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Prospects for Domesticating Western Huckleberries

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Prospects for Domesticating Western Huckleberries

Danny L. Barney

ABSTRACT. Western huckleberries (*Vaccinium* spp.) are native to the western United States and western Canada. The fruits were important for food and trade among some Native American nations and were popular with European settlers. Commercial sales of huckleberry food and health products have increased dramatically, with demand often exceeding supplies. All fruits are presently harvested from naturally-occurring stands, predominantly from 1,200 to 1,800 m (4,000 to 6,000 ft) elevation mountain sites. Harvest labor costs and weather-related fluctuations in yields have limited commercial expansion. Forest and fire management practices on public lands have adversely impacted the size and productivity of huckleberry colonies, further limiting commercialization and increasing the potential for overharvest. This paper describes western huckleberries, summarizes pertinent research, and outlines prospects for domestication.

KEYWORDS. Huckleberry, bilberry, blueberry, whortleberry, grouseberry, *Vaccinium caespitosum*, *Vaccinium deliciosum*, *Vaccinium globulare*, *Vaccinium membranaceum*, *Vaccinium myrtillus*, *Vaccinium ovalifolium*, *Vaccinium parvifolium*, *Vaccinium scoparium*, domestication

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INTRODUCTION

Huckleberries have long been prized throughout the northwestern United States and western Canada for their intense flavors. For Native Americans, huckleberries were historically important for food and trade (Turner, 1995, 1997), and continue to play important roles in some tribal cultures. Huckleberries also appealed to Europeans and have been harvested for recreation and home consumption since the first settlers arrived.

Western huckleberries, also called bilberries, blueberries, whortleberries and grouseberries, are found in genus *Vaccinium* section *Myrtillus* and are related to sect. *Cyanococcus* highbush (*V. corymbosum* L.) and lowbush blueberries (*V. angustifolium* Ait.) (Vander Kloet, 1988). The primary difference in the sections is that sect. *Myrtillus* species bear one to three individual berries in the leaf axils on current season shoots, as opposed to the clusters of fruit found in *Cyanococcus* species.

In recent years, sales of commercial food and health care products made from huckleberry fruits and leaves have grown tremendously. Products include jams, syrups, candies, pastries, vinaigrettes and salad dressings, soft drinks and ales, soaps, shampoos, lotions, and many more. Presently, all fruit is harvested from the wild, with demand often exceeding supply. The berries typically wholesale for $4 to $7 U.S. per liter ($16 to $30 per gal), but cost more during years when crop yields are reduced by weather-related damage or fire. Cold winters with little snow cover can freeze canes to the ground. Low snowfall can also encourage early bud break and leave flowers and developing fruit exposed to spring frosts. Wet springs increase problems with mummy berry [*Monilinia vaccinii-corymbosi* (Reade) Honey] and other fruit, foliar, and cane diseases. Hailstorms often destroy flowers and developing fruit, and drought seriously damages the foliage and canes. Because of these weather influences, yields of naturally-occurring huckleberry crops vary widely between sites and years. Sporadic yields have limited commercial expansion of huckleberry industries.

Another challenge for commercial expansion lies in the native habitats of these species. Black or thin-leaved huckleberry (*Vaccinium membranaceum* Douglas ex Hooker), which is the species most often harvested for commercial sales, typically grows on rugged, forested mountain sites. Most fruit is harvested from federal and state lands by independent contractors who also often harvest beargrass [*Xerophyllum tenax* (Pursh) Nutt.], mushrooms, and other special forest products. Access to prime huckleberry sites is limited by the rugged terrain and poor

or nonexistent roads. Refrigeration facilities at picking sites are usually nonexistent.

Huckleberries are labor-intensive to harvest. Stark and Baker (1992) estimated that an experienced hand picker could harvest about 3.8 L (1 gal) of *V. membranaceum* berries/h, but only on the best sites during the best years. Hand-held rakes and beaters are sometimes used to speed harvest, but the berries must then be cleaned to remove leaves, stems, and other debris. Opposition has also been expressed, occasionally, to the use of rakes for harvesting huckleberries because of the belief that the rakes damage huckleberry foliage and canes. Mechanical harvesting using most currently available equipment would be difficult because the bushes are frequently scattered across steep, rugged terrain and each bush may only bear a few dozen berries. Harvest of some huckleberry species using hand-held electro-mechanical shakers and catch baskets may be feasible. While huckleberry fruits resemble blueberries in appearance, they typically do not form abscission zones between the berries and stems. Picking the berries causes the skins to tear and allows juice to leak out. For this reason, huckleberries are sold for processing, rather than fresh use.

Complicating the situation, research done by the U.S. Forest Service (Minore, 1972) suggested that fire suppression and some forest management practices have resulted in the loss of huckleberry habitat. Excessive shading by overstory trees appears to be a key factor in the decline of huckleberry acreage and productivity. Huckleberries are seral species that flourish in and along the edges of forest openings created by fires, logging, and other disturbances. The plants thrive relatively early in the successional process, and gradually become suppressed by shade from trees and competition for moisture, nutrients, and space from shrubs, grasses, and forbs.

Oral history, related by cultural specialists of the Yakima and Warm Springs nations to the author, suggests these groups historically used fires in what is now northern Oregon and southern Washington to periodically renew clearings and keep prime huckleberry colonies healthy and productive. Boyd (1999) cites evidence of anthropogenic burning by Native American tribes throughout the northwestern United States and western Canada, primarily as part of their "food quest." Improved production of huckleberries, other wild berries, and soft-fleshed plants, such as camas, was, reportedly, often a primary objective of the burning. According to Boyd (1999), "Wherever huckleberries were gathered, fire appears to have been applied in similar ways. . . . In higher elevations, campsites and trails, as well as mountain huckleberry patches

were burned. Individuals with special 'powers' and knowledge directed the deer drive and huckleberry patch burning."

Federal funding restrictions have closed many roads previously maintained by the U.S. Forest Service and decreased logging has limited road building on public land. Recent and pending government policies regarding forest management have the potential to further reduce huckleberry productivity and harvest in naturally-occurring stands by restricting access and activities that open the forest canopy and allow huckleberries to thrive. Cultivating these species could provide reliable supplies of fruit and leaves for commercial processors while reducing the potential for adverse cultural and environmental impacts caused by overharvesting of accessible wild colonies.

LITERATURE REVIEW

Although abundant research has been published on eastern *Vaccinium* species, limited information on western huckleberries is available. The exception is *V. myrtillus* L. (dwarf bilberry or whortleberry) which is a topic in numerous, primarily European, papers. Most of the publications on *V. myrtillus* discuss physiology, biochemistry, and ecological issues. Only a few articles consider cultivation or management of naturally-occurring stands (Kardell, 1980; Kostov and Stojanov, 1985; Raatikainen and Raatikainen, 1983).

During the 1970s and 1980s, the U.S. Forest Service studied *V. membranaceum* from the viewpoint of managing naturally-occurring stands for commercial production and wildlife habitat. During these studies, researchers observed huckleberry responses to tree thinning, bulldozing, prescribed fires, herbicides, and fertilization. Some propagation techniques were evaluated. Two publications summarize much of the Forest Service research on *V. membranaceum* (Minore 1972; Minore et al., 1979). Minore and Smart (1978) reported on frost tolerance in *V. membranaceum*, *V. deliciosum* Piper (Cascade or blue huckleberry) and *V. globulare* Rydberg (synonymous with *V. membranaceum* (Vander Kloet, 1988)). Nelson (1974) found that nitrogen fertilization increased vegetative growth in natural stands and containerized plants. Minore (1975) examined *V. membranaceum* responses to boron and manganese, while Stark et al. (1989) documented nutrient allocations to various plant tissues. Miller (1977) reported on the effects of prescribed fires on *V. membranaceum* sprouting and Minore (1984) documented the effects on *V. membranaceum* of selected tree canopy management

practices. Stark and Baker (1992) described the ecology of *V. globulare* and results of physiological trials involving nutrients, light, water, and herbicides. Gough (1998) described vegetative and reproductive development in *V. globulare*. Shafii and Barney (2001) and Barney and Shafii (2001) determined the effects of drying, cold storage, and stratification on seed germination for *V. membranaceum* and described a logistic growth curve model of germination. Barney (1999) published a guide on propagating and growing western huckleberries.

Fellman et al. (1999) studied volatile flavor components of *V. membranaceum*, *V. deliciosum*, and *V. ovalifolium* Smith (oval-leaved or Alaska blueberry). Alaback and Tappeiner (1991) studied regeneration of *V. ovalifolium* and western hemlock [*Tsuga heterophylla* (Raf.) Sarg.] following forest disturbance due to windthrow. Several publications document aboriginal use of *Vaccinium* species in western North America (Lepofsky et al., 1985; Kuhnlein, 2000; Turner, 1995, 1997). Three publications describe ecology and productivity of grouseberry (*V. scoparium* Leiberg ex Coville) (Forcella, 1978; Forcella and Weaver, 1977; Weaver et al., 1990), while Romme et al. (1995) included *V. scoparium* in a study of germination ecology. Cartar (1991) examined dwarf huckleberry *(V. caespitosum* Michaux) as it pertained to foraging by wild bumblebees. Smith and McLeod (1992) reported on equations for estimating the biomass of *V. parvifolium* Smith (red huckleberry).

SPECIES OF INTEREST

Seven North American *Vaccinium* species are found in section *Myrtillus*, and all have been used to some degree for food and/or trade at various times. *Vaccinium deliciosum* grows on Washington's Olympic Peninsula and in the Cascade Range from northern California into British Columbia. It is found at elevations between 600 and 2,000 m (1,900 and 6,600 ft) in subalpine coniferous forests and alpine meadows. *V. deliciosum* can grow on either wet or drier upland sites and is often found around the edges of ponds and on dried lake bottoms. The plants bear bright blue, glaucous berries up to 1.5 cm (0.6 inch) in diameter. In a mature colony, the erect or semierect canes average about 0.6 m (2 ft) tall, with short shoots developing from rhizomes surrounding the central colony. In larger bushes, individual canes can reach at least 2 m (6 ft) in length, but are decumbent with the tips remaining within about 0.6 m of the ground. *V. deliciosum* is tetraploid (2n = 48) (Vander Kloet, 1988). This species develops dense mats and colonies sometimes form

rings around isolated trees and stumps located in forest meadows. Although rhizomatous, *V. deliciosum* has a moderately dense root system and transplants with relative ease. As the name *deliciosum* implies, this species produces especially flavorful berries, largely due to ethyl 3-methylbutanoate, ethyl 2-methylbutanoate, and other esters (Fellman et al., 1999). In preliminary field trials by the author in northern Idaho, transplanted *V. deliciosum* survived on poorly-drained silt loam soils that proved problematic for *V. membranaceum* and *V. ovalifolium*. The outstanding fruit flavor, ease of transplanting, and relative ease of picking make *V. deliciosum* an excellent candidate for cultivation and/or natural stand management.

Vaccinium membranaceum grows in forested areas throughout Idaho, western Montana, western Wyoming, Washington, Oregon, and British Columbia. Disjunct populations are found in Utah, California, Arizona, and Michigan (Vander Kloet, 1988). This species is sometimes called the globe huckleberry in Montana, and some taxonomists identify plants in the eastern Rocky Mountains as *Vaccinium globulare.* The plants are tetraploid (2n = 48) (Vander Kloet, 1988). *V. membranaceum* grows at elevations of 600 to 3,500 m (2,000 to 11,500 ft), with many productive sites located between 1,200 and 1,800 m (4,000 and 6,000 ft). This species usually grows on light-textured, ash-influenced andic or andeptic soils (Stark and Baker, 1992). Stark and Baker (1992) further reported that plants of this species are difficult to establish on heavier soils and, if so established, are rarely productive. *V. membranaceum* often grows in association with true firs (*Abies* spp.), hemlocks (*Tsuga* spp.), Engelmann spruce (*Picea engelmannii* Parry), and/or beargrass (*Xerophyllum tenax*). Organic-rich soils containing rotted wood appear to benefit *V. membranaceum* growth. Sites where trees have been thinned or cleared by logging or burning are often prime locations 10 to 15 years after the disturbance. On drier sites, *V. membranaceum* appears to grow best in light shade, but much depends on soil texture and moisture. Some large and productive colonies grow in full sun. In heavy shade, vegetative growth and berry production are reduced. *V. membranaceum* usually grows from 0.3 to 2 m (1 to 6 ft) tall and produces berries up to 1.5 cm (0.6 inch) in diameter. Fruiting usually begins three to five years after germination, with full maturity taking another five to 10 years. Plants resprouting from rhizomes on sites disturbed by logging or fire require six to 10 years to produce significant crops (Stark and Baker, 1992). This species forms only a sparse root system beneath individual bushes and mature plants transplanted from wild stands often die within one to three years of transplanting. Container-grown seed-

lings and clones transplant without difficulty. Berry colors range from black to purple to red, with rare white berries. Some phenotypes bear glossy berries while others produce fruits covered with a bluish bloom. Minore (1972) estimated yields of 1075 $L \cdot ha^{-1}$ (112 gal/acre) in highly productive, naturally-occurring stands in south-central Washington. *V. membranaceum* is the *Vaccinium* species most commonly harvested for commercial fruit utilization in the northwestern United States. The fruits are flavorful, rich in anthocyanins, and enjoy regional popularity. While site adaptability is a significant challenge for cultivation, domestication of *V. membranaceum* appears especially promising.

Vaccinium ovalifolium produces high yields (by sect. *Myrtillus* standards) of attractive, bright blue, glaucous berries. The species is found from sea level to 2,100 m (7,000 ft) elevation from Oregon to coastal Alaska and in Washington, northern Idaho, and British Columbia. Disjunct populations are found in South Dakota, along the shores of Lake Superior and the St. Lawrence River, and on Canada's Cape Breton and Newfoundland islands. Some taxonomists identify two species: oval-leaved blueberry (*V. ovalifolium* Smith) and Alaska blueberry (*V. alaskaense* Howell), but the author has chosen to follow Vander Kloet's taxonomy (1988) which utilizes a single species classification. Both diploid (2n = 24) and tetraploid (2n = 48) plants have been recorded (Vander Kloet, 1988). Coastal plants are generally found under moderate to dense shade in moist locations. Further inland, *V. ovalifolium* can be found on more open, drier sites, but it still grows primarily in partial shade. The impetus for domesticating this species lies in its adaptability to a range of growing sites and the plant's habit. The bushes grow 0.3 to 4 m (1 to 12 ft) tall, are less rhizomatous than *V. deliciosum* or *V. membranaceum*, are crown forming, and often form erect bushes that may have potential for mechanical harvesting. The fruits are generally less flavorful than *V. deliciosum* and *V. membranaceum*, but are harvested occasionally for culinary uses. *V. ovalifolium* is popular as a harvested wild fruit in southern coastal Alaska. Fellman et al. (1999) found that *V. ovalifolium* fruits typically have lower concentrations of terpenes, ketones, and esters than do *V. deliciosum* or *V. membranaceum*, but contain more anthocyanins. Variability in volatile flavor chemical concentrations was noted among collection areas. *Vaccinium ovalifolium* hybridizes with *V. deliciosum* and *V. membranaceum* (Vander Kloet, 1988). Efforts are underway by the author at the University of Idaho to produce hybrids with *V. ovalifolium's* growth habit and fruit flavors derived from *V. deliciosum* and *V. membranaceum*.

Vaccinium myrtillus is the most widely-distributed of the species discussed here, being also found in northern Europe and Asia. In North America, *V. myrtillus* grows in two areas of the Cascade and Rocky Mountains: from British Columbia to central Oregon and a second population in Colorado, Utah, New Mexico, and Arizona (Vander Kloet, 1988). *V. myrtillus* is found in open, moist, coniferous woods at elevations of approximately 600 m (2,000 ft) and above. In North America, colonies are typically open, whereas in Europe, *V. myrtillus* is known to form dense heaths. The diploid (2n = 24) (Vander Kloet, 1988) plant grows 10 to 60 cm (4 to 24 inches) tall with berries being slightly more than half the size of the tetraploid species previously described. The berries are purplish-black and occasionally glaucous. In British Columbia and northwestern Montana, the Ktunaxa, Secwepemc, and Carrier Native American peoples historically ate the fruit fresh or dried, and continue to use it today (Turner, 1997). *V. myrtillus* fruit is popular in Siberia, Scandinavia, and other parts of northern Europe (Kardell, 1980; Kostov and Stojanov, 1985; Raatikainen and Raatikainen, 1983). *V. myrtillus* appears to offer limited potential for domestic production in North America as a culinary fruit. Its small plant and berry size limit yields and the fruit flavors resemble the larger and higher-yielding *V. membranaceum*.

The greatest incentive for domesticating *V. myrtillus* appears to lie in its potential as a functional food and source of bioactive compounds. Bettini (1984) and Bettini et al. (1984) reported that bilberry anthocyanins had beneficial effects on vascular smooth muscles. Baj et al. (1983) identified 15 anthocyanin compounds in bilberry extract, including delphinidin, cyanidin, peonidin, and malvidin anthocyanin derivatives. Azar et al. (1987) isolated 12 phenolic acids and three glycosides of quercetin, including quercitrin, isoquercitrin, and hyperoside, from fresh bilberry juice. Gerhardt (1989) isolated quercetin-3-glucuronide from the leaves of *V. myrtillus*. Grigorova et al. (1984) examined the amino acid, aromatic, and polyphenolic compounds in *V. myrtillus*. Hakkinen (1999) and Hakkinen et al. (1999) examined flavonoid and phenolic acid contents in a variety of fruits, including *V. myrtillus*. These studies concluded that quercetin was the primary flavonoid in the genus *Vaccinium*. Madhavi et al. (1998) isolated flavonoids, quinones, and other bioactive compounds from *V. myrtillus* fruit and cell cultures. The antioxidant properties of *V. myrtillus* and the value of the species in providing natural drugs was also reported (Martin-Aragon et al.,1998). More work is needed to determine if the same antioxidants, antho-

cyanosides, and other compounds found in *V. myrtillus* are also produced in larger-fruited, higher-yielding sect. *Myrtillus* species.

Vaccinium caespitosum is widely distributed in the United States and Canada, with several disjunct populations in Mexico (Vander Kloet, 1988). In the United States, *V. caespitosum* is found in the Cascade Mountain range from British Columbia into central California, along the Rocky Mountains from British Columbia through Southern Colorado, around the Great Lakes, and along the Atlantic Seaboard to southern Maine and southern Vermont. The plants are scattered across Canada, with the greatest concentrations in British Columbia and western Alberta. Common names include dwarf blueberry, dwarf bilberry, dwarf huckleberry, and dwarf whortleberry. *V. caespitosum* is a diploid (2n = 24) (Vander Kloet, 1988) which grows 7 to 60 cm (3 to 24 inches) tall. The leaves are glaucous and bluish-green and the 5-9 mm (0.2 to 0.4 inch) diameter, bright blue, glaucous berries have excellent flavor.

V. caespitosum is highly adaptable and is found on dry or wet acidic sites from sea level to approximately 3,800 m (12,500 ft) elevation. According to Turner (1995, 1997), *V. caespitosum* was extremely popular among all coastal and interior First Peoples "whenever it was available," and was consumed either fresh or in dried cakes. Turner (1997) further reported that *V. caespitosum* fruits were a common trading item in the early days. Despite its adaptability to a wide range of growing sites and excellent fruit flavor, the domestication potential of *V. caespitosum* appears limited by the small plant and fruit size. Both factors contribute to low yields and difficult picking. Developing a tetraploid form of *V. caespitosum* could help offset these limitations. The species may also hold promise for ornamental landscape use as an edible groundcover.

V. parvifolium, also known as red huckleberry and red bilberry, is native from Alaska to central California along the coastal and Cascade Mountain ranges, with a small population in southeastern British Columbia. The species is found from sea level to 1,100 m (3,600 ft) elevation. This vigorous diploid (2n = 24) (Vander Kloet, 1988) grows from 1 to 7 m (3 to 21 ft) tall and bears red fruits 7 to 9 mm (0.3 to 0.4 inch) in diameter. The plants are largely crown forming but sucker when injured and the author has observed young plants spreading by rhizomes. Within its range, *V. parvifolium* can often be found growing on rotting stumps and logs in and around clearings, trails, and other openings in the forest canopy. In collecting soil samples, the author has noted that, when growing on mineral soils, *V. parvifolium* is usually found on well drained sandy or rocky, ash-influenced soils covered with organic duff.

The berries of *V. parvifolium* are tart rather than sweet and are locally popular for making pies and other pastries. Turner (1995) reported that *V. parvifolium* berries were eaten by all coastal aboriginal groups in what is now British Columbia; such groups often made long journeys to harvest the fruits, and the fruits are still consumed in large quantities today in many areas. *V. parvifolium* has potential as an edible ornamental plant, bearing red leaves in autumn and berries that remain on the bushes into late autumn or early winter. Little research has been published on *V. parvifolium*, but its adaptability to a range of elevations, vigorous growth, upright habit, reasonably high yields (by sect. *Myrtillus* standards), and potential for mechanical harvesting should provide incentive for further study relating to domestication.

Vaccinium scoparium is widely distributed from southern British Columbia south along the Cascade and Rocky Mountain ranges into northern California, northern Nevada and northern Utah, and east to Alberta, South Dakota, and southwestern Colorado. This diploid species (2n = 24) (Vander Kloet, 1988) grows in alpine and subalpine meadows, heaths, talus slopes, moraines, and at the edges of coniferous woods at elevations from 780 to 3,000 m (2,500 to 9,800 ft). Common names include small-leaved huckleberry, grouseberry, dwarf red whortleberry, and red alpine blueberry. The plants grow 1 to 45 cm (3 to 18 inches) tall, are rhizomatous, and often form dense, extensive colonies. *V. scoparium* produces soft, tart, red berries 4 to 6 mm (0.16 to 0.24 inch) in diameter. These fruits were gathered by the Ktunaxa, Nlaka'pamux, Okanogan, and Secwepemc peoples (Turner, 1997). The tiny berries were usually harvested using bone or wooden combs. Because of the small plant and berry size, domestication potential for *V. scoparium* appears more limited than for any other species in sect. *Myrtillus*. Research is now underway to characterize this species' functional food profile and potential.

CHALLENGES TO DOMESTICATION

The greatest challenge to western huckleberry domestication is our lack of knowledge of the species' physiology and cultural needs. Traditional wisdom holds, for example, that *V. deliciosum* and *V. membranaceum* grow only at high elevations on rugged, forested sites and cannot be grown in cultivation. However, research field plots containing these species have been established on open farmland at 600 m (2,000 ft) elevation in northern Idaho and near sea level in west-central Oregon.

Clearly, the species are more adaptable than was previously believed. The need for shade is also questionable. Stark and Baker (1992) reported shading to be essential for young *V. membranaceum* seedlings and beneficial for established plants. Based on photosynthesis and other tests, they concluded that, in Montana, 60% full sun was optimum. While huckleberry colonies are often located in partial shade, highly productive stands also grow on sites having no shade. It may be that genetics, soil texture, and moisture are contributing factors in determining shade requirements.

Another question involves the possible symbiotic relationships between western huckleberries and mycorrhizae. McCracken (1999) isolated three mycorrhizal species from *V. membranaceum* roots: *Oidiodendron maius* Barron, *Hymenoscyphus ericae* (Read) Korf & Kernan, and *Phialocephala fortinii* Wang & Wilcox. Whether one or more of these species (or other mycorrhizae) are important in huckleberry survival, performance, and site adaptability remains to be determined.

Genetic variability creates both opportunities and challenges. During the author's germplasm evaluations, open-pollinated *V. membranaceum* seedlings from the same seed sources exhibited significant variability in plant habit, fruit color, and other characteristics. For *V. membranaceum*, genetic expression in naturally-occurring stands is limited because seedling survival is extremely rare (Stark and Baker, 1992) and nearly all new "bushes" are clones that arise as sprouts from rhizomes. In a few years, a grower can propagate and evaluate thousands of seedlings, something that would require centuries in wild stands.

Attempts to propagate and evaluate western huckleberry seedlings for potential cloning and release were conducted sporadically throughout the 1900s, but no clonal material was released and little research published. New efforts to identify and select promising germplasm began at the U.S. Department of Agriculture–Agricultural Research Service Horticultural Crops Laboratory in Corvallis, Oregon and the University of Idaho during the late 1990s. Because these species are slow-growing and require three to five years to begin fruiting, clonal releases are likely some years distant. Limited, preliminary attempts by the author to cross *V. membranaceum* and highbush and lowbush blueberry parents have not been successful. Efforts to produce hybrids between *V. deliciosum*, *V. membranaceum*, and *V. ovalifolium* are just beginning.

Relating to genetic variability is the issue of seed source. Plants derived from high elevation sites sometimes break dormancy prematurely at low elevations and suffer freezing injury after midwinter thaws or spring frost damage to blossoms and developing berries. Identifying

and collecting germplasm from productive, low-elevation colonies is part of present selection programs.

Yield potential is a major concern. Because huckleberries produce individual berries, rather than fruit clusters, yields are lower than are typical with highbush and lowbush blueberries. Fertilization and other cultural practices may improve yields and germplasm evaluation trials may identify higher-yielding plants. The lack of fruit cluster formation, however, will likely prevent huckleberries from achieving highbush blueberry-type yields.

One might ask what the term "domestication" means. Domestic highbush blueberries are usually planted in well-defined fields and managed in a manner similar to raspberries or grapes. Lowbush blueberries, on the other hand, more typically come from managed naturally-occurring stands. Management of naturally-occurring huckleberry stands appears feasible using weed control, irrigation, fertilization, and overstory canopy management. Management of forests in the western United States for non-timber special forest products, including huckleberries, appears to be receiving greater consideration by the U.S. Forest Service for some national forests. Cultivation of huckleberries in fields also appears feasible.

CONCLUSIONS AND GROWER BENEFITS

Given research-based information available today, several species in *Vaccinium* section *Myrtillus* appear to have potential for domestication. *Vaccinium deliciosum* and *V. membranaceum* have intense, desirable, readily identifiable flavors that provide market niches as specialty products. *Vaccinium ovalifolium* fruits are less flavorful, but the species exhibits site adaptability and desirable growth habits. *Vaccinium myrtillus* fruit is popular in Europe and the species is known to produce bioactive compounds that may be medically important in retarding human aging and preventing or treating cancer and other diseases. *Vaccinium parvifolium* is a vigorous, adaptable plant that produces relatively high yields of berries suited for pastries and, perhaps, other processed foods. *V. parvifolium* may also have prospects as an edible ornamental shrub in landscapes. Without significantly increasing berry size and yields, the impetus for domesticating *V. caespitosum* as a culinary crop appears limited. *V. caespitosum* may have some promise as an edible ornamental groundcover in landscapes.

Fruits and leaves from these species are easily processed and the wide array of food and health products already in the marketplace demonstrate processing flexibility. Cultivar development efforts are underway, with early selections having been made. Further research on the biochemistry and potential for domestication or management of other huckleberry and related *Vaccinium* species native to western North America appears justified. From a historical perspective, the huckleberry industry appears to be roughly where the highbush and lowbush blueberry industries were during the early 1900s.

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