Blueberry Trials on Alaska's Kenai Peninsula
First year report

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Summary

In June 2009, 9 plants each of three highbush and six half-high blueberry cultivars were planted at test plots on two commercial farms on Alaska's Kenai Peninsula. The purpose of the trials was to determine if domestic blueberry plants could survive and produce crops in Southcentral Alaska. In October 2010, after 16 months in the fields, all of the 180 plants on both sites survived and most showed good growth, vigor, and health, despite chronic frost and midwinter freezing. During the 2009-2010 winter-months, no cover protection or snow fencing was provided for the plants. Much frost and/or freezing damage to canes was noted during evaluations in May and June 2010, although the main crown of each plant was uninjured. Whether the damage occurred during fall 2009 or later during the winter could not be determined. New shoots appeared during the 2010 growing season. Flowering and fruiting appeared to be reduced on the upper branches due to desiccation or cold injury. Cultivar fruiting differences were noted. Preliminary results suggest that the short-growing half-high 'Northblue' produced the most fruit of the cultivars tested, about 0.7 kg (1.5 pounds) per plant, and was particularly promising for the area. In August 2010, bird-netting was installed above the plants to trap and maintain protective snow cover during the subsequent winter. Data collection on plant survival, health, yield, and fruit quality will continue through April 2014. Production costs will be calculated and reported. Cultural management protocols will be suggested.

Introduction

Alaska is home to many indigenous fruit crops that have long been harvested from the wild for food and trade, including salmonberry, nagoonberry, cloudberry, crowberry, highbush cranberry, and assorted blueberries, bilberries, and huckleberries (Garibaldi, 1999; Robuck, 1989; Turner 1995 and 1997). Cultivation of domestic berry crops is now being practiced (Gorman, 2010) and efforts are underway to introduce berry production in rural native Alaskan villages (Hebert, 2008). Most fruit production in the state, whether domestically grown or harvested from wild stands, is for home use or sale at local farmers markets. Locally-produced jams, jellies, syrups, and other value-added products are abundant and popular.

Figure 1. The blueberry trials are located near the community of Kenai on the Kenai Peninsula south of Anchorage in Southcentral Alaska.

In terms of domestic small fruits, strawberries are the first fruit of the season to ripen and demand far exceeds local production, making strawberries a valuable early season cash crop for Alaskan growers. Along with strawberries, both summer-bearing and fall-bearing raspberries are grown as far north as Fairbanks (64.8 N latitude) in both open fields or under various plastic-covered low or high tunnel designs. Not surprisingly, winter damage to overwintering plants is a serious challenge. The University of Alaska Fairbanks has conducted research on commercial production of raspberries and strawberries using high tunnels to increase heat units for crop production and extend the growing season (Karlsson, 2006). Gooseberries and currants, particularly black currants, have proven well adapted to many locations in the lower third of the state. Currants and gooseberries are generally grown in open fields and gardens.

Domestic blueberries also represent a potentially high-value niche market crop for Alaska. Despite the abundance of native blueberries and closely related species, however, domestic blueberry production has not been thoroughly tested in Alaska where weather

challenges include long periods of low to very low winter temperatures, fluctuating winter temperatures, a short growing season, frequent high winds, and snow (or lack of snow). This report describes the establishment of two trial plots of nine northern-adapted blueberry cultivars on the Kenai Peninsula and presents the first year of data.

Project Objectives

Our objectives were to determine for domestically-available cultivars known for their adaptability to cold climates:

- survival under southcentral Alaska conditions.
- yield.
- berry size and quality.
- production challenges and effects on plant health and habit.
- cultural practice adaptations needed for Alaska production.

Materials and Methods

Location - The blueberries were planted at two locations on the Kenai Peninsula, approximately 60.5 N latitude, -151.0 W longitude, and elevation 100 feet (Fig. 1). The Alaska Berries farm (Brian Olson, owner) site was formerly primeval forest and was first cleared in 2008. Midwinter snow cover is variable there, with a minimum of about 12 inches being typical. The site is level with a clay loam soil low in organic material. Strawberries are the principal mid-summer cash crop for Alaska Berries. Plantings of raspberry, red and black currant, and other small fruits are being tested.

Mike O'Brien's farm is on a slope on the northern edge of a small muskeg bog. It has been used for agriculture for several years. The site is south-facing and terraced. The soils are clay loam with very high amounts of organic materials. Midwinter snow cover is reliable, with a minimum of about 20 inches being typical. Strawberries are a principal cash crop. Plantings of vegetables, fruit trees, and black currants provide diversity. Both farms are shown in Figure 2.

Figure 2. Newly-planted blueberries at Alaska Berries (left) and O'Brien farm (right), June 30 2009.

Soil tests from samples collected in May 2009 showed pH values between 4.19 and 5.03 at the Olson farm and 4.61 to 4.63 at the O'Brien farm. Soil phosphorus and potassium were generally low at both sites, as was ammonium nitrogen. Nitrate nitrogen values ranged from very low to quite high, even within rows at a single farm.

Planting and management - Twenty plants of each cultivar were provided by Fall Creek Nursery of Lowell, Oregon, through the USDA/ARS National Clonal Germplasm Repository in Corvallis, Oregon. The plants arrived in Alaska in mid-April 2009, were stored inside a greenhouse until late May, moved outdoors to harden off, and were planted on June 29-30. All of the flowers were removed from the plants while in the greenhouse.

Figure 3. Planting details and temperature monitors at the O'Brien farm, June 2010.

Planting designs were similar at both locations and each grower received 10 plants of each cultivar. At the Olson farm, rows were spaced 10 feet apart with plants spaced 4 feet apart within rows. Due to limited space, rows at the O'Brien farm were spaced an average of about 8 feet apart (Figure 3).

Peat was incorporated into the soil along the row centers before the beds were formed. A commercially-available bed former was used at the Olson farm to create beds approximately

36 inches wide and 12 inches high. Similar beds were formed by hand at the O'Brien farm. Once the beds were formed, a trench 12 inches wide and deep was made on the top center of each bed and filled with peat moss. The beds and alleyways were then covered with weed barrier fabric (3 oz/square yard), with a one-half-inch irrigation line fitted with 1 gallon per hour spaghetti tubing running to each plant. The blueberries were planted into 8-inch holes burned into the weed fabric along the centers of each row. Two temperature data loggers were installed at each farm to monitor air temperature and soil temperatures at the surface, 6 inches, and 12 inches deep. Soil samples for pH analyses were collected at the time of planting.

In May 2010, holes in the weed fabric around each plant were enlarged to 16 inches diameter and covered with sawdust from a local saw mill. The blueberries received a total of 0.7 ounces of actual nitrogen in two split applications of a 50:50% mix of ammonium sulfate and urea, with applications being made May 11 and June 10, 2010.

Winter protection - During winter 2009-2010 no cold or desiccation protection was provided for the plants. In October 2010, winter protection was added. Steel "T"-shaped fence posts were set at the ends and along the centers of the planting rows to support bird netting for each row individually. The bird netting had a mesh of approximately 0.75 inches and was left in place to help trap snow around the plants (Figure 4).

Figure 4. Bird netting was applied at both farms in August 2010 in an effort to trap and maintain snow around the blueberry plants. Photo taken October 20, 2010.

Plant materials - Nine northern-adapted blueberry cultivars were tested, including three highbush (*Vaccinium corymbosum* L. 'Duke,' 'Earliblue,' and 'Patriot') and six half-high, *V. corymbosum* x *angustifolium* 'Chippewa,' 'Northblue,' 'Northcountry,' 'Northland,' 'Northsky,' and 'Polaris.' These cultivars were selected because of their superior cold hardiness observed in the contiguous United States. The descriptions of the plants below are from germplasm release notices and cultivar summary lists (APS Press, 1997).

Highbush blueberries

Duke - Released in New Jersey by A. Draper, G. Galletta, G. Jelenkovic, and N. Vorsa in 1987. Its pedigree is (Ivanhoe x Earliblue) x 192-8 (E-30 x E-11). This cultivar became quite popular for its high, early yields and quality fruit. The berries are remarkably even-sized throughout harvest. They are medium blue, quite firm, with a notable crisp flesh. Flavor is mild, improving with cold storage. The bush is strong and one of the most productive varieties grown. Mechanical harvesting has been very successful using this cultivar to produce fresh market-quality fruit.

Earliblue - Developed by Dr. F. Coville, of the USDA in New Jersey and released in 1952. The pedigree is [‘Stanley’ x ‘Weymouth.’] The berry cluster size is medium and loose. The berries are medium-large, very firm, subacid, and have good dessert flavor and quality. They are resistant to cracking have a small scar and ripen very early. The plant is hardy, upright, vigorous, well-shaped, and productive. ‘Earliblue’ is very popular as a fresh market and U-Pick variety because of its early ripening season. The plants produce less than mid-season varieties but gross dollar return per acre can be excellent due to higher prices early in the season. Mechanical harvesting is successful with this cultivar for the process market.

Patriot - Developed by Dr. P. Hepler, University of Maine, and released in 1976. The pedigree is [(Dixi x Michigan LB-1) x Earliblue]. Productivity is high and the berries are large until midharvest, declining in size after that. The scar is small, dry, and recessed. The color and flavor are very good. The berries hang in large clusters on the outer periphery of the bush and ripen in early midseason after ‘Earliblue.’ The plant is upright, vigorous, and relatively open with pliable branches that yield to heavy snow loads in winter. ‘Patriot’ is noted for its cold hardiness and plant survival has been superior to other highbush cultivars in Maine and consistently more productive. Plants are easy to establish, tolerating less than ideal conditions such as wet or heavy soils. The plant is resistant to *Phytophthora cinnamomi.* ‘Patriot’ is well suited for U-pick or farm sales in areas with colder winters or shorter growing seasons.

Half- high blueberries

Chippewa - This cultivar was developed by Dr. J. Luby of the University of Minnesota and released in1996. Its pedigree is [B18A (G65 x 'Ashworth') x US3 ('Dixi' x Michigan lowbush No. 1)]. This parentage incorporates some of the most cold hardy selections known in North America. Berries are large (about the same size as 'Northblue'), firm, sweet, and light blue. 'Chippewa' berries tend to be larger than those of 'Polaris,' lighter blue, and having milder flavor. In Minnesota trials, the plant is productive, more upright than 'Northblue,' and ripens midseason. The plant is compact, and grows to 4 feet high. This cultivar is recommended in areas where an extremely cold hardy variety is desired.

Northblue - 'Northblue' was released by the University of Minnesota for locations where highbush blueberry production is poor due to cold winter temperatures or inadequate winter protection. 'Northblue' is quite productive for its size, producing 3 to 7 pounds per bush in Minnesota tests. Initial observation in Oregon suggest a high yield potential in milder climates. 'Northblue' is recommended for colder winter climates for commercial, U-pick and local farm sales. The midseason-ripening berries are large and have attractive dark blue skins, good "wild" flavor, and a pleasing sugar:acid ratio. The berries are firm and hold well under refrigeration. Processed quality is good. The plant grows to 20-30 inches tall.

Northcountry - 'Northcountry' was developed by Drs. J. Luby, D. Wildung, C. Stushnoff, S. Munson, and P. Read at the University of Minnesota. This cultivar is a sibling of 'Northsky' and similar to it in many characteristics, although the plants are larger and more productive. 'Northcountry' berries are medium-sized with a waxy bloom, sky blue color, a small scar, and a sweet flavor similar to its lowbush parent. Quality of processed fruit is good. Mature plants are 18 to 25 inches high and 30 to 40 inches in spread. Plants tolerate temperatures as low as -35 ^{o}F with little injury. Productivity ranges from 2 to 5 pounds of fruit per plant although eight-year-old plants can produce 7 pounds of fruit under ideal conditions.

Northland - 'Northland was developed by Dr. S. Johnson and J. E. Moulton at Michigan State University and released in 1967. The pedigree is [Berkeley x 19-H (lowbush x Pioneer seedling)]. The medium-sized berries are firm, have good flavor and a small, dry scar, and ripen in early midseason. Plant stature resembles its highbush parentage with bushes reaching four feet tall with moderate spread. Lowbush heritage appears in the form of abundant, sometimes

excessive numbers of, new canes arising from the collar. The canes are vigorous, very productive, and machine-harvestable when trained properly. 'Northland' performs well in cold climates, particularly where extremes of winter-summer temperatures may preclude other varieties and is recommended in Canada and inland areas of the Western U.S. The cultivar is suitable for processing and local farm sales.

Northsky - This sibling of 'Northcountry' was developed in Minnesota and introduced in 1983. The berries are medium-sized, have good flavor, and store well. The plants are low-growing (10-20 inches tall), an asset in cold areas with reliable snow cover for insulation from severe winter temperatures. 'Northsky' is less productive than 'Northblue' and 'Northcountry' and more popular with home than commercial fruit growers.

Polaris - 'Polaris' was developed by Dr. J. Luby at the University of Minnesota and released in 1996. The medium-sized, light blue berries are firm, have a moderately small scar and excellent flavor. This cultivar flowers and ripens early in the season. The upright plants are taller and less spreading than 'Northblue,' reaching 4 feet tall, and about as productive as 'Northblue.'

Results and Discussion

Figure 5. Alaska Berries farm in midwinter. Photo provided by Brian Olson, Alaska Berries.

Climate - During the winter of 2009-2010, fall minimum air temperatures of -17 to -20 ^{o}F were recorded on November 17, 2009 with winter lows of -17 to -25 ^{o}F occurring on March 10, 2010. In both cases, the O'Brien farm was the colder of the two locations. No records of snow depths or wind speeds and duration were maintained on site. Due to datalogger malfunction, air temperature data collected on the farms was incomplete during December 2009 and January, April, and May 2010. Photos of winter conditions and temperature data collection are shown in Figures 5 and 6.

Figure 6. Rob Carter of the ARS Arctic & Subarctic Plant Gene Bank uploading air and soil temperature data at the Alaska Berries farm on October 20, 2010.

Table 1 shows air temperature and snow data recorded by the National Weather Service in nearby Soldotna for June 2009 through September 2010.

Recorded soil temperatures were surprisingly mild. At the Alaska Berries farm, the lowest soil surface temperature recorded was 29.6 ^{o}F and 28.9 ^{o}F at the O'Brien farm. Soil temperature data are shown for both farms in Table 2.

Table 1. Air temperatures (^{o}F) and snowfall recorded by the National Weather Service in Soldotna, Alaska near the two trial sites.

Month	High	Low	Average high	Average low	Total snowfall	Snow depths
2009						
June	75	28	61.5	43.6	0	0
July	*	*	*	*	0	0
August	73	30	62.6	41.6	0	0
September	67	19	55.6	35.2	0	0
October	58	11	46.0	32.4	0	0
November	41	-20	26.8	8.0	7.1	1-5
December	40	-18	25.6	12.0	12.8	8-11
2010						
January	34	-14	23.1	8.2	5.3	8-12
February	49	-3	33.7	17.9	14.6	6-17
March	45	-21	35.3	14.3	12.0	6-17
April	59	7	44.3	26.5	3.3	0-7
May	76	23	57.5	31.6	0	0
June	67	30	60.2	40.4	0	0
July	72	29	61.8	45.3	0	0
August	70	31	62.3	43.5	0	0
* Temperature data for July 2009 was missing from the NWS data base.						

Table 2. Soil temperature data (^{o}F). Data was collected at the soil surface and at 6- and 12-inch depths. Only average temperatures are shown in the 6- and 12-inch columns.

	Alaska Berries Farm				O'Brien Farm			
	Soil surface		6 inches	12 inches	Soil surface		6 inches	12 inches
	Minimum	Average			Minimum	Average		
	2009				2009			
October	38.4	44.9	45.0	45.2	44.1	43.4	44.0	44.3
November	32.7	33.6	33.8	33.9	35.4	31.8	32.1	32.8
December	31.8	32.1	32.1	32.1	31.2	31.3	31.3	31.4
	2010				2010			
January	29.9	30.5	30.4	31.4	29.3	30.2	30.6	30.7
February	29.6	31.3	31.4	31.7	28.9	32.2	32.5	32.7
March	31.5	31.6	31.7	31.9	31.4	31.6	31.7	31.9
April	31.7	31.9	32.0	32.1	31.7	31.9	31.8	32.2
May	44.2	53.3	51.2	49.8	42.7	51.9	*	52.1
June	54.5	58.5	58.1	56.6	54.2	59.1	*	60.1
July	55.9	60.3	60.9	59.2	54.3	60.9	*	61.3
August	56.3	60.0	60.2	59.3	51.3	60.4	60.2	60.1
September	45.5	54.8	54.8	54.9	41.8	55.1	55.0	55.1
* datalogger malfunction								

Plant Responses - ARS personnel visited the blueberry plantings during May, June, August, and October 2009 and again during January, May, June, August, and October 2010. All of the blueberries survived at both locations. Visual observations in May 2010 revealed widespread cane dieback, particularly on highbush cultivars. Some flowering and fruiting appeared to be reduced on the upper branches due to desiccation or cold injury. Whether the injuries occurred during fall frosts and/or midwinter low temperatures could not be determined. Damage to 'Chippewa is shown in Figure 7. Damage due to moose browsing was also reported at the O'Brien farm.

Figure 7. Fall frost and/or winter injury to Chippewa half-high blueberry. Photo taken June 10, 2010.

'Northblue' appeared to have suffered less cane dieback than other cultivars, although the amounts were not

measured quantitatively. It is possible that this cultivar's short stature, combined with snow cover, provided some protection from low temperatures and desiccating winds. The main crowns of all plants were uninjured during the fall and winter of 2009-2010 and produced flowers, fruits, and vigorous new shoots during 2010 (Figure 8). The 2010 growing season was unusually rainy and some disease damage to flowers and developing fruits was apparent (Figure 9).

Figure 8. Northcountry fruit (left) and Northblue plant (right). Photos taken July 14, 2010.

Figure 9. Fungal blight damage to developing Northcountry fruits. Photo taken July 14, 2010.

During an evaluation on October 20-21, 2010, plant vigor and health appeared remarkable for most of the highbush and half-high cultivars. Prior to this evaluation, the plots had been exposed to temperatures of 14 to 17 ^{o}F on October 14-15 and frost damage was evident on the tips of many canes (Figure 10). Frost damage was scattered throughout the plots, and appeared to affect some cultivars more than others. 'Northcountry' and 'Northsky' exhibited some of the poorest growth and vigor at this time.

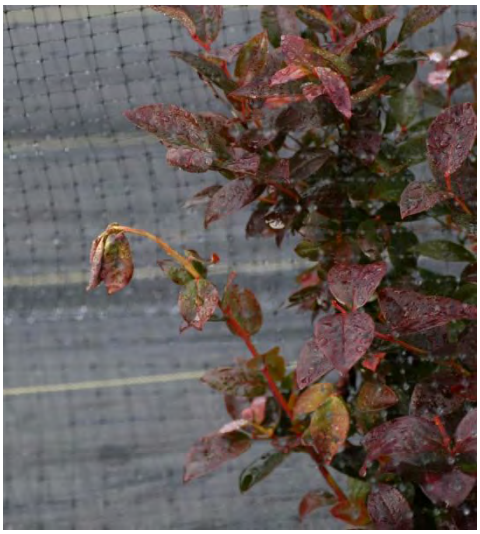

Figure 10. Frost damage was widespread on the tips of lateral branches and newly-emerging canes on many highbush and half-high cultivars at both farms in late fall 2010 following mid October lows of about 14 °F. Although widespread, the damage did not appear to be severe on most plants. Photos taken at the Alaska Berries farm October 20, 2010.

Due to the youth of the plants and the flowers being removed in 2009, no formal yield or berry quality data were collected for 2009 or 2010. Fruit data will be collected for analyses beginning in 2011. The growers reported that half-high cultivars produced more fruit than the highbush cultivars during 2010, but only 'Northblue' and 'Northsky' produced enough fruit to justify harvesting. Brian Olson reported that these two cultivars yielded about 2 pints of berries per plant (Figure 11).

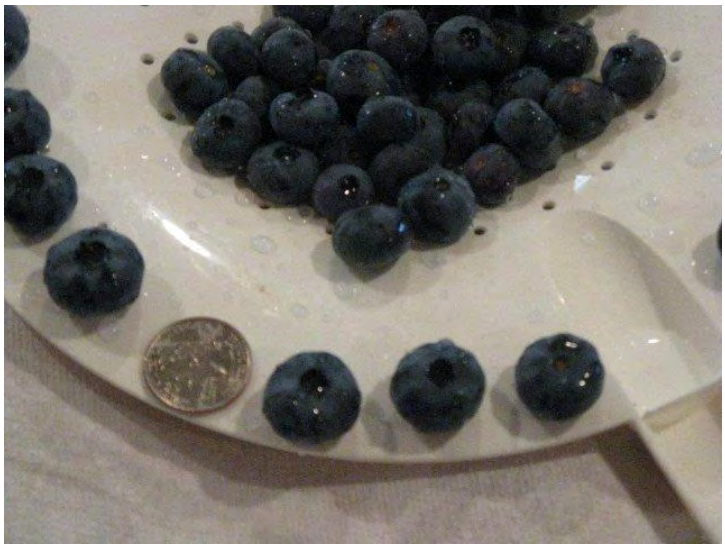

Figure 11. Northblue blueberries produced on the Kenai Peninsula. Photo taken by Brian Olson, Alaska Berries. (Berry diameter from 1.9 to 2.0 cm).

Conclusions

Despite significant cold injury sustained during the first fall and winter after planting, all plants survived at both locations. Taller plants appeared to suffer greater cane dieback. Preliminary results suggest that the half-high cultivar 'Northblue' suffered the least cold injury. 'Northblue' and 'Northsky' reportedly produced more fruit during 2010 than the other cultivars. To provide protection against cold injuries, small mesh bird-netting was installed during August 2010 above the plants to accumulate and maintain protective snow cover during the subsequent winter.

Data collection on plant survival, health, yield, and fruit quality will continue through April 2014. Production costs will be calculated and reported. Cultural management protocols will be suggested.

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