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Blueberry Distribution, Variety Evaluation and Breeding in Michigan

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DEPARTMENT OF HORTICULTURE

On the cover: The Bluehaven, one of Michigan's new blueberry varieties is examined by Prof. Stanley Johnston at MSU's South Haven Experiment Station.

THE BLUEBERRY is native to North America. Its fruit was highly prized by the Indians and later by settlers from Europe, and it is still one of the most popular berries in this country.

Many species of the blueberry are found throughout the United States. Several northern species which grow in Michigan are combined into either the low-bush or highbush group, depending on their growth habit.

Blueberries from wild plants were plentiful until the beginning of this century. As the supply of wild blueberries dwindled, Dr. F. V. Coville, botanist in the United States Department of Agriculture, began investigating the possibility of bringing the blueberry under cultivation. His work in determining the soil requirements of the blueberry and in breeding and selecting varieties producing large berries was of prime importance in the development of the cultivated highbush blueberry industry.

An important contribution to the young blueberry industry was made by the late Miss Elizabeth White of Whitesbog, New Jersey, who selected outstanding native highbush blueberry plants. One of her varieties, Rubel, is still important, and others were useful in blueberry breeding (Fig. 1).

Research with blueberries began in Michigan in 1923 at the South Haven Experiment Station. A few plants of new varieties developed by the U. S. Department of Agriculture, and native selections from New Jersey, were brought to South Haven for trial. Some native Michigan blueberry selections were included.

From this small beginning a cultivated blueberry industry has developed in southern Michigan, now totaling about 10,000 acres. The value of berries sold each year increased from a small amount in 1930 to more than \$6.5 million in 1967. Since present acreage is only in partial bearing, total production in the state will continue to increase for the next few years.



Fig. 1. Rubel, a northern highbush blueberry variety. This bush is about 5 feet high, and will eventually reach a height of 8 to 10 feet.

Distribution of the Northern Highbush Blueberry in Michigan

The highbush blueberry is native to lower Michigan about as far north as a line extending from the lower end of Saginaw Bay to slightly north of Muskegon. It grows mostly in low, moist areas, where the soil is quite acid (pH about 4.5).

These native highbush areas produced fairly large quantities of blueberries years ago, but many of these areas were cleared and used for other purposes. Also, it was almost impossible to obtain adequate insect control in these tangled thickets. Later, some of these sites were cleared and planted to cultivated blueberries.



Fig. 2. A typical lowbush blueberry plant.

The Lowbush Blueberry in Michigan

Some wild lowbush blueberry plants are found in the southern Lower Peninsula, but they are more plentiful and widely distributed in the pine areas of the northern Lower Peninsula and in the Upper Peninsula (Fig. 2 and 3).

After the original stands of pine were lumbered, lowbush blueberry plants grew more vigorously when freed from the competition of the trees, and therefore produced better in years when frost or drought did not seriously reduce the crop. As second growth timber became larger and more competitive, the production of wild lowbush blueberries declined until it was no longer commercially important.

Some have advocated controlled burning of the lowbush areas in northern Michigan as a means of insuring an ample supply of blueberries. Such attempts have been made, but they were unsuccessful because of the prevalence of frost at blossoming time and summer droughts.

Wild lowbush blueberry plants are usually found on light, sandy soil that is not very retentive of moisture. Plants growing on this soil type are frequently injured during dry weather and the berries may be very small. Occasionally, wild lowbush blueberry plants grow around the edges of marshes. These seldom suffer from drought injury, but are more susceptible to frost injury, which occurs more often in such low areas.

Attempts to grow the lowbush blueberry commercially under cultivation have so far been unsuccessful, because the plant is too low and spreading for efficient management.

The Blueberry Breeding and Variety Evaluation Project

It was realized early that neither selections of the lowbush blueberry nor the standard highbush varieties would be entirely satisfactory for commercial blueberry culture in northern Michigan. It seemed that selected hybrids of the two might prove to be satisfactory, or possibly dwarf forms of the highbush might be valuable, if they would produce satisfactory crops in the shorter growing season of the northern areas.

With this in mind, field trips were made by the senior author into wild lowbush blueberry areas of northern Michigan in the summers of 1925, 1926, 1931, and 1932, in attempts to find superior lowbush varieties. In all, 46 selections were made, and the plants were moved to the South Haven Experiment Station, where they were established and later crossed with highbush varieties.

A search was also made for superior native highbush blueberry material in Michigan. An appeal was made through the Michigan State University Office of Information Services to people in the state to notify the South Haven Experiment Station of outstanding native blueberries growing in the southern half of the Lower Peninsula. Also, the Michigan State Horticultural Society sponsored two contests for the best native highbush blueberries in the state. In all, samples of fruit from more than 200 native highbush plants were sent to South Haven. Cuttings were obtained and plants propagated from the best of these. Although none of these were good enough to name, they were very useful for further breeding.

Objectives

A wide range of crosses were made involving the native material collected and the best standard highbush varieties. Objectives in making these crosses were to find:

1. Hybrid plants about 24-40 inches high with

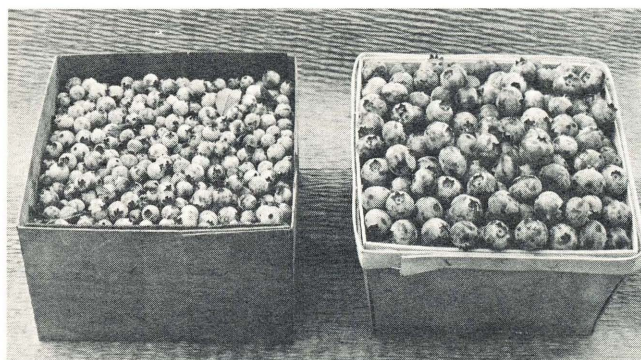


Fig. 3. A box of wild lowbush blueberries at the left. At the right, a box of cultivated blueberries.

large berries. Low stature is inherited from the lowbush and large berries and sturdy plant characteristics from the highbush species. Varieties with these traits might be suitable for commercial cultivation in northern Michigan since they would be covered by snow and escape the serious winter injury prevalent when highbush varieties are grown in the north.

2. Hybrid plants for southern Michigan that would grow about 5 feet high. These would be easier to harvest than the currently available highbush varieties that sometimes grow to a height of 10 or 12 feet.

3. Hybrids that would mature nearly all of their berries at one time. This would make harvesting easier and more economical by hand or machine. Maturing a high percentage of the berries at one time is rather common in the lowbush blueberry.

4. Earlier maturing varieties than are now available in the highbush species. Some lowbush varieties mature their fruit earlier than standard highbush kinds and might transmit this trait to seedlings that are hybrids of these two types.

5. Hybrids having greater drought resistance than the highbush blueberry. Lowbush varieties, in general, have greater drought resistance than highbush varieties.

6. Very small hybrid varieties producing large berries. These might be useful for house or border plants in the garden.

Making the Crosses

The first crosses between selected lowbush plants and the best highbush varieties were made in 1931. Crosses using native highbush selections were also included.

Unfortunately the undesirable characteristics of the lowbush blueberry — including the very low, spreading habit of growth, and small size and softness of the berry — were almost completely dominant in the first generation seedlings. Also, about 98 percent of the seedlings produced dark-colored berries, while light blue is preferred (Fig. 4).

Slightly better results were obtained in second generation seedlings. Some of these were sent to northern Michigan for trial, although they produced berries that were smaller and somewhat darker than desired.

Seedlings of the third generation produced their first berries in 1952 and some of these had the large, light blue berries of the best highbush varieties (Fig. 4). Bush stature was mostly from 3 to 5 feet in height. Again the best of these were used in new crosses, and also set out in northern trial plantings. Two selections from this generation have recently been named and are described later in this report (page 7).



Fig. 4. At left: Clusters of berries from Michigan Lowbush Selection 1, the lowbush parent of both Bluehaven and Northland. Berries are of good size for lowbush and light blue in color. Second from left: Clusters from F_1 hybrids. Berries as small as lowbush, and nearly all produced black berries. Third from left: Clusters from F_2 hybrids. Berries medium-blue and somewhat larger. Fourth from left: Clusters from F_3 hybrids. Size and color of some seedlings equal to average highbush berries. At right: Clusters from F_4 hybrids. Size and color as good as best highbush varieties, and plants have several desired traits inherited from the lowbush.

Ten thousand seedlings of the fourth generation produced their first berries in 1960 (Fig. 5 and 6). During the next 4 years, 36 selections were made from this large planting. These were the best results yet, including plant types from as small as a derby hat



Fig. 5. A field of 10,000 hybrid seedlings growing at the South Haven Experiment Station in 1964. See Fig. 6.



Fig. 6. The same field shown in Fig. 5, after all discarded plants were removed. Only 36 plants were selected for further observation from 10,000 originally growing in the field.

to a full grown highbush (Fig. 7 and 8). Most of the selections ripened nearly all of their berries so that they could be harvested in one or two pickings. Seasons of maturity ranged from very early to late-midseason. Some selections in this group will undoubtedly be named and introduced within a few years.

In the fifth generation, 4,092 seedlings produced their first partial crop in 1966. Some appear to be excellent half-high types that may be valuable in northern areas.

In addition to the crosses between lowbush and highbush varieties, several thousand crosses were made between standard highbush varieties and also between these varieties and what appeared to be native highbush selections. However, some of these selections were probably natural hybrids of lowbush and highbush parents, since many of the seedlings resulting from these crosses were definitely low-high hybrids. Hybridization of these species has occurred freely in nature.

In all, a total of 39,029 crossbred seedlings have been planted at South Haven, and about 70 percent of these seedlings have been fully evaluated. To date, 563 selections have been made and 83 percent of them fully evaluated.

Northern Trial Plantings

The first cooperative blueberry variety trial plantings were established in northern Michigan in 1933. Since then, a total of 69 plantings have been made in northern areas, mostly in the Upper Peninsula, although some important ones have been located in the northern half of the Lower Peninsula.

Plants of about 100 selections and varieties have been tested in these trial plantings, including standard highbush varieties, selections resulting from crossing the lowbush and highbush species, and 39 dwarf types which in other respects appeared to be of highbush parentage.

Possibilities of Growing Cultivated Blueberries in Northern Michigan

Much has been learned about growing blueberries from the 69 trial plantings located in northern Michigan.

Highbush varieties have failed to withstand the northern climate for the following reasons:

1. The length of the growing season (number of days between killing frosts) is insufficient for highbush varieties to develop and mature wood and fruit buds.

For best performance, the highbush blueberry requires a growing season of about 165 days, which is attained at South Haven. The Hough-



Fig. 7. A very small F_4 hybrid having the small leaves of the lowbush, and the large, light blue berries of the best highbush varieties. This type may have value as a border plant, in rock gardens or for other special purposes. (Photo courtesy of Jerry Krieger, Benton Harbor News-Palladium.)

ton area has about 145 days; the Lake City Experiment Station, 123 days; and for some interior parts of northern Michigan the growing season ranges from only 60 to approximately 100 days.

2. Killing of wood protruding above the snow level by low temperatures in late fall and winter occurs frequently. Snow cover for protection from cold is very important, even to the lowbush blueberry. Lowbush plants are usually covered with snow in northern Michigan, while highbush plants usually protrude above the snow line.
3. One can expect considerable breakage of highbush plants from very heavy accumulations of



Fig. 8. Bush type segregation occurring in F_4 hybrids. Note very low type at right, high types in the center and far left, and an intermediate type second from the left.

snow. Wood of the highbush plant is more rigid and brittle than that of the lowbush plant, and therefore breaks easier. Some hybrids are damaged little by the weight of heavy snows.

Hybrids developed by crossing the highbush and lowbush blueberry species offer the best opportunity for success in growing blueberries under cultivation in northern Michigan, especially those between 24 and 40 inches high. Northland, described later, is the first of these hybrids to be named and released for trial in northern Michigan.

Blueberry varieties, like other fruits, are susceptible to frost injury at blossoming time, which often can be severe in northern Michigan (Table 1).

Table 1 — Freezing temperatures °F at various locations in northern Michigan between May 16 and June 15, inclusive, in the years 1949 to 1958, inclusive. South Haven temperatures for entire month of May. Data from U. S. Weather Bureau.

Year	Grand Marais	Lake City Expt. Sta.	Dunbar Forestry Station	Houghton Area (Calumet).	South Haven Expt. Sta.
1949	31 26 31 32 30 29 26 24 28 26 23 32	31 31 28 31 30 29 32 24	29 32 31 32 32 31	28 26 31 32 31 31 30	30
1950	25 31 28 28 32 29	28 31 32	29 31 Partial data	29 28	31
1951	32 27 29 27 31 28	No records	32	32	32
1952	30 32 30 32 29 30 32	28 31 32 32	30 32	31 30 32	None
1953	31 29 29 26 28 26 31 28	No records	32	28 31 32	None
1954	29 26 24 31 32 25 20 25 30 30 31	32 27 30 28 25	31 30 28 29	31 32 31 30	31
1955	27 24 26 25 22 30 29 30 31	26 32 29 31	30 31	31	None
1956	28 27 24 23 23 25 21 17 23 31 26 30	29 30 26 21 32	27 31 29 27 30 29 25 31 32	25 30 25	None
1957	22 26 31 27 24 31 28 27 28 24 30 27	26 31 29	31 29	28	None
1958	32 31 31 25 26 24 27 27 25 25 27 25	27 28 23 28 32	31 30 30	32 30 32	None

Comments on Table 1

1. The temperatures are given from left to right in order of occurrence. Dates on which these temperatures occurred are available on request.
2. Temperatures for northern locations are given for May 16 to June 15, inclusive, since blueberries would be blossoming sometime during this period in northern Michigan. Temperatures for South Haven are given for the entire month of May, since blueberries are in bloom during May in this location.
3. These temperatures were obtained from Weather Bureau Stations. Thermometers at these stations are located 5 feet above the ground. Temperatures at ground level will usually be 5°F colder on frost nights than at the 5-foot level. Because most lowbush blueberries grow to a height of only a few inches, temperatures to which they would be exposed would, therefore, be lower than those reported in the table.
4. Trial plantings located at the Lake City Experiment Station, and south of Grand Marais, near Seney, had to be abandoned because of repeated crop failures. These areas are representative of the pine regions which were lumbered years ago, and have since been reforested. Blueberry trial plantings have all failed in these areas because of frost injury, and the areas cannot be considered suitable for growing cultivated blueberries.
5. Trial plantings located near Good Hart, close to Lake Michigan, near Tawas City, close to Lake Huron, and in the Houghton area on the Keweenaw Peninsula, partially surrounded by Lake Superior, have all had only minor injury from frost.
6. Undoubtedly, the danger of crop loss from frost injury is the greatest limiting factor in the future development of a cultivated blueberry industry in northern Michigan.

Recommendations for Growing Cultivated Blueberries in Northern Michigan

It is apparent that prospective blueberry growers in northern Michigan should, when plants of recommended varieties become available, plant only on suitable blueberry soil in areas located close to the Great Lakes. It may be that other locations in northern Michigan of rather high elevation can also be used, if the soil is of the proper degree of acidity and is adequately supplied with moisture. Frosts are less frequent and less severe on elevated sites. However, such locations still need to be found and tested before they can be recommended for blueberry culture.

Bulletins are available from the Cooperative Extension Service, giving the essentials of blueberry culture for southern Michigan. These should be carefully studied by prospective growers before making a planting. More complete details about growing blueberries in northern Michigan are being prepared for publication.

Comparatively little is known about growing blueberries under cultivation in northern Michigan and therefore, plantings should be small at first until more knowledge is gained. Also, new and probably better

varieties will be available at fairly short intervals in the future.

Bluehaven and Northland New Blueberry Varieties for Michigan

Two new blueberry varieties, Bluehaven and Northland, are being released from the blueberry breeding project at the South Haven Experiment Station. Brief descriptions and comments on these varieties follow. More complete information can be obtained from the Quarterly Bulletin of the Michigan Agricultural Experiment Station, Vol. 50, No. 1, 1967.

Bluehaven (selection 50-H) is a promising variety for southern Michigan (Fig. 9). It has been under trial for 15 years at the South Haven Experiment Station, located in the heart of the cultivated blueberry industry.

Bluehaven has the same parentage as Northland but favors the highbush species in many ways.

It attains a height of about 5 feet at maturity which should make it well adapted to harvesting either by hand or machine. The plant has good vigor, is hardy, and productive.

The berries begin to ripen about July 15 at South Haven, or as early as Bluecrop. They are large, round, light blue, remarkably firm, and of excellent flavor. The picking scar is very small and dry.

Bluehaven has been tested extensively in northern Michigan, but it is not recommended for this area because the bush is seriously broken in some years by the weight of heavy snow.



Fig. 9. Bluehaven. Recommended for trial where the northern highbush blueberry can be grown successfully. Note that the berries are all ripe at about the same time. This makes harvesting easier and less expensive.



Fig. 10. Northland. Recommended for trial in northern areas where locations can be found having sites with suitable soil and reasonable freedom from frost.

Northland (selection 48-H) has made an excellent record in northern trial plantings. It was named for the region where it is best adapted (Fig. 10). This variety is recommended only for the northern half of Michigan's Lower Peninsula and for the Upper Peninsula. It is not suitable for the southern part of the state.

The bush of Northland is vigorous, moderately spreading and attains a height of about 4 feet at maturity. The wood is pliable, and breakage under the weight of heavy accumulation of snow in northern Michigan has not been serious.

The fruit of Northland matures very early, about July 10 at South Haven, or a week earlier than Bluecrop. The berries are medium in size, round, medium blue, moderately firm and of good flavor. The picking scar is medium small and dry. The berries ripen nearly all at one time.

Another Variety for Trial in Northern Michigan

Rancocas is an old variety developed by the U. S. Department of Agriculture and introduced in 1926. It ripens about with Northland. It has some lowbush blueberry in its parentage which may account for withstanding the cold climate of northern Michigan better than most varieties. In some seasons, however, the tops have been killed to the snow line. The leaves are subject to a physiological leaf spot which often causes severe defoliation. The bush is highly resistant to a blight known as *Fusicoccum* canker, which is more prevalent in northern than southern Michigan. The fruits are medium-small but of good flavor. They usually crack in rainy weather. Despite its faults, this variety may provide some cultivated blueberries for northern areas until varieties having better fruit characteristics are available.

Conclusions

Hybridizing lowbush and highbush blueberry species has been time-consuming. It required 27 years to locate outstanding lowbush plants in wild areas of northern Michigan, to establish them at the South Haven Experiment Station, to make the crosses, to grow the seedlings, to evaluate the first two generations, and to bring the third generation into production. It was a discouraging task because nothing of value was apparently present in the seedlings of the first two generations. When the third generation seedlings came into production in 1952, both Bluehaven and Northland were selected. However, these and many other selections had to go through a 15-year trial period at South Haven and in northern Michigan before their value could be determined with reasonable accuracy. Unfortunately, there is no substitute for time in thoroughly appraising new fruit varieties.

Crossing species creates added problems. Undesirable characteristics present in each of the parent species are encountered frequently in the hybrid progeny. However, this project has now reached the point where a considerable number of promising selections have been found. Progress in the years immediately ahead should move at a rather rapid pace.

Acknowledgment

The writers wish to express their thanks to the nearly 300 people in Michigan who have assisted in these investigations. Sixty-nine have served as cooperators in variety testing, and over 200 have supplied plant material. Without their aid it would have been impossible to conduct these experiments efficiently covering such a large area.