Blueberry Production and Research Trends in North America

Bernadine Strik
Department of Horticulture
Oregon State University
4017 ALS
Corvallis, OR 97331-7304
USA

Keywords: *Vaccinium corymbosum*, *Vaccinium ashei*, *Vaccinium angustifolium*, northern highbush, southern highbush, rabbiteye, lowbush, markets, machine harvest, pests, cultivars, area planted

Abstract

In the last 10 years, the area planted to all blueberries in North American increased 30% to 96,869 ha. During this period, lowbush blueberry area increased 33% and highbush 22%. In the USA, the area planted to "highbush" (northern and southern highbush and rabbiteye) blueberries increased from 19,758 to 22,393 ha from 1992 to 2003, a 13% increase. In 2003, the Midwest region of the USA accounted for 36% of the area of highbush blueberries planted. The South, New England, and Western regions accounted for 28%, 17%, and 14% of the planted area in 2003, respectively. Specific states in the USA that had considerable growth from 1992 to 2003 were California, Florida, Mississippi, North Carolina, Oregon, and Washington. In Canada, the area planted to highbush blueberries increased 102% to 4397 ha. Commercial blueberry plantings in Mexico were estimated at 28 ha in 2003. In the USA, total lowbush area increased 6% since 1992 with Maine accounting for 97% of the area planted. In Canada, lowbush area increased 57% since 1992 with 37% and 34% of the area planted in Quebec and Nova Scotia, respectively. The blueberry industry is still projected to grow considerably in the next 5 to 10 years. Highbush blueberries in the USA are expected to increase 16% and 35% in the next 5 or 10 years, respectively. In Canada, planted area of highbush blueberries is expected to increase by 22% in 5 years and 25% in 10 years. If projections are correct, planted area in Mexico will increase by almost 30 fold in 10 years. The managed area of lowbush blueberries is expected to increase by 10% to 20% in the next 5 to 10 years. Data on typical yields, types of cultivars grown, markets, proportion of machine harvest, major production problems, changes in production practices and research areas are presented.

INTRODUCTION

Blueberry cultivation in North America is thought to have started when Native Americans burned wild stands of native lowbush blueberry (*Vaccinium angustifolium* Ait. and *V. myrtilloides* Michx.) in Eastern North America to tend them and to increase production. European settlers began managing wild stands in the 19th century (Eck and Childers, 1966). Cultivation of rabbiteye blueberries (*V. ashei* Reade) began near the end of the 19th century (Mowry and Camp, 1928). Elizabeth White and F.V. Coville are credited with starting cultivation of the northern highbush blueberry (*V. corymbosum* L.) in the early 1900's (Eck and Childers, 1966). The first southern blueberries (complex hybrids based largely on *V. corymbosum* and *V. darrowi*), 'Sharpblue' and 'Flordablue', developed by R. Sharpe and W. Sherman at the University of Florida, were released in 1975. Development of plantings were, however, slow with only 4 to 6 ha of pick-your-own southern highbush in Florida in 1978. The first fresh southern highbush blueberries were shipped out of Florida in 1982 (P. Lyrene, pers. commun.). In the late 1980's 'Georgiagem' from the USDA, Georgia, 'Gulfcoast' and 'Cooper' from the USDA, Mississippi, and 'O'Neal' from North Carolina were released. Many of the plantings in Florida are now made up of relatively new releases from Lyrene's program at the

Proc. VIIIth IS on Vaccinium Culture
Eds.: L. Lopes da Fonseca et al.
Acta Hort. 715, ISHS 2006

University of Florida.

The initial increase in area planted to cultivated blueberries in North America was slow. In 1930, ten years after the first cultivars were introduced from Coville's program; there were less than 80 ha in production. However, by 1965 there were 8100 ha of cultivated blueberries planted. In 1992, James Moore (1994) conducted a survey of blueberry production in North America. He reported that the area planted to blueberries increased 19% from 1982 to 1992; cultivated types increased 47% and lowbush 11%. He projected that the total area planted to blueberries in North America would increase 14% by 2000 (Moore, 1994).

Blueberries have become a major crop worldwide. This paper reports on the results of a survey conducted in 2003 on production in North America. The objectives of this survey were to determine how many hectares of blueberries were planted, what types of blueberries were being grown (northern or southern highbush, rabbiteye, or lowbush and what cultivars), average yield, harvest methods, amount of area planted for organic production, markets for fruit, types of production system changes, significant pest and other problems, breeding and research programs foci, and expected trends for the next five and ten years. This paper does not include information on harvest of any native *Vaccinium* species (i.e. in Montana or Alaska), other than the lowbush blueberry, *V. angustifolium.* Surveys were sent out to Extension and research colleagues and key industry leaders in states in the USA and provinces in Canada that were known to have at least 20 ha of blueberries planted. Key industry leaders provided information on production in Mexico. Greater detail on who provided help with this survey is provided in the acknowledgements section.

RESULTS AND DISCUSSION

Production Regions

Although blueberries are likely cultivated to some extent (i.e. home gardens or small test evaluation trials) in most regions of North America, commercial cultivation was not present or was considered very minor in 2003 in Alberta, Saskatchewan, Manitoba, Newfoundland, New Brunswick, Yukon, Northwest Territories, Nunavut, and Prince Edward Island, Canada and in Montana, Wyoming, Utah, Arizona, Colorado, New Mexico, North Dakota, South Dakota, Nebraska, Rhode Island, Alaska, and Hawaii, USA.

In the USA, the area planted to highbush, both northern and southern highbush and rabbiteye blueberries increased from 19,758 to 22,393 ha from 1992 to 2003, a 13% increase (Table 1). This is considerably higher than the 16,580 ha reported by the Agricultural Statistics Service (NASS) (USDA, 2004). The difference is likely because the NASS only reports harvested area, whereas this survey includes all planted area not yet in production. In addition, NASS does not include many states that have significant blueberry plantings i.e. Mississippi and Texas).

In 2003, the Midwest region of the USA accounted for 36% of the area of highbush blueberries planted. The South, New England, and Western regions accounted for 28%, 17%, and 14% of the planted area in 2003, respectively (Table 1). The relative importance of these production areas in the US has changed relatively little since 1992, except the proportion of area in the West increased from 6% to 14%; this increase was due to relatively little change or a decrease in area planted in the New England and Midwest regions (Table 1). Specific states in the USA that had considerable growth in hectares of highbush blueberries planted from 1992 to 2003 were California, Florida, Mississippi, North Carolina, Oregon, and Washington (Table 1). A couple of respondents felt that the hectares provided in the 1992 survey (Moore, 1994) overestimated actual area planted. Specifically, in New York the area planted was thought to have increased by 10% since 1992, rather than the 17% loss calculated based on the 1992 survey (Table 1). Secondly, in Florida the area planted was thought to have increased by 66% rather than the 38% loss based on the 1992 survey (Moore, 1994; Table 1). For the other states the

perceived increase or loss in planted area was very similar to that calculated based on the last survey. The relative proportion of total area planted located in the major states and provinces is provided in Table 2.

In Canada, the area planted to highbush blueberries increased 102% from 1992 to 2003 (Table 1). British Columbia continued to account for the majority of the area planted (Table 2), but there was also a large increase in highbush plantings in Quebec. There was no recorded blueberry production in Mexico in 1992 (Moore, 1994), some respondents felt there were likely some plantings there 10 years ago (Table 1). Commercial blueberry plantings in Mexico were estimated at 28 ha in 2003 (Table 1). North America accounted for 75% of the hectares and 83% of total highbush blueberry production in the world in 2003 (Brazelton, 2004).

The total area planted to lowbush blueberries, as managed wild stands, has also increased in the last 10 years. In the USA, total lowbush area increased 6% since 1992 with Maine accounting for 97% of the area planted in 2003. In Canada, lowbush area increased 57% since 1992 with 37% and 34% of the area planted in Quebec and Nova Scotia, respectively. There were also large increases in planted area of lowbush blueberries in New Brunswick and Prince Edward Island (Table 1). Since lowbush blueberries are native, this increase in planted area reflects a larger portion of the native stands being managed for harvest due to positive blueberry markets.

In the last 10 years, the area planted to all blueberries in North American increased 30% to 96,869 ha, much more than the 14% growth projected from 1992-2000 in the survey conducted in 1992 (Moore, 1994). From 1992 to 2003, area planted to lowbush blueberries increased 33% and for highbush 22% (Table 1).

The blueberry industry is still projected to grow considerably in the next 5 to 10 years (Table 1). The area of highbush blueberries planted in the USA is expected to increase 16% and 35% in the next 5 or 10 years, respectively. Of particular note, is the huge projected increase in plantings in California to 3238 ha in 2013. Planted area in Mississippi is expected to double and in Florida triple in the next 10 years (Table 1). In Canada, planted area of highbush blueberries is expected to increase by 22% in 5 years and 25% in 10 years (Table 1); thus there is less projected growth in Canada in the long-term. If projections are correct, planted area in Mexico will increase by almost 30 fold in 10 years (Table 1). The managed area of lowbush blueberries is expected to increase by 10% to 20% in the next 5 to 10 years. Only half of the total area of lowbush blueberries is harvested annually due to alternate year production methods (Yarborough, 2004).

In general, average farm size data for 2003 were relatively meaningless as cultivated blueberry farms in North America ranged from < 1 ha to > 350 ha in size.

Respondents estimated that there were 195 ha of highbush and 120 to 200 ha of lowbush blueberries produced organically in the USA in 2003. There were approximately 25 ha of organically managed highbush blueberries in Canada in 2003. All respondents expected the amount or proportion of organic plantings to increase in the near future.

Average yield per hectare reported by respondents and national statistics (USDA, 2003) was consistently lower than the “typical” yield reported for each region of North America. This is expected when statistics agencies calculate the average yield per hectare from total production and harvested area data – this greatly underestimates average yield of mature fields as many of the harvested fields are not yet in full production. This inaccuracy in national statistics is expected to continue while the blueberry industry in North America continues to grow.

Typical yields for well-managed, mature highbush blueberry fields were reported as 7 to 8 t $\cdot ha^{-1}$ for the Mid Atlantic, South, and Southwest regions, 9 to 10 t $\cdot ha^{-1}$ for the Midwest and New England regions, and 20 t $\cdot ha^{-1}$ for the West; excluding Idaho and California where blueberries are less well adapted. Of course, yield among fields within a region are extremely variable due to effects of microclimate, cultivar, and management practices. If all fields were managed to yield their full potential, yield in the USA would be projected to achieve 308,585 t when all the present planted area is mature, not accounting for any increase in planted area! This type of production is likely not

achievable. In Canada, typical yields for highbush blueberry range from 11 t ·ha^{-1} in Ontario and Quebec to 18 - 20 t ·ha^{-1} in British Columbia. Average yields of lowbush blueberries were 3 t ·ha^{-1} but in a well-managed field yields of 11 t ·ha^{-1} can be achieved.

Cultivars

The area planted to northern highbush and rabbiteye blueberries in North American increased 15% and 13%, respectively from 1992 to 2003 (Table 3). There was an almost five fold increase in the area planted to southern highbush blueberries in the last 10 years, due mainly to new, well-adapted cultivars released by the University of Florida. The proportion of the total area planted to northern highbush blueberries remained relatively constant at 76 to 80% from 1992 to 2003, whereas the proportion of southern highbush increased from 2% in 1992 to 8% in 2003 (Table 3).

Northern highbush blueberries accounted for 100% of the planted area in the Midwest and New England regions, 93% of the Mid Atlantic region, 81% of the West, and 15 to 17% of the South and Southwest. Respondents were asked to provide a list of cultivars in mature northern highbush plantings and in newly established ones. The most common cultivars in established plantings in the Midwest, New England, and Mid Atlantic regions were 'Bluecrop', 'Jersey', 'Blueray', 'Rubel', 'Elliott', and 'Duke'. In newly established plantings, 'Bluecrop', 'Elliott', 'Duke', 'Nelson', and 'Brigitta Blue' in Indianna. In Minnesota, however, about 40% of the area is planted to half-high blueberries developed at the University of Minnesota includes 'Northblue', 'Chippewa', 'St. Cloud', 'Polaris', and 'Northblue', due mainly to the extreme winter temperatures that occur in this region. In the northeastern region of the USA, the new cultivars that "show a lot of promise" were listed as 'Draper', 'Aurora', and 'Liberty' the new releases from Michigan State University, and 'Duke'.

In Oregon and Washington in the western region, the predominant cultivars in established, mature plantings were 'Bluecrop', 'Duke', 'Elliott', 'Berkeley', "hardyblue", 'Bluejay', 'Earliblue', 'Jersey', 'Blueray', 'Reka', 'Rubel', and 'Brigitta Blue'. In new plantings, 'Duke', 'Bluejay', 'Reka', 'Ozarkblue', 'Elliott', and 'Bluecrop' were listed. Again the new releases 'Draper', 'Liberty', and 'Aurora' show great promise. In California, there was very little northern highbush blueberry production, as this type of blueberry is not adapted to this growing region.

Southern highbush blueberries accounted for 23% of the planted area in the South and Southwest regions, 18% of the West but only in California, and 1% of the Mid Atlantic regions. In the southern region 'O'Neal', 'Bluecrisp', 'Reveille', 'Southern Belle', 'Star', 'Bladen', 'Emerald', 'Jewel', 'Sharpblue', 'Misty', 'Millenia', and 'Windsor' were listed as being planted in mature fields. In newer plantings, 'Star', 'Emerald', 'Jewel', 'Millenia', 'Sebring', 'O'Neal', 'Legacy', 'Reveille', 'Sampson', and 'Jubilee' are planted. There is a long list of promising new southern highbush for the southern region: 'Emerald', 'Millenia', 'Bluecrisp', 'Craven', 'Lenoir', 'Pamlico', 'Arlen', 'Jewel', and 'Sebring'. In California, there are not many mature plantings. The most common southern highbush planted are 'Misty', 'O'Neal', and 'Star'. The newer cultivars from Florida, 'Jewel' and 'Emerald', show promise in this state.

In 2003, rabbiteye blueberries were predominantly grown in the South and Southwest at 62% of planted area, the Mid Atlantic region at 6% and the West 1%, but all in Oregon. The cultivars 'Climax', 'Tifblue', 'Brightwell', 'Premier', and 'Powderblue' are found in mature plantings in the south and southwest. In Oregon, 'Powderblue', 'Centurion', 'Rahi', and 'Brightwell' are in mature plantings. 'Powderblue', 'Rahi', and 'Maru' are being planted in Oregon whereas 'Powderblue', 'Brightwell', 'Tifblue', 'Premier', and 'Columbus' are being planted in the south and southwest. New rabbiteye cultivars showing promise in the south are 'Ochlockonee', 'Alapaha', 'Savory', and 'Onslow'. Southern highbush blueberries and a few hectares of rabbiteyes were being grown in Mexico in 2003.

In Canada, the northern highbush cultivars being planted in British Columbia are very similar to those being grown in Washington and Oregon. Also, Ontario and Quebec

have similar cultivars to the northeastern USA with the exception that the more cold hardy 'Patriot' is more widely planted in Canada. There are no southern highbush or rabbiteye blueberries planted in Canada due to the cold winter temperatures or risk of spring frost damage with only southern highbush in British Columbia.

The major thrusts of breeding programs present in Arkansas, Florida, Georgia, Idaho, North Carolina, New Jersey, Michigan, Minnesota, Mississippi, and California as a private venture; include the development of low chilling cultivars, increased cold hardiness, better adaptation to climate, adaptation to mineral soils or soils with a high pH, early or late ripening, large yield, large fruit, suitability for machine harvest, disease, or insect resistance, and higher nutraceutical properties, depending on the region. There are cultivar trials located in many production regions to find the best suited cultivars for specific microclimates.

Respondents felt that plant patenting of new cultivars, which is becoming more common, provided increased stability for public breeding programs. Some programs felt they would not exist without income from royalties from patented cultivars. However, patenting may limit grower trial of advanced selections, limit availability of plants, restrict sharing of germplasm amongst programs, and increase the costs of nursery plants. There are no cultivars of lowbush blueberries as fields consist of clones of either *V. angustifolium* and/or *V. myrtilloides*.

Production Systems

Blueberry production in many areas has undergone some changes in the last ten years. In the southern and southwest regions, respondents mentioned the influence of better southern highbush and rabbiteye cultivars that target certain markets and production windows, have a higher yield, and higher berry quality in Florida, Georgia and North Carolina; cultivars that can be hand harvested at a higher picking efficiency in Florida, and cultivars that can be machine harvested for fresh market in North Carolina. In addition, changes such as higher density plantings, particularly in pine bark beds in southern highbush in Florida and Georgia, raised beds with irrigation in rabbiteye in Georgia, machine pruning postharvest in southern highbush in Georgia and North Carolina, annual pruning of rabbiteye in Mississippi, more machine harvest in Mississippi, and better post harvest fruit handling to improve fruit quality in Georgia, Mississippi, and North Carolina. Use of growth regulators such as hydrogen cyanamide to enhance leaf development in spring and advance ripening in southern highbush in Florida and Georgia, gibberellic acid to improve fruit set and for frost rescue in rabbiteye in Georgia and ethephon to delay bloom in rabbiteye in Georgia has also increased in the last ten years.

In the New England and Mid Atlantic and Midwest regions, respondents mentioned a shift in cultivars with more 'Elliott' and 'Duke' planted in Michigan and New Jersey, greater use of tissue analyses and use of split applications of nitrogen to improve fertility management in Michigan, New Jersey and New York, machine harvest of half-high blueberries in Minnesota, more use of electronic color sorters and broader use of controlled atmosphere storage in Michigan, and increases in Japanese beetle have prompted some growers in Michigan to go to clean cultivation which removes the sod that larvae feed on.

In the western region, the largest changes in Washington State are higher density plantings, trellising for machine harvest, and a new production region in the eastern part of the state where pH modification is necessary. In Oregon, highbush blueberry growers are now planting at less than 1m apart in the row, using trellising to improve machine harvest efficiency, raised beds are more common, less use of surface sawdust mulch to reduce production costs, a greater focus on maintaining pH within the desired range, and split applications of nitrogen fertilizer. In California, where production is very new, pH management has been critical with acidification of soil and irrigation water.

In Canada, testing of higher density plantings in Quebec and shift to 1m spacing and earlier fruiting cultivars in British Columbia, and a greater focus on pH

measurements and fertility management in both provinces were mentioned as major changes. In the USA, there is considerable blueberry planted area that is not irrigated: 56% in Indiana, 50% in New Jersey, 45% in North Carolina, 30% in Michigan, 20% of the rabbiteye in Georgia, and some of the mature northern highbush blueberries fields in northern Washington State and in British Columbia, Canada. In new plantings some areas are seeing more drip irrigation installed than overhead include Arkansas, California, Indiana, Minnesota, Mississippi, New York, and Washington state in the USA and all areas in Canada and Mexico. In contrast, overhead sprinkler irrigation is much more common in Florida, Michigan, New Jersey, North Carolina, and Oregon.

Major changes in the lowbush blueberry industry include increased use of fertilization, irrigation, bee hives for pollination, and herbicides for weed management and management of pH, all of which have led to increased yield per hectare.

The markets for fruit for the major blueberry production areas in North America are provided in Table 2. In North America, 60% of the total highbush blueberry production in 2003 was marketed fresh; this is more than a 60% increase in volume of fresh marketed fruit in the last seven years. Over 95% of the lowbush blueberry production was processed in 2003 (data not shown). Most of the highbush fruit going to the processed market was harvested by machine in 2003, with the exception of Washington where only half was machine harvested (Table 2). A large change in the last 10 years has been the use of machine harvest for fresh marketed fruit, ranging from none in California and Florida with no expected changes in the near future, to as high as 60% for fresh market rabbiteye in Georgia (Table 2). Most production areas expected an increase in the use of machine harvest due to the high cost and poor availability of labor.

Machine harvest of lowbush blueberries has increased in all production areas the last ten years to 40% in Maine, USA and 80% in Nova Scotia, 55% in Prince Edward Island, 25% in New Brunswick, and 75% in Quebec, Canada. Use of machine harvesters is expected to increase in the lowbush blueberry also.

Production Problems

1. Cultural. The cultural problems associated with production of highbush blueberries in North America included: spring frost injury in Florida, Georgia and Mississippi, winter cold damage in Minnesota and Quebec, soil problems such as drainage or undesirable pH in Arkansas, California, Georgia, Minnesota, North Carolina, New York and Mexico, pollination issues and excessive rain at harvest decreasing fruit quality in Georgia, difficulty managing irrigation in North Carolina and Oregon, short plant life in Florida, poor planting establishment in Mexico, aging fields of low yielding 'Jersey' and keeping adequate fresh fruit quality in machine-harvested fruit in Michigan, erratic yields due to wet springs during bloom in Washington, lack of knowledge of fertility requirements other than nitrogen in Oregon. In British Columbia, Canada, a reduction in Extension programs has resulted in many inexperience-induced production problems.

Cultural problems in lowbush blueberries are predominantly spring frost or winter cold damage, dry weather or heat during the season, especially in un-irrigated fields, and the natural variability in yield and quality of clones within and among fields.

2. Diseases. Disease problems were listed as prevalent in all production areas in highbush blueberries: specifically mentioned were blueberry scorch, shock or stunt viruses in Indiana, North Carolina, New Jersey, New York, Oregon, Pennsylvania, Washington, in the USA and British Columbia in Canada; *Monilinia* in Georgia, Indiana, Mississippi , North Carolina, New Jersey, Washington in the USA and British Columbia in Canada; *Anthracnose* and *Alternaria* fruit rots in Michigan, Minnesota, North Carolina, New Jersey, Oregon, Washington in the USA and British Columbia and Ontario in Canada; *Phytophthora* root rot in southern or northern highbush in Florida, Georgia, New Jersey, Oregon in USA and British Columbia in Canada; *Botryosphaeria* stem blight and cane canker in Florida, Georgia and North Carolina; *Pseudomonas* bacterial blight in Oregon and British Columbia: various leaf diseases in Florida, Georgia and North Carolina; rusts in Florida and Mexico: and *Phomopsis* and *Fusicoccum* cankers in Michigan, New Jersey

and New York.

Although many of these diseases were found in all production regions, of particular note is blueberry scorch virus, a relatively new virus to the western part of Canada. Blueberry scorch is an aphid-transmitted virus that was originally detected in New Jersey in the late 1970's. The East Coast strain, formerly known as the Sheep Pen Hill strain, causes symptoms on all cultivars except 'Jersey'. Growers with blueberry scorch virus are advised to rogue infected bushes and apply aphicides accordingly to control the spread of the virus. In 2003, this eastern strain of blueberry scorch virus was only found in British Columbia, Canada and in several eastern USA states. This virus is spreading in British Columbia and may have implications on production potential in the near future. In lowbush blueberries, *Botrytis* and *Monilinia* were the major disease problems.

3. Insects. The importance of insect pests in highbush blueberry production varies tremendously by region. Insect pests are relatively few or minor in Oregon, Washington, British Columbia (other than aphids as a vector of blueberry scorch virus), and Arkansas. Thrips and blueberry gall midge were mentioned in the southeastern USA. Blueberry maggot, cranberry fruitworm, and Japanese beetle were significant pest problems in Michigan, New Jersey, Indiana, and Pennsylvania. Cranberry fruit worm was listed as an important insect problem in Ontario and Quebec, Canada. Blueberry maggot is also a very important insect problem in lowbush blueberry production. The other problems mentioned for highbush blueberry production were weeds and birds in almost all areas, deer in New Jersey, British Columbia and Quebec, and voles or other rodent pests in Arkansas, California, Oregon and British Columbia.

Economic and Regulatory Concerns

There were various economic concerns listed for highbush blueberry production including: high costs of production, especially at high density in Georgia and Oregon; high costs of pine bark culture Florida; high pruning costs in Indiana, New York and Oregon; high labor costs in Georgia; decreased availability of labor in New York; competition from California in Georgia: competition from the USA in Mexico; cost of bringing packing sheds up to third-party audit standards, such as the Food Quality Protection Act, Good Farming Practices, Good Handling Practices in North Carolina; potential for lower prices due to increased area planted to blueberries in California and Indiana; competition from other production areas in Mississippi; low yields and thus low return for growers in Indiana and Mexico; instability of production/supply in Washington, Georgia and Minnesota; impending changes in packaging in California; and pressure for urbanization in Michigan.

Regulatory concerns included: access to migrant labor in Georgia, North Carolina, Oregon and British Columbia; wetlands or other water regulations in North Carolina, Washington and British Columbia; water use permits in Florida; third party audits for food safety assurance in Michigan, Mississippi and North Carolina; Japanese beetle and blueberry maggot tolerances in Indiana; permits for bird control devices in British Columbia; and maintaining adequate pesticide registrations in California, Florida, Michigan, New Jersey, Oregon and British Columbia.

Limits to Expansion

Most areas producing highbush blueberries have some limitations to expansion of the area planted: cold winter climate and insufficient cold hardiness of present cultivars in Minnesota, Wisconsin, Ontario, Quebec and Nova Scotia; lack of suitable soils in California, Michigan, North Carolina and Pennsylvania; lack of sufficient planting stock and pressure for urbanization in British Columbia, and cost of establishment in Arkansas, California, Florida, Georgia, Mississippi, New York and Oregon.

Research Programs

It is difficult to compare the research programs in this survey with what was

reported by Moore (1994). However, respondents were asked whether they felt the quantity of research programs on blueberry in their region had changed and how. Only one region, British Columbia, Canada, reported a decrease as there is no longer a production/physiology program and there was a reduction in support for grower educational programs. Several areas, reported no change in the last ten years: Arkansas, Idaho, Mississippi, and Washington, USA and Ontario and Quebec, Canada. Areas that have had an increase in the number of programs were: California, who now have a private breeding program and grower support and applied research in the counties with blueberry production and Florida, Georgia, Michigan, New Jersey, and Oregon, USA.

CONCLUSIONS

Blueberry production area in North America has grown 30% in the last ten years, almost double what was projected in 1992 (Moore, 1994). This industry is projected to grow another 16% and 22% in the USA and Canada, respectively, in the next five years, despite the listed limitations to expansion. If projections are correct, area planted to blueberries in Mexico is expected to increase 30 fold in 10 years. Lowbush blueberries account for a large portion of the total area planted in North America – this type of blueberry is harvested on an alternate year production cycle. The proportion of total area planted to southern highbush blueberries has increased in the last 10 years; these blueberries, as well as the rabbiteye, greatly increase the area in which blueberries are adapted and will likely increase further in proportion of total area planted in another 10 years. The amount of area machine harvested for processing is expected to increase significantly. In addition, a relatively large share of fresh market blueberries are machine harvested – this is a significant change from 10 years ago.

ACKNOWLEDGEMENTS

The author appreciates the contributions of the following research and Extension personnel and industry members: Mark Sweeney (BCMAF, Abbotsford, B.C., Canada); Andrew Jamieson (Agr. and Agrifood Canada, Kentville, N.S.); John Lewis (Agrapoint Intl., Kentville, N.S.); Adam Dale (Univ. Guelph, Simcoe, Ont., Canada); Michel Lareau (St.-Jean-sur-Richelieu, Que., Canada); Luc Urbain (Quebec Ministry of Agriculture); David Percical (Nova Scotia Agricultural College, Kentville); John Clark (Univ. Arkansas, Clarksville, AR); Brian Caster (Driscolls Assoc., Watsonville, CA); Paul Lyrene, Univ. Florida, Gainesville, FL); Gerard Krewer (Univ. of Georgia, Tifton, GA); Dan Barney (Univ. of Idaho, Sandpoint, ID); Bruce Bordelon (Purdue Univ., West Lafayette, IN); Sorkel Kadir (Kansas State Univ., KS); David Yarborough (Univ. Maine, Orono, ME); Eric Hanson (Michigan State Univ., East Lansing, MI); James Hancock (Michigan State Univ., East Lansing, MI); Jim Luby (Univ. Minnesota, St. Paul, MN); Bill Cline (North Carolina State Univ., Castle Hayne, NC); Gary Pavlis (Rutgers Univ., Mays Landing, NJ); Marvin Pritts (Univ. Cornell, Ithaca, NY); Stephen Stringer (USDA-ARS, Stoneville, MS); Dave Brazelton (Fall Creek Farm and Nursery, Lowell, OR); Mark Hurst (Hurst's Berry Farm, Sheridan, OR); Pat Moore (Washington State Univ., Puyallup, WA); Dorothy Anderson (Washington State Blueberry Commission); Rod Cook (Overlake Fruit Products, Olympia, WA); Kathy Demchak (Pennsylvania State University, University Park, PA); Debbie Stevens, Texas Blueberry Marketing Assoc., Nacogdoches, TX); Anthony Bratsch (Virginia Polytechnic and State Univ., Blacksburg, VA); Teryl Roper (Univ. of Wisconsin, Madison, WI); Dave Lockwood (Univ. Tennessee, Knoxville, TN); Joe Scheerens and Dick Funt (Ohio State University, Columbus, OH); John Pyzner (Louisiana State Univ. Ag Center, Calhoun, LA); Sonia Schloemann (Univ. Massachusetts, Amherst, MA); Bob Skirvin (Univ. Illinois, Urbana, IL); Mark Ehlenfeldt (USDA-ARS, Chatsworth, NJ); James Moore (Univ. Arkansas, retired); Chad Finn (USDA-ARS, Corvallis, OR); Gail Nonnecke (Iowa State Univ.Ames, IA); Ed White (Riverside Farms, SC); Bobby Boozer (Alabama Agricultural Exp. Station, Auburn, AL).

Literature Cited

Brazelton, D. 2004. World highbush blueberry production and acreage 1995–2003. Proc. 118th Ann. Mtg. Oregon Hort. Soc., 26–29 Jan. 2004, Salem, Ore. www.oregonhorticulturalsociety.org

Eck, P. and Childers, N.F. 1966. The blueberry industry, p. 3–13. In: P. Eck and N.F. Childers (eds.). Blueberry culture. Rutgers Univ. Press, New Brunswick, N.J.

Moore, J.N. 1994. The blueberry industry of North America. HortTechnology 4:96–102.

Mowry, H. and Camp, A.F. 1928. Blueberry culture in Florida. Fla. Agr. Expt. Sta. Bul. 194.

U.S. Dept. of Agriculture. 2004. Noncitrus fruits and nuts 2003 summary. USDA, Natl. Agr. Stat. Serv., 21 Oct. 2004. http://usda.mannlib.cornell.edu/reports/nassr/fruit/pnf-bb/ncit0704.pdf.

Yarborough, D.E. 2004. Factors contributing to the increase in productivity in the wild blueberry industry. Small Fruits Rev. 3:33–43.

Tables

Table 1. Area planted to highbush and lowbush blueberries in North America.

Country (*Region*)	State or Province	Area planted (ha)				Change (%)		
		1992[z]	2003	2008[x]	2013[x]	1992-2003	2003-2008	2003-2013
USA – HIGHBUSH								
New England								
	Connecticut	80	81	81	81	1	0	0
	Massachusetts	300	202	202	202	-32	0	0
	Maine	0	24	24	24	2300	0	0
	New Hampshire	99	99	99	99	0	0	0
	New Jersey	3320	2995	2995	2995	-10	0	0
	New York	490	405	405	405	-17	0	0
	Vermont	40	40	40	40	0	0	0
Mid Atlantic								
	Delaware	30	30	30	30	0	0	0
	Maryland	70	70	70	70	0	0	0
	Pennsylvania	200	202	223	243	1	10	20
	Virginia	85	91	117	162	7	29	78
	West Virginia	4	4	4	4	0	0	0
South								
	Alabama	200	121	121	142	-39	0	17
	Florida	850	526	809	1619	-38	54	208
	Georgia	1670	2428	3238	3642	45	33	50
	Mississippi	450	809	1214	1619	80	50	100
	North Carolina	1580	2023	2226	3035	28	10	50
	South Carolina	160	160	162	162	0	1	1
	Tennessee	70	111	162	202	62	46	82
Midwest								
	Iowa	2	10	16	30	400	60	88
	Illinois	80	81	81	81	1	0	0
	Indiana	300	322	324	324	7	1	1
	Kentucky	20	48	60	60	100	50	50
	Michigan	6890	7285	7325	7366	6	1	1
	Minnesota	30	49	61	61	60	25	25
	Missouri	120	120	120	120	0	0	0
	Ohio	110	110	110	110	0	0	0

Country (*Region*)	State or Province	Area planted (ha)				Change (%)		
		1992[z]	2003	2008[x]	2013[x]	1992-2003	2003-2008	2003-2013
	Wisconsin	2	12	14	16	500	17	33
Southwest								
	Arkansas	520	142	142	142	-73	0	0
	Kansas	3	20	20	30	614	0	50
	Louisiana	160	145	150	155	-9	3	7
	Oklahoma	80	61	61	61	-25	0	0
	Texas	530	530	546	546	0	3	3
West								
	California	20	607	2024	3238	2935	233	433
	Idaho	40	61	61	61	50	0	0
	Oregon	670	1497	1700	1902	124	14	27
	Washington	490	870	971	1093	78	12	26
	Total Highbush	19758	22393	25989	30172	13	16	35
USA – LOWBUSH								
	Massachusetts	200?	200	?	?	0	?	?
	Maine	24300	25900	?	28490	7	?	10
	Michigan	0	80	?	?	7900	?	?
	New Hampshire	560	405	?	?	-28	?	?
	Total Lowbush	25060	26585	?	?	6	?	?
CANADA – HIGHBUSH								
	British Columbia	1820	4047	4856	4856	122	20	20
	Ontario	275	162	243	324	-41	50	100
	Nova Scotia	20	66	81	89	230	24	36
	Quebec	60	182	263	344	200	44	89
	Total Highbush	2175	4397	5443	5613	102	24	28
CANADA – LOWBUSH								
	New Brunswick	3240	9794	?	?	202	?	?
	Newfoundland	810	486	?	?	-40	?	?
	Nova Scotia	11410	14974	?	?	31	?	?
	Prince Edward Island	4?	2024	?	?	50500	?	?
	Quebec	12230	16188	?	?	32	?	?
	Total Lowbush	27694	43466	?	?	57	?	?
MEXICO –HIGHBUSH		10?	28	202	809	180	614	2757

[z]Obtained from figures reported by Moore (1994), except for Mexico
[x]Estimated

Table 2. Utilization (Processed, Fresh, and Pick Your Own) and the importance of machine harvest in highbush blueberries produced in the major states or provinces in the USA, Canada, and in Mexico.

Country (State/Province)	Proportion of total area planted within country (%)			Utilization (%)			Machine harvested (%)		Change [y]
	1992[z]	2003	2013[x]	Processed	Fresh	PYO	Processed	Fresh	
USA									
Michigan	35	33	25	70	30	?	100	90	Slow +
New Jersey	17	13	10	20	80	0	91	10	0
Georgia	8	11	12	40 - 70	30 - 60	2	100	60	-
North Carolina	8	9	10	20	76	4	99	20	0
Oregon	3	7	6	55	40	5	85	15	++
Washington	2	4	4	75	25	?	50	0	+
Mississippi	2	4	5	40	60	0	100	50	+++
California	0	3	11	0	100	?	--	0	0
Florida	4	2	5	0	90	10	--	0	0
Texas	3	2	2						
Others	18	12	10						
CANADA									
British Columbia	84	92	87	40	58	2	25	5	+
Ontario	13	3	6	5	95	?	50	10	0
Quebec	0	4	6	0	35	65	--	0	0
Other	3	1	1						
MEXICO	--	--	--	0	100	0	--	0	0

[z]Obtained from figures reported by Moore (1994)

[x]Estimated

[y]Change expected from 2003 to 2013; 0: stable or little change in proportion of production that is machine harvested; "-" a decrease; "+" increase

Table 3. Area planted to northern and southern highbush, rabbiteye, and lowbush blueberries in North America from 1982 to 2003.

Blueberry type	Area planted (ha)		
	1982	1992	2003
Northern highbush	12700	17540	20287
Southern highbush	160	390	2153
Rabbiteye	1950	3900	4378
Lowbush	47450	52550	70051