

Rural Migration News

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Alternatives to Hand Labor in Strawberries

The Romans thought that wild strawberries had medicinal properties, and the French developed modern hybrids in the 1750s from wild varieties found in the Americas. China produced 2.7 million tons of strawberries in 2018, followed by the US with 1.2 million tons, Mexico with 590,000 tons, Spain with 344,000 tons, and Poland with 195,000 tons. The leading exporters of fresh strawberries in 2019 were Spain, which exported \$678 million worth of fresh strawberries or a quarter of global exports,

Mexico, \$580 million, the US, \$451 million, the Netherlands, \$271 million, and Belgium, \$186 million.

Demand for fresh berries has been rising with their perceived health benefits as well as year-round availability and convenient packaging, making berries the highest value fresh produce item sold in U.S. supermarkets. Strawberries accounted for 47 percent of the \$6.4 billion in U.S. retail fresh berry sales in 2017, followed by blueberries at

26 percent, raspberries at 14 percent, and blackberries at nine percent.

Production and Trade

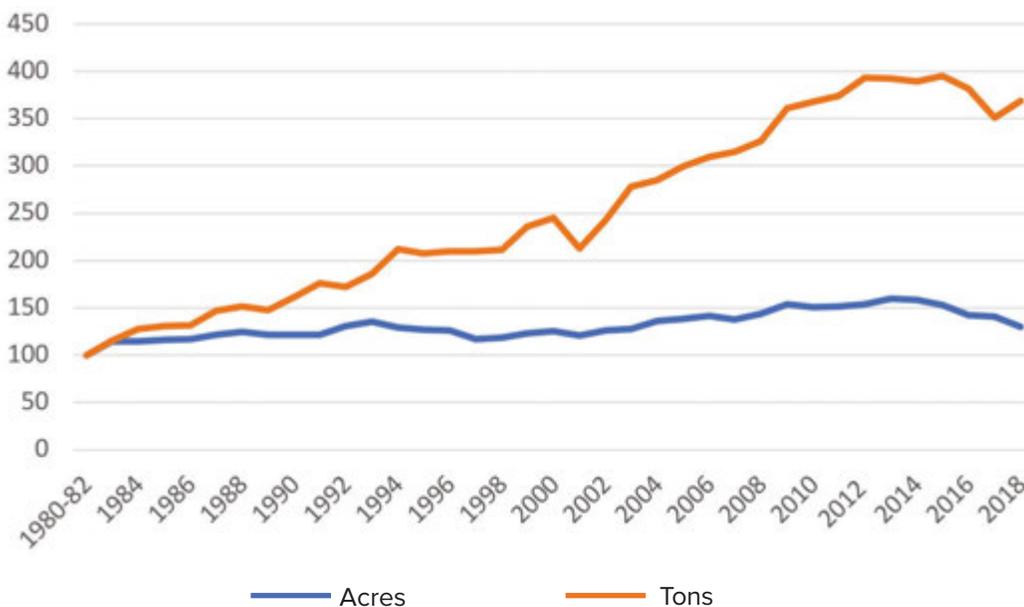
The US produced 2.9 billion pounds of strawberries from 49,220 acres in 2018 with an average grower price of \$0.94 a pound, making the U.S. crop worth \$2.7 billion, second only to apples among U.S. fruits in value. Strawberry acreage rose relatively little over the past four decades, but production more than tripled due to higher yielding varieties and improved production practices.

Strawberry acreage peaked at 60,000 in 2013-14, when over three billion pounds were produced. There has been a 22 percent drop in strawberry acreage since 2013-14, but only a slight drop in production, as higher-yielding varieties spread and producers fine-tune production practices to maximize yields.

Per capita consumption of strawberries was 8.9 pounds in 2018, including 7.1 pounds or 80 percent consumed fresh.

Grower prices for fresh strawberries were \$1.06 a pound in 2018, ranging

US strawberry acreage rose 36%, and production rose 307%, from 1980 to 2018 (1980-82 =100)



from a high of \$1.69 a pound in January to a low of \$0.53 in June; prices averaged \$0.44 a pound for processing strawberries. Imports, mostly from Mexico, are rising rapidly: they were 15 percent of the supply of U.S. fresh strawberries in 2018, up from six percent in 2000. Imports were 34 percent of the U.S. frozen strawberry supply in 2018, up from 18 percent in 2000.

California accounted for \$2.3 billion or 85 percent of U.S. strawberry cash receipts in 2018. California's climate permits a long growing season and ensures both high yields and high quality, so that most of the state's strawberries are sold fresh.

California had 34,000 acres of strawberries in 2018, including 4,000 acres or 12 percent organic strawberries. Over 80 percent of strawberry acreage is planted in the fall for winter, spring, and summer harvesting. About 60 percent of California strawberry acreage is planted with varieties developed by the University of California; the remaining 40 percent is planted with proprietary varieties.

Four firms led by Driscoll's market most fresh strawberries; Driscoll's is also the dominant marketer of raspberries. The other major strawberry marketing firms are Naturipe, Well-Pict, and California Giant, all have affiliated growers for whom they market strawberries produced in the U.S. and abroad.

Labor

Strawberries are the most labor-intensive crop grown in California, involving about 1.5 workers per acre and 50,000 to 60,000 workers to harvest strawberry fields twice a week during the peak season. Strawberries are harvested year-round, beginning in the southern part of the state in winter and moving north in spring and summer. During the winter and spring, Florida also produces fresh strawberries, competing with fresh strawberries imported from Mexico. Most strawberry growers are specialized, producing only strawberries.

A strawberry field may be picked 40 to 50 times during the harvest season. Workers push a light wheelbarrow containing the plastic clamshells in which strawberries are sold

between two adjacent elevated rows, picking from both rows. Full trays are taken to a checker at the end of the row to receive credit for the tray. Strawberries must be at least two-thirds red to be picked and packed; non-salable berries are discarded in a bucket attached to the picking cart or on the ground. Some workers literally run with full trays to the checker and back to their carts to maximize their piece rate earnings.

Most workers are paid piece rate wages of \$1.75 to \$2 per flat of 12-12 once pints or eight one-pound clamshells, and guaranteed at least the California minimum wage (\$13 an hour in 2020). Some growers offer workers an hourly wage of \$5 an hour and a piece rate of \$1.25 for each flat, while others guarantee the minimum wage and offer \$0.50 per tray after eight trays an hour. Workers typically pick eight to 12 flats an hour, enabling most to achieve piece rate earnings that exceed the minimum wage by \$2 to \$4 an hour.

Worker productivity and earnings vary with individual skill, plant yields, type of picking cart, and time of day, with workers often picking slower at the end of the day.

Labor is the major cost, representing 50 to 60 percent of variable production costs. Some growers have slow-moving conveyor belts that move in front of harvesters, allowing harvesters to place full flats of berries on the belt rather than carry them to the end of the row, giving workers more time to pick and raising their productivity. Piece rates are lower in fields with conveyor belts because workers can pick faster.

Many of the workers who harvest strawberries are non- or limited-Spanish speakers from southern Mexican states such as Oaxaca and Chiapas. There are often several members of a family and their relatives in a crew, so that strawberry

Strawberry harvesters wheel a cart with clamshells between elevated rows



Strawberry and Other Berry Employment and Weekly Pay, 2006-18

	Average Employment		Average Weekly Pay (\$)	
	Strawberries	Other Berries	Strawberries	Other Berries
2006	21,622	3,059	366	437
2007	23,652	3,488	393	429
2008	26,165	4,060	391	438
2009	27,211	4,441	392	415
2010	26,934	5,275	406	447
2011	27,088	6,103	423	450
2012	27,073	6,981	462	485
2013	26,727	8,876	480	508
2014	25,939	9,719	518	525
2015	25,975	10,618	531	524
2016	25,501	10,942	588	501
2017	25,376	10,241	591	518
2018	24,897	10,018	604	559
2006-18	15%	227%	65%	28%
2006-12	25%	128%	26%	11%
2012-18	-8%	44%	31%	15%

Source: QCEW (www.bls.gov/cew)
Strawberries, 111333; Other berries, 111334

crews are more diverse than the solo male work crews that dominate the harvest of tree fruits. This means that there is more variance in productivity among strawberry harvesters than other crops that pay piece rate wages, such as crews that pick apples or oranges. Most strawberry harvesters are hired directly by farmers rather than brought to farms by contractors, and some farmers keep older and slower workers on their payrolls in order to retain the younger and faster relatives with whom the older workers car pool.

The strawberry labor market is “fluid,” with workers often changing employers. Some workers monitor yields to determine where they are most likely to maximize their piece-rate earnings, and change employers to pick in the fields with the most berries to harvest. In the past, some growers refused to rehire workers who quit during the season and went elsewhere but, since the slowdown in unauthorized Mexico-U.S. migration after the 2008-09 recession, few growers maintain no-rehire-during-the-season policies.

Strawberry harvesting crews typically include 30 to 60 workers. The key figure is the crew supervisor who is responsible for ensuring that the crews have 80 to 90 percent of their expected workers. Crew supervisors are responsible for recruiting additional workers to replace those who quit or are fired and they help to monitor the quantity and quality of berries that are picked.

Fewer unauthorized newcomers have prompted many growers to use the H-2A program to obtain harvest workers, so that up to half of Salinas-Watsonville strawberries may be picked by H-2A guest workers. Berries were the most common type of job filled by H-2A workers in FY19, accounting for 10 percent of the 258,000 U.S. jobs certified to be filled with guest workers.

The combination of fewer unauthorized newcomers and more H-2A guest workers, who must be paid an Adverse Effect Wage Rate that is higher than the state’s minimum wage, \$14.77 an hour in 2020 when the California’s minimum wage was

\$13 an hour, has put upward pressure on farm labor costs. Average employment in California’s strawberry industry (NAICS 111333) rose from 21,600 to 24,900 between 2006 and 2018, up 15 percent. Average strawberry employment rose 25 percent between 2006 and 2012, and has since fallen by eight percent.

Average employment is the number of workers on the payroll for the (usually weekly) payroll period that includes that 12th of the month. The number of farm workers exceeds average employment by a factor of two to 2.5 due to seasonality and turnover, suggesting 50,000 to 62,500 unique workers employed in California strawberries and 20,000 to 25,000 are employed in other berries.

Other berry employment in California, primarily blueberries and raspberries, rose much faster, up over 200 percent since 2006. As with strawberries, other berry employment rose faster between 2006 and 2012 than between 2012 and 2018. There were seven full-time equivalent strawberry jobs for each other berry job in 2006, but the ratio of strawberry to other berry jobs fell to 2.5 in 2018 due to the rapid growth of other berry employment.

The average weekly wages of other berry workers were 10 percent higher than strawberry weekly earnings until 2014. Since then, strawberry weekly wages have exceeded the wages of other berry workers, \$604 a week for strawberry workers in 2018 compared with \$559 a week for other berry workers. There was a major jump in strawberry wages between 2015 and 2016, up 11 percent, likely reflecting an increase in the state’s minimum wage.

Most berry workers are not employed the entire year, so their annual earnings are less than average weekly wages multiplied by 52

weeks. The California Employment Development Department found that 38,800 workers were primarily employed in strawberry farming in 2015, meaning their highest earnings from all jobs were from strawberry establishments. These primary strawberry workers earned an average \$17,850.

There were 16,150 primary other berry workers in 2015, meaning their highest earning job in California was from a non-strawberry employer who produced blueberries or raspberries, and they earned an average \$16,700. Workers employed only in other berries earned an average \$9,150, suggesting that many were employed for only short periods. It should be noted that there are no data on the commodity of workers brought to farms by labor contractors. There were 294,000 workers who had their highest earnings with California labor contractors in 2015, and they earned an average \$9,900, the lowest of any NAICS commodity or category. An unknown number of FLC employees worked on berry farms.

Strawberry Alternatives and Outlook

The strawberry industry is at a crossroads, dealing with the loss of methyl bromide to fumigate soils, rising labor costs, and increased imports. There are potential solutions, including using substrate rather than soil for berry plants and growing berries in protected culture structures such as under hoop-covered plastic structures to minimize disease and raise yields. Strawberries can be grown on waist-high table tops or in vertical rows to facilitate hand or machine harvesting. However, these alternatives are expensive, raising the production costs of an already costly crop.

The key actors in the strawberry industry are the marketers or shippers who often develop new plant

Conveyor belts reduce walking for strawberry harvesters



varieties and market berries for farmers. Marketers or shippers deduct cooling, marketing, and other fees before sending the balance of 70 to 80 percent of the revenue from berry sales to growers. Marketers are financially stable and take the long view, breeding and patenting superior plant varieties and developing brand names that allow their berries to command premium shelf space and higher prices in supermarkets.

The major labor aid to increase worker productivity is a conveyor belt that travels in front of berry pickers and eliminates some picker walking. Over 200 conveyor belts that straddle up to 17 rows of berries were used in Ventura county's strawberry harvest in 2020, allowing workers to pick at least 20 percent faster. Growers reduce piece rates by 10 percent to 20 percent when workers can place full trays on conveyor belts. There are also smaller machines that straddle eight rows of berries, which make it easier to assemble crews that pick at the same speed.

Conveyor belts are common in the Oxnard area, where the ground is flat and fields are relatively large. There are fewer conveyor belts in the Sali-

nas-Watsonville area, both because of hills and because of disputes about how much the piece rate should be reduced with increased worker productivity. Conveyor belts are available in many sizes, with some covering only a few rows of berries for up to five workers and others covering a dozen or more rows for 20 to 30 workers.

Conveyor belts require workers to be of similar productivity to improve worker picking efficiency. An alternative is a system of field-assist robots that take full trays from pickers and transport them to a collection location, which can improve efficiency even if worker productivity varies. Field-assist robots are relatively simple and inexpensive, but must be programmed and adjusted to anticipate when workers will need an empty tray so that workers can pick without interruption.

During a test in a high-yield period of the 2018 season, half of the pickers averaged 15 trays an hour, a quarter averaged 10 trays an hour, and the others averaged more than 15 or less than 10 trays an hour. Analysis suggested that five robot tray conveyors for a 25-person picking crew could maximize the workers' picking efficiency.

Several efforts are underway to mechanize strawberry harvesting, which is difficult because strawberries are soft and fields must be re-picked repeatedly. The Spanish-made Agrobot has arms to pick ripe strawberries that are identified by taking pictures of the fruit and comparing them to stored images of ripe berries. The machine travels along rows with hardened sides and picks the berries that grow over the hardened sides of the rows. Another version of the Agrobot has arms to harvest strawberries that are grown on raised hydroponic beds in greenhouses.

Other mechanical harvesting efforts include the British Autonomous Strawberry Harvesting and Management Robot or AUTOPIC project that aims to develop a robotic picker to harvest soft fruit on a 24/7 basis. Both Harvest CROO in Florida and Belgium's OCTINION have developed machines with soft grippers to pick individual strawberries. Harvest CROO believes that its machine will be able to harvest eight acres a day or cover 25 acres if strawberries are picked every third day, replacing a crew of 30 hand pickers. Machines work best on strawberries grown under protected culture structures and in ways that make it easier for machines to identify ripe fruit.

The challenge for strawberry harvesting machines is to identify and pick ripe fruit quickly without damaging the plant and immature fruit, and to repick fields 30 to 50 times over a season. While algorithms can teach machines to improve their selection of ripe fruit over time, the presence of leaves and other obstacles can make it difficult to detect and pick strawberries fast enough to compete with hand harvesters.

The second option is more H-2A guest workers to replace U.S. workers who are aging out of farm work and whose children educated in

the U.S. shun seasonal farm jobs. The H-2A program allows US farm employers who anticipate shortages of workers to be certified by DOL to employ H-2A workers if they try and fail to recruit US workers. Employers must provide H-2A workers with free housing and transportation to and from the fields, which makes their labor costs \$20 to \$22 an hour, versus \$16 to \$18 for U.S. workers. H-2A workers tend to be younger and more homogeneous, and will pick in fields with more and fewer strawberries, unlike U.S. workers who may switch employers to find higher-yielding fields that generate higher piece rate earnings.

H-2A workers are a rising share of strawberry workers, in part because of the importance of having a labor force available to pick the highly perishable fruit. Strawberry growers must weigh the value of the labor insurance provided by H-2A workers against the high cost of housing in the coastal areas where strawberries are grown; most employers use motels to house H-2A workers four to a room in bunk beds. The number of H-2A strawberry workers has expanded fastest in Santa Maria, which has lower housing costs than the Oxnard and Salinas-Watsonville areas. Some employers are building

new housing or remodeling facilities to house H-2A workers.

U.S. strawberry pickers are mostly Mexican-born and often unauthorized adults who often have U.S.-born children. Local workers do not get free housing and transportation to the fields, and have social security taxes deducted from their wages, prompting some to resent H-2As for their free housing and their higher after-tax earnings. Most farm worker unions and advocates oppose expanding the H-2A program, although they supported the Farm Workforce Modernization Act approved by the House in December 2019 that would have legalized unauthorized farm workers and made employer-friendly changes to the H-2A program (<https://migration.ucdavis.edu/rmn/blog/post/?id=2370>). The FWMA is expected to be the starting point for Congressional deliberations over agricultural guest workers in the Biden Administration.

Imports of fresh strawberries from Mexico are increasing. Most Mexican strawberries arrive between November and April, but the Mexican export season is lengthening as more Mexican strawberries are grown under protected culture structures. Mexico

Conveyor belts reduce walking for strawberry harvesters



Source: <https://www.roboticstomorrow.com/story/2015/04/agrobot-strawberry-harvesters/5950/>

has land that has not been planted to berries in the past and thus has fewer pest pressures, wages that are a tenth of U.S. levels, and a declining peso, factors that combine to expand Mexican strawberry production and exports.

Mexico's berry industry is expanding with the help of U.S. and Chilean partners. A third of Mexican strawberries are exported to the United States, as are almost all of Mexico's raspberries and blackberries. Mexico's major berry production areas are Irapuato, Guanajuato (strawberries), Michoacán (strawberries and blackberries), and Jalisco (blueberries and raspberries). Baja California also produces organic strawberries and raspberries on sandy soils with desalinated water. In 2016, over 73 percent of Mexican strawberries were from Michoacán, 15 percent from Baja California, and 8 percent from Guanajuato, where many strawberries are often frozen or used for preserves.

Mexican berry workers are similar to U.S. berry workers. A survey of 4,489 workers employed by 205 berry farms in Jalisco (100 farms) and Michoacán (105 farms) in spring 2018 found that two-thirds were between the ages of 18 and 35 and 90 percent were younger than 50. Almost 60 percent of the strawberry workers were married, and married workers had an average 2.8 children.

Some 20 percent of berry workers were indigenous, and 70 percent of these indigenous workers were Purépecha speakers from Michoacán. More workers were employed year-round (55 percent) than seasonally (45 percent), but only 40 percent

Harvest CROO has a picking wheel with cameras to identify ripe berries



Source: <https://www.roboticstomorrow.com/story/2015/04/agrobot-strawberry-harvesters/5950/>

of those speaking an indigenous language were year-round workers, suggesting that many of the indigenous workers filled seasonal jobs, often on larger berry farms.

Smaller growers with fewer than 23 acres of berries hired mostly local workers who were better educated, more experienced, and more satisfied with their wages and working conditions than the migrant workers who were concentrated on farms with more than 90 acres of berries; these workers expressed more concerns about low wages and poor working conditions.

There are several scenarios for U.S. strawberries. One envisions declining U.S. strawberry acreage and rising imports from Mexico, with imports facilitated by U.S.-based marketers who build coolers and provide patented varieties to growers in Mexico. These marketers are also seeking alternative ways to sterilize U.S. soils and to harvest U.S. strawberries by machine. If new

planting methods and harvesting machines are developed, strawberry production could expand in the California coastal areas that have ideal climates for strawberries.

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