Olives: An Economic Assessment of the Feasibility of Providing Multiple-Peril Crop Insurance

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Executive Summary

The olive is a drupe, botanically similar to the almond, apricot, cherry, nectarine, peach, and plum. The flesh of the olive fruit may be pickled for table use or it may be pressed or processed to recover its oil. The oil is prized for cooking and table use. Fresh olives are extremely bitter and are not considered palatable.

California's olive industry produces primarily black-ripe pickled olives, used as appetizers and condiments or in salads and sandwiches. Olives are also used to add color and seasoning to prepared dishes, such as pizza. Oil production is a salvage operation in California, for cull olives and those that are too small for canning.

California accounts for all commercial U.S. olive production, 30,600 bearing acres in 1994. The farm value of the crop was $39 million in 1994, down from $57 million in 1993 and $91 million in 1992. The Census reported 1,317 farms with olives in 1992.

Olive yields and production are highly variable from year to year. Since 1975, output has ranged from a low of 43,000 tons in 1977 to a high of 165,000 in 1992. Alternate bearing accounts for part of this variability. In the "on" year, trees produce abundant flowers and set more fruit than can grow to marketable sizes. In addition, the large crop of fruit draws down carbohydrate reserves, causing sub-normal shoot growth. A large crop also delays fruit maturity and increases the chance of losses due to early fall frosts. Since olive trees develop fruit buds on the previous year's shoots, repressed shoot growth diminishes the crop potential for the next year, the "off" year.

The alternate-bearing pattern in olives, however, occurs less dependably than among certain other tree crops, such as pecans and pistachios. Sometimes, olive trees produce large (small) crops for several years before yielding a small (large) crop.

Olives are a minor item in the American diet. Per capita use of canned (pickled) olives averages between 1 and 1.5 pounds annually. Consumption of pickled cucumbers, in contrast, averages about 4.5 to 6 pounds per person per year. Sixty-five percent of the olives consumed domestically in 1993/94 were produced in California. The remainder was imported, largely from Spain, Greece, Mexico, and Portugal.

The highest-quality olive production occurs in areas having mild winters and long, hot, dry summers. Being a subtropical tree, small limbs and shoots can be damaged by temperatures below 22°F. Temperatures below 15°F can kill large limbs and whole trees. Ideal temperatures range between 35°F and 65°F. This temperature range supplies the chilling hours required for good flower development without damaging vegetative growth.

Since olive trees do not "come true" from seed, trees for commercial production are vegetatively propagated. Historically, olives have been grown from cuttings as own-rooted plants. This method continues to be the preferred way of propagating olives. Sometimes, seedlings are grown and are then budded or grafted to a desired variety. It may take up to two years longer to produce a mature bearing tree from seedlings than from rooted cuttings.

The ideal crop load varies with cultivar and with tree age and vigor. As a rule, six fruit per foot of shoot appears to result in good fruit size while ensuring moderate shoot growth for next year's crop. Fruit thinning is the most effective method of controlling crop size. Thinning involves removing fledgling fruit, which allows the remaining crop to grow larger and shoot growth to proceed normally. Because of the high cost of hand thinning, chemical thinning is used in commercial crops.

The bulk of California's olives (90 to 95 percent) are processed as canned ripe olives. Other uses include pressing for olive oil and producing Spanish-style green olives and other pickled products, such as Sicilian, Greek, and other styles of olives. All California olives sold for canning as black-ripe or green-ripe olives are subject to the regulations of Federal Marketing Order No. 932.

The Order provides for mandatory inspection of olives and canned olive products and for the industry-wide support of research, advertising, and public relations activities. Each lot of fruit designated for canned ripe olives must be size-graded by California state inspectors (incoming inspection). These inspectors classify the olives as "canning," "limited," "undersize," or "culls." This classification serves as the basis for paying growers for their fruit.

A cold, wet spring is the most frequently-occurring natural peril in producing olives. Prolonged, abnormally-low temperatures during April and May retard bud development and diminish the proportion of fruit-bearing, pistil-containing blossoms. A deficiency of pistil-containing flowers reduces fruit set and subsequent production. Other production perils include early fall freezes and excess moisture. Most disease and insect problems can be controlled through management practices.

Disaster payments over the 1988-93 period were paid to olive growers in ten California counties and in one New Jersey county, totalling $2.25 million in aggregate. Tulare County received $1.58 million in payments over the six years, the greatest volume received by any county. Tulare County's payments accounted for about 70 percent of the U.S. total. Butte County olive growers received about $208,000 in payments over the six-year period, while Kern County received about $181,000. All other counties received less than $80,000 in total payments.

We believe that, if crop insurance were available for olives, participation at the catastrophic coverage level would be relatively high. The cost of catastrophic coverage is so small relative to the potential benefits that most growers who know about the program would likely participate.

Substantially less participation would likely occur at the buy-up coverage levels than at the catastrophic level. A number of contacts indicated they thought that participation in buy-up coverage would be similar to that for the almond, citrus, fresh plum, and stone fruit policies. They said that olive producers face many of the same production perils faced by other tree fruit producers. Since the larger olive growers frequently also produce citrus or stone fruit, those who purchase citrus or stone fruit insurance would also likely buy insurance for olives.

A problem in insuring olives is the alternate bearing tendency of the tree, which creates a potential for adverse selection. By purchasing insurance only during years in which they expected substantially below average yields, growers could reduce their premium outlays and raise indemnity receipts above actuarially sound levels. Offering only multi-year policies would diminish insurers' losses from growers insuring only during years in which they expected substantially diminished yields.

Olives:
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Feasibility of Providing Multiple-Peril Crop Insurance

Introduction

The olive is a drupe, botanically similar to the almond, apricot, cherry, nectarine, peach, and plum. The flesh of the olive fruit may be pickled for table use or it may be pressed or processed to recover its oil. The oil is prized for cooking and table use. Fresh olives are extremely bitter and are not considered palatable.

California's olive industry produces primarily black-ripe pickled olives, used as appetizers and condiments or in salads and sandwiches. Olives are also used to add color and seasoning to prepared dishes, such as pizza. Oil production is a salvage operation in California, for cull olives and those that are too small for canning.

California accounts for all commercial U.S. olive production, 30,600 bearing acres in 1994. The farm value of the crop was $39 million in 1994, down from $57 million in 1993 and $91 million in 1992 (Table 1). The Census reported 1,317 farms with olives in 1992 (Appendix tables 1 and 2).

This report examines those aspects of the olive industry that relate to the demand for crop insurance and the feasibility of developing an olive insurance policy.

The Olive Tree

The olive is a long-lived, sub-tropical evergreen tree; some specimens have been reported to live for 1,000 years. The tree's shallow root system penetrates only 3 or 4 feet, even in deep soils. The above-ground portion of the tree is recognizable by its dense assembly of limbs, short internodes, and compact foliage. Unless pruned to open light channels, the dense foliage excludes light from the center of the tree.

The flower bud inflorescence (flower bud cluster) is borne in the axil of each leaf. Buds form on the current season's growth and begin visible growth the next season. Buds may, however, remain dormant for more than a year and then begin growth, forming inflorescence a season later than expected. Each inflorescence contains between 15 and 30 flowers, depending on the cultivar and the growing conditions in that year. If all leaf axils produce an inflorescence, each twig has the potential to produce hundreds of flowers.

Full bloom in California occurs during May. Blooming generally occurs 1 to 2 weeks earlier in the southern part of the state than in the northern part. The fruit matures to the processing stage in September or October. The fruit's oil percentage, however, continues to rise as it approaches physiological maturity. Harvesting for oil may continue as late as February.

Table 1--Olives: Bearing acreage, production, utilization, season-average grower price, and value, California, 1975 to date

Year	Bearing acreage	Production	Utilization		Processed utilization 1/				Grower price	Value
			Fresh	Processed	Canned		Crushed for oil	Other 3/		
					Canning-size fruit	Limited-size fruit 2/				
	Acres	Short tons							Dollars	
1975	29,100	67,000	900	66,100	53,300	4,496	3,800	4,504	336	22,512
1976	30,800	80,000	600	79,400	65,500	6,214	3,700	3,986	330	26,400
1977	33,100	43,000	600	42,400	32,300	5,451	2,300	2,349	403	17,329
1978	37,200	126,000	800	125,200	99,100	15,991	7,300	2,809	303	38,178
1979	36,900	62,000	500	61,500	52,300	3,008	1,600	4,592	408	25,296
1980	36,300	109,000	300	108,700	76,800	15,935	3,500	12,465	368	40,137
1981	34,300	44,900	300	44,600	37,900	2,430	2,000	2,270	695	31,222
1982	35,000	146,500	500	146,000	98,000	25,943	4,600	17,457	501	73,459
1983	35,100	61,000	400	60,600	48,000	3,606	4,100	4,894	519	31,641
1984	33,800	90,600	400	90,200	76,700	5,702	2,900	4,898	550	49,810
1985	32,900	96,000	500	95,500	76,100	8,416	5,800	5,184	559	53,634
1986	32,300	111,500	500	111,000	85,000	11,905	6,000	8,095	587	65,407
1987	31,600	67,500	500	67,000	55,000	5,484	3,000	3,516	608	41,053
1988	31,500	87,500	500	87,000	70,000	8,500	3,000	5,500	518	45,316
1989	29,800	123,000	500	122,500	94,000	14,000	5,500	9,000	467	57,458
1990	30,400	131,500	500	131,000	88,000	22,000	5,000	16,000	423	55,663
1991	29,700	65,000	500	64,500	53,700	7,300	1,800	1,700	559	36,306
1992	30,100	165,000	500	164,500	121,000	31,500	5,700	6,300	549	90,561
1993	30,100	122,000	500	121,500	93,000	19,700	5,300	3,500	467	56,991
1994	30,600	84,000	500	83,500	66,500	8,400	4,400	4,200	463	38,991

1/ National Agricultural Statistics Service (NASS) began reporting "limited" and "undersized" as separate categories in 1990 and made estmates for 1988 and 1989. All data since 1988 are as reported by NASS. 2/ Mostly canned, except for 1980 when use of limited-size fruit in canned ripe olivies was not permitted. Reported by California Olive Committee for 1975 to 1987. 3/ "Limited and undersized" reported by NASS, minus "limited size" reported by California Olive Committee for 1975 to 1987. Includes undersized and culls.

Sources: National Agricultural Statistics Service, USDA, and California Olive Committee.

Types of Pickled Olives

Pickled olives are prepared in several different styles that vary according to color and flavor. The style of preparation depends on the maturity of the fruit when harvested and the method of processing.

California-Style Black-Ripe Olives

California-style olives are prepared from fully developed (but not ripe) fruit, which is green to straw yellow in color when picked. The fruit is treated with dilute solutions of lye (sodium hydroxide) to remove its bitter flavor. A combination of the lye treatment and exposure to air, or aeration in water, produces the dark color. The olives are washed to remove the lye and placed in a mild salt solution for several days for curing. Olives intended for pitting are put through an automatic pitter after curing.

The cured olives are packed into cans or jars and heat treated to destroy micro-organisms that could cause spoilage. Pitted olives are canned in the same manner as unpitted olives. The black-ripe style reportedly accounts for 98-99 percent of California's pickled olive output (Ferguson; Daniels).

California-Style Green-Ripe Olives

Canned green-ripe olives can be produced from Manzanillo, Mission, and Sevillano fruit, which are pink or straw yellow in color when harvested. As with the black-ripe olives, green-ripe olives are successively treated with lye solutions to remove bitterness. To avoid darkening between lye treatments, however, green ripe olives are never exposed to air. After washing to remove the lye, green-ripe olives are canned in the same manner as black-ripe olives. Green-ripe olives constitute a very small portion of California's production.

Spanish-Style Green Olives

Spanish-style olives, like the ripe olives discussed above, are processed from fully developed fruit which is green to straw yellow in color when harvested. As in producing California-style olives, the process for Spanish-style green olives consists of a lye-solution treatment to remove bitterness. The lye treatment for Spanish-style olives, however, may be stopped before all of the bitterness is removed, contributing to the Spanish-style flavor. After the lye treatment, the olives are placed in a salt solution and fermented for two to twelve months. The pickled olives are then ready for sale or packaging.

Spanish-style olives are always green when marketed. Most are pitted, or pitted and stuffed with pimento strips or other ingredients, such as onions or anchovies. Nearly all Spanish-style olives for retail sale are packed in glass bottles to which a brine solution has been added. An estimated 1,000 to 1,500 tons of the California crop were processed as Spanish-style olives in 1995 (Daniels).

Greek-Style, Naturally Ripe, Olives

Greek-style olives are made from ripened fruit which has turned purple or black in color before harvesting. The olives are fermented in salt brine for several months. When fermentation is completed, the olives are sorted and packed in fresh brine for consumer use. They may also be packed in vinegar brine for use as appetizers.

The color of Greek-style olives ranges from black (the most characteristic) to pale pink. As no lye treatment is used in processing, Greek-style olives exhibit a somewhat bitter flavor. A specialty product in California, Greek-style olives account for a minor portion of California's production.

Sicilian-Style Olives

Sicilian-style olives are prepared from fully developed olives which still retain their green color at harvest. They are prepared in a similar manner to Greek-style olives, and have the same characteristic bitter flavor. Sicilian-style olives are green in color when marketed and may be packed in glass bottles or plastic buckets. As with the Greek-style, Sicilian-style olives account for only a minor part of California's production.

Olive Cultivars

Of the many known olive cultivars in the world, only five have commercial significance in California. These cultivars are: Manzanillo, Sevillano, Ascolano, Mission, and Barouni (Table 2).

Manzanillo

The Manzanillo cultivar was introduced to the U.S. from Spain during the 1870s, and is the most widely used olive for canning in California. Manzanillo fruit are relative small, but have uniform size and shape. The fruit has a relatively high oil content, which makes it suitable for oil extraction as well as for canning. Although the largest acreage is grown in the southern San Joaquin Valley, a substantial portion of the new acreage in Tehama County has been planted with Manzanillo (Krueger; Moran). Manzanillo is less tolerant of the cold winter temperatures in northern California than are Sevillano and Mission. Manzanillo also is very susceptible to olive knot and Verticillium wilt. Its susceptibility to black scale is similar to that of other varieties.

Sevillano

Sevillano, the second most widely grown variety in California, was introduced from Spain in 1885. Sevillano produces the largest fruit of any of the cultivars grown in California. It is used exclusively for canned olives as its low oil content precludes its use for oil extraction.

Sevillano yields tend to be more variable from year to year than yields for other varieties. In addition to the normal "alternate bearing" characteristic of olives, Sevillano reportedly has several "off" years followed by one year with a heavy crop. In addition, the fruit bruises easily and split pits can be a problem. The fruit must be harvested at an earlier stage than other cultivars for acceptable processing results.

Sevillano is somewhat resistant to cold damage, with the largest acreage planted in Tehama County in northern California. Substantial plantings have also been established

Table 2--Characteristics of major olive cultivars grown in California

Cultivar	Mean Fresh Weight per Fruit (grams)	Oil Content (% of fruit)	Harvest Period	Main Uses
Ascolano	9.0	18.8	Mid-Sept. to late Oct.	Black-ripe Green-ripe
Barouni	7.4	16.5	Mid-Oct. to early Nov.	Fresh Black-ripe
Manzanillo	4.8	20.3	Late Sept.	Black-ripe Green-ripe Spanish Green Oil
Mission	4.1	21.8	Late Oct. through Nov.	Black-ripe Green-ripe Oil
Sevillano	13.5	14.4	Oct.	Black-ripe Green-ripe Spanish Green

Source: Ferguson, et al.

in Butte and Tulare counties. Sevillano is resistant to olive leaf spot but is susceptible to olive knot. It may be used as a pollinator for Manzanillo.

Ascolano

Ascolano originated in Italy and was introduced into California during the 1880s. It produces very large, soft-textured fruit which is difficult to pick without bruising. Ascolano is used almost exclusively for canned-ripe olives.

Ascolano makes up only about 3 percent of the olive acreage in California. It is resistant to cold injury and grows well in all the olive-producing areas. Most plantings, however, are in the San Joaquin Valley.

Ascolano is fairly resistant to both olive leaf spot and olive knot. It is considered more susceptible to olive knot than Mission, but is more resistant than Manzanillo, Sevillano, and Barouni. Ascolano shows some resistance to Verticillium wilt.

Mission

Originally introduced from Mexico in 1769, Mission produces the smallest fruit of any of the commercial varieties. Mission, however, is the most cold resistant of the commercial cultivars. Because of its cold resistance, it remains an important variety in northern California, particularly in Butte County.

The Mission olive is primarily used for pickling, but can also be used for oil extraction because of its high oil content. Because the fruit matures late in the season, it is more likely to be damaged by fall frosts than the other varieties. Frost damage makes the olives useless for pickling, but they can still be used for oil. When used to produce oil, Mission olives are harvested from mid-December to late February. Mission exhibits a somewhat less alternate bearing pattern than Manzanillo and Sevillano.

Mission is very susceptible to olive leaf spot and also develops olive knot. Its susceptibility to scale insects is similar to that of other cultivars.

Barouni

Introduced into California from Tunisia in 1905, Barouni produces relatively large fruit. The trees show resistance to cold damage and are grown mostly in Butte County. A major advantage of Barouni is that it exhibits regular, dependable bearing. Barouni exhibits less alternate bearing than other cultivars, yielding relatively uniform size crops every year.

Barouni olives are usually sold as fresh fruit for home processing, since they process poorly as a commercially canned product. That fruit processed commercially is used for black-ripe olives. Barouni olives have a low oil content and are not used for oil extraction.

Barouni is susceptible to olive knot, but somewhat resistant to olive leaf spot.

The Olive Industry

Location

All commercial U.S. olive acreage is located in California. The bulk of California's acreage is situated in the Sacramento Valley (in the northern region) and the San Joaquin Valley (in the southern region). Butte, Glenn, and Tehama Counties comprised the bulk of the northern region's output in 1994, with 33 percent of the acreage (Table 3). Kern, Madera, and Tulare Counties (in the San Joaquin Valley) accounted for the majority of the southern region's output and had 64 percent of California's acreage.

The Orland and Corning areas in Glenn and Tehama counties are noted for Sevillano production. Although Sevillano currently makes up the majority of the acreage in Glenn and Tehama counties, there is a trend toward planting more Manzanillo in new orchards than in the past (Krueger; Moran).

The Oroville district in Butte County produces primarily Mission olives. Butte County is an older production area and many of the trees were planted when Mission was a more widely grown variety than it is today. Olive acreage declined nearly 20 percent in Butte County between 1987 and 1992. In contrast, olive acreage in the Sacramento Valley has remained relatively stable at about 10,000 acres since the 1930s (Ferguson, et al.).

Manzanillo is the dominate cultivar in the Lindsay area of Tulare County and in the western part of Kern County. Tulare County olive acreage rose slightly between 1987 and 1992, while the acreage in Kern County declined.

Acreage in the San Joaquin Valley increased during the 1960s and 1970s from about 10,000 acres to nearly 25,000. When irrigation became available from the state water project, growers planted significant acreage to olives on land in western Kings and Kern counties that was previously planted to cotton. High levels of Verticillium pathogen existed in many of these soils and infected the new olive plantings. Losses due to Verticillium wilt (and olive knot) caused a decrease in San Joaquin Valley's acreage during the 1980s (Ferguson, et al.).

Farm Characteristics

Most olive growers report small orchards. Of the 1,415 growers identified in a 1984 survey, 43 (or 3 percent) accounted for 54 percent of the industry's raw tonnage.[1] These large growers averaged more than 200 tons production each per year. The 9 percent of the growers that produced between 51 and 200 tons accounted for another 22 percent of total raw tonnage. The 32 percent of growers producing between 11 and 50 tons and the 57 percent with less than 11 tons per crop, combined, accounted for 24 percent of total output.

[1] Reported in Ferguson, et al.

Table 3--California olive acreage by variety, production region, and county, 1994

Region/county	Ascolano	Sevillano	Manzanillo	Mission	Other
	Acres				
North:					
Butte	21	113	238	1,102	118
Glenn	496	1,171	1,872	120	
Shasta	1	78	28	23	
Tehama	83	3,495	1,584	396	
North Total	601	4,857	3,722	1,641	118
South:					
Calaveras			5		
Fresno		39	283		
Kern	1	48	1,388		
Kings	290	29	135		
Madera	228	215	1,433		
Merced		9	57		
San Joaquin			10		
Tulare	689	1,101	16,109	24	19
South Total	1,208	1,441	19,420	24	19
California	1,809	6,298	23,142	1,665	137

Source: California Olive Committee.

Farms tend to be somewhat larger in the San Joaquin Valley area (Madera and Tulare counties) than in the Sacramento Valley (Butte, Glenn, and Tehama counties) (Table 4).

Olive farms in Tulare County, the largest producing county in the San Joaquin Valley, reported an average 30 acres of olives in 1992. Olive farms in Madera County, also in the San Joaquin Valley, averaged 166 acres. Producers in Butte County, on the other hand, averaged only 21 acres of olives per farm in 1992, down from 24 acres in 1987. Farms in Glenn and Tehama averaged 21 and 24 acres in 1992, respectively, up from 15 and 18 acres in 1987.

The Olive Market

Supply

The United States produced 84,000 tons of olives in 1994, down from 122,000 tons in 1993 and nearly half the peak output of 165,000 tons produced in 1992 (Table 1). In addition to domestic production, the U.S. imported nearly 118.6 million pounds (59,000 tons) of preserved olives in 1994.

Olive yields and production are highly variable from year to year. Since 1975, output has ranged from a low of 43,000 tons in 1977 to a high of 165,000 in 1992. Alternate bearing accounts for part of this variability. Figure 2 illustrates the alternate "up and down" pattern of production, and also indicates that the pattern does not occur every year.

Demand

Olives are a minor item in the American diet. Per capita use of canned (pickled) olives averages between 1 and 1.5 pounds annually (Table 5). Consumption of pickled cucumbers, in contrast, averages about 4.5 to 6 pounds per person per year. Sixty-five percent of the olives consumed domestically in 1993/94 were produced in California.[2] The remainder was imported, largely from Spain, Greece, Mexico, and Portugal. Pitted, stuffed green olives from Spain are the most significant single import category.

A small export demand exists for California-style olives. Foreign buyers purchase 2-5 percent of U.S. production in most years. California exported 6.6 million pounds (3,300 short tons) of canned olives during 1993/94.

Prices

Olive prices vary more or less inversely with changes in production. Prices tend to be higher during small-crop years and lower during years with a large crop (Figure 3 and Table 6).

Although olive prices move inversely with variations in production, they change by a smaller percentage than output changes. Statistical studies of the demand for olives indicate that a 10-percent change in production is typically associated with a 4-6 percent opposite-direction change in the farm price (McKusick; Roark).

[2] Calculated from Table 5.

Table 4--Olives: Total acreage and average acreage per farm, selected counties, 1987 and 1992

County	1992		1987	
	Acres	Farm Size	Acres	Farm Size
Butte	2,358	21	2,836	24
Glenn	3,418	20	2,330	15
Madera	2,162	166	2,616	110
Tehama	6,000	24	4,769	18
Tulare	16,536	30	16,007	26

Source: U.S. Department of Commerce, Bureau of the Census.

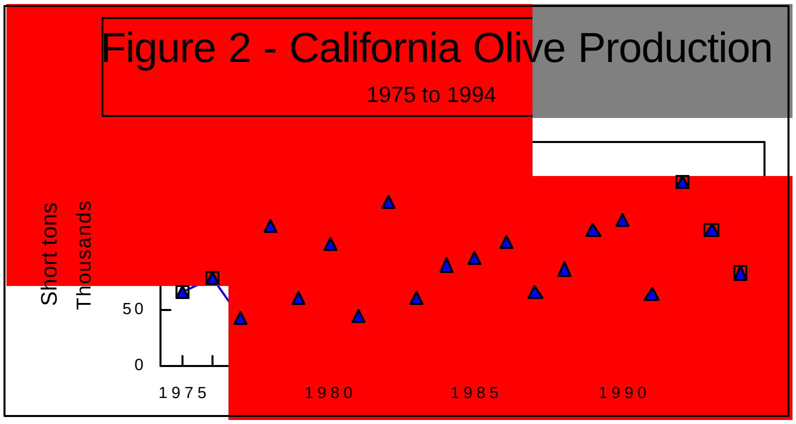
Figure 2 - California Olive Production
1975 to 1994
Short tons
Thousands
50
0
1975
1980
1985
1990

Table 5--Canned olives: Supply and utilization, 1983/84 to 194/95

Year 1/	Supply				Utilization			
	Production 2/	Imports	Beginning stocks	Total supply	Ending stocks	Exports	Consumption	
							Total	Per capita
	Million pounds							Pounds
1983/84	119.8	127.1	92.9	339.8	80.9	3.9	255.0	1.08
1984/85	185.1	120.7	80.9	386.7	87.2	3.2	296.3	1.25
1985/86	190.2	153.7	87.2	431.1	93.8	3.4	333.9	1.39
1986/87	222.6	158.3	93.7	474.6	114.6	3.0	357.0	1.48
1987/88	135.7	173.0	114.6	423.3	93.9	4.5	324.9	1.33
1988/89	166.4	135.1	93.9	395.4	89.4	5.2	300.8	1.22
1989/90	229.0	128.5	N.A.	357.5	N.A.	4.9	352.6	1.42
1990/91	233.2	111.4	N.A.	344.6	N.A.	4.3	340.3	1.35
1991/92	129.3	101.6	N.A.	230.9	N.A.	5.5	225.4	0.89
1992/93	323.3	118.3	N.A.	441.6	N.A.	7.2	434.4	1.69
1993/94	238.9	124.7	N.A.	363.6	N.A.	6.6	357.0	1.38
1994/95 3/	158.8	118.6	N.A.	277.4	N.A.	8.3	269.1	1.03

N.A. = Not available.

1/ Season begins August 1 of the first year shown. 2/ National Agricultural Statistics Service canned utilization estimates converted to product weight. 3/ Preliminary.

Source: Economic Research Service, USDA.

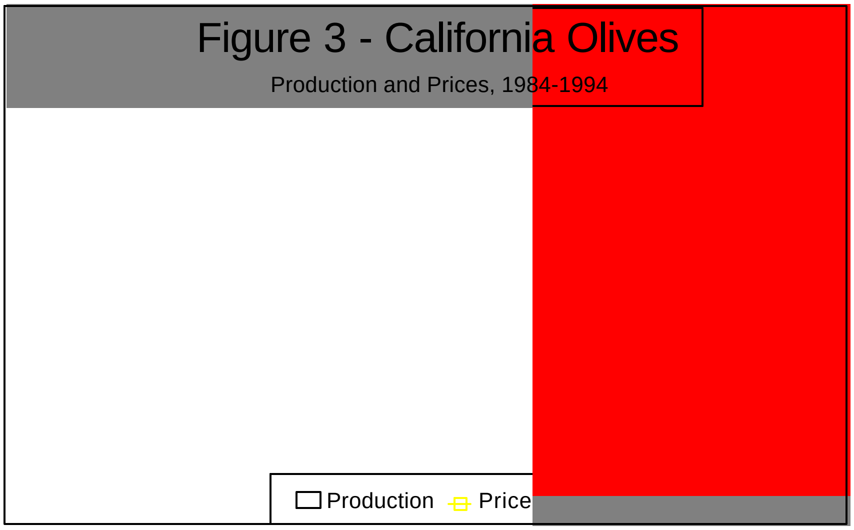
Figure 3 - California Olives
Production and Prices, 1984-1994
Production
Price

Table 6--Olives: Grower prices, by use, 1985-94

Season	All	Canning	Crushed for Oil	Limited	Undersize
	$ per ton				
1984	560	628	21	212	NA
1985	559	658	23	235	NA
1986	594	716	24	247	NA
1987	625	721	22	248	NA
1988	518	603	13	310	28
1989	467	563	12	289	22
1990	423	553	10.9	295	13.9
1991	559	631	10.3	291	23.9
1992	549	676	10.5	266	10.5
1993	467	558	10.5	235	37.2
1994	463	551	10.5	231	13.5

NA = not available.

Source: USDA, NASS, Various issues.

One reason for the relatively small change in price is that pickled olives can be stored from one year to the next. Unsold stocks carried over from the previous season tend to even out total supply and moderate price variations. Olive imports also smooth out available supplies and buffer the price changes that occur due to variations in domestic production.

Under-sized olives and culls have no value except for crushing for oil. As a result, crushers can purchase them for a nominal price, usually $10-$30 per ton. Olives used for oil usually return only 3-5 percent of the price received for canning olives.

The prices reported for olives crushed for oil represent only a fraction of the cost of harvesting. Usually, crushers purchase these olives on the tree for a nominal price. In some cases, the grower lets the crusher have the olives for the picking. Growers prefer to have the olives picked, because leaving them on the tree reduces the fruit set of the following year's crop.

Cultural Practices

Climate Requirement

The highest-quality olive production occurs in areas having mild winters and long, hot, dry summers. Being a subtropical tree, small limbs and shoots can be damaged by temperatures below 22ºF. Temperatures below 15ºF can kill large limbs and whole trees. Ideal temperatures range between 35ºF and 65ºF. This temperature range supplies the chilling hours required for good flower development without damaging vegetative growth.

Warm, dry summers are desirable for olive production because such conditions are associated with a low incidence of diseases. Frequent summer rainfall is conducive to epidemics of fungal and bacterial diseases, which can injure trees and reduce productivity.

Soil

Although olive trees adapt to a wide variety of soil types, they produce the highest yields on moderately fine-textured loams. Such soils provide good aeration for root growth and have a high water-holding capacity. Poorly drained, saturated soils deprive the roots of oxygen and promote root rots, leading to tree decline and death.

Because olive trees have shallow root systems, they do not require very deep soils. Soils having an unstratified profile of 4 feet or more are suitable for olive production. Olive trees tolerate soil pH levels between 5.0 and 8.5.

Water and Irrigation

Olives trees require about 3 acre-feet of water annually, which should be distributed evenly throughout the growing season for good tree growth and maximum production. Although olives are drought tolerant, California orchards require supplemental irrigation to produce maximum yields.

The type of irrigation system used depends on the cost of water, the slope of the orchard floor, and growers' preferences. Low-volume systems--drip systems, mister/fogger systems, mini-sprinkler systems, and fan jet systems--are expensive but efficient and can be adapted to sloping land. Pipeline systems and open-ditch systems are common where water is cheap and abundant and the orchard floor is flat enough to ensure uniform distribution.

Propagation and Planting

Since olive trees do not “come true” from seed, trees for commercial production are vegetatively (asexually) propagated. Historically, olives have been grown from cuttings as own-rooted plants. This method continues to be the preferred way of propagating olives. Sometimes, seedlings are grown and are then budded or grafted to a desired variety. It may take up to two years longer to produce a mature bearing tree from seedlings than from rooted cuttings.

Olives can be planted throughout the year, but March and April, at the beginning of the growing season, are the preferred months. Permanent trees are usually spaced 30 to 40 feet apart, and are planted in squares. Filler trees may be planted between the permanent trees. Filler trees boost orchard production during the first 6 to 10 years, but increase establishment costs. When the orchard becomes crowded and the trees compete for sunlight, the filler trees must be removed.

Cross pollination between varieties enhances fruit set. Most new orchards and those in isolated locations are planted with a pollinator variety. Because cross pollination is most effective within a 100-foot radius, pollinator rows are usually spaced every 200 feet in new orchards. Sevillano, Manzanillo, and Barouni all make good pollinator trees.

Fertilization

Olives are fertilized according to the needs in the specific orchard. Determination of needs is based on an assessment of nutrient levels in the leaf tissue and in the soil and water, and on visual symptoms of nutrient deficiency in the trees. It is common to apply 1 to 2 pounds of nitrogen per tree per year. In the southern San Joaquin Valley, some soils may carry over adequate nitrogen, so that fertilizer is only applied in alternate years. Most soils have sufficient amounts of other fertilizer nutrients for olive production and require applications only when leaf analysis indicates a deficiency.

Olive Fruit Thinning

Olives normally produce crops in alternate-year cycles. In the “on” year, trees produce abundant flowers and set more fruit than can grow to marketable sizes. In addition, the large crop of fruit draws down carbohydrate reserves, causing sub-normal shoot growth. A large crop also delays fruit maturity and increases the chance of losses due to early fall frosts. Since olive trees develop fruit buds on the previous year’s shoots, repressed shoot growth diminishes the crop potential for the next year, the “off” year.

The ideal crop load varies with cultivar and with tree age and vigor. As a rule, six fruit per foot of shoot appears to result in good fruit size while ensuring moderate shoot growth for next year’s crop. Fruit thinning is the most effective method of controlling crop size. Thinning involves removing fledgling fruit, which allows the remaining crop to grow larger and shoot growth to proceed normally. Because of the high cost of hand thinning, chemical thinning is used in commercial production. The common method is to apply napthaleneacetic acid (NAA), a chemical thinning agent, 12-18 days following full bloom.

Although chemical thinning has been available for years, some growers have been slow to adopt the practice. One reason may be that the thinning must be done before the crop load can be accurately judged, and the possibility of over-thinning or poor thinning always exists. Further, chemical thinning represents a relatively large addition to cash expenses. Budget estimates for Glenn and Tehama Counties indicate chemical thinning adds $123 per acre, about 25 percent, to cash growing expenses. Some operators may avoid thinning to keep cash expenses to a minimum.

Pruning

The pruning of bearing olive trees helps control insect and disease problems and facilitates harvesting. Black scale and peacock spot (a fungal disease) prefer dense trees and humidity for best growth. Pruning to produce thin, open trees admits heat and light into the interior of the canopy, effectively minimizing these pests. Open trees also improve spray penetration and coverage, which enhances chemical pest control.

Pruning has a dwarfing effect on the tree, which is desirable for hand harvesting. Left unpruned, trees grow beyond the 15-18 feet height recommended as safe for hand harvesting. Mechanical harvesting does a better job of fruit removal when trees are pruned to an upright shape. This is especially important for the Manzanillo trees, which naturally assume a low, rounded profile.

Olive trees are pruned in spring and summer, after winter rains have passed. Pruning at this time provides the opportunity to manage production, with minimum risk of disease infection and insect attack.

Harvesting Olives

Ideally, olives begin to bear fruit in the third growing season. Typical yields during the first bearing year average less than one ton per acre, depending on the variety and production region. As the trees grow, they develop more bearing shoots and yields rise. Trees usually reach their mature yielding capacity in about 8 years.

In the early bearing years, olives may be hand harvested from the ground. As the trees grow taller, ladders must be used. Most California olives are hand harvested. Hand picking minimizing fruit loss and cullage. A few growers (primarily in the San Joaquin Valley region) have converted to mechanical harvesting or a combination of mechanical and hand harvesting.

Harvesting reportedly accounts for 45-65 percent of cash production expenses. As crop size increases, so does the total harvest expense. However, the larger the crop, the lower the harvest cost per ton. One study estimated hand harvesting at $200 a ton for a 3-ton yield, but only $175 a ton for a 5-ton yield (Ferguson, et al.). For mechanical harvesting, the corresponding estimates were $241 for a 3-ton yield and $151 for a 5-ton yield.

Hand Harvesting

When hand harvesting is used, the picker strips the fruit from the branch by sliding a cupped, gloved-hand down the branch. The branch is positioned so that the fruit fall into a picking bag. When the bag is full, the olives are dumped into standard orchard bins of 1,000-pound capacity for delivery to the processor.

Mechanical Harvesting

With mechanical harvesting, the olives are mechanically shaken from the tree and dropped onto a roll-out tarp or a catching frame. The fruit is then dumped into field bins for transport to the processor.

The greatest drawback to mechanical harvesting is the low rate of fruit removal. The removal rate for hand picking is about 95 percent, depending on crew supervision and tree size. In contrast, removal rates for mechanical harvesting range from 65-80 percent. The removal rate declines as tonnage per acre increases. The smaller, lighter fruit and the larger trees associated with high tonnage make it difficult to shake the olives loose. Olives remaining on the tree mean lost income for 2 years--reduced income for the current year, and reduced flowering and fruiting for the next (Ferguson, et al.).

Cullage also rises with mechanical harvesting. The primary cause of added cullage is due to the puncturing and bruising of the fruit's skin.

Another drawback to mechanical harvesting is the potential increase in limb breakage. Olives require up to five times more energy to shake them loose from the tree than other fruits. This intense shaking can damage the trees. Damage related to mechanical harvesting was associated with olive knot problems in the southern San Joaquin Valley in the late 1970s and early 1980s.

Marketing Olives

The bulk of California's olives (90 to 95 percent) are processed as canned ripe olives. Other uses include pressing for olive oil and producing Spanish-style green olives and other pickled products, such as Sicilian, Greek, and other styles of olives. All California olives sold for canning as black-ripe or green-ripe olives are subject to the regulations of Federal Marketing Order No. 932.

The California Olive Marketing Order

California olive growers and canners established Federal Marketing Order No. 932 in 1965. At the present time, provisions of the Order apply only to black and green canned-ripe olives and not to tree-ripened, Spanish style, Sicilian, Greek, or other styles of olives or to olive oil (California Olive Committee).

The Order provides for mandatory inspection of olives and canned olive products and for the industry-wide support of research, advertising, and public relations activities. Each lot of fruit designated for canned ripe olives must be size-graded by California state inspectors (incoming inspection). These inspectors classify the olives as "canning," "limited," "undersize," or "culls."[3] This classification serves as the basis for paying growers for their fruit.

Inspectors of the U.S. Department of Agriculture examine the olives again (outgoing inspection) before they leave the processor to certify whether the products meet industry standards for size, color, and flavor. The outgoing inspection also ensures that handlers dispose of undersize and cull olives into outlets other than canned ripe olives.

The industry funds research studies conducted by the University of California and other schools on problems experienced in the production and processing of olives. These studies include investigations of solutions to such problems as Verticillium wilt, black scale, and mechanical harvesting losses.

The Marketing Order's advertising activities are designed to promote the demand for olives through education and public relations. These activities include the distribution of recipes containing olives and nutritional information to newspapers, homemaker magazines, the food service industry, and the general public.

The California Olive Committee

The California Olive Committee is charged with administering the program set up by the Olive Marketing Order. The Committee consists of eight members (plus 8 alternates) representing olive growers (producers) from four olive-growing districts. In addition, eight members (plus 8 alternates) represent independent and cooperative canners (handlers). Members serve a term of two years.

Processor assessments on each ton of olives received for use as canned ripe olives fund the Order program. The assessment in 1995 was 30.04 cents per ton.

The Committee employees a full-time manager and other staff responsible for administering the Marketing Order program. Their duties include compiling statistical data for the industry, ensuring compliance with the Order, and conducting in-house advertising and public relations.

Grading Canning Olives

State inspectors first examine incoming fruit to determine that the olives are suitable for canning. Processors may reject olives because they are immature, overripe, damaged, or contaminated with illegal chemicals. Common types of damage include defects caused by machinery, hail, scale insects, mutilation, wrinkling, and frost. Olives can also be damaged due to dropping, either from the tree or by the picker.

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[3] Size grading is based on the fruit count per pound of olives. The count requirement for the different grades varies by variety (See Appendix 2). Olives designated as "canning" size are deemed large enough for canning as whole and pitted olives. "Limited" use olives are too small for canning as whole or pitted olives, but are used for producing sliced, wedged, and chopped olives. "Undersize" olives are too small for canning and, along with "culls," are diverted to oil production.

Damage can occur due to various causes. For example, machine damage causes dimples or brown scar tissue on the mature olives, making them unacceptable for processing as whole or pitted fruit. Hail damage results in a similar appearance. Frost damage causes surface blisters and spots on the stylar end (blossom end) of the fruit, and appears about three days after the frost occurs.

Processors usually agree to separate damaged olives from good olives. If separation is not possible, they generally pay a price based on "petite" fruit (undersize or limited size, depending on the variety) and use them for chopped or sliced olives. Olive oil processors crush the culls for oil.

Size grading involves determining the number of fruit per pound. Fewer olives per pound translate into larger size grades. Consequently, both the size and the weight of the olives contribute to the size designation.

Costs of Production

Production costs for olives average about $2,200 per acre, or $550 per ton for a 4-ton yield (Table 7). Costs per ton tend to rise with lower yields and decline with higher yields.

Annual cash costs account for 75-80 percent of total costs. Harvesting expenses make up the largest part of cash expenses, accounting for roughly 50 percent of annual cash outlays. (See Appendix 1 for detailed cost of production budgets.)

Production Perils

Frosts and Freezes

Early fall frosts can damage unharvested fruit intended for processing as canned olives. Such frosts normally affect only a portion of a grower's crop. This is because olives are harvested over a long period, and most of the crop is usually harvested before frosts occur. Frost damage causes surface blisters and spots on the stylar (blossom) end of the fruit several days after the freeze occurs. Blisters indicate that internal damage has occurred, and that the olives cannot be used for canning. Damaged olives are usually salvaged for oil.

If extreme cold occurs, it is usually after the current year's olive harvest. Consequently, the greatest damage occurs to subsequent crops. Temperatures below 22°F injure or kill small wood and fruit-bearing branches, thereby reducing the subsequent season's yields. Temperatures below 15°F may kill large limbs or the entire tree.

Extreme cold may also result in ancillary damage from olive knot infections. The olive knot bacterium invades the tree through openings in the fruit wood caused by freeze injuries. The resulting infection kills the injured areas. Manzanillo trees are more susceptible to cold damage than are Mission, Sevillano, and Ascolano trees.

Table 7--Costs of Producing Manzanillo Olives in California

Expense Category	Tulare County		Glenn/Tehama Counties	
	$/acre	$/ton	$/acre	$/ton
Cash expenses:				
Cultural	530	132	567	142
Harvesting	1,000	250	820	205
Interest on Operating Capital	30	8	35	9
Total Cash Operating	1,560	390	1,423	356
Cash Overhead	290	72	266	66
Total Cash Expenses	1,850	462	1,688	422
Non-Cash Overhead	414	104	512	128
Total Costs	2,264	566	2,200	550

Sources: Sibbett, Steven G., Karen Klonsky, and Pete Livingston. *Sample Costs to Establish and Produce Manzanillo Olives in Tulare County- 1994*. University of California Cooperative Extension. February 1994. Krueger, Bill, Karen Klonsky, and Pete Livingston. *Sample Costs to Establish an Olive Orchard and Produce Manzanillo Olives in Glenn and Tehama Counties*. University of California Cooperative Extension Service. 1995.

Prolonged Cold Temperatures

A cold, wet spring is the most frequently-occurring natural peril in producing olives. Prolonged, abnormally-low temperatures during April and May retard bud development and diminish the proportion of fruit-bearing, pistil-containing blossoms. A deficiency of pistil-containing flowers reduces fruit set and subsequent production.

Cold, wet weather during the spring of 1967 delayed the olive bloom by several weeks. A poor fruit set ensued and the crop yielded only 14,000 tons, the lightest in modern California history. A light crop in 1995 also has been attributed to cold, wet weather in the spring (Sibbett; USDA, NASS, August 1995).

Hail

Hail occasionally causes damage to olives. Dimples or brown scar tissue form on the fruit over the hail-damaged areas, making the fruit unacceptable for processing as whole or pitted olives. Hail-damaged olives grade as “limited use” or “undersize” fruit, and sell at substantially discounted prices. Although hail occurs infrequently in California, reportedly up to 60 percent of the fruit on the tree can be damaged (Ferguson, et al.).

Drought

Although olive trees are relatively drought tolerant, moisture deficiency during flower bud development reduces fruit set. Stress from lack of water and nutrients leads to increased pistil abortion and a large proportion of non-fruiting staminate flowers. However, few yield losses are likely to occur in California due to drought because virtually all olives are grown on irrigated land (Ferguson, et al.).

Yield losses may occur if an irrigation district does not allocate enough water to produce a crop. During extreme droughts, water districts sometimes restrict water supplies and growers may use only enough water to keep their trees alive.

Excessive Rain and Flooding

Poorly drained soils or soils with an impervious layer may become water-logged during periods of excessive rain, resulting in poor aeration and root deterioration. Long periods of soil saturation cause shoot die-back and may eventually kill olive trees. In addition, water-logged soils promote the development of soil-borne pathogens, such as phytophthora and Verticillium wilt.

Periods of excessive rain are most likely to occur during the winter and early spring, which is the rainy season in central California. Spring flooding can stress olive trees, thereby diminishing flowering and reducing fruit set.

Excessive Heat and Wind

Olive trees normally perform well in hot, dry locations. However, excessive heat accompanied by high winds during the blooming period increases natural floral abscission, reducing fruit set.

Fire

Fires can kill olive trees to the ground level. Fires reportedly do not occur very often in olive orchards. One contact, however, indicated that, on occasion, growers plant barley between the rows in young orchards, and that the dry barley creates a fire hazard (Sibbett). Negligent weed management also creates fire hazards. Weed growth that remains in the orchard after it dries can also result in fires, damaging the olive trees.

Diseases

Verticillium wilt, olive knot, and olive leaf spot (peacock spot) represent the most serious olive diseases in California. Verticillium wilt kills many trees (both young and mature) each year in the southern San Joaquin Valley. Phytophthora root and crown rot, armillaria root rot, and diplodia canker occasionally infect olive orchards, but seldom create enough damage to require treatment.

A careful spray program usually prevents serious losses from disease. One exception may be losses associated with olive knot, which can follow a hard freeze. Freezing temperatures cause the bark to split, creating an avenue for the olive knot bacterium to attack the tree. Preventative sprays mitigate, but may not avoid, such losses (Sibbett).

Verticillium Wilt

Each year, Verticillium wilt infections kill many young trees and cause decline and eventual death among older trees in the southern San Joaquin Valley. Leaves on one or more branches of Verticillium-infected olive trees suddenly collapse and die soon after the first warm weather of summer. Trees die after repeated attacks over several years.

Many agricultural crops, including cotton, melons, peppers, pistachios, stone fruit, and tomatoes host the Verticillium wilt fungus. The fungus resides in the soil and infects plants many years following the host crop. Cotton has proven an especially favorable host, with the Verticillium inoculum building up rapidly in cotton fields.

There are no reliable controls for Verticillium wilt in olive orchards. Although effective in nurseries, soil fumigation has proven unreliable in established plantings. Care in site selection plays an important role in avoiding the disease. The cropping history of potential sites for new plantings should be examined to determine whether the soil contains high levels of Verticillium. Inoculum levels can be determined by soil analysis. No Verticillium-resistant olive rootstock is available, although some tolerance has been reported in the Ascolano cultivar.

Olive Knot

Olive knot, a bacterial disease, occurs throughout California. The infection reduces tree productivity by destroying twigs and branches. In addition, fruit from infected trees may have off-flavors. All cultivars are susceptible and damage can be severe when weather favors its development.

Infections are characterized by rough galls (the “knots”), usually ½ inch to 2 inches in diameter, that develop at wounds on twigs and small branches. The galls interfere with the transport of water and sugars, causing defoliation and death of affected branches.

Spread of the disease is favored by rain, followed by high humidity. Most infections in California happen between October and June, in the rainy season. The knots, however, develop when the tree is actively growing, in spring and early summer.

The principal control strategy is prevention. Copper-containing fungicides help in minimizing infection by protecting leaf scars or other injuries. Pruning during the dry season to remove the galls, which produce the bacterial inoculum, helps control the disease.

Olive Leaf Spot

A fungal disease, olive leaf spot (also called "peacock spot" and "bird's eye spot"), occurs in all olive-growing regions in California. Cultivars vary in susceptibility, but all are subject to infection. Outbreaks are sporadic, and the disease may take several years to become serious enough to cause alarm.

Olive spots develop on leaves, fruit, and fruit stems, but most frequently occur on the upper leaf surfaces. Some lesions develop a yellow halo and remind people of the “eye” spot on a peacock’s tail feathers. This coloration results in the names "peacock spot" and "bird’s eye spot." Most infected leaves fall prematurely, which weakens and kills small wood and eventually reduces productivity. Copper-containing fungicides, applied once in late fall before winter rains begin, usually provide adequate control.

Phytophthora Root and Crown Rot

Phytophthora root and crown rot, a fungal disease, occasionally occurs in olive trees in California. Usually, infections are only a minor concern to growers. Seriously infected trees grow slowly, have thin canopies, and may eventually die. Cultural practices that avoid prolonged soil saturation, such as planting on berms, shortening irrigation time, and improving water penetration, lessen the incidence of root rot. No chemicals are available to control this disease, and resistant rootstocks have not been identified.

Armillaria Root Rot

Not considered serious in California, armillaria root rot is a soil-borne fungal disease that occasionally infects olive orchards. Infected trees have slowly thinning canopies and appear weak. Removal of roots from infected plants, followed by deep fumigation, slows the progress of the disease, but the fungus cannot be eradicated. No olive rootstocks are resistant, and infected trees cannot be cured.

Diplodia Canker

A fungal disease, diplodia canker is found in olive orchards in the Sacramento Valley. It does not cause direct harm to the tree, although it can aggravate damage resulting from olive knot disease. There is no recommended control.

Insects

Natural predators, proper pruning, and irrigation generally keep insect pest populations below levels requiring pesticide treatments. If pesticides are needed, however, care must be exercised to avoid disrupting biological control for other potential pests.

Black Scale

Black scale causes the greatest pest-related yield losses in olives. It is a small, sucking insect which extracts carbohydrates from shoots and leaves and, in rare cases, from the fruit, weakening the trees. The resulting stress diminishes bud formation, causing leaf drop and twig die back, and reduces the next year's crop. In addition, black scale produces a sticky honeydew which reduces fruit quality. Sooty mold develops on the honeydew produced by the scale and shades the leaves, depressing photosynthesis and respiration (Ferguson, et al.).

Hot, dry weather commonly kills newly hatched scale (crawlers) and reduces scale populations. Regular pruning to keep an open, airy canopy raises the temperature and reduces humidity within the orchard, maximizing scale mortality. A number of natural enemies have been introduced to control black scale, but none have been fully effective. Dormant oil sprays effectively control light to moderate infestations, especially when used in combination with regular pruning. Severe infestations, however, require pesticide treatment for control.

Olive Scale

A second scale insect which occasionally attacks olives is the olive scale. Olive scale occurs throughout the olive growing areas of California, but normally its natural enemies keep populations below levels requiring chemical treatments. Parasitic controls are usually excellent. Chemical treatments are rarely needed unless the natural parasite population is reduced by treatments for other pests.

Extremely heavy scale infestations cause defoliation and twig death, reducing productivity of the tree. Scale also settle on the fruit, causing misshapen fruit and purple spotting of the green fruit, rendering it worthless for pickling.

Other Scale Insects

Oleander Scale, Latana Scale, Greedy Scale, and California Red Scale also infest olive orchards in California. In general, parasites and predators play a prominent role in controlling these insects and populations seldom reach levels requiring pesticide treatment. As with Black and Olive Scales, the Oleander, Latana, Greedy, and California Red scales feed on leaves, shoots, and occasionally fruit, weakening the plant and causing spotted and misshapen olives.

Olive Mite

Although widespread in olive orchards, olive mites generally cause little or no damage to the tree or its productivity. In the spring, the mites collect on the developing flower buds. Heavy populations cause the blossoms to abort, lowering the subsequent yield. Ascolano is the most susceptible cultivar, follower by Sevillano, Manzanillo, and Mission. Treatment is not recommended unless fruit set and crop yields have been below normal for several years and large mite populations are found.

Western Flower Thrips

Western flower thrips are tiny insects that feed on a wide range of host plants throughout western North America, including olives. Although they feed on leaves and tender shoots, most damage is caused when they feed on the fruit. Damaged fruit is scarred and dimpled and must be culled before processing. Infestations can be prevented culturally by timing cultivation operations to prevent the build-up of thrip populations on nearby host plants, and their migration to olive trees.

Other Insect Pests

Branch and twig borer, American plum borer, and black vine weevil occasionally attack olive trees in California. Damage from these insects seldom causes enough damage to justify pesticide treatment. Burning all infested wood inside and around the orchard to destroy developing branch and twig borer larvae minimizes infestation.

Nematodes

Plant-parasitic nematodes are microscopic roundworms that derive their nutrition directly from plants. Three types of nematodes--root lesion nematodes, citrus nematodes, and root knot nematodes--feed on olive roots in sufficient numbers to cause damage. Some prominent symptoms of severe nematode infestations include poor growth in young trees, reduced tree vigor, and a thin foliar canopy.

Nematodes cannot be eradicated over a large area. Their populations gradually rebuild and there are no effective post-plant treatments. Pre-plant soil fumigation, however, allows time to develop a healthy root system that can ultimately tolerate nematode build-ups.

Weeds

Weeds can compete with trees for water, nutrients, and sunlight, especially in newly planted orchards and shallow soils. Young orchards infested with weeds take longer to come into production, which increases establishment costs. Weeds are less competitive after 3 or 4 years when the orchard becomes established. Some perennial weeds, however, such as Bermuda grass, dallisgrass, and Johnson grass can lower tree productivity even in established orchards. Weedy orchards also provide shelter or over-wintering sites for other pests, such as insects and rodents. In addition, dried winter vegetation creates a fire hazard.

Weed management is most critical in new plantings. Control may include the use of herbicides, hand weeding, the use of plastic mulches, and tillage cultivation. Mowing or discing effectively controls weeds between the rows.

Ad Hoc Disaster Assistance for Olives

Ad hoc disaster payments were made available to olive growers for losses due to natural causes in each of the years 1988-93.[4] In the absence of a crop insurance policy for olives, producers who faced a yield loss of at least 40 percent of expected production were eligible for ad hoc disaster payments in those years.

Data on ad hoc disaster payments provide an indication of potential high-loss areas. The states and counties with large ad hoc payments from 1988 to 1993 are most likely to face a relatively high risk of loss under a potential FCIC policy for olives, and would likely have a relatively high demand for crop insurance.

Disaster payments during the six-year period were paid to olive growers in ten California counties and in one county in New Jersey, totalling $2.25 million in aggregate. Tulare County received $1.58 million in payments over the six years, the greatest volume received by any county (Table 8). Tulare County's payments accounted for about 70 percent of the U.S. total. Butte County olive growers received about $208,000 in payments over the six-year period, while Kern County received about $181,000. All other counties received less than $80,000 in total payments.

The disaster payments made for olive losses in most years have been quite small. No payments were made in 1988, and less than $50,000 was paid in each of the years 1989, 1990, 1992, and 1993. The largest payments by far were made in 1991, at $2.15 million, accounting for 95 percent of the payments made over the six-year period.

Insurance Implementation Issues

Alternate Bearing and Adverse Selection

Olive yields follow a somewhat alternate bearing pattern in which larger-than-normal crops often occur following seasons with smaller-than-normal crops. Likewise, smaller-than-normal crops tend to follow seasons with large crops. The pattern, however, occurs less dependably in olives than among certain other tree crops, such as pecans and pistachios. Sometimes, olive trees produce large (small) crops for several years before yielding a small (large) crop.

Several management practices help dampen the alternate bearing tendency. Reducing the fruit population on the tree by hand thinning or spraying napthaleneacetic acid (NAA) helps control crop size. Pruning some of the fruit-bearing wood during years with a heavy fruit set also helps control crop size and avoids alternately producing small and large crops. Although less expensive than hand thinning, pruning moderates the alternate bearing pattern less effectively than thinning.

Growers (especially smaller producers and those in the southern counties) have been slow to adopt chemical thinning. Effective thinning requires that growers apply the chemical before fruit set becomes fully apparent. Misjudging the amount of thinning

[4] ERS is acquiring data on 1994 ad hoc disaster payments.

Table 8--Ad Hoc Disaster Payments by County, 1988-93

County	Total Ad Hoc Payments, 1988-93 (1,000 dollars)
Tulare	1,575
Butte	208
Kern	181
Tehama	78
Fresno	59
Madera	57
Glenn	56
Kings	25
Cumberland	6
Calavera	5
Yolo	1
U.S. Total	2,251

Source: USDA, Farm Service Agency. Ad Hoc Disaster Assistance Files, 1988-93. Compiled by the General Accounting Office.

chemical to apply occasionally results in over-thinning, causing a smaller-than-desired crop. Hot weather following application of the thinning spray also causes over-thinning. Hot spells are more likely to occur in the southern counties than in the north. Consequently, farmers in the south have been reluctant to use chemical thinning.

Alternate bearing creates a potential for adverse selection in insuring olives. By purchasing insurance only during years in which they expected substantially below average yields, growers could reduce their premium outlays and raise indemnity receipts above actuarially sound levels. Offering only multi-year policies would diminish insurers' losses from growers insuring only during years in which they expected substantially diminished yields.

Verticillium Wilt and Adverse Selection

Verticillium infections have seriously affected olives, especially on land previously planted with cotton in the southern San Joaquin Valley. Insuring olive production from orchards planted on old cotton land, however, does not appear to create an adverse selection dilemma. Although trees planted on land previously in cotton appear to be at greater risk of Verticillium infection, yields decline gradually over a number of seasons. Such yield declines would gradually lower production histories and would not likely trigger crop insurance indemnities.

Insuring olive trees planted on old cotton land is more likely to result in adverse selection than insuring the crop. Young trees are especially susceptible to losses due to Verticillium and are at greater risk of death when planted on land containing high levels of Verticillium inoculum than those planted on land with lower levels of Verticillium.

Moral Hazard Issues

Moral hazard could arise during some seasons when the industry experiences an unusually large crop. One contact cited the 1992/93 season, in which California produced a record large crop, as such an example. He indicated that, because of a market glut that season, some growers could not sell all of their olives (Neves). Such a situation creates a market incentive for moral hazard.

During most years, however, moral hazard is not likely to be a problem in insuring olives. The farm price for olives almost always exceeds the cash harvesting expenses and growers earn some return above their variable costs. In such situations, market incentives favor harvesting and selling the crop. Consequently, there is not generally an economic incentive for incurring a yield loss for the purpose of collecting an insurance indemnity.

Setting Reference Prices

Both USDA and the County Agricultural Commissioners in California report olive prices, which would serve adequately as an indicator for setting reference prices. USDA reports a season average price, for several end uses of the fruit, and the County Agricultural Commissioners report county-level season average prices.

Estimating "Appraised Production"

The yield estimation procedures used for other insured tree crops, such as almonds, plums, and other stone fruits, provide a suitable method for estimating appraised production.

Individual Yield Data

Yield history documentation is available for all olives intended for use as canned-ripe olives. The California Olive Committee collects production and acreage statistics by variety for its producers.

Insuring Trees vs. Insuring Fruit

The loss of olive trees causes greater economic injury than the loss of the crop. A tree constitutes a long-term capital investment and its loss entails multiple years of foregone production, as well as the expense of establishing a replacement.

Demand for Insurance

We believe that, if crop insurance were available for olives, participation at the catastrophic coverage level would be relatively high. The cost of catastrophic coverage is so small relative to the potential benefits that most growers who know about the program would likely participate.

Substantially less participation would likely occur at the buy-up coverage levels than at the catastrophic level. A number of contacts indicated they thought that participation in buy-up coverage would be similar to that for the almond, citrus, fresh plum, and stone fruit policies. They said that olive producers face many of the same production perils faced by other tree fruit producers. Since the larger olive growers frequently also produce citrus or stone fruit, those who purchase citrus or stone fruit insurance would also likely buy insurance for olives. Participation in crop insurance varies widely among the tree crops in California.

Interest in olive insurance has been expressed in the past. In 1988, the California Farm Bureau Federation (CFBF), which represented nearly 700 olive growers at that time, requested that FCIC develop an olive policy. The CFBF's letter stated that a survey of olive-producing members conducted in 1987 indicated a very strong interest by growers in acquiring Federal crop insurance for olives. It also stated that, "Without FCIC crop insurance, the only resource available to growers has been to secure crop insurance through one's handler. In one instance, the handler charged as much as 25% of the entire crop value." (See Appendix 3.)

Participation in buy-up coverage may be limited mostly to larger producers. Such producers usually have higher cash expenses per acre than part-time producers and may be more likely to purchase the expanded coverage to manage this greater financial risk. In addition, the large producers frequently grow other tree fruits and nuts whose yields are subject to some of the same production risks as olives. Consequently, low olive yields may occur simultaneously with losses among their other crops, exacerbating the grower's financial situation.

Producers with small olive acreages may feel less need to purchase the higher coverage levels than growers with larger acreages. Many growers with small acreages, especially in the Sacramento Valley, farm part-time. These growers tend to rely heavily on unpaid family labor and operate with a minimum of purchased inputs. By keeping operating expenses low, these growers lessen the financial losses associated with a crop disaster. In addition, small producers frequently have off-farm income in addition to olive returns, which provides a financial cushion if their olive crop fails.

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Appendix table 1--Olives: Number of U.S. (California) farms, acres, trees, and pounds harvested, 1987 and 1992

Item	Farms	Acres	Trees	Pounds
Total:				
1987	1,363	33,264	2,412,869	NA
1992	1,317	35,636	2,739,991	NA
Non-bearing:				
1987	298	NA	203,835	NA
1992	300	NA	306,838	NA
Bearing:				
1987	1,315	NA	2,209,034	NA
1992	1,256	NA	2,433,153	NA
Harvested:				
1987	1,151	NA	NA	167,503,573
1992	1,082	NA	NA	213,258,987

NA = not available.

Source: U.S. Department of Commerce, Bureau of the Census.

Appendix table 2--Olives: Farms and numbers of trees, California by county, 1987 and 1992

County	1992				1987			
	Farms	Acres	Bearing Trees	Non-Bearing Trees	Farms	Acres	Bearing Trees	Non-Bearing Trees
Butte	114	2,358	142,472	10,711	118	2,836	181,747	8,864
Calaveras	7	448	(N)	(N)	5	71	(N)	(N)
Fresno	51	1,562	118,233	14,792	40	1,320	105,445	15,051
Glenn	170	3,418	224,651	59,704	155	2,330	130,730	33,214
Kern	9	1,941	(N)	(N)	17	1,441	(N)	(N)
Kings	6	266	(N)	(N)	(N)	(N)	(N)	(N)
Madera	13	2,162	191,364	2,616	20	2,198	(N)	(N)
Merced	3	34	(N)	(N)	5	209	(N)	(N)
Shasta	15	173	10,120	116	21	748	(N)	(N)
Sutter	5	109	(N)	(N)	(N)	(N)	(N)	(N)
Tehama	250	6,000	409,399	78,408	268	4,769	330,424	16,908
Tulare	548	16,536	1,057,068	109,700	619	16,007	1,015,722	106,530
Other	126	629	(N)	(N)	95	(N)	(N)	(N)
California	1,317	35,636	2,433,153	306,838	1,363	33,264	2,209,034	203,835

(N) = not available or included in "other."

Source: U.S. Department of Commerce, Bureau of the Census

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