Chapter 7. California's Fruits and Tree Nuts

Rachael E. Goodhue, Philip Martin, and Leo K. Simon

Abstract
California produces two-thirds of U.S. fruits and nuts. The state’s fruits and nuts were worth $18 billion in 2015, almost 40 percent of the state’s $47 billion in farm sales. Nuts were worth over $7 billion, including almonds, $5.3 billion; walnuts, $1 billion; and pistachios, $670 million. Grapes were worth $5 billion, including half from wine grapes, one-third from table grapes, and a seventh from raisins. Berries were worth $2.5 billion, including three-fourths from strawberries, one-fifth from raspberries, and 5 percent from blueberries. The most valuable tree fruits are oranges, worth $773 million in 2015; lemons, $545 million; avocados, $412 million; and peaches, $340 million. Cherries and plums were worth $200–$300 million each. The acreage of tree nuts is rising, while the acreage of citrus and peaches, pears, and plums is declining.

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Introduction

California leads among U.S. states in the production of 28 fruits and nuts, and was the sole commercial producer of 11 fruits and nuts (CDFA, 2016). This chapter covers tree nuts, tree fruits, and melons, and focuses on six major fruits: oranges, lemons, peaches, avocados, prunes and plums, and cherries, and three major tree nuts: almonds, walnuts, and pistachios.

Figure 1 shows the five largest fruit and tree nut crops by acreage. By value of production, strawberries and table grapes would replace pistachios and raisin grapes in the top five (Figure 2). Nut acreage has been increasing and fruit acreage decreasing, with the exception of berries and cherries. Almonds stand out for having rapidly rising acreage and value of production.

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**Figure 1. Fruit and Nut Crops by Acreage, 1985–2015**

- **Grape-Raisin**
- **Pistachio**
- **Walnut**
- **Grape Wine**
- **Almond**

Source: CDFA 2015

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**Figure 2. Fruit and Nut Crops by Value of Production, 1985–2015**

- **Walnut**
- **Grape Table**
- **Strawberry**
- **Grape Wine**
- **Almond**

Source: CDFA 2015
The U.S. produced fresh fruit worth almost $20 billion in 2016, including $16.6 billion worth of noncitrus fruit and $3.4 billion worth of citrus (ERS Fruit Yearbook, Table A-3). The leading fruits by value were grapes for all uses, $6.3 billion in 2016, apples $3.6 billion, strawberries, $2.3 billion, and oranges, $1.9 billion; these four fruits accounted for 70 percent of U.S. fresh fruit production in 2016.

About half of U.S. fresh fruit worth $14 billion in 2016 is imported, led by bananas, $2.4 billion; avocados, $2 billion; fresh grapes, $1.7 billion; and fresh raspberries and blackberries, $871 million. The U.S. exported fresh fruit worth $6.5 billion, giving the country a fresh-fruit trade deficit of over $7 billion.

U.S. fresh fruit consumption declined 127 pounds per capita during 1994–98 to 119 pounds in 2007–08, reflecting less orange juice consumed and fewer oranges and stone fruits such as peaches and nectarines eaten (Linn and Morrison, 2016). Between 2009 and 2014, average per capita “consumption events” of all fruits decreased from 315 to 296 a year, as reported by the Produce for Better Health Foundation in 2015, driven by the decline in fruit juice consumption. The number of consumption events increased for store-bought fresh fruit, and declined for all other fruit. Among fruit consumed “as is” and in other dishes, berries accounted for 24 consumption events per year, oranges for 14 events, melons for 13, grapes for 12, and peaches for 6. Overall, 83 percent of fruit consumption events involved fruit eaten without additional preparation.

California’s top agricultural exports in 2015 included several fruits: table grapes (No. 7, $766 million worth of exports), oranges and products (#9, $582 million), strawberries (#10, 390 million), raisins (No. 12, $335 million), lemons (No. 16, $237 million), dried plums (No. 18, $182 million), raspberries and blackberries (No. 19, $148 million), and peaches and nectarines (No. 20, $139 million). The state’s agricultural exports were $21 billion, so these seven fruits accounted for slightly under 10 percent of all agricultural exports (CDFA, 2016).

Table 1. Top 15 California Fruits in 2015

<table>
<thead>
<tr>
<th>Rank</th>
<th>Fruit (raise, table, and wine)</th>
<th>Value of Production 2015 ($1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grape (raisin, table, and wine)</td>
<td>6,038,422</td>
</tr>
<tr>
<td>2</td>
<td>Strawberry (fresh and processed)</td>
<td>1,703,831</td>
</tr>
<tr>
<td>3</td>
<td>Orange (navel and Valencia)</td>
<td>1,376,582</td>
</tr>
<tr>
<td>4</td>
<td>Lemon</td>
<td>772,265</td>
</tr>
<tr>
<td>5</td>
<td>Peach</td>
<td>665,054</td>
</tr>
<tr>
<td>6</td>
<td>Raspberry</td>
<td>471,198</td>
</tr>
<tr>
<td>7</td>
<td>Plum (fresh and dried)</td>
<td>467,536</td>
</tr>
<tr>
<td>8</td>
<td>Avocado</td>
<td>400,386</td>
</tr>
<tr>
<td>9</td>
<td>Cherry</td>
<td>351,907</td>
</tr>
<tr>
<td>10</td>
<td>Melon</td>
<td>324,768</td>
</tr>
<tr>
<td>11</td>
<td>Nectarine</td>
<td>286,887</td>
</tr>
<tr>
<td>12</td>
<td>Olive</td>
<td>145,566</td>
</tr>
<tr>
<td>13</td>
<td>Blueberry</td>
<td>128,793</td>
</tr>
<tr>
<td>14</td>
<td>Pear</td>
<td>118,277</td>
</tr>
<tr>
<td>15</td>
<td>Grapefruit</td>
<td>82,122</td>
</tr>
</tbody>
</table>

Source: CDFA, 2015
California produces a wide variety of fruits, but Table 1 shows that only grapes and strawberries were worth over $1 billion in 2015. Oranges were worth $776 million and lemons $545 million. Remaining fruits that exceeded $100 million in value included plums (fresh and dried), avocados, cherries, melons, nectarines, olives, and pears.

Fruit production often occurs on smaller farms with less than 15 acres; there are relatively few operations with 100 or more acres, although they often produce most of a particular fruit (https://quickstats.nass.usda.gov/). The U.S. fruit and nut bowl is the San Joaquin Valley, which produces most of California’s fruits and nuts.

### Citrus: Oranges and Lemons

Some 4,800 farms reported oranges in the 2012 Census of Agriculture, and two-thirds reported fewer than 15 acres while 8 percent reported 100 or more acres. Two-thirds of California’s orange acreage was in Tulare and Kern counties, with Tulare having half of the state’s orange acreage.

Orange groves typically yield commercial harvests the third or fourth year after planting. Yields increase gradually, stabilizing ten years after planting. According to a 2015 UC Cooperative Extension costs and returns study for the Southern San Joaquin Valley, accumulated net cash costs to establish an orange grove were $9,000 an acre at the end of the fifth year. Once in full production, annual operating costs are $6,000 an acre, and harvest costs account for over half of operating costs, while pest and disease management costs are 10 percent (O’Connell et al., 2015).

Table 2 shows that orange yields increased by a third between 1985 and 2015, contributing to the increase in value of production despite a reduction in acreage. Orange acreage increased by 17 percent between 1985 and 1995, followed by declines of 5 percent between 1995 and 2005, and 13 percent between 2005 and 2015. Revenues per acre in 2015 and the total value of production were slightly higher than in 1985, although 1995 and 2005 values were substantially lower.

California had 2,000 farms with lemons in 2012, including 75 percent with fewer than 15 acres and 6 percent with 100 acres or more. One-third of the state’s lemon acreage in 2015 was in Ventura County, while Tulare County in the Southern San Joaquin Valley accounted for 17 percent and Riverside County 14 percent, giving these three counties over 60 percent of the lemon acreage.

Lemon groves typically yield commercial harvests in the third or fourth year, and yields increase until year 8 and then plateau. A 2015 UC Cooperative Extension costs and

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**Table 2. Oranges, 1985–2015**

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Harvested Acreage (acres)</td>
<td>173,899</td>
<td>202,804</td>
<td>193,005</td>
<td>167,077</td>
</tr>
<tr>
<td>Yield (tons/acre)*</td>
<td>9.06</td>
<td>11.46</td>
<td>12.60</td>
<td>14.80</td>
</tr>
<tr>
<td>Value of Production ($1000)</td>
<td>1,398,273</td>
<td>1,392,333</td>
<td>1,306,184</td>
<td>1,425,949</td>
</tr>
<tr>
<td>Revenue ($/acre)</td>
<td>8,041</td>
<td>6,865</td>
<td>6,768</td>
<td>8,535</td>
</tr>
</tbody>
</table>

Source: CDFA, 2015

*Yield data for navel oranges

**Table 3. Lemons, 1985–2015**

<table>
<thead>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvested Acreage (acres)</td>
<td>46,376</td>
<td>48,893</td>
<td>45,054</td>
<td>46,743</td>
</tr>
<tr>
<td>Yield (tons/acre)</td>
<td>13.04</td>
<td>15.61</td>
<td>15.59</td>
<td>16.14</td>
</tr>
<tr>
<td>Value of Production ($1000)</td>
<td>501,737</td>
<td>520,189</td>
<td>408,779</td>
<td>772,265</td>
</tr>
<tr>
<td>Revenue ($/acre)</td>
<td>10,819</td>
<td>10,639</td>
<td>9,073</td>
<td>16,522</td>
</tr>
</tbody>
</table>

Source: CDFA, 2015
returns study for the Southern San Joaquin Valley assumes a 40-year production cycle. At the end of the fifth year, net accumulated cash costs (operating and cash overhead) are around $4,300 per acre. Once the grove is in full production, total operating costs are slightly under $8,800, of which harvest costs are almost two-thirds. Pest and disease management costs and pruning are each 5 percent of costs (O’Connell et al., 2015).

Lemon acreage remained stable between 1985 and 2015, while yields increased by 20 percent. Revenues per acre, which are determined by yield and price, increased by a third. The total value of production increased by 50 percent.

Table 4. Peaches, 1985–2015

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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvested Acreage (acres)</td>
<td>58,623</td>
<td>69,566</td>
<td>78,778</td>
<td>55,532</td>
</tr>
<tr>
<td>Yield (tons/acre)*</td>
<td>18.00</td>
<td>15.44</td>
<td>15.66</td>
<td>17.58</td>
</tr>
<tr>
<td>Value of Production ($1,000)</td>
<td>518,165</td>
<td>497,383</td>
<td>570,006</td>
<td>665,054</td>
</tr>
<tr>
<td>Revenue ($/acre)</td>
<td>8,839</td>
<td>7,064</td>
<td>7,236</td>
<td>11,976</td>
</tr>
</tbody>
</table>

Source: CDFA, 2015

*Yield data for clingstone peaches

Table 5. Plums and Prunes, 1985–2015

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvested Acreage (acres)</td>
<td>106,232</td>
<td>129,318</td>
<td>105,165</td>
<td>71,144</td>
</tr>
<tr>
<td>Yield (tons/acre)</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Value of Production ($1,000)</td>
<td>579,683</td>
<td>614,632</td>
<td>432,058</td>
<td>467,536</td>
</tr>
<tr>
<td>Revenue ($/acre)</td>
<td>5,457</td>
<td>4,753</td>
<td>4,108</td>
<td>6,572</td>
</tr>
</tbody>
</table>

Source: CDFA, 2015

Peach acreage decreased between 1985 and 2015, although in 2005 acreage was around a third higher than in 1985. Yields fluctuated between 16 and 18 tons an acre, and revenues per acre and the value of production increased by a third to $12,000 an acre.

Plum and prune acreage was reported by 1,400 farms, including 57 percent with fewer than 15 acres and 14 percent with 100 acres or more. Plum production for the fresh market and plum production for the prune (dried plum) market use different cultivars that are reflected in differences in the size distributions of farms. For example, 58 percent of plum operations reported fewer than 15 acres in plums, and only 4 percent had 100 or more acres. In contrast, 24 percent of prune operations reported fewer than 15 acres in plums for prune production, and the same

Tree Fruits: Peaches and Plums

About 1,700 farms reported peaches in the 2012 Census, including clingstone, freestone, or both. Most were small: 71 percent reported fewer than 15 acres, while 8 percent reported more than 100 acres. Operations with clingstone peaches differed from freestone peach farms, as 78 percent of freestone peach operations reported 15 or fewer acres, compared with two-thirds of clingstone operations. At the other end of the distribution, 1 percent of farms with clingstone acreage reported 100 or more acres, compared with 5 percent of freestone peach operations. Over half of freestone peach acreage is in Fresno and Tulare counties, while clingstone peaches are concentrated in the Northern San Joaquin and Sacramento Valleys.

According to a 2017 UC Cooperative Extension costs and returns study for processing peaches in the Central Valley, peaches generate commercial yields in the third year and continue to yield for another 15 years. At the end of year 4, net accumulated cash costs are around $6,600 an acre, and then total operating costs drop to $5,600 per acre, of which harvest costs are a third. Pest and disease management costs are 14 percent, and fruit thinning is about a fifth (Halsey et al., 2017).

Plum acreage remained stable between 1985 and 2015, while yields increased by 20 percent. Revenues per acre, which are determined by yield and price, increased by a third. The total value of production increased by 50 percent.
percentage reported at least 100 acres. Most plum acreage is in Fresno and Tulare counties (88 percent) in the San Joaquin Valley, while 86 percent of prune acreage is in the Sacramento Valley.

Different systems produce fresh plums and prunes. A 2016 UC Cooperative Extension cost and return study in the Southern San Joaquin Valley reports that fresh plums generate a commercial crop in year 3 and reach yield maturity in years 5 to 7, and continue yielding for 18 years. Establishment costs are $7,000 an acre, the total accumulated net cash cost at the end of year 3. Once in production, annual operating costs per acre are $11,366, with three-fourths reflecting harvest costs. Irrigation costs are 8 percent of total operating costs, thinning is about 4 percent, and pest and disease management costs are about 3 percent (Day et al., 2016).

The most recent cost study for prune production was conducted in 2012. Prunes achieve economic production in the fourth year after planting and reach full production beginning in year 7, with orchard life estimated to be 30 years. The establishment cost at the end of year 4 is $7,635, and accumulated net cash costs increase through year 7. Once in full production, annual operating costs are $3,200 per acre, with harvest costs 60 percent and pest management costs are about 10 percent (Buchner et al., 2012).

Plum and prune acreage declined by a third between 1985 and 2015, and revenue per acre and the total value of production declined by a fifth.

### Avocados and Cherries

California produces an average 350 million pounds of avocados each year, which is 85 percent of U.S. production. The state’s avocado production peaks during the summer months. Table 39 of the 2012 COA reported 7,500 U.S. farms with 73,500 acres of avocados, including 120 farms that each had 100 or more acres and accounted for 40 percent of total U.S. avocado acreage.

California had 5,200 avocado farms in 2012, including 84 percent with fewer than 15 acres and 2 percent with 100 or more acres. Avocados are grown primarily in San Diego and Ventura counties, which had 69 percent of the state’s acreage in 2015.

Avocados (and bananas) are a climacteric fruit that matures on the tree but ripens off the tree. Avocados are picked when they are hard and green and ripen at room temperature in two weeks, or faster if exposed to ethylene gas. Avocados can remain on trees without damage for weeks.
California Agriculture: Dimensions and Issues

Avocado harvests begin in year 3 and trees reach full production in year 5. A 2011 University of California Cooperative Extension study estimated accumulated cash costs in year 4 of $21,800 an acre in Ventura and Santa Barbara counties, and annual operating costs of $4,600, with harvest costs 40 percent of operating costs. Irrigation accounts for 20 percent of costs, and pest and disease management costs are 7 percent (Takele, Faber, and Wu, 2011).

Avocado acreage and yield declined between 1985 and 2015. Revenues per acre increased by 40 percent due to higher prices that reflected higher consumption. Per capita use of avocados was over seven pounds per person in 2015/16, double the per capita consumption in 2005/06.

California has 1,000 farms producing sweet fresh cherries, including 56 percent with fewer than 15 acres and 10 percent with 100 or more acres. San Joaquin County accounted for slightly over half of California cherry acreage in 2015.

Cherries reach economic yields in year 4 and full yields in year 9, and are viable for 25 years. A 2017 UC Cooperative Extension cost and return study estimated net cash costs at the end of year 4 at $8,688 per acre and operating costs per acre at $15,000, with harvest costs 80 percent of operating costs. Pruning was 6 percent of costs and pest and disease management 5 percent (Grant et al., 2017).

Cherry acreage almost quadrupled between 1985 and 2015. Yields declined by 15 percent, and revenue per acre declined by around 5 percent. The total value of production increased sharply.

Packers and Shippers

There are a relatively small number of buyers of most fruits and tree nuts. For example, the California Avocado Society reported that 93 percent of the state’s avocados were handled by 12 packer/shippers (http://www.californiaavocadosociety.org/packers-and-handlers.html), while the California Avocado Commission lists 16 (http://www.californiaavocado growers.com/industry/packers-and-handlers). Calavo, formed as a grower cooperative in 1924 and now a publicly traded company, shipped 35 percent of the avocados consumed in the U.S. in 2005 (http://www.calavo.com/store/history.html).

The California Cherry Board lists 23 shippers (http://calcherry.com/our-growers/), while the California Dried Plum Board lists 23 packers (https://www.californiadriedplums.org/growers-and-packers/list-of-packers) and the California Canning Peach Association lists six processors (http://www.calipeach.com/processors/).

Many fruits have marketing orders that collect grower-paid fees to engage in activities such as advertising, health research, and production research. If the majority of growers representing the majority of production approve, all growers can be compelled to support these activities, with first handlers collecting a fee for each box or bin handled. Boards, commissions, and other groups may be created by state or federal law. The California Avocado Commission, California Cherry Board, Citrus Research Board and California Citrus Nursery Program, California Canning Peach Advisory Board, and California Dried Plum Board are state organizations.

Cooperatives and voluntary associations are also important. Sunkist, a grower cooperative, markets a significant share of California citrus production, while the California Canning Peach Association is a bargaining cooperative for peach growers. The California Fresh Fruit Association is a voluntary trade association that focuses on public policy issues for its members, who produce 95 percent of deciduous tree fruit shipped from California and 85 percent of table grapes (http://www.cafreshfruit.org/about-california-fresh-fruit-association). California Citrus Mutual is a voluntary trade association that focuses on public policy issues and advocates for citrus producers.

Outlook

Figure 3 shows the five fruits with the largest declines in acreage since 1985. The list is led by cantaloupes, whose acreage declined over 50 percent, and is followed by Valencia oranges, pears, apricots, and grapefruit with 40 percent acreage declines.

Of the fruits with the largest percentage declines in acreage, Figure 4 shows that only cantaloupes and Valencia oranges were among the five fruits with the largest absolute declines in acreage, over 100,000 acres apiece. Valencia oranges are typically used to make orange juice.
Their acreage began to decline in the early 2000s and has continued to fall as orange juice consumption drops. Raisin grape, avocados, and dried plums had the next largest absolute declines.

On a percentage basis, raspberries displayed the largest percentage increase in acreage, but from a very low base. Cherries displayed the second largest percentage increase in acreage. As shown in Figure 5, the three remaining fruits in the top five percentage increases in acreage were strawberries, wine grapes, and freestone peaches.

Figure 6 shows the five fruits with the largest increases in acreage, led by cherries and followed by strawberries and wine grapes, and then table grapes and navel oranges.

Fruits with the largest decreases in acreage were also those with the largest decreases in the value of production. Figure 7 shows the five fruits with the largest absolute declines in their value of production between 1985 and 2015 (measured in 2015 dollars). Valencia oranges, cantaloupes, and raisin grapes had large declines in value and declines in acreage, followed by plums and prunes.
and grapefruit. Declining consumption of dried fruit and increased competition from lower cost imports means that some raisin grape vineyards and plum orchards are being replaced by nuts.

Figure 8 shows the five fruits with the largest absolute increases in the value of production between 1985 and 2015. Four of the five were also among the five fruits with the largest absolute increases in acreage.

Figure 9 plots the farm share of the retail price for selected fresh fruit. Since the mid-1990s, the farm share of the retail price has increased for all fresh fruit, but not for oranges, lemons, and peaches.
Figure 7. Five Fruits with Decreasing Values, 1985–2015

Source: CDFA, 2015

Figure 8. Five Fruits with Increasing Values, 1985–2015

Source: CDFA, 2015

Figure 9. Farm Share of Retail Prices for Selected Fruits, 1995–2015

Almonds, walnuts, and pistachios are California’s major tree nuts. Almonds were California’s most valuable crop in 2015, walnuts were ranked ninth, and pistachios were ranked fifteenth (CDFA, 2016). U.S. per capita tree nut consumption increased by 62 percent between 1994–1998 and 2007–08, from 1.7 to 2.6 pounds (ERS, 2016). For 2015/16, per capita utilization for almonds was 1.8 pounds; for walnuts, 0.39 pounds; and for pistachios, 0.20 pounds (USDA, 2017). The substantial increase in nut consumption over the past two decades has been associated with their health benefits (Ros, 2010).

Most California tree nuts are exported. California is the world’s largest almond producer, accounting for 80 percent of world production. Approximately two-thirds of the California crop was exported in 2015 (CDFA, 2016). California is the world’s third largest producer of walnuts after China and Iran.

Nut crops are three of California’s top five agricultural exports. Almonds were California’s largest agricultural export commodity by value in 2015 ($5.1 billion) followed by dairy products ($1.6 billion) and walnuts ($1.5 billion). Pistachios ranked fifth ($0.8 billion) behind wine ($1.5 billion). These three nut crops accounted for over a third of all agricultural exports (CDFA, 2016). California accounts for almost all U.S. almond, English walnut, and pistachio production. Table 8 ranks nut crops by their 2015 value of production.

There were 6,000 almond farms in the 2012 Census of Agriculture, including 28 percent with 100 or more harvested acres; 2 percent reported 1,000 or more harvested acres (NASS, 2017), while 26 percent harvested fewer than 15 acres. Most almond acreage is in the San Joaquin Valley, with half in four counties: Kern, Fresno, Stanislaus, and Madera. There are roughly 100 almond processors and handlers (Agricultural Issues Center and Romero, 2015).

Almond acreage increased by 170 percent between 1985 and 2015, and revenues per acre increased by 267 percent in inflation-adjusted dollars. The total value of almond production increased ninefold.

A 2016 UC Cooperative Extension costs and returns study for almond production in the Southern San Joaquin Valley estimated an establishment cost of $8,072 per acre, with annual operating costs of $4,027, including 10 percent or $421 for harvesting, about the same as pollination costs of $400 an acre. Pest and disease management costs are 15 percent of total operating costs, and winter sanitation is an additional 6 percent (Yaghmour et al., 2016).

A 2016 study for almond production in the Sacramento Valley estimated an establishment cost of $4,591 per acre and annual operating costs of $2,267 per acre, including harvest costs of 17 percent and pollination costs of 20 percent (Pope et al., 2016). In 2016, irrigation water was the major difference in costs between the Sacramento and San Joaquin Valley: $392 per acre in the Sacramento Valley and $2,490 in the San Joaquin Valley.

The 2012 Census of Agriculture reported 5,000 walnut farms, including 15 percent with 100 or more harvested acres and 1 percent with 1,000 or more harvested acres (NASS, 2017). Half of all walnut operations harvested less than 15 acres. Walnut production is spread throughout the Central Valley, from Shasta County in the north to Kern County in the south. The top three counties in 2015 were San Joaquin County (Northern San Joaquin Valley), Butte

Table 8. California Tree Nuts by Value, 2015

<table>
<thead>
<tr>
<th>Rank</th>
<th>Crop</th>
<th>2015 Value of Production ($1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Almond</td>
<td>7,130,359</td>
</tr>
<tr>
<td>2</td>
<td>Walnut</td>
<td>1,549,118</td>
</tr>
<tr>
<td>3</td>
<td>Pistachio</td>
<td>895,894</td>
</tr>
<tr>
<td>4</td>
<td>Pecan</td>
<td>7,972</td>
</tr>
</tbody>
</table>

Source: CDFA, 2015
County (Sacramento Valley) and Tulare (Southern San Joaquin Valley). There are about 100 walnut processors (Boriss, Brunke, Krieth, and Romero, 2015).

A 2015 UC Cooperative Extension costs and returns study estimated an establishment cost of $7,212 per acre, which can be amortized over 30 years of production. Annual operating costs are $2,241 per acre and harvest costs are half of total operating costs, while pest and disease management costs are one-quarter.

Walnut acreage more than doubled between 1985 and 2015, and yields increased by a third. Revenues per acre, reflecting changes in both yield and prices, effectively doubled and the total value of production quadrupled.

There were slightly more than 1,000 pistachio farms in 2012, including 29 percent that harvested 100 or more acres and 3 percent that harvested more than 1,000 acres; 35 percent harvested fewer than 15 acres. Virtually all pistachio acreage is in the San Joaquin Valley, including one-third in Kern County. Pistachios must be processed within 24 hours of being harvested.

A 2015 UC Cooperative Extension costs and returns study estimated an establishment cost of $11,207 per acre for a pistachio orchard in the Southern San Joaquin Valley and annual operating costs of $2,641. Harvest costs are 15 percent of operating costs, pest and disease management 18 percent, and winter sanitation 5 percent (Brar et al., 2015).

Pistachio acreage increased eightfold between 1985 and 2015, and the value of the crop increased almost eightfold as well.
Figure 10. Harvested Acreage of Tree Nuts, 1985–2015

Source: CDFA, 2015

Figure 11. Harvested Acreage of Tree Nuts, 1985–2015

Source: CDFA, 2015

Figure 12. Value of Production of Tree Nuts, 1985–2015

Source: CDFA, 2015
Trends

Figure 10 plots harvested acreage for California tree nuts from 1985 to 2015. The three major nuts—almonds, walnuts, and pistachios—have increased in acreage. Almond acreage is substantially higher than that for the other two nuts, and is plotted against the right-hand axis.

Figure 11 “stacks” the acreage of the three major tree nuts between 1985 and 2015. The acreage of many major fruits have declined, and some fruit orchards have been converted to nuts, as in parts of eastern Tulare County.

The value of production followed a similar path until 2015, when the price of almonds fell from $4.00 per pound in 2014 to $2.84 per pound (CDFA, 2016). Walnuts also experienced a significant price decrease, from $3,340 a ton to $1,620 a ton, while pistachio prices and yields fell substantially: from $3.57 to $2.48 per pound and from 2,330 to 1,160 pounds per acre.

Labor Challenges

Half of the 80 top policy issues mentioned by the Board of Directors of the California Fresh Fruit Association between 2010 and 2017 involved labor, including potential enforcement to prevent the hiring of unauthorized workers, immigration reform to provide a legal workforce, and federal and state laws dealing with unionization, health and safety, and minimum wages and overtime (http://www.cafreshfruit.org/top-10-issues).

The state’s largest peach grower, Gerawan Farms, has been embroiled in a dispute with the United Farm Workers since the early 1990s, including an unsuccessful challenge to the state’s 2002 Mandatory Mediation and Conciliation (MMC) law. The California Supreme Court in November 2017 held that a union remains certified to represent farm workers until that union is decertified lawfully by current workers.

The Agricultural Labor Relations Act was enacted in 1975 “to ensure peace in the agricultural fields by guaranteeing justice for all agricultural workers and stability in labor relations.” Contemporary observers expected the ALRA to usher in an era when most of the state’s farm workers would work on farms with collective bargaining agreements. In fall 1975, there were almost 100 elections a month, and unions won over 95 percent of those whose results were certified.

Election activity slowed in the 1980s and 1990s after internal UFW changes, Republican appointments to the Agricultural Labor Relations Board, and rising unauthorized migration. Despite a unique make-whole remedy for bad-faith bargaining that requires employers who fail to bargain in good faith to make their employees whole for any wage and benefit losses while the employer failed to bargain as required, the UFW charged that employers were delaying bargaining, discouraging workers from voting for union representation.

The UFW in 2002 persuaded the California Legislature to enact the MMC law to reduce employer-caused delays after unions were certified to represent workers by ensuring a collective bargaining agreement within a year of a union being certified. After bargaining for six months, MMC allows unions or employers to request a mediator to help reach an agreement. If mediation fails, the mediator becomes an arbitrator and develops a contract that the ALRB can order the parties to implement.

The expectation was that MMC would unleash a wave of organizing, elections, and collective bargaining agreements at farms that never had elections or contracts. Instead, MMC was invoked at so-called “old certifications,” cases where a union was certified to represent workers before 2002, the employer committed an unfair labor practice, and a collective bargaining agreement was never signed.

Gerawan was an old certification. The ALRB certified the UFW as the bargaining representative for Gerawan workers in July 1992, but no contract was negotiated during a February 1995 bargaining session, and there were no further negotiations.

The UFW in 2012 requested bargaining and, after several bargaining sessions, the UFW requested mediation. Many of Gerawan’s workers objected to UFW representation, pointing out that only a few workers who voted for the UFW in 1990 were still at Gerawan in 2012. They asked the ALRB to supervise an election to de-certify the UFW, which was held in November 2013. However, the ALRB found that Gerawan unlawfully interfered with the decertification election, and the votes were not counted.
Meanwhile, a mediator developed a Gerawan-UFW contract that the ALRB ordered Gerawan to implement. Gerawan refused and challenged the constitutionality of MMC, arguing that MMC allowed the state to impose different rules on different farms. The 5th District Court of Appeal in May 2015 agreed that MMC was unconstitutional, and also agreed that Gerawan should have been able to challenge the UFW’s continued right to represent Gerawan employees after almost two decades of no contact between the UFW and Gerawan.

The California Supreme Court reversed the 5th District Court and upheld the constitutionality of the MMC law and upheld the ALRB’s finding that a union remains certified to represent farm workers until it is decertified. The Supreme Court found that a mediator can take into account the unique circumstances of each farm and variance in wages and benefits by commodity and area, so mediator-imposed contracts do not violate equal protection guarantees.

After the ruling, the UFW said that Gerawan workers were owed $10 million based on the difference between the mediator’s contract and the wages and benefits that were paid by Gerawan since 2013. Gerawan disputes this assertion, saying it would not have agreed to a contract with higher wages and benefits even with good-faith bargaining.

**Mechanization**

Labor costs are rising for all farmers who hire workers, but especially for growers of fresh fruit. Machines grasp the trunks of trees and shake tree nuts to the ground, where they are swept into rows, picked up by machine, and cleaned and sorted before being processed. Fresh fruit trees that are picked multiple times, and where the fruit is sometimes obscured by leaves and limbs, are a more difficult challenge for harvesting machines.

There are experiments underway to make fruit trees more amenable to machine harvesting, including planting dwarf trees so that the fruit falls a shorter distance and improving machine vision systems to detect ripe fruit and robotic arms to pick it. Another approach is to develop new varieties of apples and peaches that produce fruit that ripens more uniformly. If 80 to 90 percent of the fruit could be harvested in one pass through the field, shake-and-catch machines with catching skirts that surround the tree trunk so that the fruit does not touch the ground could spread quickly.

Most analysts expect a wave of mechanization in fresh fruit orchards by 2030 in reaction to higher labor costs. Until then, many farmers are experimenting with mechanical aids, including hydraulic lifts that eliminate the use of ladders to harvest tree fruit, which makes these jobs more appealing to older workers and women. The most recent comprehensive survey of the status of mechanization in fresh fruit harvesting concluded that mechanization required “new varieties, new cultural practices, and pre- or post-harvest treatments to improve ripeness uniformity and decrease both the susceptibility to and consequences of produce damage.” (Sarig, 2000)

**Declining Fruit Consumption**

Fruit consumption, whether measured in pounds or consumption events, has declined, with the exception of at-home consumption events for fresh fruit purchased from stores, rising from 130 events in 2004 to 150 events in 2014. Frozen, canned, dried, juice, and homegrown fruit consumption events decreased.

One barrier to increasing fruit consumption is meals away from home. Restaurants account for 10 percent of all meals but only 2 percent of fruit consumption events. Seniors consume the most fruit, but their consumption per capita has declined the most among demographic groups. Declining domestic consumption, all else equal, reduces prices and increases the importance of exports.

Of California’s top 15 fruits, only berries have realized significant gains in consumption events. Bananas (46 events), a non-California crop, and apples (32), a smaller California fruit crop, account for a substantially larger share of consumption events than the next three most commonly consumed fruits: berries (24), oranges (14), and grapes (12) (Produce for Better Health Foundation, 2015). Seasonality means that California’s market share is not constant throughout the year, and consumption events do not represent only California fruits.
There are many fruits, and organizations representing one commodity, such as apples or pears, tend to focus on enhancing demand for their commodity rather than for all fruit. Since 1991, the “Five a Day” public-private program has promoted fruit and vegetable consumption with several organizations cooperating to promote increased consumption. The Produce for Better Health Foundation was formed in 1991 by commodity groups, and supports the “Fruits and Veggies: More Matters” initiative (https://www.fruitsandveggiesmorematters.org/).

Invasive Species

An invasive species is a non-native plant, animal, microbe or disease that causes economic or environmental damage in one or more agricultural or natural systems. In addition to reducing marketable yield and negatively impacting plant health and future yields through direct damage and the transmission of disease, invasive species can negatively affect exports due to phytosanitary regulations in importing countries. Pimente, Zuniga, and Morrison (2005) estimated that for the U.S. as a whole, losses due to invasive species are $120 billion a year.

The California Department of Food and Agriculture’s Plant Health and Pest Prevention Services Division is responsible for state efforts to detect, eradicate, and manage invasive species. CDFA had detection and emergency projects for 18 insect pests and 3 diseases regarded as significant sources or potential sources of economic and environmental damage in 2017 (CDFA, 2017b). Sumner, Brunke, and Krieth (2006) estimated that each state dollar has a benefit-cost ratio ranging from 2.8 to 5.1 in terms of economic damages averted.

Not all non-native species become invasive species. A species must first be introduced, become established, and spread. Invasive species can be addressed through prevention (trapping, inspection at borders, quarantines), eradication, and ongoing management. According to the Center for Invasive Species Research (CISR) at the University of California, Riverside, 10 percent of species that enter a new ecosystem will survive, and 10 percent of the survivors will become invasive (CISR, 2017).

Three invasive species of current concern in California fruit crops include the polyphagous shot hole borer, the Mediterranean fruit fly, and the Asian citrus psyllid. The Polyphagous Shot Hole Borer (PSHB) is an economic pest in avocados that carries the fungal pathogen, *Fusarium euwallaceae*, and causes Fusarium dieback disease, which disrupts the tree’s ability to transport water and nutrients (Eskalen, Dimson, and Kabashima, 2015). The pest and the disease it carries have many other host species, but the largest potential economic impact is associated with avocados (Eskalen, 2017).

The Mediterranean fruit fly (medfly) has appeared repeatedly in California, leading to significant damage and disruption. The fly lays eggs under the skin of fruit, making it unmarketable. The medfly was detected in San Mateo County in December 2017, leading CDFA to place a quarantine on parts of the county. California seeks to eradicate the medfly when it is detected by releasing sterile males and using targeted applications of the organic pesticide Spinosad (CDFA, 2017a).

The California citrus industry is currently facing a serious invasive species problem: Asian citrus psyllid, which transmits huanglongbing disease (also known as citrus greening disease). In the nymph stage, the Asian citrus psyllid survives on the new flush tips of citrus leaves and generates a substance that is toxic to the tree, causing the leaves to stop growing properly. Diseased trees produce commercially undesirable fruit that is small, unattractively colored, and distorted in shape with bitter juice.

The spread of huanglongbing disease in Florida was associated with a substantial decline in citrus acreage. In California, the disease was detected in backyard citrus a decade ago, prompting efforts to remove infected plants. If the pest and disease were to appear in commercial citrus production regions, the cost of eradicating diseased trees would be significant (Grafton-Cardwell, 2017).
Conclusions

Tree fruits and nuts account for 40 percent of the state’s farm sales, and tree nuts such as almonds are important agricultural exports. California’s tree nut acreage and production are increasing, while the acreage and production of tree fruits such as peaches and oranges is decreasing.

Tree fruits face more challenges than nuts, which have enjoyed rising production and prices but may face market saturation and water issues. Harvesting tree fruit is a labor-intensive process that is now done largely by unauthorized workers. The costs of labor are rising with the state’s minimum wage, prompting efforts to mechanize pruning and harvesting. Meanwhile, the fruit industry must grapple with declining consumption and threats from invasive species.
References


