



# Bi-weekly Bulletin

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## DEVELOPMENTS IN BERRY PRODUCTION AND USE

Canadian acreage cultivated for berry production has been expanding rapidly. In western Canada, production has more than doubled over the last ten years in response to increasing demand by consumers. This has mostly been achieved by the combined efforts of producers, researchers and marketing associations to educate the public to the potential health benefits of a berry-rich diet. Sales have been aided by new harvesting, packaging and refrigeration methods that have greatly increased post harvest quality. Innovative processing methods have also greatly expanded the potential uses of berries by processors. Both domestic and export demand is expected to continue to grow in response to continued clinical evidence supporting the health aspects of berry consumption. Varieties which are suited to prairie and northern climates may provide a viable source of diversification and income.

### Introduction

Globally in 2001, functional foods represented \$56 billion (G) in sales, led by the US, with \$18.5G, Europe \$18G, and Japan, the oldest and most established market, with \$14G. Worldwide, sales of functional foods grew approximately 7% in 2001, with growth of 7-8% anticipated through 2010.

Functional foods represented \$56G in sales in 2001, or 37% of the \$150G global nutrition industry. It is currently believed that the demand for nutraceuticals and functional foods in Canada is in the CAN\$1-2G range, though estimates depend on the definition of the industry. It is estimated that between \$300 million and \$1G of farm production value goes to supplying ingredients for functional foods. For more information on nutraceuticals and functional foods, please visit the following Agriculture and Agri-Food (AAFC) Canada website

[www.agr.gc.ca/food/nff/agbenefits/agbenefits\\_e.html](http://www.agr.gc.ca/food/nff/agbenefits/agbenefits_e.html)

In 1998, nutraceuticals and functional foods were estimated to be part of a dynamic and growing \$71G global industry. By 2010, global sales are expected to grow to \$500G. Growth in this industry is being driven by various demographic, economic and social trends. Consumers are taking a proactive approach by increasingly demanding natural products that prevent rather than treat disease.

Currently, health care professionals recommend a balanced diet with at least five servings of antioxidant-rich fruits and vegetables per day. These antioxidant components are highly concentrated in the natural pigments that give food their distinctive colors, (blue, red, green, yellow, etc.). Research has found that the deeply colored fruits and vegetables, in general, contain higher levels of these beneficial compounds.

### Berries

The Canadian berry industry is dynamic and diverse with significant markets and developmental initiatives evident over a wide range of crops including, but not

limited to, wild (low bush) blueberries, cranberries, strawberries and raspberries. This paper focuses on examples presented by high bush blueberries, lingonberries, saskatoon berries and elderberries. More information on Canada's berry industry is available through Agriculture and Agri-Food Canada's Market and Industry Services Branch website at [www.agr.gc.ca/misb/hort/trends\\_e.php](http://www.agr.gc.ca/misb/hort/trends_e.php)

Research into high value crops, such as berries, is a key theme of AAFC's Research Branch program (<http://res2.agr.gc.ca>), undertaken in keeping with the science and innovation component of Canada's Agricultural Policy Framework. Such work is carried out in a number of research centres across Canada, including St. John's, Newfoundland, Kentville, Nova Scotia, Saint-Jean-sur-Richelieu, Quebec, and Summerland, British Columbia.

Berries have a long history of use in native and folk medicine in North America. In the more recent past, berries were mostly consumed fresh, baked in pies, or

processed into jams and spreads. Today, new and innovative methods of processing, freezing and packaging have greatly increased berry uses. Improved harvesting and climate controlled environments have enabled distributors to significantly extend the shelf life of fresh berries.

Studies have found that berries contain some of the highest biomedical benefits of all fruits. The greatest opportunity for a growing berry market has been and should continue to be in promoting berries as a health food. As research continues to explore the biomedical benefits of berries and as the food industry strives to incorporate the healthful antioxidants into their products, demand for berry production should continue to increase.

Research has shown that berries grown in Canada can be processed into a supplement as an alternative to the traditional serving of fruits. Products incorporating berries have been used in a variety of pharmaceutical and supplemental products and are expected to continue to grow.

### **Health Factors**

Many studies have supported the view that fruits and vegetables are an important component of a healthy diet. Flavonoids, carotenoids, vitamins, and polyphenols are the main compounds in fruits and vegetables which have been shown to reduce disease risk. These compounds are believed to provide the health benefits of disease prevention through antioxidant activity. Oxidation sometimes produces reactive substances called free radicals that have the potential to damage key components in cells and is believed to initiate the onset of some diseases. Antioxidants are capable of stabilizing these free radicals, before they can cause harm.

Diseases that may be reduced by the consumption of fruits and vegetables are cancer, cardiovascular disease and diabetes. As well, fruit and vegetable consumption may help to slow down the aging process. Results of the SNN Competitive Intelligence Study (March

2000) involving middle-aged rats given a dietary supplement of various berry extracts containing high levels of antioxidants demonstrated a reversal of neuronal and behavioral aging in just an eight week period. The conclusion summarized that a diet rich in antioxidants, in addition to their known beneficial effects on cancer and heart disease, may be helpful in reversing the course of neuronal and behavioral aging.

Chemical analysis of 16 species of cultivated berries and 9 species of wild berries has confirmed that the levels of flavonols, known anticarcinogens, were significantly higher than in most commonly consumed fruits and vegetables. The lowbush blueberry had the third highest antioxidant activity of the fruits and vegetables tested.

### **Improvements in post-harvest methods**

Fresh blueberry sales have historically provided higher returns to producers. However, commercial sales of fresh berries are constrained by the extremely short shelf life of the product. Under normal room temperatures, berries quickly begin to spoil, reducing their appeal and lowering nutrient value. New harvesting methods that extend shelf life and maintain consistently high post-harvest quality, should translate into higher profits for producers. Several harvesting methods studied and some now in practice, have proven to extend post harvest quality.

Berries in general freeze very well and can maintain their quality for up to two years. Most of the freshly harvested berries are flash frozen within two hours which has allowed sales to be extended year-round. The United States Department of Agriculture (USDA) has concluded that frozen fruits and vegetables are just as healthy as fresh and may even retain their nutritional value longer. Tests measuring the recoverable levels of anticarcinogenic flavonoids in frozen fruit and vegetables found that flavonol levels ranged from 77 to 110% and that of flavones from 99 to 106% compared to the unfrozen sample. Berries were found to freeze the best of all fruits and vegetables tested. This has added to

the marketability of berries.

### **Processing**

A relatively new process called infusion, involves drying the berry and infusing it with sugar to increase its stability and flavour. This process, developed for the cherry industry, is now used for blueberries, cranberries and saskatoon berries. This process allows processors to use the infused berry in baked goods without it disintegrating. In comparison to dried fruit, this process increases the flavour and the improved texture creates the potential for these berries to be used by the large cereal, snack food, and ice cream processors.

### **Production Considerations**

Production of berries is a long-term crop decision. Estimated costs to establish the crop during the first three years are about \$10,000 per acre (/ac) (excluding land and equipment costs). Thereafter expenses of approximately \$2,800/ac are fairly stable, with the exception of expenses for nitrogen applications, harvesting and pruning which increase every year. Harvest can begin 3-4 years after planting but the plants do not reach full maturity until roughly the 6<sup>th</sup> to 12<sup>th</sup> year, depending on the species. Production will generally increase from year three to year eight.

## **HIGHBUSH BLUEBERRY**

### **Profile**

Blueberry area in British Columbia (BC) has tripled from almost 3,000 ac in 1985, to an estimated 9,000 ac in 2003. Blueberry farms range in size from a few acres, to over 300 ac, however, most operations are about 20 acres.

BC accounts for about 97% of the highbush blueberry production in Canada, with roughly 99% of BC production occurring in the lower Fraser Valley. BC ranks as the third largest producer in the world following Michigan and New Jersey. In 1999, the US accounted for about 83% of the total 208.1 million pounds (Mlb) of North American production, with BC accounting for just over 16%. In 2000, the total value of blueberry sales in BC is

## MONETARY VALUE OF BRITISH COLUMBIA BLUEBERRIES

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
.....thousand dollars.....											
Fresh Wholesale	3,061	4,950	2,810	6,362	6,865	9,975	11,529	11,810	12,685	20,161	15,340
Farm & Roadside	2,629	1,409	652	851	1,232	878	727	904	1,504	2,036	2,902
Processed	<u>4,278</u>	<u>17,103</u>	<u>5,362</u>	<u>9,110</u>	<u>7,245</u>	<u>13,770</u>	<u>7,650</u>	<u>10,440</u>	<u>18,842</u>	<u>21,060</u>	<u>14,940</u>
<b>Total</b>	<b>9,968</b>	<b>23,462</b>	<b>8,824</b>	<b>16,324</b>	<b>15,342</b>	<b>24,623</b>	<b>19,906</b>	<b>23,154</b>	<b>33,030</b>	<b>43,258</b>	<b>33,182</b>
.....dollars per pound.....											
Fresh Wholesale	0.77	0.86	0.59	0.62	0.58	0.95	1.00	0.75	1.10	1.10	0.80
Farm & Roadside	1.01	0.99	1.17	1.14	0.77	1.16	1.24	0.87	1.21	1.06	1.38
Processed	<u>0.65</u>	<u>0.72</u>	<u>0.40</u>	<u>0.53</u>	<u>0.38</u>	<u>0.90</u>	<u>0.75</u>	<u>0.60</u>	<u>0.90</u>	<u>0.90</u>	<u>0.60</u>
<b>Total*</b>	<b>0.78</b>	<b>0.77</b>	<b>0.52</b>	<b>0.60</b>	<b>0.50</b>	<b>0.93</b>	<b>0.91</b>	<b>0.69</b>	<b>0.99</b>	<b>1.00</b>	<b>0.76</b>

\* weighted average

Source: British Columbia Ministry of Agriculture, Food & Fisheries

estimated at over \$43M and as the 13<sup>th</sup> largest agricultural sales commodity is ranked just slightly lower than apples.

In BC, production is expected to continue to grow as new fields are planted and young plantings mature and bear more fruit. Production in 2003 is estimated to be about 40 Mlb, 5 Mlb higher than in 2002 and over 26 Mlb higher than in 1991.

Almost all of the highbush blueberries are grown in BC because good varietal selection and a moderate climate produces a larger, higher yielding berry. Varieties suited to colder climates with winter temperatures as low as -40 degrees will also produce, however they will have lower yields because plant size is smaller.

### Marketing

Organic grown blueberries generally command the highest prices but there is a limited amount grown in BC. Farm and roadside sales provides the next highest return for producers per pound, however, these sales are generally very small in comparison to total sales. Fresh wholesale sales and sales to processors provide the third and fourth highest return for producers respectively.

From 1997 to 2001 approximately 70% of the BC crop was sold to the processing market with the remainder sold wholesale fresh, on farm or at roadside stands. In 1999, it is estimated that 11.5 Mlb were

sold fresh with the remaining 21.0 Mlb sold to the processing market. Because of higher prices BC producers are continually making efforts to increase sales of fresh berries. These marketing efforts have proven successful as the cash receipts of fresh market berries have increased from \$2.8M in 1993 to about \$20.2M in 2000.

Because of the significant annual variation of blueberry production, prices are largely influenced by supplies. In BC alone, production of blueberries has increased over 20 Mlb between 1991 and 2001, yet prices were still able to increase significantly. From 1991 to 1995, the average price per pound (/lb) for fresh wholesale and to processors was \$0.68/lb and \$0.54/lb respectively. In comparison, during the period from 1996-2000, the average fresh wholesale price increased to \$0.98/lb, while the processing price increased to \$0.81/lb. The higher overall average price per pound even as production increased, is a tribute to the successful marketing efforts of blueberry producers and their associations.

Michigan in particular and New Jersey, to a lesser extent, both have a significant influence on prices because of their relatively large production. In 1999, production in Michigan and New Jersey was estimated at over 100 Mlb. This represented over 50% of the total North American highbush market.

Most of the fresh and processed berries are sold to the Prairie provinces, the US, Japan, the European Union (EU) and Australia. The total value of blueberry exports has increased from just over \$7.5M in 1990 to almost \$63.0M in 2001. The US, at roughly 86%, is by far the largest export market for our highbush blueberries, followed by Japan with about 13%. Sales to other countries such as the EU, Australia, New Zealand and China are small but with some further market development effort, may provide a potentially large export market.

Producers are members of both the BC Blueberry Council (BCBC) and the North American Blueberry Council (NABC). Both organizations conduct promotional activities, fund research projects, sponsor grower education programs and comment on issues that impact blueberry growers.

### LINGONBERRY

#### Profile

Lingonberry fruit is a cool-climate berry crop harvested from the wild throughout its distribution in northern regions of the world. It is a commercially important fruit crop, a medicinal plant and is used as a landscape ornamental ground cover. The smaller North American variety in Canada is traditionally harvested from natural stands in Newfoundland and Labrador and by the Aboriginal peoples in northern Canada.

The berries and leaves are used medicinally as bladder and kidney disinfectants, to lower cholesterol levels and to treat stomach disorders and rheumatic diseases. Lingonberries have higher levels of antioxidants than lowbush blueberries and the second highest antioxidant activity of all fruits and vegetables.

Natural stands have been harvested in Newfoundland, but due to the increased demand for nutritious, natural fruit-based drinks and other products such as sauces, preserves, candy, jelly, syrup, ice cream, pickles, wine, and liqueurs, demand now exceeds production. Urban encroachment, changes in forest management, uncontrollable fruit quality from native stands and fluctuations in annual yield due to climatic variation have intensified the need to select superior native plants for horticulture.

The expectation of continuing fluctuations in the supply of lingonberries from the wild suggests potential for commercial success in cultivation and marketing of this new crop. More than 200 lingonberry clones from natural stands have been collected at the Atlantic Cool Climate Crop Research Centre of AAFC. Biotechnology, along with traditional breeding will provide superior and better adapted crops which should produce improved and higher yielding berries.

Currently there is only small scale commercial production of lingonberry in North America and costs of production are relatively unknown. However, these costs are likely similar to those estimated for blueberries under production considerations.

Sandy, acid soil with a pH between 5-6 and at least 2% organic matter is reported to be the best medium for early establishment and growth of lingonberries. Sawdust, wood chips or tree mulch may be added to keep the soil acidic and to protect the roots from severe cold. Lingonberries require very little fertilization, but irrigation is often needed to ensure consistent production.

## Marketing

Export competition from the EU is not expected to be significant because lingonberries grow wild in the woods, and the common law of Scandinavian countries provides that anyone may pick wild berries regardless of land ownership. The geography of these countries is mostly mountainous and hence there are few areas of flat sandy land to plant lingonberries. Commercial production in the US was attempted in Wisconsin during the mid-1990s with limited success. The conclusion from the test site was that in general the climate was too hot and the soil too heavy for a successful operation.

The commercial harvest can vary greatly, due primarily to weather conditions during the year and market prices. Between 1989-1999, the Canadian commercial harvest varied between 82,000 lb and 1,000,000 lb. In 1994, the price of lingonberry was \$1.17/lb, and the amount picked was almost 1,000,000 lb. In 1998, the price was \$0.64/lb, and the amount picked was about 353,000 lb. Successful commercial production will depend on the ability to supply the market with a consistent high quality product and then to increase market size. The significantly high antioxidant levels found in lingonberries would be an important marketing tool considering the uses are very similar to those of cranberries.

## SASKATOON BERRY (SASKATOONS)

### Profile

The saskatoon is a fruit bearing shrub native to the southern Yukon, the Northwest Territories, Canadian prairies and northern plains of the US. It is

extremely adaptable and grows under a wide range of environmental conditions.

Until recently, saskatoons could only be picked in the wild and were a main food source for the native peoples and prairie settlers. In the modern era, public demand for the fruit has been centered around its unique taste and most recently, its potential health benefits. A three-year study at the University of British Columbia found that saskatoons had antioxidant activity that was comparable to blueberries.

During the past two decades, area planted on the Canadian prairies is estimated to be as high as 3,300 ac. The majority of new producers start out as u-pick operators, typically with less than five acres. As they become established and increase area, a larger portion of their crop is likely to be sold to processors rather than as fresh berries. Like other berries, saskatoon plants do not bear fruit until they become three or more years old. Mature irrigated plants (especially cv Smoky) can have yields as high as 15,500 lb/ac. The five-year average at University of Saskatchewan trials has been 8,000 lb/ac. In 2001, prairie production was estimated to be more than 4.5 Mlb, which represents about 97% of total North American production. However, production of saskatoons can vary widely depending upon the type of cultivar and the growing season. In 2002, prairie production is estimated to have dropped to 2.5 Mlb. This has been an obstacle to marketing efforts since a consistent annual supply is difficult to obtain.

## 2001 ESTIMATED SASKATOON BERRY INDUSTRY

	Plantings (acres)	Number of Growers	Production		Percent of North America
			acres	million pounds	
Saskatchewan	1,000-1,500	200-250	900-1,100	2.0	43%
Alberta	1,000-1,500	100-150	900-1,100	2.0	43%
Manitoba	300-400	40-60	200-300	0.5	11%
Canada	-	-	-	4.55	98%
North America	-	-	-	4.65	100%

Source: University of Saskatchewan

## Marketing

Saskatoons are well known in central Canada, but relatively unknown in other areas. As a result, the present market for saskatoon berries has tended to be in the prairie provinces. However, due to increasing consumer demand for saskatoons outside of the prairie provinces, the number of processing companies is estimated to have increased from a few just over ten years ago, to more than 25 companies in 2002. These companies, generally small and medium sized, are gradually making a transition from niche market status to the main stream. In 2002, eight Saskatchewan berry orchards entered into a marketing and distribution effort to market frozen saskatoons in 300 co-op grocery stores across western Canada. However, the long-run viability of the saskatoon industry will need to be built on consumer acceptance in areas other than the prairie provinces. Currently, about 30% of the processors are involved in export, but this is a relatively small percent of total production. Recent successful international marketing efforts with European distributors offer promising export potential.

Prices received for U-pick berries traditionally have the highest returns for producers, however in years of shortages, berries sold to processors can have higher returns. Saskatoon berries compete for market share with other berries, therefore the price of saskatoons will also be determined by the supply and demand for berries. Generally U-pick berries sell on average for about \$2.00/lb whereas prices paid by processors have averaged about \$1.50/lb. Because these berries are potentially shipped over large distances, they are frozen at the farm gate and are sold throughout the year. Processors use saskatoons to produce products such as syrups, jams, fillings, sauces, muffins, liqueurs and wine.

## ELDERBERRY

### Profile

Elderberry belongs to the honeysuckle family, comprising about 20 species of shrubs or small trees. The elderberry of most interest for its valued berry is the common Canadian elderberry (*Sambucus canadensis*). It is native to eastern North America, from Nova Scotia to Florida and west to Minnesota and Texas. Canadian elderberry is a bushy, multi-stemmed, wide spreading shrub often forming dense thickets as a result of suckering from the roots. The shrub produces small white flowers in June which form umbrella-shaped clusters of purple-black berries 4-6 millimeters (mm) in diameter.

Elderberry has been used as a food source for centuries in Europe and North America. Cultivation has been expanded mainly for the production of wine, juice, jam, jelly, pies and for the production of non-poisonous dye used for marking cuts of meat. Elderberry has an extensive reputation as a healing plant. The leaves, flowers, bark and fruits have all been used in healing and the plant has been used in folk medicine throughout history. Elderberries have been a traditional remedy for constipation, colic, diarrhea, cold, fever and rheumatism by native Americans. Recently it has attracted considerable attention from researchers and industry for its nutritional and medicinal values.

The flowers of the European variety (*Sambucus nigra*) are believed to have diuretic and laxative effects and the fruits contain viburnic acid, which promotes respiration. The flowers are also used for medical treatment of allergic dermatosis and bronchial asthma and it is believed they stimulate the body's ability to resist viral infections such as colds and influenza. According to German regulatory authorities, there are no known side effects or drug interaction with use of the flowers. Elderberry tea is an old remedy thought to provide relief for coughs and sinus congestion, and it reduces swelling associated with sore throat. It promotes the removal of waste products from the

body, and is thought to be a powerful immune stimulant.

Elderberry is going beyond its traditional medicine uses and is increasingly becoming a popular functional food ingredient. The fruits contain high nutritional values including vitamin C and B6 with a high anthocyanins content. Clinical trials have demonstrated that the antioxidant-rich juice has health protective potential in humans. Raw berries have laxative and diuretic properties, however, the seeds are toxic. When cooked, elderberries are edible.

Elderberry planting is similar to that for apple orchards and it should be planted very early in the spring to take advantage of its early growth characteristics. Elderberry can withstand temperature variations from -40 C to 38 C. All elderberries are only partially self-fertilizing. Planting a mixture of two or more varieties to ensure proper pollination is recommended. A trial has been initiated in Canada with native elderberry for assisted pollination to improve fruit production.

Under cultivation, to increase fruit size and yield, elderberry needs irrigation when annual precipitation is less than 700 mm. Yield is affected by planting space and soil nitrogen levels. At plant maturity, yields can be as high as 15 tonnes per hectare. Elderberry is tolerant of a wide range of soil conditions, although it prefers well drained, moist sandy and loamy soils, rich in organic matter. A pH range of 5.5-6.0 is recommended for optimal growth, however it can tolerate a pH range of 5.5-7.5. The shrub grows rapidly in a sunny open location. Early season pruning is important to encourage strong shoot growth, to remove winter injured canes and improve fruit production. Weed control is a vital procedure for cultivation of elderberries especially during the first 3 to 5 years. Growth and survival of young plants can be increased significantly when there is little competition from weeds. A survey is being taken in Quebec to evaluate the effect of crop management practices such as plant density, fertilization and irrigation on yield and crop quality.

Selections of superior plants from the wild have traditionally been used but high quality cultivars from breeding programs in New York, Pennsylvania and Nova Scotia have been developed. Nutritional value improvement of elderberry juice and increased anthocyanin protection against oxidative degradation should be obtained through selection of cultivars with a higher vitamin C content. Virus free varieties and varieties with improved pigment stability are areas of interest for future breeding direction.

There are many forms and varieties of Canadian elderberry developed in Canada. The cultivar Adam was selected for its larger and more numerous fruits. The cultivar Johns was selected and evaluated at the AAFC Research Station in Kentville, Nova Scotia. It is a large shrub of three meters in height with very large fruit and appears to be more tolerant to frost damage. Kent was introduced in 1960 at the Kentville research Station from an open pollination of Adams. Kent, the earliest maturing cultivar, has less vigorous growth but it produces medium fruits with early and uniform maturation. Victoria, a cultivar also developed from open pollination of Adams, is less vigorous but the fruits are very easy to harvest. To determine hardiness and potential growth of native plants and cultivars, a trial is underway to evaluate indigenous and five other cultivars in five provinces across Canada.

### Marketing

Elderberry is a valuable crop with promising economics. As a juice the drink contains considerable amounts of Vitamins A, B and C, as well as flavonoids, sugar, tannins, carotenoids and amino acids.

*Sambucus nigra* leaves and flowers are a mild astringent which has been used in skin washes to refine complexion and help relieve eczema, acne and psoriasis. Flower water has been used as a soothing gargle and is an excellent eye wash. The leaves and flowers are a common

ingredient in ointments for burns, swelling, cuts and scrapes. The colorant from the fruit is used in wines, as a dye, and as a natural food colorant in foods.

Continued research needs to be carried out to determine the full medicinal potential of *Sambucus canadensis*. Preliminary results have suggested that it may provide most of the same benefits as *Sambucus nigra*. The dye extracts from *canadensis* have received considerable attention for their special characteristics of increased stability to light and heat than any other *Sambucus* species.

As research in Canada continues to develop improved varieties and as additional knowledge of crop management practices is gained, elderberry production is expected to become a viable alternative crop. Demand for elderberry is expected to increase in response to a growing global demand for nutraceuticals, functional foods and other products which are specifically derived from elderberry.

### OUTLOOK

Berry production is expected to continue to expand in reaction to high market prices, increasing demand by consumers and the need to diversify farm operations. Demand from processors is expected to increase when consistently higher cultivated production levels are achieved. This applies more to lingonberries, elderberries and saskatoons where production and cultivation is relatively small. Sustainability and long-term growth of the blueberry and saskatoon berry industries is dependant on markets beyond western Canada to provide price support.

Public awareness of the health benefits of berry consumption has proven to be a powerful marketing tool and should continue to provide the catalyst for expanding demand. Scientific research along with promotional and educational efforts should continue to increase

consumers' knowledge of the benefits of berry consumption.

Cool climate berries such as the lingonberry and the saskatoon which are ideally suited to prairie and cool climates could become a potential source of diversification and economic development for farmers and aboriginal people. Berries grown in remote northern areas are grown in clean land with little use of pesticides. Market studies have determined that berries grown in such areas can command a price premium similar to organic grown berries.

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