiaceae), has many common names. Recently, it has been developed from a novelty into an economically important crop (Ferguson 1990; Strik and Cahn 1998). The fruit are small, about the size of a large table grape, and are packaged multiply in "clam shell" containers rather than as single fruit. Darrow, in 1937, presented this species as a potential crop but it was not until the 1990s that it has become a small scale commercial crop. As the New Zealanders brought the fuzzy Chinese gooseberry (renamed the kiwifruit) to world attention, homeowner enthusiasts spread the more winter tolerant *A. arguta* across North America. It might have remained in the realm of enthusiasts until Hurst's Berry (Sheridan, Oregon) decided it would fit well in a diverse fresh berry product line. Their interest and development of this crop demonstrate the impact a single company, with good marketing savvy, can have on a relatively obscure crop. While the consistent demand for this crop is undetermined, more than 35 ha of fruit have been planted in Oregon since 1994 and there are a few growers with substantial plantings in Pennsylvania. *Growing Kiwifruit* is an excellent guide to growing *A. arguta* commercially (Strik and Cahn 1998). The major drawbacks to this crop are the expense of establishing a planting and the length of time to the first crop. *Actinidia arguta* requires a substantial trellis system, irrigation, and takes three years until a small crop is produced. Once in production, the biggest problems are frosts that kill newly emerged shoots that would produce the flowers, and abrasion on the fruit surface due to wind. Irrigation and other forms of frost protection reduce this problem. The fruit is harvested and put into storage when it is mature but before it begins to soften. When it is ready to ship it is treated with ethylene to begin the final ripening process. In storage, the pedicels, which do not form an abscission zone with the fruit, dry out and harden which can be of concern to consumers. This problem has yet to be solved but mechanical or genetic solutions may be possible.

## Alpine Strawberry

*Fragaria vesca* L. production seems to have reached its peak prior to the development of *F. ×ananassa* as the primary commercial strawberry. There seems to be a constant interest in producing these small but aromatic fruit (Reich 1991). Bakers like to use these small fruit in products such as muffins where an entire berry is desirable. Homeowners often write passionately about them. They are not likely to have a major commercial impact but could be grown and marketed successfully to niche markets if the labor costs of harvest and low yields can be justified. While the plants are relatively easy to grow and can be raised from seed, they are short-lived where virus pressure is high. In breeding programs, *F. vesca* is often used as an indicator plant for strawberry viruses.

## Rubus

Cloudberry (*R. chamaemorus*) and arctic raspberry (*R. arcticus*, *R. stellatus* and their hybrids) in northern Europe and mora (*R. glaucus*) in Andean South America are regionally extremely important and valuable crops. As a group, their perishable nature lends them to processing as juice, preserves, and liqueurs. Rapp et al. (1993) addressed the potential of *R. chamaemorus* at the 1992 New Crops Symposium.

Arctic raspberries are native to the colder regions of the northern hemisphere and are renowned for the strong aromatic character of their fruit. Breeding programs in Finland and Sweden have developed cultivars from these species (Jennings 1988). The cultivars are largely self-sterile so more than a single cultivar must be planted. The cultivars are apparently widely and successfully grown in Scandinavia. Production at this point in time appears to be limited to Scandinavia.

*Rubus glaucus* is commonly sold in the Andean countries of South America. This crop is typically grown in small, up to 0.5 ha plantings for local sale. Large bottles (2 L) of mora carbonated soda were available in grocery stores suggesting larger scale commercial production is viable. A large fruit processor seriously considered commercial production of this crop in the US in the 1970s but pulled out just before the plantings were to be established. This crop may be similar to the ‘Marion’ blackberry, which is renowned for its flavor and aroma and excellent processing characteristics. However, as with ‘Marion’, *R. glaucus* fruit are too perishable for the fresh market. This crop appears to be a developed “land-race;” cultivars have not been developed but the species has commercial qualities. Plants require irrigation on their native volcanic soils and are often trellised (Gaitoni ~1970; Federación Nacional de Cafeteros de Columbia ~1984 [The exact date of these publications is unknown but they are available upon request]). Because the species is native to high elevation near the equator (little change in photoperiod and moderate temperatures year round), widely adapted types must be developed if this crop were to be more widely planted. Commercial production has been reported in Mexico and Central and South America (Gaitoni ~1970; Federación Nacional de Cafeteros de Columbia ~1984; Rincon 1987).

## Aronia, Chokeberry

*Aronia melanocarpa* is native to the eastern US, however, this crop was popularized and is commonly planted in Eastern Europe and the former Soviet Union. Prior to World War II, aronia was primarily used as an ornamental. Seeds were later imported from Germany to the former Soviet Union where cultivars were developed for fruit production (Kask 1987). By 1971, 5400 ha were planted in the former Soviet Union, 4000 of which were in Siberia. The original species is diploid, however, most of the cultivars are tetraploid. The 4x cultivars are sometimes designated as *Aronia mitshurinii* Skvorsov et Majjtulina, Rosaceae. The fruit was designated as a “healing plant” in the former Soviet Union. Experimental plantings of cultivars have been established in Czechoslovakia, Scandinavia, and Germany. The fruit is valued for its juice which is very high in anthocyanins, blends well with other fruit juices and is reputed as a source of “phenols, leucoanthocyanins, catachines, flavonoles, and flavones” that are considered to be bioactive in humans. The plants have no special cultural or site requirements. In the Pacific Northwest, the extremely vigorous plants will bear a small crop one year after rooted cuttings are planted. The plants resemble *Amelanchier*, Rosaceae in many respects. Yields of up to 17 kg/bush with 10 kg/bush average are reported in Eastern Europe. The fruit is often hand harvested by cutting the fruit clusters, but they can be mechanically harvested. In Oregon, an unidentified spring rust on the fruit caused some yield loss but its effect appeared to be minimal. Currently, there is interest in establishing commercial production of *Aronia* in the US. (Much of this information is from an unpublished document of an unknown source but is available upon request.)

## Muscadine Grape

*Vitis rotundifolia*, a southeastern US native, seems to primarily have consumer appeal in that region. While evolutionarily related to the “bunch grapes” such as *V. vinifera* L., Vitaceae and *V. labrusca* L., Vitaceae, the muscadines differ in many ways including chromosome number, vine and berry anatomy and morphology, and physical and chemical characteristics of the fruit and juice (Olien 1990). The fruit with its distinctive musky or fruity aroma is eaten fresh but is even more commonly made into juice, wines, pies, jellies, and other processed products. While the fruit has been cultivated by indigenous peoples for more than 400 years,

production has been limited to the South. Most of the 1600 ha in production is concentrated in the coastal states from North Carolina to Louisiana (Olien and Hegwood 1990). Traditionally, muscadines have been grown where Pierce's disease has limited the production of American and French-hybrid grapes (Olien 1990). Lack of research on improved cultivars, cultural techniques, and processing methods has also limited commercial expansion of the industry (Olien 1990). Currently, the price for fruit has been good. In 1998, muscadines were being sold at 1.6 times the price of 'Thompson Seedless' on the fresh market (J. Clark, pers. commun.). Although more research is needed, information is available about production practices (Dearing 1947; Hegwood et al. 1983; Olien 1990; Anderson 1996) and breeding of muscadines has been reviewed (Goldy 1992)

### **Juneberry/Saskatoon**

A number of *Amelanchier* sp. have been harvested for their fruit and included in breeding programs (Reich 1991). The Saskatchewan government has developed excellent production guides for saskatoons (St.-Pierre 1997). While this crop has widespread commercial potential, because the purple fruit appear somewhat similar to blueberries (*Vaccinium* sp., Ericaceae), success in the fresh market will probably be limited to areas where blueberry cannot be grown due to extremely cold winter temperatures or alkaline soils (Stang 1990). However, there is certainly the potential to develop processed products that are uniquely different from blueberry. Currently, the industry is concentrated in the Canadian Provinces of Alberta (500 ha), Saskatchewan (200 ha) and Manitoba (80 ha) where growers feel they do not have enough production to meet the demand (Mazza and Davidson 1993; Delidais 1998).

### **Edible Honeysuckle**

*Lonicera caerulea* (Synonym of *Lonicera caerulea* var. *edulis* Turcz. ex Herder, Caprifoliaceae) is widely harvested in regions of China and northern Eurasia. Superior Russian cultivars have been developed. The cylindrical, blue fruit ripen extremely early in the season on 1–2 m tall bushes. As with *Amelanchier*, its similar appearance to blueberry will make it difficult to establish a marketing foothold. However, it is extremely winter hardy and can grow in regions where blueberry cannot. In trial plantings in the US, it has been extremely susceptible to leaf disease in the Midwest (M. Widrechner pers. commun.) and, as with apricot, it flowers very quickly given warm temperatures and can be severely damaged by frost. However, the flowers are reported to be able to survive temperatures several degrees below freezing.

### **Schisandra**

A native of northeastern China and the former Soviet Union, *Schisandra chinensis* (Turcz.) Baill. vines produces red fruit that are high in vitamin C. It is harvested from the wild for local consumption and has received a great deal of attention for its reputed medicinal qualities. While it is mentioned as a cure for a large number of maladies, most refereed publications seem to focus on its effects on liver function (Ahumada et al. 1989; Mizoguchi et al. 1991; Ko et al. 1995a,b). Managed plantings would be most comparable to grape production. Currently, most production is from wild harvested fruit and commercial viability is unknown. I could find no references that discussed cultural management. Improved selections from the wild are currently being evaluated in Jilin Province by the Chinese Academy of Agricultural Science (Shen Yugie pers. commun.).

### **Sea Buckthorn**

*Hippophae rhamnoides*, a native of the colder regions of Eurasia, has been harvested on a large scale in eastern Europe as a vitamin C rich fruit for processing into jellies, juices, and liqueurs. Cultural management (Li and Schroeder 1986; Bernáth and Földesi 1992; Pietilä 1998) and breeding potential (Anderson and Wahlberg 1994) have recently been reviewed for sea buckthorn. This crop could be a valuable crop in North America. Plants can tolerate extremely harsh winters and poor soils. The main limitations are the development of an infrastructure for a processing market. The "Catch-22" with this crop, and others that are only suitable for processing, is that processors are not likely to get interested unless there is a market and conversely, there is not likely to be a market developed unless there are processed products in place.

## POTENTIAL NEW BERRIES

Many locally harvested crops from indigenous and introduced fruit could become economically important crops. For example, several companies in the western and northwestern US are hiring pickers to harvest wild fruit for regionally, nationally, and internationally distributed fresh and processed products. In Europe and Asia, native fruit are also commonly harvested to supply a growing nutraceutical industry. Native *Vaccinium* and *Rubus* are the most common examples of these “wild” harvested crops. Potential new crops often follow a natural progression. Interest is first generated in the crop from “wild” harvested plants. When the suppliers run into difficulty with erratic supply, interest in stabilizing the supply of the crop through cultivation follows. If the crop can be adapted to cultivation economically and the market remains in place the crop can become a new crop with commercial potential. In this group I include examples of *Rubus* and *Vaccinium* that are currently harvested from the wild.

### *Vaccinium* “Huckleberries”

“Huckleberry” is a confusing common name. Most accurately huckleberries would describe species in the genus *Gaylussacia* Kunth., Ericaceae. However, in the commerce, this name is often used regionally as a name for the local wild *Vaccinium* species. In late summer and early fall, pickers fan out over the Northwest from the Cascade Mountains as far east as the mountains of Montana to primarily pick *V. membranaceum* Douglas ex Torr. (syn. *V. globulare* Rydb.), Ericaceae as well as *V. ovalifolium* Smith and *V. deliciosum* Piper. The fruit is sold on roadsides and to wholesalers. The restaurant trade is a major consumer of fruit and a company in Montana has become well known nationally for their “chocolate-covered huckleberries.” Stark and Baker (1992) present a great deal of information on the biology of the species and propose how they could be raised commercially. While their suggested production practices may be valid they are not practical for large scale production. Recently, our US Dept. of Agriculture laboratory has begun to evaluate populations of these species at a low elevation location using cultural practices that are similar to those used for highbush blueberry (*V. corymbosum*). While the planting is only three years old, it has begun to fruit, and some genotypes appear to be adapted to low elevation production. Whether this crop will prove to be commercially viable in cultivated stands has yet to be determined. In the Northwest, some fruit is also harvested in the Coastal Range from *V. ovatum* Pursh which is more commonly cut as an evergreen “green” for floral arrangements or used as an ornamental plant in the landscape. In the past two years, more than 3 ha have been planted for commercial fruit production. While *V. ovatum* has been grown successfully in the landscape for decades, the fruit are much lower quality, particularly aromatic components to fruit flavor, than the other species discussed.

### Mortiño

*Vaccinium floribundum* Kunth., Ericaceae grows profusely in northern South America (Popenoe 1924). The evergreen nature of this species and its fruit are similar to *V. ovatum* of North America and *V. confertum* Kunth of Mexico and *V. consanguineum* Klotzch of southern Mexico and Central America. In Ecuador, baskets of fruit are commonly available in the market. Mortiño could be more widely grown as it is a popular crop and should be amenable to cultivation. However, if production is expanded it will most likely be successful in a niche market similar to the *Vaccinium* huckleberries of North America. Since, commercial highbush blueberries, which are relatives and produce a somewhat similar fruit, are in such wide production in North America, Chile, and Argentina, it would be difficult for *V. floribundum* to displace this market.

### Bilberry

Bilberry (*Vaccinium myrtillus* L., Ericaceae) has a long history in European folk medicine (Morazzoni and Bombardelli 1996) and while the fruit is largely harvested from the wild, commercial production is not unknown (Dierking and Dierking 1993). Recently attention has been focused on bilberry as efforts to determine whether cultivated North American blueberries have similar nutraceutical characteristics to *V. myrtillus* (Kalt and McDonald 1996; Kalt 1997; Prior et al. 1998). These preliminary studies indicate that while *V. myrtillus* has higher levels of antioxidants than the North American commercial blueberries, the commercial blueberries do contain high levels. Although there is potential for commercial production of *V. myrtillus*,

Dierking and Dierking (1993) would not recommend it from a horticultural point of view. From a nutraceutical point of view, it would appear that the commercial blueberries, produced in such great abundance and at a relatively low cost, could satisfy this demand.

### **Bog Bilberry**

Millions of hectares of *Vaccinium uliginosum* L., Ericaceae stretch across circumboreal regions of the Northern Hemisphere. In China, we saw these fruit harvested and sold locally and the fruit pressed for juice that was marketed around China and in the Western US. In Scandinavia, the fruit are sold from wild harvested plants and cultivars have been developed for commercial production (Hiirsalmi 1989; Hiirsalmi and Lehmushovi 1993). Unfortunately, this crop has the same niche as North America's commercial blueberry industry. While it would be hard to justify cultivation of this crop if it is to be marketed in competition with the North American blueberries there would seem to be ample justification for improved management of the huge expanses of this species for the processing market.

### **Trailing Blackberry**

*Rubus ursinus* Cham & Schldl., Rosaceae is an early colonizer of disturbed sites throughout the Northwest. In this era where timber is clear-cut and agriculture has disturbed many sites, the northwest trailing blackberry is very common. As with the *Vaccinium* huckleberries, pickers harvest these fruit from native stands for the restaurant trade and specialty markets. The species is dioecious and the fruit are medium sized, soft, and have a very aromatic flavor. 'Marion' blackberry is remarkable for its flavor and this can be traced to the *R. ursinus* in its pedigree. Trailing species can be grown like the commercial trailing cultivars. However, the only justification for establishing a managed planting of the species as opposed to cultivars is if the "wild" label is critical to marketing. In general, the species is much more susceptible to foliar diseases than the cultivars. Our first generation hybrids between cultivars and this species have yielded disease tolerant, thornless, and early ripening genotypes that retain the species flavor. Whether these are commercially viable will be determined in the future.

### **Miscellaneous *Rubus***

As you move to different regions, there is often a *Rubus* species that is harvested from the wild for local sales. These species are very similar in their place in the market to the *R. ursinus* just described. Examples worldwide would include the southern dewberries (*Rubus trivialis* Michaux) in the US; *Rubus parvifolius* L. of China and Japan; *R. phoenicolasius* Maxim. in Japan; *R. crataegifolius* Bunge; *R. niveus* Thunb. and *R. coreanus* Miq. in China; and the many blackberry species (*Rubus*) in Europe (Anon. 1912a,b; Card 1915; Williams and Darrow 1940; Sherman and Sharpe 1971; Jennings 1988; Finn et al. 1998). Any of these crops could be developed into a major crop. However, as with mortiño, they will be competing against a well established, productive industry that produces a somewhat similar crop, i.e. red (*R. idaeus*) and black raspberry (*R. occidentalis*), and blackberry (*Rubus* sp.).

### **POTENTIAL CROPS WITH UNMET POTENTIAL**

Finally, many crops that have previously been mentioned in these sorts of forums have not been further developed. Usually, market drives the production, either a large market does not exist or another berry is filling that market niche. A few examples of previously described potential crops in this class include: Nanking cherry (*Prunus tomentosa* Thunb., Rosaceae); cranberry bush (*Viburnum opulus* L., Caprifoliaceae); and buffalo berry (*Shepherdia argentea* Nutt. Elaeagnaceae).

### **Nanking Cherry/Hansen Bush Cherry**

*Prunus tomentosa* is native throughout temperate regions of eastern Asia and is widely sold in the local markets. At least a century ago, seed lots were brought to the US and breeding programs released a few cultivars in the first half of this century (Darrow 1937; Fogle 1975; Kask 1989). Hansen in South Dakota recognized that the superior cold hardiness of this productive, but small fruited, cherry might be valuable for the northern Great Plains (Kask 1989). While the species has not developed into a commercial crop, it is

commonly sold through catalogues to homeowners (Reich 1991). This crop will remain in the realm of homeowners in North America and in local markets of Asia because the fruit are inferior to the commercially available sour cherries (*P. cerasus* L.).

### **Cranberry Bush**

*Viburnum opulus* (syn. *V. trilobum* Marsh.) is found in northern temperate regions. While popular as an ornamental plant in the landscape, the species has never developed into a commercial fruit crop. The fruit is unpalatable fresh and must be processed into jellies or juice (Card 1915). Cultivars with superior fruit and processing characteristics have been released (Darrow 1975). Cranberry bush may have potential for small scale, local production, or for a unique processed product (Stang 1990) but, in general, the fruit is too similar to cranberry (*Vaccinium macrocarpon*) or red currant (*Ribes rubrum*) as a processed product (Darrow 1975) to justify large scale production.

### **Buffalo Berry**

*Shepherdia argentea* has been stuck in the “potential” class for nearly two centuries. In 1915, Card wrote, “The buffalo berry has enjoyed the distinction of remaining a new fruit for a very long time.... Yet we are still talking about buffalo berry as a new fruit which ought to be introduced.” He cites references back to 1841 that state that buffalo berry was widely grown. This species is native to the Great Plains of the US (Darrow 1975). I think horticulturists continue to return to this crop because the plants are productive, extremely winter hardy, and drought tolerant, the flowers are frost tolerant, and the scarlet fruit are very high in Vitamin C. Despite being dioecious and spiny, it would appear that it might be well adapted for mechanical harvesting and processing as a juice. Buffalo berry is likely to retain its “potential” label until someone aggressively develops the market for the fruit.

## **CONCLUSION**

Berries have been an important part of the diet of indigenous people. The world is now a global market which will have adverse and beneficial effects on crops that have developed from a specific region. Some crops that formerly had only local interest will develop demand worldwide. Other crops may be lost as similar crops from other regions will displace them. These crops will remain regionally important but will not develop worldwide importance.

Blueberry, strawberry, and grape production will continue to expand worldwide. Cranberry production will likely expand rapidly where the proper soil and water requirements can be found or where “wetlands regulations” are not as stringent as they are in the US. Red raspberry, blackberry/hybridberry, lingonberry, and black currant will steadily increase in production. It becomes more difficult to predict the future of “neglected” berries, as there seems to be serious problems with each crop except *Actinidia arguta*. *Actinidia arguta* shows tremendous promise and will see increased production worldwide. Elderberry, aronia, and sea buckthorn production will increase if their unique anthocyanin characteristics are desirable for the colorant and nutraceutical markets. Alpine strawberry, muscadine grape, juneberry, cloudberry, arctic raspberry, and mora will continue to play important roles in regional or niche markets but are not likely to join the lists of major crops worldwide. Similarly, we hope that the “potential new crops” will develop stable crop areas with consistent production as they solidify their standing as important regional or niche market crops. I do not see great potential in Nanking cherry, cranberry bush, or buffalo berry unless someone energetically develops markets for them. The rising interest in the nutraceutical characteristics of foods has carried over to berries. Schisandra and bilberry are two examples of crops primarily harvested for their nutraceutical potential. Whether this is a trend or a fad may impact which new crops will develop a large commercial industry.

Each era has their surprises as to which new crops develop into important crops. In 1915, Card had blueberries listed in the miscellaneous section of his book. By the second half of this century blueberries had become an important crop and today they are one of the major berry crops worldwide. Who would have thought a few years ago that a major chain store in the US would be promoting “Aronia Berry Juice Cocktail?” George Darrow in 1975, gave equal space to *Actinidia arguta* and *Viburnum trilobum* (syn. *V. opulus*) in a chapter on minor temperate fruit. Twenty-five years later, *A. arguta* is on the verge of becoming an

important fruit crop while *V. trilobum* remains “only” a beautiful ornamental for the landscape. Let us hope in the future that we continue to be surprised by the neglected or unknown crops.

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