Blueberry Culture in Chile— Current Status, Future Prospects

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Summary. There is great interest in growing blueberries in Chile. Although only a few hundred hectares are now planted, thousands of hectares are predicted by the turn of the century. There are many areas in the country that are adaptable to blueberry culture, and labor costs are extremely low. Chileans feel they have a golden opportunity to make a profit by producing blueberries during the North American off-season.

Over the last few years, interest in planting blueberries (*arándanos*) has grown tremendously in Chile. Where there were only a few experimental hectares a decade ago, there are now ≈ 280 ha of commercial plantings (Table 1). Estimates indicate that there may be as many as 4000 ha by the year 2000 (Hanson and Hancock, 1990).

This interest has stemmed from the unique geographical location of Chile. Because it is located in the Southern Hemisphere, its seasons are the reverse of those in North America. This means that Chilean producers can grow and ship fruit to the Northern Hemisphere during its non-producing winter. Among horticultural species, the Chileans have successfully marketed grapes, apples, pears, kiwifruit, and raspberries in this manner, and they hope to use the same strategy with blueberries.

Chile stretches for ≈ 2500 miles in a narrow band along the southwest coast of South America (Fig. 1). The snow-capped Andes Mountains are on the east side of the country and the Coastal range is on the west; between these two mountain ranges is a long central valley where most Chilean fruit is grown. The large continuum in altitude and

latitude provides Chile with a climatic range suitable for numerous fruits.

Chile is divided into 12 political regions plus a Metropolitan Region (Santiago) (Fig. 1). Regions 1 and 2 are primarily desert and therefore unsuitable for most agriculture. Fruit is produced from Regions 3-10, including the Metropolitan region; in this area, the climate ranges from an arid Mediterranean climate in the north to a temperate, moist climate in the south. In Regions 11 and 12, the growing season is too short and cold for fruit production.

The various regions contain a broad diversity of agriculture. Early ripening table grapes are grown primarily in Regions 3 and 4. Grapes and stone fruits are produced mainly in the Metropolitan Region and Regions 5 and 6. Apples are concentrated in Regions 6 and 7, along with pears, kiwifruit, and some blueberries. Regions 8 and 9 are primarily devoted to cattle and forestry, although blueberries are beginning to appear. Raspberries and blueberries are produced in Region 10.

Current Situation

Blueberry production regions. The highest density of blueberries is found in the 10th Region, in a 25×50 km area surrounding Osorno (Fig. 1). Here there are 10 to 15 growers, who account for ≈ 100 ha. Most individual farms have <5 ha of blueberries, a few have >25 ha, and the largest has 50 ha. Almost all of the plantings are ≤ 3 years old, with the majority being newly planted (Figs. 2 and 3).

The climate in the Osorno area is very favorable for blueberries. Sufficient chilling hours are received for all varieties; additionally, winters are mild and spring frosts rare (Table 2). The soils are diverse, but a loamy-gravel (Table 2) with a high organic matter of 10% to 12% is commonly found. Water tables are moderately high; in some cases drainage is poor, but the soil appears to be aerated sufficiently to sustain vigorous growth. Soil pH is in the range 5.0-5.8. The oldest commercial planting of highbush blueberries in Chile (5 ha) is near Osorno and is 6 years old (Fig. 4).

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Widely distributed throughout the more northern regions (6, 7, and 8) are another 20 to 25 plantings (Table 1). These have no particular center, although a group of 15 to 20 small hectareages (< 2 ha) are scattered in Regions 7 and 8. Most of these plantings are also very young, with the largest (≈ 15 ha) being newly planted.

Except for a strip of volcanic soils stretching alongside the Andes Mountains in a north-south direction, most of the soils in Regions 7-10 are marginal for blueberries and must be modified for optimal growth. Soil organic matter is usually low (1% to 5%) and pH is generally >5.8 , but climatic conditions are excellent, as winter temperatures rarely fall below 0C and summer temperatures seldom exceed 30C. Chilling hours (<7 C) vary from 600 to 1200, depending on location (Retamales, 1991).

Cultural practices. Because most of the plantings are so young, few recommendations have been developed for fertilization, pruning, and pollination. In most cases, plants have been set at distances of $\approx 1.5 \times 3.0$ m, although some plantings are more dense, with one field spaced at 0.5×1.0 m (Fig. 5). Soil amendments are commonly used. On the better sites, 0.4-m^3 holes are dug and filled with various mixtures of organic matter and soil before planting. On the poorest sites, growers often lay down ridges of sawdust and set the plants directly into them (Fig. 6). Sulfur or sulfuric acid is used to acidify the high pH soils, although most that were lowered to <5.8 were adversely affected. Irrigation systems vary widely, from furrow to trickle or overhead with portable pipes. Growers have relied on native bee populations for pollination, and most pruning has been restricted to training young bushes. Most of the plants are too young to determine whether they will grow more quickly or slowly than those in North America.

Varieties. Both highbush and rabbiteye varieties appear to grow well in Chile, with the greatest density of rabbiteye being found in the more northern regions (Table 1). Most propagation is by tissue culture for phytosanitary reasons and also to speed prolifera-

Fig. 1. Geographical and regional situation of Chile. The country is divided into 12 regions plus the Metropolitan Region (Santiago).

tion of plants. In many cases, 1-year-old rooted cuttings are planted directly in the field.

Most of the rabbiteye and highbush cultivars currently grown in North America are now in Chile, including the newest USDA releases. The most commonly planted highbush blueberries are 'Bluecrop', 'Blueray', 'Elliot', 'Patriot', 'Berkeley', 'Coville', and 'O'Neal'. The most widely used rabbiteye blueberries are 'Premier', 'Brightwell', 'Climax', 'Beckyblue', and 'Bonita'.

Production costs and marketing. Although many sites are not in production yet, the harvest season is expected to extend from late November to early March, depending on location. The southern sites tend to be much later, due to the cooler conditions; proximity to the Andes and the microclimates in the

Table 1. Estimated blueberry area in Chile (Nov. 1991).

Region	Region (ha)	Highbush (ha)	Total (ha)
VI		4	4
VII	16	9	25
VIII	30	16	46
IX	6	80	86
X	15	108	123
Total	67	217	284

Fig. 2. Typical blueberry site in Region 10 and surrounding environs.

different regions also extend the harvest season. Blueberry development appears to be compressed in Chile, with the cultivars blooming and ripening over a much shorter period than in North America. Bloom dates of 'Earliblue' and 'Jersey' differ by only a few days, and the difference in harvest interval for these two varieties is only a few weeks (Muñoz et al., 1989). In North America, these cultivars are separated by 7 to 10 days at bloom and almost a month at harvest (Hancock et al., 1987).

Chilean growers estimate costs of \$10,000-15,000/ha to establish a field, including land, labor, plants, and irrigation. One of the major advantages in Chile is the cost of labor: unskilled laborers usually receive only \$3/day, and hand pickers earn only \$0.05/half pint (400 g). Land prices vary from \$1200-2500/ha, depending on location. Plants, which cost about \$2.20 each, are the only high-priced item. Packing materials, fertilizers, and agricultural chemicals cost about the same as in the United States. Most growers feel they can grow, pick, and pack fruit for \$0.50/kg, if they average 8 to 10 t/ha¹. They expect to recover their establishment costs by the 6th year and estimate yearly profits of \$25,000/ha by the 8th year

(Dinamarca, 1991). This assumes a return to the grower of \$5/kg for fresh fruit.

Most of the fruit is shipped by commercial airlines, although a limited quantity has been sent by boat to North America. Shipping prices are about \$3.50/kg by air and \$1/kg by ship. There are several companies that plan to sell blueberries in North America, and all have previous experience with other fruits, particularly raspberries. MBG Marketing of the United States is planning to sell a large quantity of the fruit in association with Hortifruit and Agrícola e Inversiones San José of Chile.

Research infrastructure. The first blueberry plants were imported into Chile from the United States in 1979 by the government research agency, Instituto de Investigaciones Agropecuarias (INIA). Blueberries have been planted at five INIA research stations (Muñoz et al., 1989). Several INIA scientists are now involved with blueberries, including C. Muñoz (cultivars and micropropagation), A. Campos (economics), A. Lavin (culture and nutrition), and J. Valenzuela (culture and micropropagation). University scientists studying blueberries include: J. Retamales (nutrition and physiology), C. Sandoval (pathology), and C. Moggia (postharvest physiology) at the Universidad de Talca; F. Kiger (processing) and F. Sudzuki (culture) at the Universidad de Chile, Santiago; R. Hepp (virology), at the Universidad de Concepción, Chillán; F. Medel (culture and irrigation) at the Universidad Austral, Valdivia; J. Guerrero (insects and diseases) and W. Lobos (culture and post harvest) at the Universidad de la Frontera, Temuco. A blueberry symposium at the Universidad de Talca in 1991 was attended by >50 scientists, growers, and exporters.

Current problems. As previously mentioned, Chile's favorable climatic conditions make successful blueberry cultivation likely. The unique soil conditions will probably demand the development of specific nutritional and irrigation practices, but the current vigor and condition of the plants suggests that the necessary cultural modifications will not be too dramatic, at least in favorable sites south of Talca. The success of the Arkansas blueberry industry on upland, low-organic-matter soils indicates that blueberries can be grown on a diverse array of soils if sufficient amendments are made (Moore, 1979). A particular challenge to the Chilean growers will be to balance fruit production and vegetative vigor in the early establishment years. The present temptation to maximize fruit yield while prices are high may reduce vegetative growth and increase the number of years required for fields to reach full production.

Fig. 3. A 3-year-old field at Rio Bueno, near Osorno. Plant rows were made weed free by applying paraquat dichloride.

Table 2. *Climates and soils of southern and northern production regions in Chile*”.

Characteristic	Santiago (Metropolitan)	Osorno (Region 10)
Climate		
Mean annual temp (°C)	14.0	10.3
Mean daily max temp (°C)	22.4	16.3
Mean daily min temp (°C)	6.6	5.2
Frost-free days (>2C)	220	128
Heat units (>10C)	1346	793
Chilling hours (<7C)	1232	1797
Rainfall (mm)	370	1342
Dry months	7 (October–April)	3 (December–February)
Soils		
Classification	Molisol	Typic Distrandept
Origin	Aluvial	Volcanic
pH (H ₂ O)	7.5–8.0	5.2–5.7
Organic matter (%)	1–2	5–13
Texture	Loamy sand	Silty clay loam
Depth (cm)	90–140	80–120

Sources: P. González, personal communication; IREN (1964); Tosco (1985).

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Currently, there are few pest problems. Heavy applications of paraquat dichloride have eliminated most weed problems, although herbicide damage to blueberry plants is widespread. Except for the larvae of a native weevil (*Aegorhinus superciliosus germari*), which has caused root damage in some fields (Muñoz et al., 1989), insect pests have not become a problem, and none of the typical North American insect or mite pests have appeared. Few North American disease problems have emerged, with the exception of *Botrytis* sp., *Phomopsis* canker, *Pseudomonas syringae*, and *Phytophthora* root rot (Guerrero, 1991; Muñoz et al., 1989). Some of the plantings receive no pesticides.

Future Prospects

Blueberries are the latest in a series of fruit crops raised by Chilean growers for export to North American and European markets. The growers' experience with previous export crops should serve the Chileans well in developing this new industry. The climate is generally favorable for blueberry cultivation, and there is no reason the crop cannot be grown successfully.

There is much interest in predicting the number of hectares of blueberries that should be planted in Chile to satisfy world demand for fresh blueberries during the Chilean market window without depressing prices to unprofitable levels by overproduction. In the past, raspberries and kiwifruit were overplanted in Chile to the extent that the less-productive farms became unprofitable.

Several factors will determine the volume of fresh blueberries that can be marketed profitably from Chile. These include length

of the marketing season; the price at which berries must be sold to cover the costs of production, harvest, packing, shipping, and brokerage fees; competition from other production areas that share the same marketing season; quality of the fruit as judged by consumers; and the extent of investment in advertising and promotion of winter blueberries in Northern Hemisphere markets.

Blueberry growers, export companies, and research personnel in Chile appreciate the importance of a long marketing season. In the area from Los Angeles to Osorno, where soils and climate seem most favorable for blueberries, most of the crop will ripen during January and February. At the southern end of this production area, growers are interested in planting the late-ripening cultivars, such as 'Elliot', to extend the harvest season into March. Refrigerated export ships to transport the fruit will not only greatly reduce transportation costs but will also delay the arrival of the fruit in the Northern Hemi-

Fig. 4. A 6-year-old highbush plant in one of the oldest plantings in Region 10.

Fig. 5. A 5-year-old field of rabbit-eye bushes near Los Angeles, Chile. Plants were very closely spaced (0.5×1.0 m).

sphere by ≈ 2 weeks, which is considered desirable for the fruit harvested at the end of the season.

There is much potential for extending the harvest season into October and November. Because low-chill highbush cultivars can produce fruit during April and May in the Northern Hemisphere, it should be possible to use them to produce fruit during the corresponding months of October and November in the Southern Hemisphere. But in order to get sufficient heat units in the early spring for early crop development, it is necessary to plant low-chill varieties farther north, possibly even north of Santiago, where soils are generally unfavorable for blueberries due to high pH and low organic-matter content. Research is underway to determine if such plantings can be successful.

The volume of fresh blueberries that can be sold per week is highly dependent on the price the consumer must pay. Although it is true that U.S. consumers will pay \$5.00 or more for 200-g packages of fresh blueberries at times of the year when blueberries are in

low supply, the amount of product sold at these prices and the total income from the sale of these berries is relatively low. At the other times of the year, when large volumes of blueberries are being sold (1 June-1 Sept.), consumers normally pay less than \$2.00 per 400-g package, and growers receive about \$1.00 per 400-g package for fresh blueberries sold in the United States. If Chilean growers can sell fresh blueberries at similar prices in North American markets from December through February, the potential market is very large. The exact relationship between price and volume of sales is, however, hard to predict.

Competition from other production areas for the November through March fresh blueberry market may also affect market size. Favorable climate and soils and low labor costs make Chile a strong competitor with established regions like New Zealand. In addition, there are many other areas in South and Central America and in Mexico where blueberries may be planted in the future, and it may eventually become necessary for Chile to share part of its market with one or more new blueberry production areas.

One question remaining about South American blueberries is how North American consumers will respond to fresh blueberries in the winter. Year-round availability of blueberries may help change people's concept of the fruit from a specialty item to a regular component of their diet. The blueberry production season has been extended 2-months through varietal development over the last 10 years, and this expansion has not negatively affected sales. In fact, per capita blueberry consumption has increased by 50% over the last 10 years (Eck, 1988). Chilean growers are counting on North Americans to further expand their appetites for fruit as they did when strawberries and grapes became available on a year-round basis.

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Fig. 6. Growing blueberries on suboptimal soils. Plants were set directly into sawdust strips and trickle irrigated.

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