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HORTICULTURAL SCIENCE NEWS

Emergence of Blackberry as a World Crop

Chad E. Finn and John R. Clark

Once thought of as a berry consumed only from wild plants, blackberries (*Rubus* subgenus *Rubus* Watson) have now become a common fruit choice in marketing outlets, particularly in North America and the European Union. Termed the "fourth" berry by some, after the more common strawberry (*Fragaria xananassa* Duch.), blueberry (*Vaccinium* spp.), and red raspberry (*R. idaeus* L.), blackberries have enjoyed expansion due to a combination of factors including improved cultivars, expanded marketing efforts and fruit availability, and an overall increase in berry consumption, especially as fresh fruit, in many areas of the world. It is estimated that cultivated blackberries are grown in excess of 25,000 ha.

HISTORICAL

Blackberries are native across much of Eurasia and North America. This presence combined with their tendency to colonize disturbed areas has made them a food source for humans for thousands of years. The various members of the genus have had a multitude of uses throughout human history as documented in archaeological studies, as well as in art and herbals (Hummer and Janick, 2007; Hummer, 2010). For most of

their history, they were a fruit to be gathered from the wild. It wasn't until the mid to late 1800s that people started to select for better or, more typically in the early stages, novel characteristics in plants that were brought into cultivation (Clark et al., 2007). Fresh fruit production began to be more common for local sales in the 1900s. The development of the raspberry/blackberry hybrid 'Logan' in the 1880s served as the basis for a substantial canning industry in the Pacific Northwest. This industry expanded with

the development of freezing technology. The growing conditions in the Pacific Northwest and California were ideal for the newly discovered raspberry/blackberry hybrid 'Boysen' and for the first trailing blackberry cultivars developed by the USDA-ARS's George Waldo in the 1930s-1950s. While the fresh blackberry industry slowly grew as a locally produced product, the processed blackberry flourished with the release of 'Marion' in 1956 and the invention of viable machine harvesters, the first being from the Iron Wino Co. (Oregon), in the 1960s.

The success of the fresh red raspberry industry in some ways paved the way or provided an example of how blackberry could become an important fresh market crop. The fresh red raspberry industry grew rapidly from the 1970s to the 1990s with the development of cultivars, primarily developed initially by Driscoll Strawberry Associates in Watsonville, California that could be shipped internationally from California. Blackberries have many similar horticultural



● Blackberry is becoming the fourth most important berry after strawberry, blueberry, and red raspberry.

characteristics to raspberries but have lower production costs than raspberries due to their more vigorous nature, greater disease tolerance and therefore longer lived plantings. California growers looked to blackberries as a profitable way to meet consumer's desires for new products. Blackberry consumers in the south and in the Pacific states had wild blackberries growing in their backyards and developed a preference for "their" blackberries. While vastly simplified, the southern species tended to be sweet with a slightly grassy, and occasionally quite bitter flavor along with somewhat crunchy seeds while the main species in the west tended to have an intense, aromatic flavor with a sweet/acid balance that when right leads to the intense flavor but when too acid leads to a tart berry and they had less noticeable seeds. Cultivars developed for the fresh market tend to blend these characteristics being well balanced but with a strong sweetness and seeds that don't predominate your chewing experience. As these cultivars were combined with the horticultural and economic factors, blackberries have become much more desirable to consumers. Perceived health benefits of highly colored fruit due to their anthocyanin or anti-oxidant content have also helped drive increased customer demand. Thus, blackberries complemented other berries in the expanded consumer interest.



● Blackberry in bloom.

RECENT CROP EXPANSION

North America

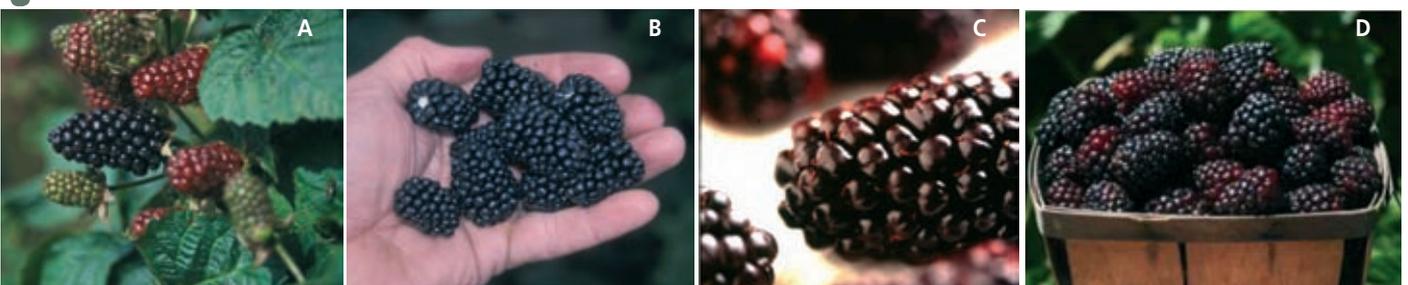
The greatest recent expansion in blackberry production has been in North America, especially California and Mexico, for fresh consumption across the U.S. and Europe (Strik et al., 2007). This expansion has been driven by factors including a stable blackberry supply in most or all months of the year made up of cultivars that allow shipping to distant markets. While the fresh blackberry industry expanded rapidly in California in the 1990s, it exploded in Mexico in the 2000s. The Pacific Northwest, while primarily a processed industry, had a significant expansion of their fresh market during the same time. The most exciting production area for blackberries that has developed in recent years is Central Mexico, in the states of Michoacan and Jalisco. Most blackberries produce vegetative primocanes the first year and after these canes go through a dormant period they become floricanes that bear the crop. In the 1980s, cultural manipulations were developed to allow floricanes to be forced into fruiting without a dormancy period. This production system is cultivar dependent and was first developed on the thorny 'Brazos' (developed by Texas A & M University, USA), which had an estimated chilling requirement of approximately 300 hr. Production of 'Brazos' was the basis of the development of the Mexican blackberry industry in the 1990s. In 1990, the Brazilian cultivar 'Tupy' was brought to Mexico (developed by EMBRAPA, Pelotas, Brazil) and was estimated to have similar chilling requirement as that of 'Bra-

zos'. Although initial efforts to manage 'Tupy' with the same practices used on 'Brazos' were not fully successful, adjustments were tried and fine-tuned to provide for dependable production of 'Tupy' (Jorge Rodriguez, personal communication). The substantially increased quality of 'Tupy' over 'Brazos' led to expanded market development and tremendous expansion in production area. Fruit production in Mexico spans the months of October to June using these specialized management methods. It is estimated that 'Tupy' is produced on 6,500-8,000 ha in Central Mexico as of 2011. This production has provided for a dependable fruit supply during the "off" season in the US and Europe.

With the expansion of blackberry marketing in the winter and spring in the US and Europe, US domestic production for fresh market was encouraged to increase. Crop area expanded further in the western states, particularly California, and production for commercial shipping began in the South. Georgia, North Carolina, Arkansas, and Texas initiated acres for retail-market sales. Current production in the US is at an all time high with the development of these additional areas. Fig. 1 provides a view of shipping to terminal markets in the USA for 2000-2010. This figure includes data for only California for the US, but with increases in other states in the US, particularly from 2005 onward, one can see a strong upward trend in production. The production in the US is dwarfed by that of Mexico, however. Therefore, although not all production for shipping is included, one can see that blackberries shipped increased from just above 4,500 kg in 2000 to approximately 54,545 kg in 2010. While the tonnage of Mexican fruit going to processing is much less than the tonnage going fresh, with the tremendous expansion of the industry, there now is a processing industry where there was not one in the past.

The Pacific Northwest in the US, with over 3,500 ha, and Serbia in Europe, with over 5,000 ha, have remained as the leading producers in the world for the processed market. The Pacific Northwest, primarily Oregon, also has a substantial fresh market industry but this is dwarfed by their processing industry. 'Marion', marketed as "marionberry", is a trailing blackberry that has been the most important cultivar in this region since the 1960s. While renowned for its

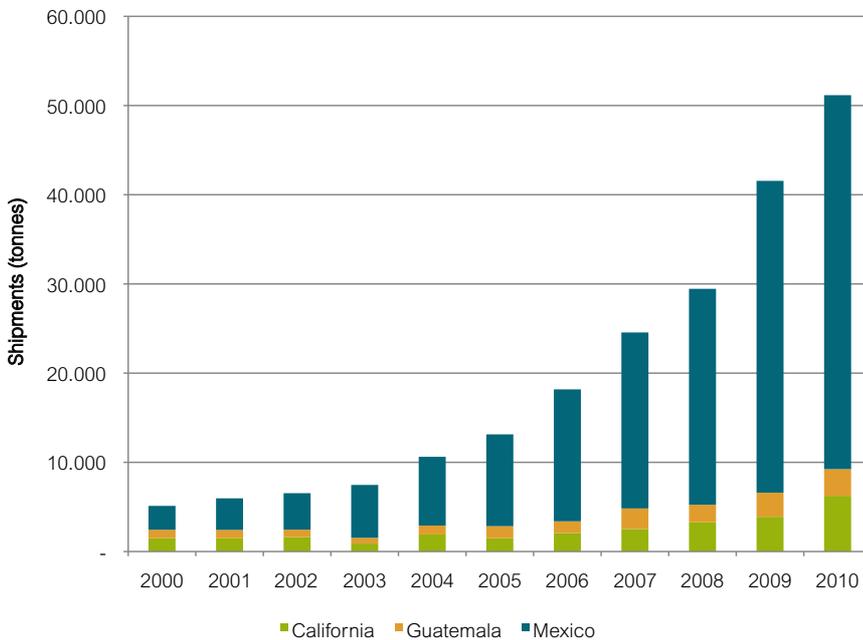
● Popular trailing blackberry cultivars recently released by USDA-ARS in Oregon: A. 'Black Diamond', B. 'Obsidian', C. 'Black Butte' (courtesy of USDA-ARS) and D. 'Newberry', a 'Boysen' like blackberry (courtesy of Mark Crosse, Fresno Bee).





● Popular erect blackberry cultivars recently released by the University of Arkansas: A. 'Apache', B. 'Arapaho', C. 'Natchez' and D. 'Ouachita'. See also Prime-Ark® 45 figure.

■ Figure 1. Growth in U.S. fresh market shipments 2000-2010 by major production regions. These are not total shipments because not all regions report to USDA including the southern USA, however, data are indicative of the trend. Source: USDA Agricultural Marketing Service.



flavor and processing characteristics, it is thorny, which is a legal liability especially in a machine harvested crop, and it is too soft to ship fresh. New high quality, thornless trailing cultivars that are suited for machine harvesting and processing have been developed and are being widely planted. In addition, trailing cultivars that have firm fruit and can be shipped have been developed and are being planted in this region for the fresh market. While the fresh blackberry industry has rapidly expanded, the processing industry has remained relatively stagnant with only a small increase in acreage worldwide.

South America - Primarily Chile

While Chile had become a major supplier of fresh berries for off season consumption in the northern hemisphere, the cost of air freighting fruit from Chile was high and led to a search for new production areas. As a result Chile went from a major fresh red raspberry and blackberry producer in the 1990s and early 2000s to very little fresh production for export by the mid 2000s while in a similar time frame, Mexican production rapidly increased. Chile still is a significant producer for the processed market. Their industry is fairly unique in that most of the growers have less than 1 ha under cultivation

● 'Marion' (aka "marionberry") field in Oregon.



● 'Metolius' field in Oregon.





● A. 'Tupy' production in central Mexico. Different cropping cycles with crop in bloom (left) and ripening fruit (right). B. Blackberry field in Serbia (courtesy of Brankica Tanovic, Institut za pesticide i zastitu zivotne sredine). C. Semi-erect blackberry production in China (courtesy of Zhang Qinghua, Chinese Academy of Forestry).

and over 50% of the crop is harvested from wild plants. 'Boysenberry' continues to fill an important niche market for processing in Chile and Uruguay.

Europe - Primarily Serbia

Serbia has been an important raspberry and blackberry producer for several decades and most of their fruit has gone to the processed market. During the wartime periods in the 1990s, production plummeted as the infrastructure was not in place to handle processing and storing fruit. Now in better times, production has resumed and expanded and there are 4,500-5,200 ha of blackberries. Locally developed cultivars have played a major role in supporting acreage expansion.

China

While a clear picture of the Chinese industry is difficult to obtain, there is no doubt that there was substantial increase in the production area in the late 1990s and 2000s. A number of cultivars were trialed in the mid 1990s throughout China. Based on results from these trials, most of the production has been concentrated along

the Yangzi River and is largely in semi-erect cultivars that are harvested for fresh and processed markets. A concern that pesticides may have been used illegally causing a collapse in internal consumption led to thousands of acres being removed in 2009. Currently, China is believed to have about 3,500 ha.

New plantings in Spain, South Africa, and Australia have all further helped drive the worldwide expansion in blackberry production.

PRODUCTION INNOVATIONS

Production practices and cultivars that bring a higher quality, year round product to the consumer, and that are profitable for growers, packers, and processors have been an integral part of this fresh market expansion.

Tunnel Production

Traditional, open-field, floricanne production has been, and continues to predominate in worldwide production even in the more moderate climates such as California. However, after high tunnel production systems that were developed

in Europe for a number of horticultural crops began to move to the US, they were found to be very useful for blackberry production. Precipitation, most typically in the fall, is detrimental to the quality of fall ripening fruit and greatly reduces shipping ability and shelf life. With tunnels, northern producers in mild climates can have excellent fruit nearly until winter although they typically shut down when cheaper fruit begins to arrive from Mexico in the fall.

The development of Mexican blackberry production has involved development of unique production practices that when combined with the mild, high elevation environment of central Mexico and use of the 'Tupy', allows for year round production of fruit. Individual blackberry fields can be manipulated to flower and ripen fruit at nearly any time of the year. The primocanes are grown and trained using typical management practices but then they are defoliated and treated with growth regulators to bring the canes into bloom. In addition, the just-fruited floricanes can be pruned to induce a second flower bud break. Mexican production is usually tailored so there is little production in the main production season of the US as this is the hot-

● Evaluation of machine harvestability of blackberry selections at Enfield Farms (Lynden, Wash.).



● 'Chester Thornless' with rain protection tunnels in place for use in fall in Oregon.



Introduction of Primocane Fruiting Cultivars

The University of Arkansas recently released the first commercially viable, primocane fruiting blackberry, 'APF-45' (marketed as Prime-Ark@45). While it is too early to tell the impact of this cultivar, it is expected that a substantial portion of the industry will be growing primocane fruiting types in the future. For example, primocane-fruiting red raspberries served a critical role in the expansion of their raspberry industry. The primocane habit allowed growers to grow the crop in areas of low or no chill and also more fully manipulate cropping time. This has resulted in red raspberries being grown in a short-term perennial production system where yield, fruit size, and fruit quality were maximized. As improved cultivars of primocane-fruiting blackberries are developed, it is expected they will have the same sort of impact on fresh production.

THE FUTURE

The rapid expansion of the blackberry industry has been remarkable. New, higher quality, cultivars, modified production practices and new production regions have all combined to make

this crop one that consumers expect to be available fresh year-round in their grocery stores. As new cultivars are developed that combine the industry's need for high quality arrivals with consumers demand for luscious fruit we only expect demand to further increase.

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Pitless Plum: Reality or Fantasy

Ann Callahan, Chris Dardick and Ralph Scorza

*RIT. The wall between Reality and fantasy
Is Sometimes so small And not so tall
Raphael Gualazzi, Reality or Fantasy*

Luther Burbank began a breeding program to produce stoneless plums (*Prunus domestica*) over 100 years ago. He released two plums, 'Miracle' and 'Conquest', whose fruit contained only a very small part of the stone. These plums are no longer available. In today's world of convenience a plum that does not contain either the stone or the seed might be very welcome. Is it possible to again produce plum cultivars that are completely stoneless and seedless? A combination of gained knowledge in genetics and breeding, molecular technology and remnants of stoneless germplasm, probably from Burbank's program, suggest that it is possible to now produce a pitless plum.

INTRODUCTION

A number of seedless fruit and vegetable products have found tremendous market appeal. This is especially true for banana, grape, orange, and watermelon for which consumers have come to expect seedlessness. In grapes, only one out of the top 14 California table grapes still contains seeds (<http://www.freshcalifornia-grapes.com/topvarieties.php>). Seedless watermelon, although smaller, are the most popular type (Bentley, 2010), and market demand for seedless citrus such as mandarin oranges is

reflected in the higher prices commanded for those products (<http://www.growingproduce.com/varieties/citrus/varietynews/?storyid=3682>; <http://westernfarmpress.com/markets/market-prices-separating-mandarins>). Whether consumers desire seedless fruit for the personal preference of not having to dispose of seeds or concern for choking hazards, there is clearly a strong market for these genetic improvements.

Satisfying consumer preference for seedlessness has thus far been limited to particular crops as seedless traits are currently unavailable for many

fruits, especially those that contain a hard protective covering that surrounds the seed (called the stone). Fruits that contain a hardened stone are classified as drupes and include all the stone fruits (*Prunus* species) such as peach, plum, apricot, and cherry, other fruits such as coffee, olive, and date, many of the nuts, as well as raspberry and blackberry. In drupes, it would be necessary to eliminate both the stone and seed, a task that has to date been elusive. But

Fruit from the original stoneless plum, 'Sans Noyau', next to fruit resulting from successive hybridizations with high quality fruit (Burbank, 1914a).

