

CHAPTER 7. CALIFORNIA'S FRUITS AND TREE NUTS

RACHAEL E. GOODHUE, PHILIP L. MARTIN, AND LEO K. SIMON

ABSTRACT

California produces three-fourths of U.S. fruits and nuts. The state's fruits and nuts were worth \$22 billion in 2017, 44 percent of the state's \$50 billion in farm sales. Nuts were worth over \$8 billion, including almonds, \$5.6 billion; walnuts, \$1.6 billion; and pistachios, \$1 billion. Grapes were worth \$6.5 billion, including over 60 percent from wine grapes and almost 20 percent each from table grapes and raisins. Berries were worth \$3.7 billion, including \$3.1 billion from strawberries, \$450 million from raspberries, and \$138 million from blueberries. The most valuable tree fruits are oranges, worth \$1.9 billion in 2017; lemons, \$820 million; avocados, \$383 million; and peaches, \$540 million. Plums were worth \$345 million and cherries \$330 million. The acreage of tree nuts is rising, while the acreage of citrus, peaches, pears, and plums is declining.

ABOUT THE AUTHORS

Rachael E. Goodhue is a professor and chair of the Department of Agricultural and Resource Economics at UC Davis. She can be contacted by email at regoodhue@ucdavis.edu. Philip L. Martin is an emeritus professor in the Department of Agricultural and Resource Economics at UC Davis. He can be contacted by email at plmartin@ucdavis.edu. Leo Simon is an adjunct professor in the Department of Agricultural and Resource Economics at UC Berkeley. He can be contacted at leosimon@berkeley.edu. All are members of the Giannini Foundation of Agricultural Economics.



California leads among U.S. states in the production of 28 fruits and nuts. Nut crops are three of California's top five agricultural exports. In 2017, almonds were California's largest agricultural export commodity by value at \$4.5 billion.

Photo Credit: Brittney Goodrich, UC Davis

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INTRODUCTION

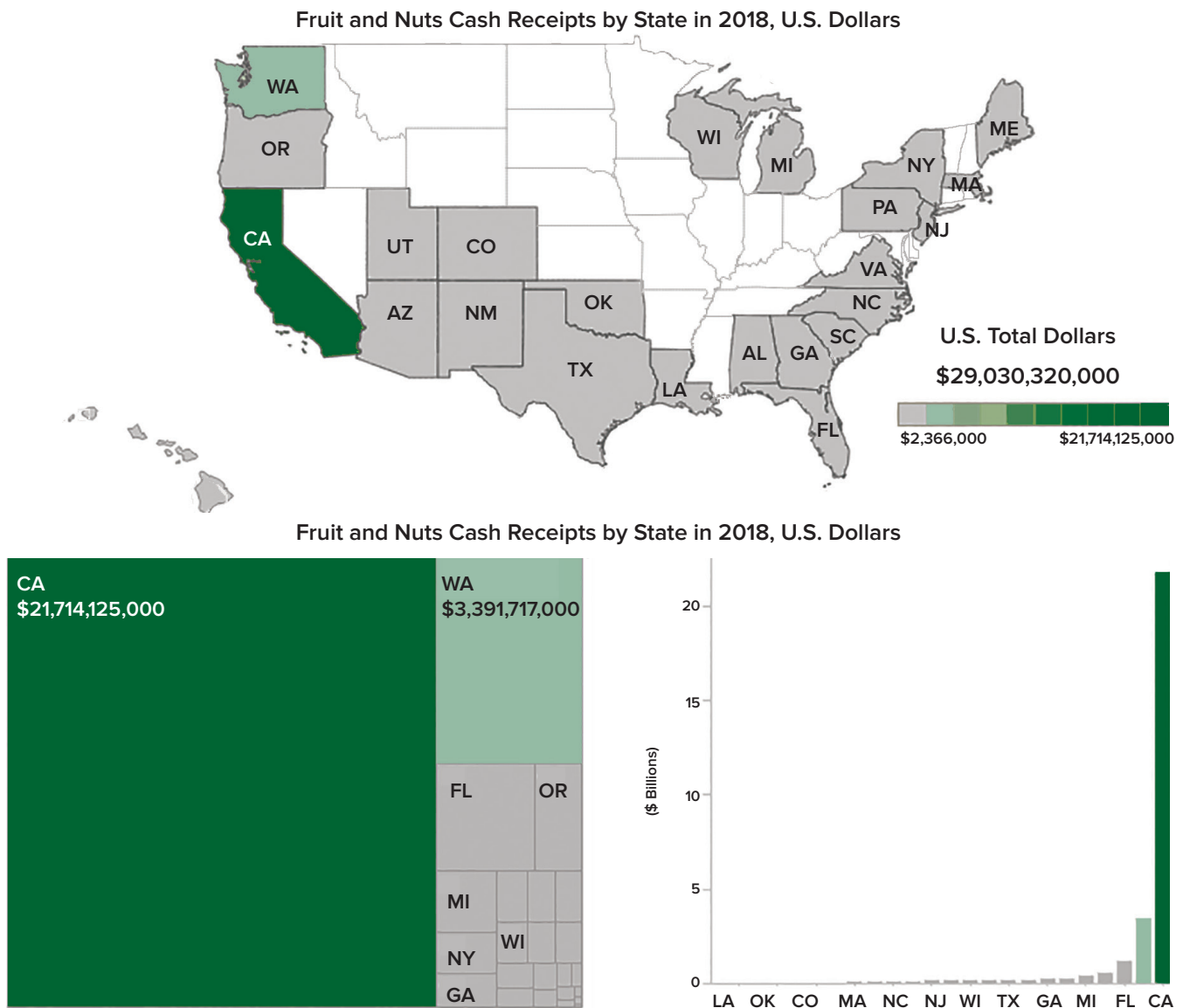
California leads among U.S. states in the production of 28 fruits and nuts, and was the sole commercial producer of 11 fruits and nuts (CDFA, 2018).¹ U.S.-produced fruits and nuts were worth \$29 billion in 2018, and California's \$22 billion was three-fourths of U.S. fruit and nut cash receipts. This chapter covers six major fruits: oranges, lemons,

peaches, avocados, prunes and plums, and cherries, and three major tree nuts: almonds, walnuts, and pistachios.

Figure 7.1 shows that California accounted for three-fourths of U.S. fruit and nut cash receipts in 2018. 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.

¹ Statewide and county data for figures and tables in this chapter are available at: <https://www.cdfa.ca.gov/Statistics/> and https://www.cdfa.ca.gov/exec/county/county_liaison.html

Figure 7.1. California Accounted for Three-Fourths of U.S. Fruit and Nuts Cash Receipts in 2018



Source: The ERS Farm Income Team. Available at: <https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics.aspx>

Note: States without shading have no production for this commodity or are included in miscellaneous crops or all other animals and animal products.

FRUIT

The U.S. produced fresh fruit worth almost \$20 billion in 2018, including \$16.4 billion worth of noncitrus fruit and \$3.3 billion worth of citrus (USDA, 2017 *Fruit and Tree Nut Yearbook*, Table A-3). The leading U.S. fruits by value were grapes for all uses, \$6.6 billion in 2018; apples, \$3.0 billion; strawberries, \$2.7 billion; and oranges, \$1.8 billion; these four fruits accounted for 70 percent of U.S. fresh fruit production in 2018.

Over half of U.S. fresh fruit is imported, up from a quarter in 1975. One reason is year-round availability that led to increased per capita consumption of mangoes, limes, avocados, grapes, asparagus, artichokes, and squash. Mexico provides about half of U.S. fresh fruit imports, followed by Chile with 15 percent and Guatemala with 10 percent. Projections suggest that three-fourths of U.S. fresh fruits and half of U.S. fresh vegetables may be imported by 2030, up from one-half and 30 percent today.

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, the number of “consumption events,” instances of people consuming fruit, decreased from an average 315 to 296 a year, driven by the decline in fruit juice consumption, according to the Produce for Better Health Foundation in 2015.

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 a year, oranges for 14 events, melons for 13, grapes for 12, and peaches for six. Overall, 83 percent of fruit consumption events involved fruit eaten without additional preparation.

California’s top agricultural exports in 2017 included several fruits: table grapes (No. 6, \$795 million worth of exports); oranges (No. 7, \$677 million); strawberries (No. 10, \$415 million); raisins (No. 16, \$307 million); and lemons (No. 17, \$219 million). The state’s agricultural exports were \$19 billion, so these five fruits accounted for 12 percent of all agricultural exports (CDFA, 2016).

California produces a wide variety of fresh fruits, led by grapes and strawberries. San Joaquin Valley is the U.S. fruit and nut bowl, where most of California’s fruits and nuts are produced. California had 23,000 farms producing non-citrus fruits in 2017 from 1.2 million acres of orchards; 6,581 farms producing citrus fruits from 312,162 acres; and 13,676 farms producing tree nuts from 2 million acres (Census of Agriculture, Table 37).

For each type of fruit and nut, most producers are small, with fewer than 100 acres, but these smaller producers account for less than half of the total acreage with the exception of avocados. Table 7.1 shows that half of the farms producing noncitrus fruits produced grapes, and one-seventh of grape farms that had 100 or more acres of vineyard accounted for 82 percent of all grape vineyards. Grapes are the noncitrus fruit most concentrated on farms with 100 acres or more, and avocados are the least concentrated; only a quarter of avocado acreage is on farms with 100 or more acres of avocados. In the other fruits, less than 10 percent of farms had 100 acres or more, and they accounted for over half of total acreage.

Citrus crops are similar in having most acreage on relatively few farms with 100 or more acres. Less than 10 percent of lemon and orange farms are 100 or more acres, but these farms accounted for 60 percent or more of total acreage. A higher share of nut farms, 20 to 30 percent, have 100 or more acres, but these larger farms accounted for 80 to 90 percent of the acreage of almonds, pistachios, and walnuts.

Table 7.1. California Fruit and Nut Farms in 2017

	Farms	Acres	Farms	Acres
	Percent Share > 100 acres			
All Noncitrus Fruit	22,977	1,300,428		
Avocados	4,826	57,192		
>100 acres	107	15,390	2	27
Cherries	1,254	36,853		
>100 acres	83	21,302	7	58
Grapes	11,812	935,272		
>100 acres	1,610	769,175	14	82
Olives	2,124	42,421		
>100 acres	72	22,287	3	53
Peaches	1,688	44,987		
>100 acres	121	29,231	7	65
Plums	1,642	64,702		
>100 acres	158	41,783	10	65
Citrus				
Lemons	2,254	58,190		
>100 acres	115	33,789	5	58
Oranges	4,145	170,241		
>100 acres	381	116,860	9	69
Mandarins (tangerines)	1,747	66,965		
>100 acres	100	47,910	6	72
Nuts				
Almonds	7,611	1,265,815		
>100 acres	2,364	1,103,519	31	87
Pistachios	1,515	334,949		
>100 acres	479	305,668	32	91
Walnuts	5,676	416,201		
>100 acres	1,004	326,000	18	78

Source: Table 37, Census of Agriculture, 2017. Available at: https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_US/usv1.pdf

Note: Walnuts >100 acres acreage is estimated.

Table 7.2. Oranges, 1985–2015

	1985	1995	2005	2015
Harvested Acreage (acres)	173,899	202,804	193,005	167,077
Yield (tons/acre)*	9.06	11.46	12.60	14.80
Value of Production (\$1,000)	1,398,273	1,392,333	1,306,184	1,425,949
Revenue (\$/acre)	8,041	6,865	6,768	8,535

Source: CDFA, *California Agricultural Statistics Review*, 2015. Available at: <http://www.cdfa.ca.gov/Statistics/PDFs/2015Report.pdf>

Note: *Yield data for navel oranges.

Table 7.3. Lemons, 1985–2015

	1985	1995	2005	2015
Harvested Acreage (acres)	46,376	48,893	45,054	46,743
Yield (tons/acre)	13.04	15.61	15.59	16.14
Value of Production (\$1,000)	501,737	520,189	408,779	772,265
Revenue (\$/acre)	10,819	10,639	9,073	16,522

Source: CDFA, 2015

CITRUS: ORANGES AND LEMONS

Most of California's citrus is from Tulare and Kern counties. Navel and Valencia oranges consumed fresh are the most valuable citrus, worth three times more than lemons, and most are from the San Joaquin Valley.

Orange groves typically yield commercial harvests three or four years after planting, and yields stabilize ten years after planting. A 2015 UC Cooperative Extension costs and returns study for the Southern San Joaquin Valley found that accumulated net cash costs to establish an orange grove were \$9,000 an acre at the end of the fifth year. Annual operating costs at full production are \$6,000 an acre, with harvest costs accounting for over half of operating costs while pest and disease management costs are 10 percent (O'Connell, Kallsen, Klonsky, and Tumber, 2015).

Table 7.2 shows that orange yields increased by a third between 1985 and 2015, contributing to the increase in the value of orange production despite a reduction in acreage. Orange acreage increased 17 percent between 1985 and 1995, declined 5 percent between 1995 and 2005, and declined a further 13 percent between 2005 and 2015. In 2015, revenues per acre and the total value of production were slightly higher than in 1985, although 1995 and 2005 values were substantially lower.

California has about half as many lemon farms as orange farms, and lemons account for one-third as much acreage as oranges. Lemons are the one citrus fruit that is not concentrated in the San Joaquin Valley, since Ventura and Riverside counties have about half of the state's acreage.

Lemon groves typically yield commercial harvests in the third or fourth year; yields increase until year 8 and then plateau. A 2015 UC Cooperative Extension costs and returns study for the Southern San Joaquin Valley assumed a 40-year orchard life and found at the end of the fifth year, net accumulated cash costs (operating and cash overhead) were \$4,300 per acre. In full production, total operating costs are slightly under \$8,800, including two-thirds for harvest costs and 10 percent for pest and disease management and pruning (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 one-third. The total value of production increased by 50 percent.

California produced almost all U.S. tangerines (mandarins); 96 percent of U.S. cash receipts of \$576 million in 2018 from 59,000 acres. California also produces some grapefruit.

Table 7.4. Peaches, 1985–2015

	1985	1995	2005	2015
Harvested Acreage (acres)	58,623	69,566	78,778	55,532
Yield (tons/acre)*	18.00	15.44	15.66	17.58
Value of Production (\$1,000)	518,165	497,383	570,006	665,054
Revenue (\$/acre)	8,839	7,064	7,236	11,976

Source: CDFA, 2015

Note: *Yield data for clingstone peaches.

Table 7.5. Plums and Prunes, 1985–2015

	1985	1995	2005	2015
Harvested Acreage (acres)	106,232	129,318	105,165	71,144
Yield (tons/acre)	NA	NA	NA	NA
Value of Production (\$1,000)	579,683	614,632	432,058	467,536
Revenue (\$/acre)	5,457	4,753	4,108	6,572

Source: CDFA, 2015

TREE FRUITS: PEACHES AND PLUMS

California peaches were worth \$372 million in 2018 and plums and prunes \$345 million. California had almost 1,700 peach farms with 45,000 acres in 2017, and the 120 that had 100 or more acres accounted for two-thirds of total acreage. There are two major types of peaches, clingstone and freestone, with similar acreage and value. Clingstone peaches have pits to which the fruit clings, and most are used for canning and freezing. Freestone peach fruit is more easily separated from the pit, most are sold as fresh fruit. Clingstone peach production is concentrated in the Northern San Joaquin and Sacramento Valleys, while freestone peach production is concentrated in Fresno and Tulare counties.

A 2017 UC Cooperative Extension costs and returns study for processing peaches assumed commercial yields in the third year and an orchard life of 18 years. Four years after planting a new orchard, net accumulated cash costs are \$6,600 an acre. Total operating costs are \$5,600 per acre, of which harvest costs are a third. Pest and disease management costs are 14 percent, and fruit thinning is 20 percent (Hasey, Duncan, Sumner, and Murdock, 2017).

Peach acreage decreased between 1985 and 2015, although in 2005 acreage was 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.

Some 1,600 farms reported 65,000 acres of plums and prunes in 2017, including 158 with 100 or more acres and 65 percent of total plum acreage. The difference in the size distribution of farms producing plums reflects the different cultivars used in plum production for the fresh market and plum production of the prune (dried plum) market. Farms that grow plums for the fresh market tend to be smaller and concentrated in Fresno and Tulare counties, while farms that grow prunes or dried plums tend to harvest later and are located mostly in the Sacramento Valley.

A 2016 UC Cooperative Extension costs and returns study in the Southern San Joaquin Valley reported that fresh plums generate a commercial crop in year 3 and reach yield maturity in years 5 to 7, and then 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 are \$11,366 per acre, with three-fourths reflecting harvest costs. Irrigation costs are 8 percent of total operating costs, thinning is 4 percent, and pest and disease management costs are about 3 percent (Day, Klonsky, Sumner, and Stewart, 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

Table 7.6. Avocados, 1985–2015

	1985	1995	2005	2015
Harvested Acreage (acres)	73,533	61,614	67,825	55,081
Yield (tons/acre)	3.14	2.78	2.81	2.68
Value of Production (\$1,000)	377,814	434,156	477,961	400,386
Revenue (\$/acre)	5,138	7,046	7,047	7,269

Source: CDFA, 2015

Table 7.7. Cherries, 1985–2015

	1985	1995	2005	2015
Harvested Acreage (acres)	10,243	16,045	27,143	39,712
Yield (tons/acre)	2.69	1.28	1.80	2.28
Value of Production (\$1,000)	95,659	123,598	218,737	351,907
Revenue (\$/acre)	9,338	7,703	8,059	8,861

Source: CDFA, 2015

\$7,635 per acre, 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 10 percent of total operating costs (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 produced 113,000 tons of avocados in 2018 from 51,000 acres, accounting for 98 percent of U.S. production. The state's avocado production peaks during the summer. California had 4,800 avocado farms with 57,000 acres in 2017 (including non-bearing acres), and the 107 avocado farms that each had 100 or more acres accounted for 27 percent of the state's avocado acreage. Avocados are grown primarily in San Diego and Ventura counties.

Avocados 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.

Avocado harvests begin in year 3 and trees reach full production in year 5. A 2011 UC 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 an acre, with harvest costs accounting for 40 percent of operating costs. Irrigation accounts for 20 percent of costs, and pest and disease management costs are 7 percent (Takele, Faber, and Vue, 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 had 1,254 farms producing sweet fresh cherries in 2017. The 83 cherry farms that each had 100 or more acres accounted for almost 60 percent of the state's almost 39,000 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 costs and returns 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 accounting for 80 percent of operating costs. Pruning was 6 percent of costs and pest and disease management 5 percent (Grant, Caprile, Sumner, and Murdock, 2017). Cherry acreage almost quadrupled between 1985 and 2015. Yields declined by 15 percent, and revenue per acre declined by around 5 percent, but the total value of production increased sharply.

PACKERS AND SHIPPERS

There are a relatively small number of buyers of most fruits. For example, the California Avocado Society reported that 12 packer/shippers handled 93 percent of the state's avocados, while the California Avocado Commission lists 16. 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. The California Cherry Board lists 23 shippers, while the California Dried Plum Board lists 23 packers, and the California Canning Peach Association lists six processors.

Many fruits have marketing orders that collect grower-paid fees to engage in activities such as advertising the commodity and research to deal with pest management and other issues. If the majority of growers representing the majority of production acreage 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 Cling 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. California Citrus Mutual is a voluntary trade association that focuses on public policy issues and advocates for citrus producers.

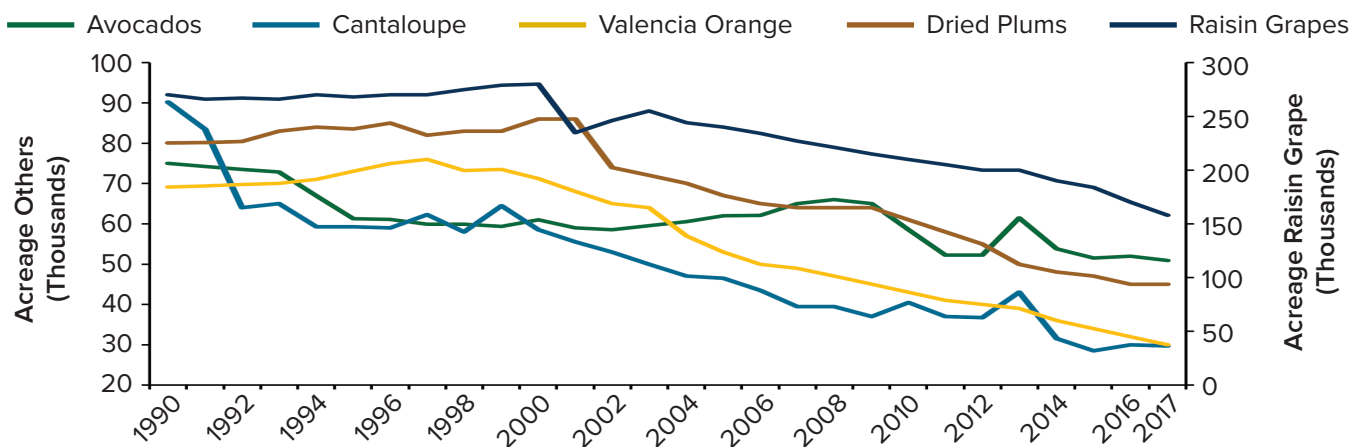
TRENDS

Figure 7.2 shows that cantaloupes and Valencia oranges each declined by more than 100,000 acres over the past two decades. 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 grapes, avocados, and dried plums had the next largest declines in acreage. Fruits with the largest decreases in acreage were also those with the largest decreases in the value of production.

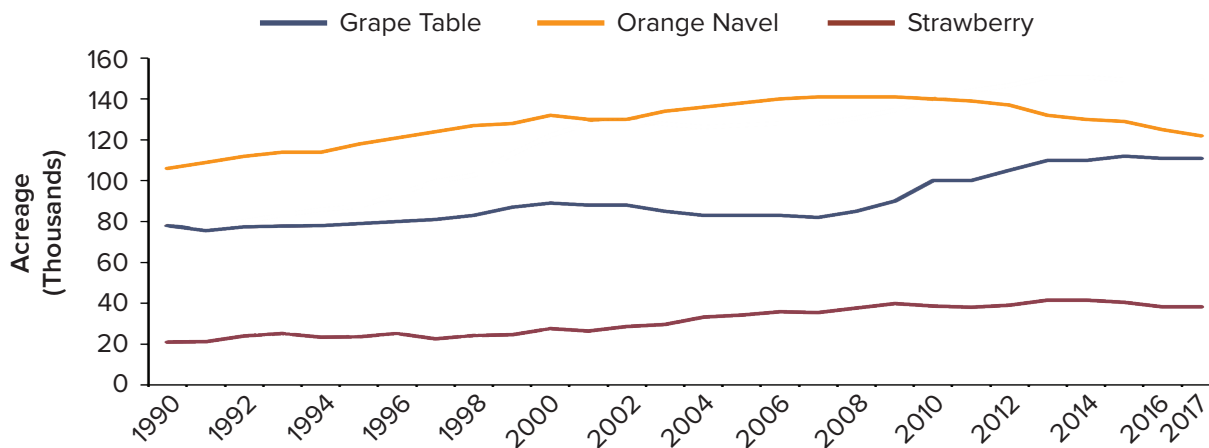
Valencia oranges, cantaloupes, and raisin grapes had large declines in value and declines in acreage, followed by plums and prunes and grapefruit. Declining consumption of dried fruit and increased competition from lower-cost imports means that nuts are replacing some raisin grape vineyards and dried plum orchards.

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

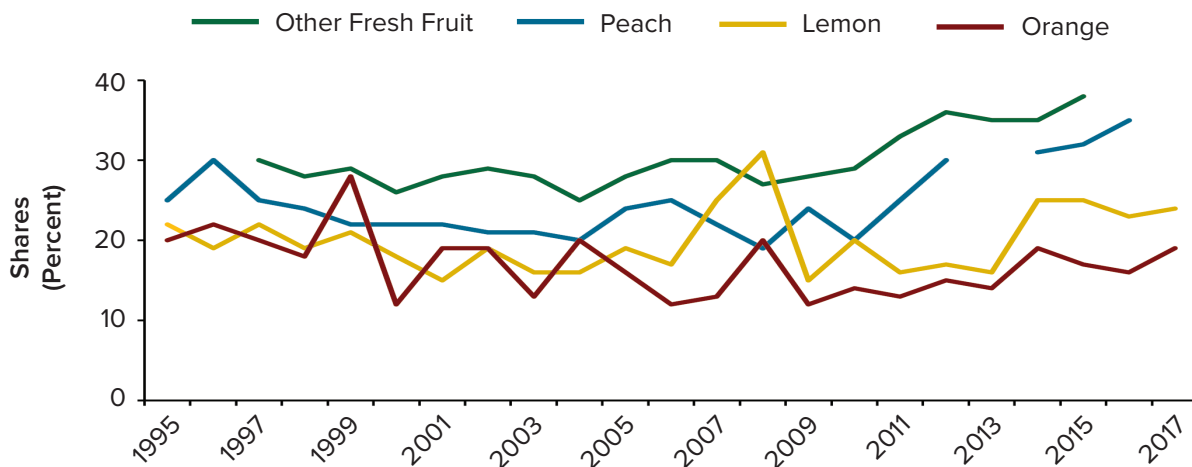
Figure 7.2. Five Fruits with the Largest Absolute Declines in Acreage, 1990–2017



Source: California County Agricultural Commissioners' Report. Available at: https://www.nass.usda.gov/Statistics_by_State/California/Publications/AgComm/index.php

Figure 7.3. Three Fruits with Increasing Acreage, 1990–2017

Source: CDFA, *California Agricultural Statistics Review*, 2017. Available at: <http://www.cdfa.ca.gov/Statistics/PDFs/2016-17AgReport.pdf>

Figure 7.4. Farm Share of Retail Prices for Selected Fruits, 1995–2017

Source: USDA, Economic Research Service. Available at: www.ers.usda.gov/data-products/price-spreads-from-farm-to-consumer.aspx

in acreage. The three remaining fruits in the top five percentage increases in acreage were strawberries, wine grapes, and freestone peaches. Figure 7.3 shows the three fruits with the largest increases in acreage, led by strawberries, and then table grapes and navel oranges.

Figure 7.4 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 except oranges, lemons, and peaches.

TREE NUTS

Almonds, pistachios, and walnuts are California's major tree nuts. Almonds were California's most valuable crop in 2017, walnuts were ranked seventh, and pistachios were ranked ninth (CDFA, 2018). U.S. per capita tree nut consumption increased by 62 percent between 1994 to 1998; between 2007 and 2008, it increased again from 1.7 to 2.6 pounds (ERS, 2016). 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. In 2017, almonds were California's largest agricultural export commodity by value, \$4.5 billion; followed by dairy products, \$1.6 billion; pistachios, \$1.5 billion; and wine and walnuts, \$1.4 billion each. The three nut crops accounted for over one-third of all agricultural exports. Table 7.8 ranks nut crops by their 2017 value of production.

California had 7,600 almond farms in 2017, including 2,364 with 100 or more acres; 31 percent of almond farms had 100 or more acres, and they accounted for 87 percent of the state's almond acreage. 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 per acre, including 10 percent or \$421 per acre for harvesting and \$400 an acre in pollination costs. Pest and disease management costs are 15 percent of total operating costs, and winter sanitation is an additional 6 percent (Yaghtmour et al., 2016).

A 2016 UC Cooperative Extension 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, the cost of irrigation water was the major difference between the Sacramento and San Joaquin Valleys: \$392 per acre in the Sacramento Valley and \$2,490 per acre in the San Joaquin Valley.

California's Sustainable Groundwater Management Act (SGMA) may limit growth in almond acreage in the San Joaquin Valley, where yields are 30 percent higher than in the Sacramento Valley, which has more access to water. Critically overdrafted groundwater basins are required to have plans to limit overpumping by 2020, which may slow the expansion of almond acreage in the San Joaquin Valley. Almond consumption in China and India, countries with over a third of the world's people, is less than a tenth of the U.S. average of 2.6 pounds per person per year. There

Table 7.8. California Tree Nuts by Value, 2017

Rank	Crop	2017 Value of Production (\$1,000)
1	Almond	5,603,950
2	Walnut	1,593,900
3	Pistachio	1,014,507
4	Pecan	11,500

Source: CDFA, 2017

Table 7.9. Almonds, 1985–2015

	1985	1995	2005	2015
Harvested Acreage (acres)	409,670	429,113	611,723	1,109,526
Yield (tons/acre)	0.62	0.45	0.83	0.94
Value of Production (\$1,000)	716,331	1,464,126	3,444,807	7,130,359
Revenue (\$/acre)	1,749	3,412	5,631	6,426

Source: CDFA, 2015

Table 7.10. Walnuts, 1985–2015

	1985	1995	2005	2015
Harvested Acreage (acres)	179,005	200,404	238,087	363,705
Yield (tons/acre)	1.35	1.23	1.75	1.97
Value of Production (\$1,000)	383,746	510,531	732,886	1,549,118
Revenue (\$/acre)	2,144	2,548	3,078	4,259

Source: CDFA, 2015

Table 7.11. Pistachios, 1985–2015

	1985	1995	2005	2015
Harvested Acreage (acres)	31,909	58,375	115,349	291,339
Yield (tons/acre)	0.47	1.29	1.46	0.50
Value of Production (\$1,000)	102,702	240,186	860,811	895,894
Revenue (\$/acre)	3,219	4,115	7,463	3,075

Source: CDFA, 2015

is little competition from other countries that produce almonds; so if almond consumption keeps increasing in China and India, and almonds are used to make commodities from milk to butter, U.S. production and prices could continue to increase.

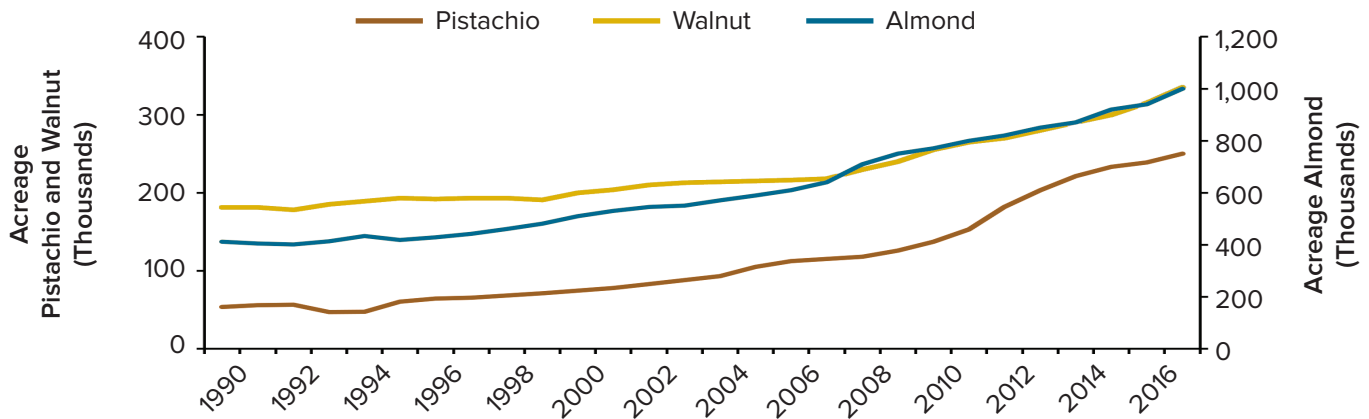
California had almost 5,700 walnut farms in 2017, including 1,000 with 100 or more acres that accounted for almost 80 percent of walnut acreage. Walnut production occurs throughout the Central Valley, from Shasta County in the north to Kern County in the south. There are about 100 walnut processors (Boriss, Brunke, and Krieth, 2015).

A 2015 UC Cooperative Extension costs and returns study estimated an establishment cost of \$7,212 per acre for orchards expected to produce for 30 years. 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 of costs.

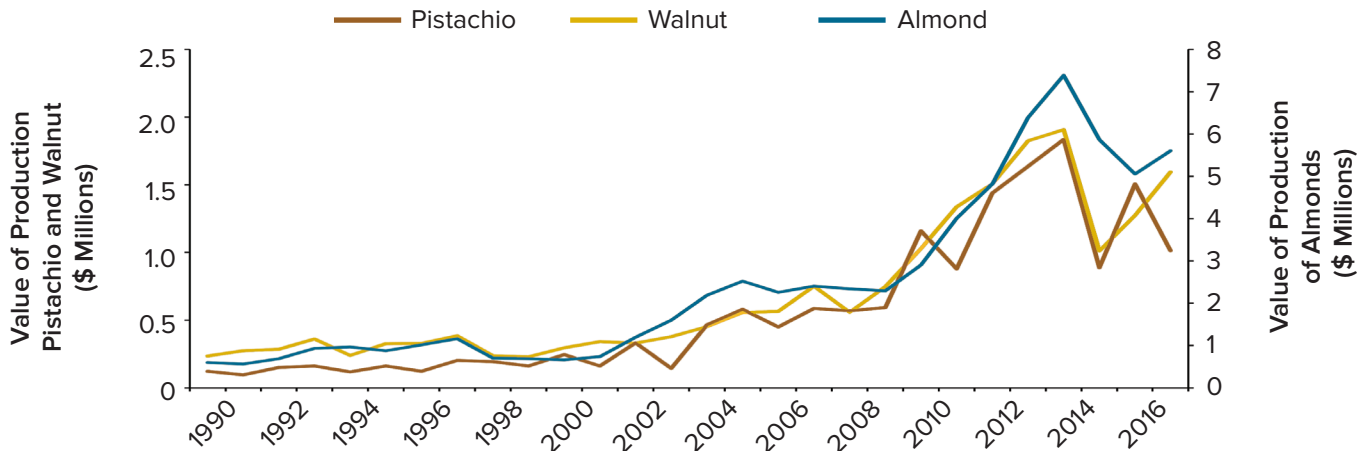
Walnut acreage more than doubled between 1985 and 2015, and yields increased by a third. Revenues per acre, reflecting changes in both yield and prices, doubled and the total value of production quadrupled (Hasey et al, 2015).

There were 1,500 pistachio farms in 2017, including 480 with 100 or more acres and 3 percent that accounted for over 90 percent of the total acreage. Almost all pistachio acreage is in the San Joaquin Valley, including a 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 per acre. 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 7.5. Harvested Acreage of Tree Nuts, 1990–2017

Source: CDFA, 2017

Figure 7.6. Value of Production of Tree Nuts, 1990–2017

Source: CDFA, 2017

TRENDS

Figure 7.5 plots harvested acreage for California tree nuts from 1985 to 2015. Acreage of the three major nuts—almonds, walnuts, and pistachios—increased. Almond acreage is substantially higher than that of the other two nuts, and is plotted against the right-hand axis.

As shown in Figure 7.6, 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 (www.cafreshfruit.org/top-10-issues).

The state's largest peach grower, Gerawan Farms, was embroiled in a dispute with the United Farm Workers (UFW) between 2012 and 2018, including an unsuccessful challenge to the state's 2002 Mandatory Mediation and Conciliation (MMC) law. In November 2017, the California

Supreme Court held that a union remains certified to represent farm workers until that union is decertified lawfully by current workers. However, the votes cast in a November 2013 decertification election were counted in 2018, revealing that workers voted 197 to retain the UFW and 1,098 to decertify the UFW as bargaining agent; with another 660 votes disputed.

The Agricultural Labor Relations Act (ALRA) 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 (ALRB), 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, and 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. In November 2013, the workers asked the ALRB to supervise an election to decertify the UFW. 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 owed workers \$10 million based on the difference between the mediator’s contract and the wages and benefits that were paid by Gerawan since 2013. Gerawan disputed this assertion, saying it would not have agreed to a contract with higher wages and benefits even with good-faith bargaining. After the ALRB upheld the certification of the UFW, the make-whole issue became moot. Gerawan Farming and Wawona Packing agreed to merge in September 2019 to create the largest U.S. stone fruit producer, accounting for a third of the state’s peaches and nectarines.

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 are often picked multiple times, and the fruit is sometimes obscured by leaves and limbs, posing a 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 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 make 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. For example, the per capita consumption of peaches declined from almost 11 pounds per person in the mid-1980s, including 6 pounds consumed as fresh peaches, to less than 5 pounds of fresh peaches. There are more at-home consumption events for fresh fruit purchased from stores, 130 in 2004 and 150 in 2014, but this increase in events does not compensate for declining consumption of frozen, canned, dried, juice, and homegrown fruit.

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 all 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 the 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.

INVASIVE SPECIES

An invasive species is a non-native plant, animal, microbe or pathogen that causes economic or environmental damage in one or more agricultural or natural systems. In addition to reducing marketable yields 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 (CDFA) 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 three 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 spent on this program 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. Means of addressing invasive species include: prevention (trapping), inspection or restriction of movement between 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 can transmit huanglongbing disease (HLB) (also known as citrus greening disease). In the nymphal stage, the Asian citrus psyllid survives on the new flush tips of citrus leaves and injects a substance that is toxic to the tree, causing the leaves to stop growing properly. More importantly, infected psyllids can spread a bacterium that causes huanglongbing

disease. Diseased trees produce commercially undesirable fruit that is small, unattractively colored, and distorted in shape with bitter juice; it can also kill the tree in as little as 5 years.

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 disease were to appear in commercial citrus production regions, the cost of eradicating diseased trees would be significant (Grafton-Cardwell, 2017).

CONCLUSION

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.

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