cooperatives, which after 1958 merged to form communes. Since then some large citrus orchards have been introduced by the production teams or brigades under the communes, but they still are small compared with those in the leading citrus growing countries of the world.

A plan is now being drawn up to establish large orchards in areas most suited to citrus cultivation. This, coupled with the application of modern cultural practices, will transform the Chinese citrus industry in the years ahead.

The following report was presented at the American Pomological Society Meeting at Ohio State University, August 3, 1979.

Blackberry Production and Cultivar Situation in North America

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Wild species of blackberry are indigenous in most temperate areas of the northern hemisphere and are usually the most abundant of wild fruits (2). Strangely, blackberries are among the more recent fruits to be domesticated, being largely developed as a cultivated crop in the latter half of the 19th Century. The abundance and availability of wild blackberries may have made early cultivation unnecessary. More likely, the thorny, unmanageable character of most wild blackberries created a prejudice against them as a garden fruit, and this prejudice was brought to the New World by the pioneers from Europe (2).

The first pomological articles to recommend the cultivation of blackberries in the U.S. began to appear about 1829 (2), and little by little blackberries were brought under cultivation. In the meantime, during the 200 or so preceding years, the clearing of forests and subsequent spread of wild blackberries had created a massive natural breeding program among the various, interfertile, heteroploid, and highly heterogenious blackberry species (1). Blackberry enthusiasts had only to select the best from among the vast array of wild seedlings.

Two cultivars, Lawton and Dorchester, selected from the wild in the 1830's and introduced in the 1850's, contributed greatly to the new interest in selecting and cultivating blackberries. Soon other superior sorts appeared, some selected from the wild, some resulting from sowing open-pollinated seeds, and a little

[1]Published with the approval of the Director, Arkansas Agriculture Experiment Station. The author is grateful to the many research and extension workers who provided current information on blackberry production in the states discussed in this article.

later, actual hybridization was begun. It was not until 1909 that the first public blackberry breeding program in the U.S. was started by the Texas Agricultural Experiment Station. In the meantime, many superior cultivars had been developed by private breeders and the blackberry industry had grown greatly.

Blackberries never became popular in Europe. Recently, interest there has begun to develop, and several countries have established trial plantings and preliminary breeding programs. In the U.S., blackberry culture continued to increase from the mid-nineteenth century until the 1940's. The shortage of harvest labor during and after World War II resulted in a sharp decline in blackberry acreage. The 1974 Census of Agriculture (3) lists a total of only 5,866 acres (2375 ha) of blackberries and dewberries for the U.S., mostly in Oregon, Texas and California (Table 1).

A recent survey of 19 states and provinces indicates that blackberries are still a minor fruit crop, but interest in expanding culture in 13 states is increasing (Table 2). This renewed interest is attributable to three things: 1) the development of mechanical harvesters for large scale production for processing; 2) the expanding interest in small pick-your-own (PYO) operations throughout the country; and, 3) the recent development of cultivars more widely adapted and suited to mechanical harvest and PYO. The present situation in various areas follows.

Alabama. Only about 50 to 100 acres of blackberries are presently grown. Most plantings are ¼ to 3 acres in size. However, acreage is on the increase with plantings for local markets and PYO. Comanche, Cherokee, and Cheyenne are the predominant cultivars being planted. Orange rust is rampant in wild blackberries and is a threat to susceptible cultivars. Rosette (double blossom) also poses a threat although there have been no serious outbreaks yet. New cultivars are needed that have disease resistance and are thornless. Also, firmer fruit would increase shelf life for fresh market blackberries. There is no breeding or testing program at Auburn, but some testing is being done at Tuskegee.

Arkansas. Commercial blackberry production was non-existent until the early 1970's at which time a mechanical blackberry harvester and superior, adapted cultivars were developed by the Arkansas Agricultural Experiment Station. These developments have stimulated much interest in new plantings in Arkansas and neighboring states. The acreage, estimated at slightly less than 100 acres, is slowly increasing, mostly in small (1-4 acre) plantings for PYO. The only cultivars used are Cherokee, Cheyenne, and Comanche. All are well-suited to mechanical harvest and have large fruit size and high productivity for PYO. The major limitation of these cultivars is susceptibility to rosette *(Cercosperella rubi)* which is prevalent in south and central Arkansas but has not yet been a problem in northern parts of the state. An extensive breeding program is in progress with several objectives, including the development of erect, thornless types.

British Columbia. Only a few acres of Thornless Evergreen are grown. Blackberries are not considered a commercial crop. Himalaya Giant *(R. procerus)* grows wild everywhere and meets local needs.

Florida. Blackberry production is down to only about 3 to 4 acres of PYO. Recommended cultivars are Oklawaha, Flordagrand, and Brazos. Warm winters entice these cultivars to bloom in mid-January and later freezes greatly reduce the crop. Better cultivars would result in increased

Table 1. Blackberry and Dewberry Production in the United States, 1974.[1]

State	Farms (No.	Acres (No.)	Quantity (Lbs.)
Arkansas	12	99	93,070
California	46	528	3,832,771
Connecticut	4	1	1,270
Florida	8	11	10,540
Georgia	3	2	1,070
Illinois	9	18	20,555
Indiana	6	3	3,552
Kentucky	26	37	24,241
Maryland	5	2	2,200
Massachusetts	5	9	5,475
Michigan	27	76	167,199
Missouri	12	102	80,770
New Jersey	10	15	17,100
New York	13	32	61,025
North Carolina	14	28	25,280
Ohio	10	7	13,321
Oklahoma	13	10	5,921
Oregon	399	3,380	19,904,037
Pennsylvania	18	22	18,130
Tennessee	9	18	11,712
Texas	67	1,166	1,499,913
Vermont	4	4	2,400
Virginia	5	5	6,128
Washington	34	201	1,476,495
West Virginia	7	9	8,775
Wisconsin	10	61	151,310
All Others	12	19	60,878
U.S. Total	788	5,866	27,505,138

[1]Source: 1974 Census of Agriculture

interest. A small blackberry breeding program is being conducted.

Georgia. There is currently only about 10 acres for PYO, but interest is increasing due to the apparent adaptability of Cherokee, Comanche, and Cheyenne. Other cultivars being grown are Flint, Gem, Georgia Thornless and Brazos. The major cultivar needs are later bloom to escape frost and later fruit ripening to lengthen the PYO season after Cherokee. A new breeding project is being written for 2-3 years duration.

Illinois. A total of about 30 acres exist, all marketed PYO from plantings of ½ to 2 acres. The major cultivars are Dirksen, Black Satin and Thornfree. Interest increased greatly during the 1970-75 period, but winter kill the past three years has dampened the enthusiasm for blackberries. Interest has primarily been in thornless cultivars, but the available ones lack winter hardiness and need better quality. Most thorny cultivars, including Darrow, have sustained winter injury in northern Illinois. No cultivar improvement exists in the state.

Kentucky. Less than 20 acres, all PYO, are planted to Black Satin and Smoothstem. Cultivars are needed with better flavor, greater winter hardiness, and more erect growth habit. Interest in thornlessness and sterility in many old thorny cultivars has resulted in resistance to trying thorny cultivars. No cultivar improvement program exists.

Louisiana. The commercial blackberry acreage in Louisiana is less than 10 acres, all in small PYO operations, and there is around 100 acres in backyard plantings for home consumption. The leading cultivar is Brazos, which has good vigor and yield, but poor fruit quality. Cherokee and Comanche have better quality, but produce less yield than Brazos and are more susceptible to spider mites. Interest in blackberry production is slowly increasing. A breeding program has recently been initiated with the major objective being the development of erect types with good quality and high yields.

Michigan. Not over 100 acres of blackberries are cultivated with all being PYO. Cultivars being tried are Cherokee, Cheyenne, Comanche, Darrow, Ranger, Raven, Thornfree, Smoothstem and Black Satin. Comanche and Cheyenne appear very promising, but sustained winter injury from

Table 2. Blackberry Production Trends in 19 Selected States and Provinces in North America, 1979.

State	Commercial Acreage (acres)	Acreage Trend Expected[1]	Leading Cultivars	Breeding Program	Testing Program
Alabama	<100	I		No	Yes
Arkansas	<100	I		Yes	Yes
British Columbia	< 10	NC		No	No
Florida	4	I		Small	Small
Georgia	10	I			
				Yes	Yes
Illinois	30	I		No	Yes
Kentucky	< 20	I		No	Yes
Louisiana	10	I		Yes	Yes
Michigan	100	I			
				No	Yes
Minnesota	0	NC		No	Yes
Missouri	<100	I		No	Yes
New York	10	NC		Small	Yes
North Carolina	<100	I			
				Small	Small
Nova Scotia	0	NC		No	No
Ohio	< 5	NC		No	Yes
Oklahoma	240	I		No	No
Oregon	3000	I		Yes	Yes
Texas	500	I		Yes	Yes
Washington	210	NC			
				No	Yes

[1]NC = No change; I = Increasing

−35° F. temperatures in February, 1979. A few growers are interested in commercial plantings of Comanche and Cheyenne for machine harvest. These growers are planting raspberries for machine harvest and see blackberries as a good supplement. There may be substantial acreages planted to blackberries in the next few years.

Minnesota. No blackberries are grown because no cultivar is hardy enough. Darrow seems the hardiest, but must be protected. No breeding program exists, but a cooperative hardiness screening program has recently been started with USDA.

Missouri. Approximately 100 acres grown, mostly for PYO. The Arkansas cultivars, Cherokee and Cheyenne are the leading cultivars. Interest is increasing and new plantings are expected in the next few years. There has been a sterility problem with Darrow.

New York. The blackberry industry is almost non-existent. Only about 10 acres are grown in plantings of ½ to 2 acres. Darrow is the only cultivar grown, but it is too tender to winter cold, too thorny, and very susceptible to sterility. Thornless cultivars are too susceptible to winter injury, but might have possibilities in the snowbelt or

in mulch culture on Long Island, where the $2.00 per pint selling price at roadside stands would make mulching for winter protection feasible. Only a small breeding effort is being made on blackberries.

North Carolina. The 500 acre commercial dewberry industry of 20 years ago no longer exists. Less than 100 acres, in small plantings, are being established now for PYO. Most popular cultivars are Dirksen, Black Satin, Darrow, and Carolina dewberry. These cultivars are far from ideal. Black Satin and Dirksen are too tart and too soft, are susceptible to fire blight and have some sterility problems. Darrow is too thorny. Carolina must be trellised. Needed is a good flavored, firm, large fruited, disease resistant, thornless, upright cultivar. Only a minimal breeding and testing program is being conducted at this time.

Nova Scotia. No commercial blackberry production exists. Such cultivars as Eldorado, Bailey, Darrow, Ebony King, Hedrick, and Lowden have been tested, but none was winter hardy enough. Wild blackberries are abundant and most people gather their fruit from wild plants. Since the red raspberry appears to have greater potential for this area, available resources in breeding are placed on raspberry.

Ohio. There is practically no blackberry production in Ohio. There was a surge of interest with the introduction of Thornfree and Smoothstem, but their demonstrated lack of winter hardiness terminated this interest. There is opportunity for a profitable blackberry industry if satisfactory cultivars were available. Needed is a hardy, productive, thornless type for PYO. There is also slight interest in machine harvest for wine. A cooperative program is in effect with USDA to evaluate thornless selections for hardiness. Evaluations of selections from other areas are also being conducted.

Oklahoma. A single planting of 200 acres of Cherokee which is mechanically harvested for processing makes up the bulk of Oklahoma's acreage. Some smaller plantings of Cherokee and Cheyenne are going in for PYO. Interest is on the increase and acreage may increase dramatically in the next few years.

Oregon. The leading blackberry producing state in the U.S. with an acreage of about 3000 acres. Acreage is increasing (up 20% in 1979) with better prices being the main stimulus. Almost all fruit is processed, although there is limited interest in a firm, attractive berry for fresh market. The leading cultivars are Thornless Evergreen and Marion, occupying about 2600 acres. Evergreen outproduces Marion by 1-2 tons per acre, while Marion has better quality. There are about 300 to 400 acres consisting of Chehalem, Santiam, and Cascade. About 75% of the Evergreen and 50% of Marion is machine harvested. A limited breeding program is underway with thornless, better hardiness, and high quality being major objectives.

Texas. The nearly 1200 acres in blackberries in 1974 has dwindled to no more than 500 acres at present. About 90% is going to canneries. PYO remains very limited. Interest has been decreasing, but is now picking up due to recent price increases. The most popular cultivars are Brazos, Humble, and Cherokee. Neither Brazos nor Humble are suitable for mechanical harvest. Cherokee is very good for mechanized harvest, but susceptibility to double blossom makes its future uncertain. The greatest need is for incorporation of more disease resistance into Cherokee or related types. A breeding program was start-

ed in 1978, primarily for mechanical harvest types.

Washington. There are approximately 210 acres of cultivated blackberries of which 95% is Evergreen and 5% Marion and Chehalem. In addition there are about 200 acres of Loganberries, Boysenberries, and wild trailing blackberries. Ninety-five percent of the fruit is processed with the remainder sold on the farm. The industry is probably at the bottom of a long decline in acreage. The major factor limiting production is lack of winter hardiness of cultivars. Evergreen is the predominant cultivar because it is the hardiest, but it is unsatisfactory for fruit quality. Marion and Chehalem have much better quality, but are less winter hardy. No breeding program exists, but selections from the Oregon breeding program are widely tested in Washington.

CONCLUSIONS

It appears that there is at present considerable and increasing interest in blackberry culture throughout much of the United States. Whether this interest will be translated into increased acreage is almost totally dependent upon the development of superior cultivars. Blackberry culture cannot expand in the northern regions of North America until more winter hardy cultivars are available. Lack of winter hardiness appears to be the major limiting factor to blackberry production in much of the country. Hardy wild species have been reported, but it appears that there has not been, nor is at present, a concerted effort to breed a superior hardy cultivar.

The limiting factor for blackberry production in much of the South is susceptibility of cultivars to disease. The cultivars Cherokee, Cheyenne and Comanche represent great genetic advances in yield, fruit size, quality, and adaptability to mechanical harvest, yet their susceptibility to rosette (double blossom) may limit their usefulness in large areas of the deep South.

Thornlessness will continue to be an important characteristic, especially as PYO operations expand. The available thornless cultivars have many drawbacks. Their culture is very liimted due to susceptibility to winter injury. Other weaknesses are their poor quality, large seed size, late maturing, susceptibility to fire blight, and the necessity of trellising. More effort needs to be expended in developing erect thornless types with improved fruit qualities.

Since the future of blackberry culture in the U.S. is very dependent on improved cultivars, one is forced to take a pessimistic view when considering the present lack of activity in blackberry breeding. Only seven state experiment stations (Arkansas, Florida, Georgia, Louisiana, New York, Oregon, Texas) and the USDA report any blackberry varietal development activities. Of these, most report that blackberries receive only very minor effort. Since success in fruit breeding is almost never achieved without an extensive, ambitious and aggressive effort involving the production and evaluation of thousands of seedlings per generation, one has to wonder where the needed cultivars of the future will be originated. If blackberries are to become a prominent fruit crop, present breeding programs must be greatly expanded and additional ones initiated. Without greatly improved cultivars, the future of cultivated blackberries is indeed bleak, and future generations of Americans may never know the pleasure of eating the delectable blackberry.

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A Population of *Vaccinium corymbosum* L. in Wisconsin

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A short note in Wisconsin Horticulture (1) reported "while hunting 2 years ago, Allan Troemner of Friendship noticed bushes resembling blueberries, but which grew much taller and somewhat more vigorously. Later examination revealed the berries to be much like our native low blueberry.

The tall growing blueberry bushes are growing with native lowbush blueberries in the sandy soils of central Wisconsin. This area is subject to harsh weather conditions and cold winters where a minimum of 52 below zero has been reached.

Highbush blueberry clumps were found growing in a wet peat swamp in a mixed stand of jack pine, birch, and larch. . . . No winter injury was found on these plants and little or no injury or freezing back has been observed on the highbush clumps which reach a height of 5 or 6 feet."

In July, 1973, Mr. Troemner guided us to the location of the blueberry colony. About one mile from any habitation and far removed from any currently cultivated land, the colony of blueberry bushes persists in the bog setting described in the earlier report. The colony was more or less circular and covered an area approximately 50 feet in diameter. A crop of green fruit was present on the bushes. The tallest blueberry bushes reached 7 feet in height. They are rather sparsely branched due presumably to the poor light conditions under which they persist in this location. Intermixed with the highbush blueberries were some low bush blueberries, *V. angustifolium* Ait. and some intermediate size blueberry bushes of undetermined identification along with huckleberries, *Gaylussacia* sp., larch, *Larix laricina* Koch., birch, *Betula* sp. and the expected sphagnum moss ground cover. There were no jack pine *Pinus banksiana* Lamb. in the bog although the surrounding sand area does have a population of jack pine and oak, *Quercus* sp. The colony of highbush blueberries is in southwestern Adams County, Wisconsin, approximately 60 miles north of Madison at about 44° north latitude.

Several years earlier a number of plants from this colony were moved to a wet sand garden area near the Troemner homestead about one mile away. At the time of our visit these bushes were 6-8 feet in height and were carrying a fruit crop. Mrs. Troemner, Allan's mother, indicated that these plants almost always set a crop of fruit but they rarely ripened the crop. We assume that failure to ripen was the result of spring and summer frosts that are common in that area of the state and particularly in the lowland habitat.

A later visit to the native colony resulted in the harvest of ripe berries of small size and blue color typical of the *V. corymbosum* description (2). Leaf and fruit samples examined by

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