bush rabbiteye selections grown in replication studies To date, plantings have been made in 1984, 1986 and 1988.

Active rabbiteye blueberry breeding programs are present in Florida, Georgia, Texas, North Carolina, and Mississippi. Emphasis is being placed on development of late-blooming plants which ripen uniformly and early. Interspecific hybridization using rabbiteye, highbush, and wild southern blueberry germplasm has produced 6 newly released southern highbush cultivars with adaptability in the rabbiteye growing area. These plants lack the vigor of rabbiteye but have potential for producing early fruit with more freeze tolerance than rabbiteye.

Rabbiteye characteristics such as wide soil-type adaptability, heat tolerance, disease and insect resistance, firm fruit with small scar, and high vigor need to be included in any new blueberry cultivars developed for the South.

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Changes in the Lowbush Blueberry Industry[1]

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Introduction

Munson (24) described the wild blueberry (principally *Vaccinium angustifolium* Ait.) industry in Maine as exceeding 150 thousand acres of blueberry barrens, utterly worthless for agricultural purposes but which through management may be improved for the cultivation and systematic improvement of the fruit. The management at that time consisted of periodically burning over land which had been burned by Indians in the past or opened by logging. Much has changed with the blueberry industry since that time, but despite these changes the lowbush blueberry is still very much a wild crop.

The lowbush or wild blueberry is a rhizomatous shrub averaging 20 cm in height (42) which occurs from Northern Quebec to the isolated uplands of the Appalachian mountains of Virginia. There is an estimated 50,000 acres of commercial blueberry land in Maine, and an equavilent area in the Canadian Provinces of Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland (25). Quebec has thousands of acres of semi-managed Crown land which is harvested when the yield and price is favorable. There are also a few hundred acres in New Hampshire and Massachusetts.

Although there are several named varieties of the lowbush blueberry released through the Agriculture Canada breeding program (8), few commercial plantings exist. Culture consists of managing wild stands by biannual pruning, fertilizing, and the use of chemical and cultural controls for pest management. Most of the wild blueberry crop is frozen but there has been an effort to increase fresh sales in recent years (12). Harvesting is done by hand with a scooptype rake and several mechanical harvesters are now available and are increasing in use (11). Adaptation of improved cultural practices and favorable weather conditions have resulted in the average yield in Maine increasing from less than 20 million pounds to nearly 40 million pounds over the past 10 years

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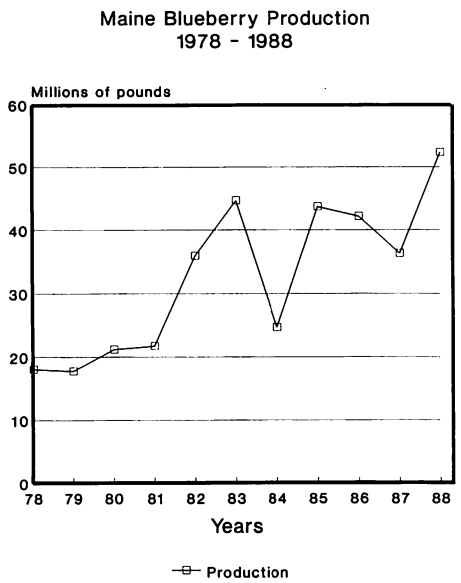

Figure 1. Annual harvest of lowbush blueberries in Maine as reported by the North American Blueberry Council in conjunction with the Wild Blueberry Association of North America.

(Figure 1). This paper will discuss the recent changes in blueberry culture that have contributed to this increase and look at future trends which will further improve production.

Management

Pruning

Until recently, commercial blueberry fields have been pruned by fire with straw or oil burners. Repeatedly burning fields for a number of years has resulted in a decline in production (35) from destruction of the organic pad and exposure of the rhizomes. Mechanical mowing will produce equivalent yields (14) without depleting the organic pad (17), and since it is less costly than using oil or straw (16) it has been widely adopted by blueberry growers.

Burning does, however, provide some advantages by partially removing competitive growth of other species and by reducing certain insects and diseases which occur in the leaf litter. Favorable weather conditions could lead to periodic outbreaks of these pests in mowed fields necessitating periodic burning to reduce their populations.

Pest Management

Suppression of competing weeds with hexazinone (45), and the use of glyphosate with selective applicators (46) has resulted in increases in yield and allowed for more efficient use of mechanical harvesters (11). However, not all species are controlled. A recent survey in Maine (44) and Nova Scotia (22) have indicated that certain species, and especially the bunchberry *(Cornus canadensis)* is increasing under current management practices. Research for the control of bunchberry and other species is continuing.

A system of monitoring the blueberry maggot *(Rhagoletis mendax)* and an action threshold has been developed through an IPM program, resulting in a decrease in frequency of sprays and an increase in their efficacy (6). Periodic outbreaks of blueberry thrips *(Frankinella vaccinii)* and blueberry flea beetles *(Altica sylvia)* (4) still cause sporadic damage but increases in the blueberry spanworm *(Itame argillacearia)* (7) have resulted in considerable economic damage.

The major blueberry diseases include mummy berry *(Monilinia vaccinii-corymbosi)* and blossom blight *(Botrytis cinerea)* (19). Cool, wet weather provides the necessary conditions for infection and spread of these diseases. Lambert (20) has reported that mowed fields have a higher incidence of mummy berry than burned fields so increased use of fungicides will be necessary if mowing continues to be the preferred pruning practice.

Irrigation

Irrigation will result in an increase in the number and weight of berries if moisture is limiting (3). Irrigation during the nonbearing year increased bud

formation and may result in increased yield in the crop year. Currently, irrigation is used commercially by a few growers the bearing year and the feasibility of irrigating nonbearing fields is being further evaluated.

Pollination

Blueberries require insect pollination and the use of honeybees will increase the fruit set and seed number (47, 48) resulting in higher yields. Current recommendations are for 2 to 4 hives per acre depending on the field size and location (13).

Fertilization

Fertilization recommendations have been traditionally based on observing stem height and leaf spotting (36, 37) and applying 35-45 kg N/ha from urea. The response to N fertilizer has not been consistently positive (15, 29). Most studies reporting significant increases in yield due to added N were conducted in fields which had no chemical weed control (36).

More recently, researchers have found blueberries not responding to fertilizer applications (3, 32), perhaps due to more effective chemical weed control. By removing weed competition for nutrients, many fields appear to be receiving adequate levels of nutrients provided by mineralization of soil organic matter (32, 24). Growers are being urged to abandon the traditional approach of fertilizing with urea (35-45 kg N/ha) every burn cycle and instead to sample leaf tissue to determine if N fertilizer is needed (27). Maine (39) and Canadian (21, 40) standards of satisfactory levels of nutrients in leaf tissue have been reported. Recent surveys of Maine blueberry fields (26) indicated nitrogen was adequate in leaf tissue samples but phosphorus levels were low, according to Trevett's standards (39). Poor correlations of leaf nutrient concentrations and organic pad or 3 inch soil samples (26) suggest leaf samples give a better indication on fertilizer needs than soil samples.

Planted lowbush blueberries have responded well to fertilization, resulting in more successful establishment, greater top and rhizome growth, and higher early yields (31). Frequency of fertilizer application was shown to be important for maximizing early growth and yield in a plowed sandy soil (33).

Propagation

Plants for establishing new blueberry fields have been produced from softwood cuttings of select clones and from seed (9) obtained by pollinating flowers of an outstanding clone with pollen from an equally good clone. Micropropagation techniques for blueberry, including the lowbush, have been reviewed by Smagula and Lyrene (30). Tissue culture propagated plants exhibit the spreading growth habit of seedlings along with the uniform productivity characteristics of rooted cuttings (23).

Mulching has been extremely beneficial for increasing survival of planted lowbush blueberry and encouraging their lateral spread through rhizome growth (28). Guidelines for cultivating newly planted lowbush blueberries are available from the New Brunswick Agriculture Plant Industry Branch, Ontario Ministry of Agriculture and Food and the University of Maine Cooperative Extension.

Breeding Program

A breeding program at the Agriculture Canada Research Station, Kentville, Nova Scotia has resulted in a significant improvement on size and yield of the lowbush blueberry (6). Selected clones from this breeding program outyielded closely related seedlings (1). When seedlings are used to start new fields or fill in bare spots in established old fields, it is also advantageous to use select clones as parents (1, 8).

Harvesting

Hall et al., (11) reported that a tractor-mounted mechanical harvester recovered less berries than hand-raking but the quality of the berries was the same. In a preliminary study of two self propelled harvesters Yarborough (43) reported a 50% loss of berries when compared to hand-harvested. Despite this, machine harvesters are being adopted because of the difficulties of obtaining and managing labor. A more thorough evaluation of the mechanical harvesters available and a computer model for an economic analysis is being developed (5).

Marketing

The majority of blueberries sold at the retail level are processed, individually quick frozen and a smaller quantity is canned. Fresh marketing of berries has increased with the recent trend of higher production (12). Product development and market research has increased to market the larger quantities of wild blueberries being produced. The Wild Blueberry Association of North America is an American-Canadian corporation formed in 1980 to promote marketing, utilization, encourage new product development and provide leadership on issues affecting the wild blueberry industry.

Future Trends

Horticulturists (2, 18, 38) have indicated a need for domesticating the lowbush blueberry using matted row culture and improved varieties. Except for a few small plantings (41), this type of culture has not been adopted by the industry. The limited availability of plant material, the high cost of establishment and the slow rate of spread are some of the reasons growers have not established cultivated lowbush blueberry fields.

Plant cover is dependent on the number of years a field has been in production because blueberry clones spread slowly (10). Blueberry fields in production 50 years or more may have nearly 100% cover, but younger fields may have less than 50%. A survey taken in 1985 (44) found that cover on commercial blueberry fields averaged from 40 to 70%. Increasing the cover by interplanting of improved selections could greatly improve the productivity of native lowbush blueberry fields. Interplanting will preserve the genetic diversity of the native fields. An increase in the production of seedlings and micro-propagated plants will be needed to fill these areas.

Increased yields will come from more intensive management, interplanting, mulching, increased pest management, fertility, irrigation and pollination. Costs per pound will be reduced by higher yields per acre and decreased cost of mechanical harvesting. An effort is being made to provide a consistent supply of blueberries to the existing markets but weather conditions will still have a major influence on the crop yield.

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Highbush Blueberry Cultivars and Production Trends[1]

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Abstract

Highbush blueberry (*Vaccinium corymbosum* L.) production in North America has increased dramactically over the last 10 years (5). Acreage has expanded rapidly in all of the traditional regions and strong industries have developed in several non-traditional areas as well. This paper will summarize the current status of highbush blueberry acreage and cultivar use in North America. Since significant highbush blueberry industries will likely develop in several countries outside of North America, acreage trends in these countries are also discussed.

The following fruit researchers and Extension workers were contacted in 1989 to compile information for specific production areas: Richard Hayden (Purdue University, Lafayette, IN), David Handley (University of Maine, Orono, ME), Dominic Marini (University of Massachusetts, E. Bridgewater, MA), Steven Justace (Vermont Department of Agriculture, Burlington, VT), Paul Eck (Rutgers Univer-

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