Blueberry Breeding for Chilean Conditions

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Abstract

The production of blueberries, *Vaccinium corymbosum* L. in Chile, particularly for export to countries in the northern hemisphere, has increased annually. In 2000, Chile exported about 4,000 tons; in 2004 it exported 10,000 tons; and the increase continues. Most of the fruit exported consists of cultivars bred in the United States, which is the biological center of origin. There are a number of breeding programs in the United States, each having its own characteristic selection pattern and priorities. Although these breeding programs cover a range of environmental (E) and cultural conditions, they do not produce cultivars that are ideally suited to the particular Chilean growing conditions or soil types. The aim of the *Genberries* breeding program, based in the VII Region of Chile (Latitude: 34–36° S), is to produce cultivars that are optimally adapted to conditions of central Chile. This will be achieved by selecting among the crosses of suitable germplasm (G), principally northern highbush genotypes, under the conditions prevailing in a range of regions of the country that are, or could, be suitable for growing blueberries. An initial round of crossing has been carried out and a GxE trial is in the planning stage. The aim will be to produce suitable cultivars that will contribute to the export from Chile during the "window" of no fruit production in the target markets in the United States, Asia and Europe.

INTRODUCTION

World production of blueberries has shown a positive annual trend, with an increase of almost 51% in the last 8 years (Strik, 2007). The areas of major growth have been in northern Europe, Spain, south-east Canada, east coast of United States, Chile and in certain parts of Asia, particularly China, which is likely to be a major producer in the future (Strik, 2006).

Although worldwide production of blueberry has increased in recent years, expansion in Chile has been even greater than in other producing countries (Bañados, 2006; Brazelton and Strik, 2007). In 1993, Chile had 580 ha planted to blueberries, while in 2003/04 the area planted to this crop expanded to 2500 ha. At present, it is estimated that 11,000 ha of blueberries (highbush and rabbiteye) are currently grown in this country (INE, 2007). Most of the expansion in the last 10 years has been based on highbush blueberry cultivars released in the United States. This expansion has made Chile the main blueberry exporter in the southern hemisphere (Bañados, 2006; Brazelton and Strik, 2007).

Chile is the principal exporter of blueberries in the southern hemisphere, involving some 10,000 tons in 2004, mostly using cultivars bred in United States of America and Europe (Bañados, 2006). This has permitted an important expansion of the area grown in Chile and the development of a major export effort. Continuing expansion of such exports will require an increase in the planted area and greater efficiency and quality of production per unit area (Brazelton and Strik, 2007). This implies the need for cultivars specifically suited to Chilean conditions and, indeed, a range of cultivars specifically adapted to different eco-geographic climatic zones existing in the different regions of the country (Brazelton and Strik, 2007).

The area of blueberries grown in Chile covers about 11,000 hectares (INE, 2007)

of which approximately 11% are in Regions IV, V and RM (29º10' S to 33º50' S); 33% are in the VI, VII and VIII Regions (33º50' to 38º10' S) and 32% are in the IX and X Region (38º10' to 43º55' S). The period of production in the southern hemisphere, is counter to that of the main consumer markets of the United States and Europe (Brazelton and Strik, 2007; Bañados, 2006). Indeed, the major reason for the increase in production is the potential export market. Thus, most of the characteristics of new cultivars are those which satisfy consumer requirements in these overseas markets. Additional requirements include prolonged storage life, tolerance to freight conditions while maintaining fruit quality, appearance, taste, nutritional attributes and integrity (Draper, 2007).

Surveys carried out during 2003 in the VIIth region, one of the largest blueberry growing regions in Chile, show that the most commonly planted cultivars are 'O'Neal' and 'Duke', while 'Berkeley', 'Brigitta Blue' and 'Elliott' are intermediate (Table 1). Thus, early, mid and late season cultivars are planted in South-Central Chile with the aim of extending the harvest season as well as fitting the need for labor to pick fruit for fresh export markets. Strik (2007) and Strik and Yarborough (2005), reported that in United States the most common northern highbush cultivars were 'Bluecrop, 'Jersey' and 'Duke; while 'O'Neal', 'Bluecrisp' and 'Reveille' were the most frequently planted southern highbush cultivars. Thus the early cultivars 'O'Neal' (southern) and 'Duke' (northern) are among the most commonly planted highbush blueberries in both countries.

As noted, Chilean production is in the off-season of growers in the target export countries. However, competition for such markets can potentially occur from neighboring countries and others in the southern hemisphere (Argentina, Perú, Brazil and Uruguay), as well as from the possible extension of the growing season in the northern hemisphere (Brazelton and Strik, 2007). The production chain needs to maximize efficiency, minimize costs and maximize profit. Thus, optimally suitable genotypes must be grown for Chilean environmental conditions.

MATERIALS AND METHODS

Adaptability Trials – GxE

A number of trials will be established to cover the main growing areas using existing cultivars and newly developed genotypes. This material will be planted in two parallel rows 3 m apart with 60 cm between plants. There will be three replications of 25 plants each with a common planting date within each trial. Planting dates will be optimized for each eco-agronomic zone. The characters to be recorded will include those relevant to establishment (percent survival, disease incidence), early growth (number of axis, total shoot length) as well as phenological traits (dates of bud break and full bloom), yield characteristics (harvest period, total fruit harvested) and fruit characteristics at harvest (diameter, weight, taste) and during storage (rate of dehydration and rotting, storage life).

Breeding Program

Crosses have been made between selected parental genotypes to give progenies with a wide range of important characteristics. Seeds are being germinated and seedlings transplanted into pots for initial growth in glasshouse and nursery. Later in 2008, these will be transplanted into a field site at the Universidad de Talca Agricultural Experiment Station. Seedlings will be scored for establishment and early growth and fruit will be scored when it develops (Hancock et al., 2008). From these early data, preliminary selection will be made of those genotypes showing particular promise but, more importantly, those with the highest likelihood of producing cultivars (Brown and Caligari, 2008) will be identified and these crosses repeated on a larger scale. Based on progeny data, superior parental genotypes will be identified and used in further crosses.

CONCLUSIONS

A northern highbush blueberry breeding program has been initiated at the

Universidad de Talca whose aim is to develop cultivars that are suitable to the environmental conditions of the various blueberry growing regions in Chile. Material produced in this breeding program will be compared to standard cultivars for vegetative and reproductive variables, with special emphasis on fruit quality and post-harvest life.

Land planted to blueberries has expanded in different growing regions of the world. Growth of the blueberry industry in Chile has been at a greater pace than in other latitudes. The incorporation of new productive areas requires cultivars adapted to different environments and geared to satisfy the quality and post-harvest requirements of the fresh markets in Asia, United States and Europe. To achieve this goal, a breeding program has been initiated at the Universidad de Talca. Initial crosses have been made and the first hybrid seedlings will be planted in the spring of 2008. Evaluation of this material comprises establishment, early growth, standard agronomic traits, yield and fruit characteristics at harvest and during storage. The aim of the program is to produce cultivars that will allow the continuing export from Chile during the "window" of no fruit production in the target markets in the northern hemisphere.

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Tables

Table 1. Frequency of highbush cultivars planted commercially in the VIIth region of Chile. Results of a survey of 20 growers. Source: Fundación Chile, 2003.

Cultivar	Frequency of planting (%)
O'Neal	75
Duke	70
Elliott, Berkeley, Brigitta Blue	30
Sierra, Patriot, Bluecrop	20
Denise Blue, Blueray, Bluegold	15
Spartan, Coville	10
Others	5