

placed on root rot tolerance in the breeding programs.

Cultivars that are not suited to mechanical harvesting and are adapted only to fresh marketing will not be successful in the future since the majority of the summer-bearing raspberry fruit in this region is mechanically harvested for processing. With decreasing labor availability and increasing labor costs, the proportion of mechanically harvested fruit will continue to increase. Adaptations to mechanical harvesting include easy release of fruit from the receptacle, strong attachment of laterals to the canes and concentrated ripening. Future cultivars must be adapted to both fresh market and processing or used specifically for processing.

The yields of 'Meeker' in Oregon and Washington and 'Comox' and 'Tulameen' in British Columbia are very high, exceeding 10 tons/acre in research plots. Future cultivars may not have higher yields than these cultivars, but may excel in other traits such as root rot resistance, cold hardiness, or fruit firmness.

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Blackberry Cultivars and Production Trends in the Pacific Northwest

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There are three types of blackberries (*Rubus spp.*) commercially grown in the United States: 1) erect, 2) semi-erect and 3) trailing. Erect and semi-erect types predominate in the eastern and southern regions of the United States. The Pacific Northwest (California, Oregon, and Washington, USA, and British Columbia, Canada) is the

principal producing area for training blackberries. Hectarage of erect and semi-erect types in this region is still small, but will likely increase.

The following fruit researchers and extension workers were contacted in 1991 to compile information for specific production areas in the Pacific Northwest: Bill Peters (BCMAF, British

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Columbia); Craig MacConnell, Bill Scheer, Dyvon Havens, Charles Brun (Washington State University Cooperative Extension, Whatcom, Pierce, Skagit, and Clark Counties, respectively); Ronald Tyler (University of California Cooperative Extension, Santa Cruz County). The following individuals, contacted in other regions, indicated there is currently no commercial production of blackberries in their region: Dan Barney (Sandpoint, ID); Nancy Callan (Corvallis, MT); Richard Renquist (Grand Junction, CO); and George Dickerson, (Albuquerque, NM). Information on hectareage and cultivar use in Oregon was obtained from the Agricultural Statistics Service (9) and the Oregon Caneberry Commission (7).

Hectarage. Hectarage of trailing, erect, and semi-erect blackberry cultivars in 1980, 1990, and 2000 (anticipated) is summarized in Table 1. Trailing blackberries account for 98% of the blackberry hectareage in the Pacific Northwest. Oregon is the leading producer with 2810 hectares in 1990, a 45% increase in hectareage since 1980. Hectarage in Washington has increased 25% since 1980, but remains low with 50 hectares in production. Production is expected to increase in Washington in the next ten years. British Columbia has no commercial hectareage of trailing blackberries because current cultivars are not winter hardy. Hectarage of trailing blackberries in California has decreased 30% since 1980 and is expected to continue to decline. The trend appears to be for increased plantings of erect and semi-erect types (Table 1).

There is currently relatively little hectareage of erect and semi-erect types in the Pacific Northwest (Table 1). British Columbia has very little hectareage. Future production in this region will depend on the development of suitable cultivars for this northern production region. 'Loch Ness' is being tested and shows some potential for

Table 1. Trailing, erect, and semi-erect blackberry hectareage in the Pacific Northwest, 1980, 1990, and 2000 (anticipated).

	Hectares		
	1980	1990	2000
<i>Trailing:</i>			
British Columbia	0	1	?
California	385	265	200
Oregon	1,950	2,810	3,645
Washington	40	50	80
Total	2,375	3,126	3,925
<i>Erect:</i>			
British Columbia	0	0	?
California	0	4	40
Oregon	0	27	80
Washington	0	0	15
Total	0	31	135
<i>Semi-Erect:</i>			
British Columbia	0	2	?
California	0	2	20
Oregon	8	18	60
Washington	5	3	8
Total	13	25	88
TOTAL	2,388	3,182	4,148

this region. Oregon accounts for the greatest percentage of erect and semi-erect hectareage with 45 hectares, 80% of the total. Production in Oregon and California is expected to increase by 210% and 900%, respectively, by the year 2000.

Cultivars. The most important trailing, erect and semi-erect cultivars in each production area are summarized in Table 2. 'Marion,' 'Thornless Evergreen,' and 'Boysen' are the most important trailing blackberry cultivars in the Pacific Northwest. 'Marion' accounts for more than 50% of the hectareage in this region and continues to be widely planted. 'Thornless Evergreen' (*Rubus laciniatus*) is the second most widely planted cultivar in the Pacific Northwest. Hectarage of 'Kotata' is increasing in Oregon, as this cultivar has similar fruit quality to 'Marion' but the fruit is firmer. 'Waldo,'

Table 2. Trailing, erect, and semi-erect blackberry cultivars in the Pacific Northwest. Cultivars in italics were those most commonly planted in 1990.

Location	Cultivars and % of Hectarage
Trailing:	
British Columbia	Thornless Evergreen (30); Kotata (30); Silvan (30)
California	Boysen (86); Olallie (33); Silvan (1)
Oregon	<i>Marion</i> (50); Thornless Evergreen (29); <i>Boysen</i> (17); Logan (2); <i>Kotata</i> (1); <i>Waldo</i> (1)
Washington	Thornless Evergreen (85); <i>Boysen</i> (10); <i>Marion</i> (4); Kotata (1)
Erect:	
British Columbia	---
California	<i>Shawnee</i> (30); <i>Comanche</i> (20); <i>Cherokee</i> (20); <i>Cheyenne</i> (15)
Oregon	<i>Cherokee</i> (48); Shawnee (43); Choctaw (9)
Washington	---
Semi-Erect:	
British Columbia	<i>Loch Ness</i> (60); Black Satin (30); Hull Thornless (2)
California	<i>Hull Thornless</i> (50); <i>Chester</i> (40); Black Satin (5)
Oregon	<i>Chester</i> (67); Hull Thornless (33)
Washington	Chester (100)

a genetically thornless cultivar, is also being planted. However, although the thornless canes of this cultivar are an advantage, it is more difficult to manage because canes are less vigorous than those of 'Marion' or 'Kotata' (3). 'Boysen' commands 29% and 66% of the hectarage in Oregon and California, respectively. However in California, hectarage of 'Boysen' and Olallie, the other widely planted cultivar, is decreasing. 'Olallie' is not grown commercially in Oregon, Washington, or British Columbia, as this cultivar is not winter hardy.

Over 85% of the trailing blackberry hectarage in Oregon is machine harvested whereas only 10% is machine harvested in California. From 20% to 55% of the trailing blackberries in Oregon are grown on an alternate year production system (A-Y) in a given year. Primocanes are produced one year, the "off year", and allowed to fruit the following year, the "on year" (8). Early primocanes are removed in the "on year" to prevent interference with machine harvesting (4). The A-Y system will yield about 70% to 90% as much as the traditional every-year

(E-Y) production system over a 2-year period (1, 5). There are, however, economic advantages to producing blackberries in the A-Y system. Average cost of production over 11 years for a hand picked 'Marion' blackberry field was estimated at 79¢/kg for A-Y production and 88¢/kg for E-Y production in 1987 (2).

'Shawnee,' 'Comanche,' 'Cherokee,' and 'Cheyenne' erect blackberries are planted in similar proportions in California and continue to be planted (Table 2). In Oregon, 'Cherokee' and 'Shawnee' are most widely planted with 'Cherokee' being preferred for new plantings. Growers in Oregon feel that 'Cherokee' has superior fruit quality, yield and plant growth to 'Shawnee.' Some growers in the Northwest are establishing trial plantings of 'Navaho' an erect, genetically thornless cultivar released by the Arkansas breeding program (6).

'Hull Thornless' and 'Chester' dominate the hectarage of semi-erect blackberries in the Pacific Northwest (Table 2). Both of these cultivars are the choice for new plantings in California. However in Oregon, growers seem to

prefer 'Chester' as this cultivar has produced as much as 34 T/ha in a grower's trellised, hand-picked planting. All of the erect and semi-erect blackberries are hand-picked in the Northwest.

Markets. Over 90% of the trailing blackberry fruit produced in Oregon and Washington is for processing (Table 3). Approximately 50% of the 'Boysen' and 'Olallie' crop in California is marketed fresh. Most of the erect and semi-erect crop in the Pacific Northwest is marketed fresh, although in Oregon 40% to 50% of the drop may be processed (Table 3). There is very little pick-your-own marketing in the Pacific Northwest.

It is difficult to accurately predict what impact the anticipated increase in production of blackberries in the Pacific Northwest (Table 1) will have on national and international markets for fresh and processed blackberry fruit. Erect and semi-erect types are being planted because newer cultivars can be pruned mechanically, have lower training costs, produce higher average yields than trailing blackberries and produce fruit that is suitable

Table 3. Markets for trailing, erect, and semi-erect blackberry fruit produced in the Pacific Northwest, 1990.

Location	Percent of Total Production		
	Processing	Fresh	Pick-Your-Own
<i>Trailing:</i> *			
California	40	50	10
Oregon	94	4	2
Washington	90	10	0
<i>Erect:</i>			
California	0	95	5
Oregon	50	50	0
<i>Semi-Erect:</i>			
California	0	95	5
Oregon	40	60	0
Washington	20	80	0

*British Columbia growers market fruit predominantly fresh. However, due to the youth of this industry and severe winter injury the past few years, no yield figures are available.

Table 4. Characteristics of current blackberry cultivars grown in the Pacific Northwest which limit production.

Characteristic	Location
<i>Climate:</i>	
Winter hardiness	Oregon, Washington, British Columbia
Sun scald damage to fruit (especially erect and semi-erect)	Oregon, California
<i>Diseases</i>	
Fruit rot	Oregon, Washington, British Columbia
Crown gall	California, Oregon
Cane and leaf spot	Oregon, Washington
<i>Plant Characteristics</i>	
Thorns	Oregon, Washington, British Columbia, California
Time of ripening	Oregon
Yield	California
Suitability for machine harvest	Oregon
<i>Fruit Characteristics</i>	
Firmness	California, Oregon, Washington, British Columbia
Shelf or storage life	California, Oregon, Washington, British Columbia
Small size	California, British Columbia
Large seeds	Oregon

for fresh market shipping. Growers and shippers in Oregon still consider the trailing blackberry to have the highest fruit quality for processing.

Factors limiting production. Resource people in each region were asked to list the characteristics of currently available cultivars that limit production or the potential for expansion of blackberry hectareage. Limitations related to climate, diseases, and fruit and plant characteristics were cited (Table 4). Susceptibility of cultivars to winter injury is a major concern to

the Oregon blackberry industry since about 50% and 60% of the trailing blackberry crop was lost to winter injury in 1989 and 1991 respectively. 'Marion,' 'Logan,' and 'Boysen' were more affected by winter injury than 'Thornless Evergreen.' The erect and semi-erect types are considered more hardy. However in 1991, 'Shawnee' showed more winter injury than 'Cherokee' after temperatures in December dropped as low as -18°C in some production regions of Oregon.

Most of the trailing blackberries produced in the Pacific Northwest are thorny. 'Thornless Evergreen' is an exception. However, this cultivar is chimeral and often reverts back to thorniness in older plantings. Thorny canes are a major disadvantage when training canes and machine harvested fruit is often damaged by thorns.

Fruit firmness is critical for both machine harvest and for shelf-life for fresh market. Most of the trailing blackberries have softer fruit than the erect types. Thus, most of the fresh market fruit, except fruit produced in California, is produced by erect types. Although erect and semi-erect blackberries tend to have a larger seed than trailing types, this is generally considered less of a disadvantage for fresh than for processed markets.

In general, trailing blackberries have a better fruit flavor than erect or semi-erect types. Blackberry production in this region would increase most rapidly if a hardy, thornless, trailing cultivar with firm, highly-flavored fruit suitable for processing or fresh marketing was released.

Blackberry breeding for cultivars suited to the Northwest continues in Oregon. This program currently concentrates on trailing cultivars. Cultivar trials are underway in Oregon and British Columbia. Research programs in this region include nutrition in Oregon and California and winter injury, alternate year production, alternative training methods, and yield component analysis in Oregon. Research on cultural and management practices that increase potential for mechanization and reduce unit cost of production are needed.

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Erratum

In the paper "Early field performance of several self-rooted, micropropagated apple cultivars vs. trees on seedling or M.7A rootstocks," *Fruit Varieties Journal* 44:185-192, 1990 the degree of leaning in Table 1 and the text is over stated by 10 degrees.