

**Globe Artichokes:
An Economic Assessment of the
Feasibility of Providing Multiple-Peril Crop Insurance**

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Executive Summary

The globe artichoke, *Cynara scolymus*, is a thistle-like herbaceous perennial. The adjective "globe," which describes the immature flower head, is used to differentiate this true artichoke from the Jerusalem artichoke (*Helianthus tuberosus* L.) and the Japanese or Chinese artichoke (*Stachys sieboldii* Miq.), both of which are grown for their edible tubers.

Virtually all U.S. commercial artichoke production, about 9,000 acres, is located in California. Of the 67 U.S. farms reporting artichoke production in 1992, 63 were located in California. The value of the California crop was \$58.5 million in 1994, a record high.

The United States produced 109 million pounds of artichokes in 1994, down from the peak output of 134 million pounds in 1985. Domestic production follows a distinct seasonal pattern, peaking between March and May, and remaining relatively low during the remainder of the year. In addition to domestic production, the U.S. imported nearly 71 million pounds of artichokes in 1994, mostly canned and brined products from Spain.

Artichokes are a minor vegetable in the American diet. Although consumption is rising, U.S. consumers use less than one pound of artichokes annually. Consumption of fresh artichokes closely follows the seasonal availability of domestic shipments, cresting in the spring when California's production peaks.

Artichoke prices vary substantially from month-to-month, largely due to the highly seasonal nature of production. The highest prices usually occur from November through February, when the quality of fresh artichokes is relatively high, but volume is low. The lowest prices occur during March, April, and May, when high volumes drive prices down.

Because its cool, foggy summer climate and frost-free winters are ideal for artichokes, the coastal areas of central California (in particular, Monterey County) account for a large share of U.S. artichoke production. The Desert valleys in southern California and western Arizona have emerged as minor commercial areas since 1990. An estimated 450 acres of artichokes were grown in California's Imperial County in 1993, with about 200-300 acres, in total, in the Coachella Valley in Riverside County, California and in Yuma County, Arizona. In addition, nominal acreage is planted to artichokes in Oregon's Willamette Valley for late summer and fall harvest.

Due to the lack of homogeneity in seed-propagated populations, artichoke varieties traditionally have been propagated vegetatively to maintain the genetic consistency needed to assure uniformity among artichoke buds. A high degree of uniformity is needed for commercial acceptability. In recent years, several seed-propagated varieties have been released that produce uniform buds. One of these, "Imperial Star," was released by the University of California and is grown commercially in the coastal regions of southern California and in the Desert areas of California and Arizona.

Vegetatively-propagated perennial artichokes are grown almost exclusively in coastal California, while seed-propagated annual artichokes are grown mainly

in the low Desert areas of southern California and in western Arizona. Coastal California's mild winters permit the production of artichokes as a perennial crop, and the cool spring, summer, and fall promote artichoke quality. Perennial culture has been desirable because it allows spreading the high costs of establishing vegetatively-propagated artichokes over time. Vegetative propagation was at one time necessary to maintain commercially-acceptable uniformity.

The development of seed-propagated varieties that have commercially-acceptable uniformity permit production of artichokes as an annual crop. Growers can now afford to establish a planting for a single season because seed propagation is less expensive than vegetative propagation. Annual production of seed-propagated artichokes is adapted commercially in the low desert areas, where summers are too hot for artichokes. Desert-grown artichokes are seed-planted in late summer and harvested during the winter and early spring. Desert production ends when the on-set of hot weather lowers quality in the spring.

Some growers in the California's coastal areas are currently experimenting with annual culture, but at this time, most continue following perennial culture practices.

Artichokes are a comparatively hardy plant that produce over an extended harvest period. They can withstand severe stress and yet survive to produce a considerable crop later in the season. A hard freeze in December 1990, for example, appeared to have destroyed the California artichoke crop, but the plants recovered and produced a typical-size crop the following spring.

Although recovery appears less complete than following the 1990 freeze, a substantial amount of California's artichokes survived flooding during the winter of 1995, and produced a crop later in the season. As of the end of November, 1995, artichoke shipments for the year to date from California were about 55 percent of the shipments at the same time in 1994.

Our assessment is that there is a fairly limited potential for artichoke crop insurance, particularly at the buy-up coverage levels, because growers are likely to view artichokes as relatively free of production perils. Most growers reportedly feel they can manage the production risks associated with artichoke pests by following recommended cultural practices, particularly in California's coastal areas. Hard freezes, excessive rains, and flooding are the greatest production perils, and damage from these hazards occurs rather infrequently.

Large growers account for the bulk of artichoke acreage in the Salinas Valley and are often not eligible to receive benefits under the Non-Insured Assistance Program (NAP) because their annual gross incomes (and hence, qualifying gross revenues) exceed \$2 million. In addition, these growers are likely to quickly reach the \$100,000 payment limit in the event of disasters. These growers may want to see artichokes become an insurable crop so that they may buy catastrophic insurance coverage, which they could do at a negligible cost. The director of the San Mateo County Farm Bureau indicated that his organization is currently working with USDA to establish an artichoke policy.

**Globe Artichokes:
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Introduction

The globe artichoke, *Cynara scolymus*, is a thistle-like herbaceous perennial. Its immature flower head, or so-called "bud" or "choke," is used in salads or consumed as a hot vegetable. The edible portion consists of the tender bases of the bracts or scales, the young flowers, and the receptacle or fleshy base upon which the flowers are borne. The adjective "globe," which describes the immature flower head, is used to differentiate this true artichoke from the Jerusalem artichoke (*Helianthus tuberosus* L.) and the Japanese or Chinese artichoke (*Stachys sieboldii* Miq.), both of which are grown for their edible tubers.

Virtually all U.S. commercial artichoke production, about 9,000 acres, is located in California (Appendix table 1). Of the 67 U.S. farms reporting artichoke production in 1992, 63 were located in California. The value of the California crop was \$58.5 million in 1994, a record high (Table 1).

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

The Artichoke Plant

The Plant

The artichoke is a perennial that grows to a height of 3-6 feet and spreads to a diameter of about 6 feet (Sims, et al.). Established plants send up offshoots or suckers each season from a permanent crown. The number of shoots varies with the age of the plant. Young plants produce a single shoot, while plants that are 4 or 5 years old may produce a dozen or more shoots. Each shoot forms a cluster of large basal or rosette leaves, from the center of which the flower-bearing stalks grow. The edible buds are produced at the tips of these elongated stalks and their branches.

Normally, new growth begins in the fall and the edible buds form the following spring. If the buds are not removed, they develop into purple-centered, thistle-like flowers with heads 6-8 inches in diameter.

Table 1--Artichokes: California harvested acreage, yield per acre, production, and value, 1940-89

Year	Harvested acreage	Yield per acre	Production	Value	
				Per cwt	Total
	Acres	cwt	1,000 cwt	dollars	1,000 dollars
1940	10,100	32	323	4.25	1,374
1945	6,400	42	269	8.38	2,251
1950	7,100	40	284	9.75	2,769
1955	8,900	40	356	8.50	3,026
1960	9,300	45	418	8.88	3,712
1965	9,200	70	644	8.95	5,761
1970	11,000	61	671	10.30	6,920
1975	10,200	72	734	16.10	11,847
1980	9,900	80	792	34.70	27,473
1981	9,700	115	1,116	32.00	35,673
1982	11,463	101	1,163	32.10	37,340
1983	11,840	75	892	38.25	34,123
1984	12,357	89	1,099	30.65	33,677
1985	12,032	111	1,338	28.60	38,235
1986	13,359	79	1,052	34.45	36,259
1987	11,126	109	1,217	30.20	36,716
1988	11,879	110	1,246	29.35	38,193
1989	11,407	116	1,296	26.50	35,297
1990	9,921	114	1,114	29.50	33,239
1991	9,801	122	1,206	29.65	35,806
1992	9,600	115	1,104	39.40	43,447
1993	8,300	110	913	50.10	45,762
1994	8,400	130	1,092	53.60	58,551

Source: USDA, National Agricultural Statistics Service, 1940-75 and 1992-94. California Country Commissioners' Annual Reports, 1976-91.

Varieties

Due to the lack of homogeneity in seed-propagated populations, artichoke varieties traditionally have been composed of a single clone or a group of phenotypically similar clones. These varieties are propagated vegetatively to maintain the genetic consistency needed to assure uniformity among artichoke buds. A high degree of uniformity is needed for the artichoke to be commercially acceptable.

The vegetatively propagated "Green Globe" variety currently accounts for nearly 90 percent of the artichokes grown in the United States. Seeds under the same name are also offered by several seed companies, but the Green Globe propagated from seed may be, and usually is, quite different from that grown from shoots. Although artichoke plants grown from seed produce a percentage of marketable "chokes," the flower buds may be quite different from plant to plant, yielding a less uniform product than those grown from shoots.

Several seed-propagated varieties (both open-pollinated and hybrid types), with commercially acceptable uniformity, have been released in recent years. One of these, "Imperial Star," was released by the University of California and is grown commercially in the coastal regions of southern California and in the Desert areas of California and Arizona. Imperial Star has shown broad climatic adaptability and does not need as much cold treatment to initiate flower bud production as does Green Globe.¹ "Emerald" is another variety available as seed. In addition, there are a number of proprietary cultivars grown by individual shippers.

The Artichoke Market

Supply

The United States produced 109 million pounds of artichokes in 1994, down from the peak output of 134 million pounds in 1985 (Table 2). Domestic production follows a distinct seasonal pattern, peaking between March and May, and remaining relatively low during the remainder of the year (Figure 1).

In addition to domestic production, the U.S. imported nearly 71 million pounds of artichokes in 1994, mostly canned and brined products from Spain. Chile was the principal foreign supplier of fresh artichokes, shipping its largest volume between October and December, when U.S. supplies are relatively small.

¹ Certain plants require a period of exposure to cold temperatures in order to initiate flowering. The exposure to an extended cold period is called vernalization. In the case of artichokes, vernalization promotes greater flowering.

Table 2--U.S. artichokes, all uses: Supply, use, and price, farm-weight, 1970-95

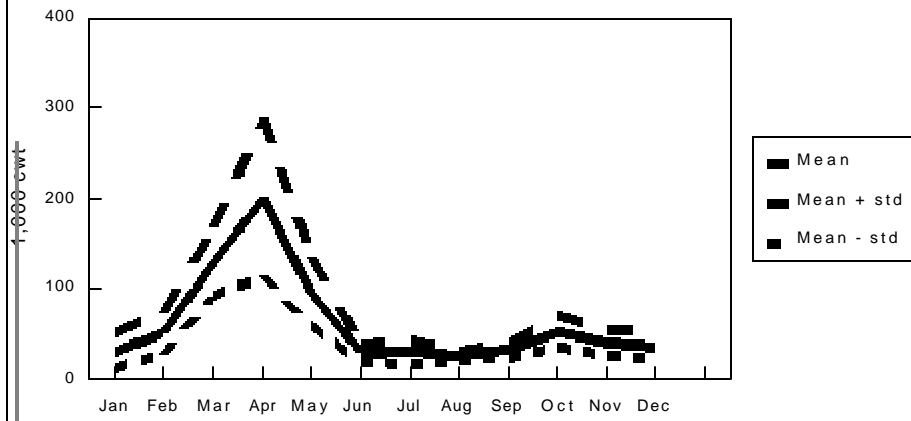
Year	Supply			Utilization			Season-ave price	
	Produc- tion 1/	Imports 2/	Total	Exports 2/	Total	Per capita use	Current dollars 1/	Constant 1987 dol- lars 3/
----- Million pounds -----			----- Pounds -----			----- \$/cwt -----		
1970	67.1	9.5	76.6	--	76.6	0.4	10.30	29.34
1971	79.2	8.7	87.9	--	87.9	0.4	9.72	26.27
1972	71.0	15.6	86.6	--	86.6	0.4	11.60	29.82
1973	60.0	14.5	74.5	--	74.5	0.4	14.50	35.11
1974	70.2	12.6	82.8	--	82.8	0.4	17.30	38.53
1975	73.4	10.8	84.2	--	84.2	0.4	16.10	32.72
1976	80.6	14.3	94.9	4.6	90.3	0.4	14.40	27.53
1977	71.3	11.5	82.8	3.8	78.9	0.4	19.30	34.53
1978	52.5	19.5	72.0	3.3	68.7	0.3	27.00	44.78
1979	87.3	18.0	105.3	4.0	101.3	0.5	27.70	42.23
1980	79.2	19.5	98.7	4.0	94.7	0.4	34.70	48.40
1981	111.6	21.8	133.4	5.1	128.3	0.6	32.00	40.56
1982	116.3	26.4	142.7	4.4	138.3	0.6	32.10	38.31
1983	89.2	28.7	117.9	3.2	114.7	0.5	38.25	43.86
1984	109.9	40.0	149.9	4.3	145.6	0.6	30.65	33.68
1985	133.8	38.7	172.5	6.0	166.5	0.7	28.60	30.30
1986	105.2	41.8	147.0	5.5	141.4	0.6	34.45	35.55
1987	121.7	41.6	163.2	5.4	157.8	0.7	30.20	30.20
1988	124.6	35.4	160.0	6.7	153.3	0.6	29.35	28.25
1989	129.6	39.7	169.3	6.3	163.0	0.7	26.50	24.42
1990	111.4	36.3	147.8	6.5	141.3	0.6	29.50	26.04
1991	120.6	33.0	153.7	5.7	148.0	0.6	29.65	25.21
1992	110.4	41.6	152.0	4.9	147.1	0.6	39.40	32.59
1993	91.3	43.7	135.0	4.5	130.5	0.5	50.10	40.57
1994	109.2	71.0	180.2	5.9	174.3	0.7	53.60	42.44
1995 f	105.0	53.2	158.2	5.1	153.1	0.6	--	--

-- = Not available. f = ERS forecast.

1/ Source: USDA, NASS, *Vegetables* (1970-81 & 1992-93), California County Agricultural Commissioners Reports (1982-91). 2/ Source: U.S. Dept. of Commerce, Bureau of the Census (Trade data). Includes canned and fresh. World exports not available prior to 1989. Exports represent Canadian imports of U.S. artichokes as reported by Canada. Canned and brined are recorded on a product weight basis. 3/ Deflated by the GDP implicit price deflator.

Figure 1--Artichokes: Fresh-market shipments

Monthly Average 1980-89



Source: AMS, USDA.

Demand

Artichokes are a minor vegetable in the American diet. Although consumption is rising, U.S. consumers use less than one pound of artichokes annually. Consumption of fresh artichokes closely follows the seasonal availability of domestic shipments, cresting during the spring when California's production peaks.

Foreign markets purchase 4-5 percent of U.S. production. In 1994, the U.S. exported nearly 6 million pounds of fresh artichokes, 83 percent of which was shipped to Canada. Japan was the only other notable foreign market, accounting for approximately 13 percent of 1994 exports.

Prices

Artichoke prices vary substantially from month-to-month, largely due to the highly seasonal nature of production (Figures 2 and 3). The highest prices usually occur from November through February, when the quality of fresh artichokes is relatively high, but volume is low (Figure 2, Table 3). The lowest prices occur during March, April, and May, when high volumes drive prices down.

Production Locations

Because its cool, foggy summer climate and frost-free winters are ideal for artichokes, the coastal areas of central California account for a large proportion of U.S. commercial artichoke production. The Desert valleys in southern California and western Arizona have emerged as minor commercial areas since 1990. An estimated 450 acres of artichokes were grown in California's Imperial County in 1993, with about 200-300 acres, in total, in the Coachella Valley in Riverside County, California and in Yuma County, Arizona (Mayberry). In addition, nominal acreage is planted to artichokes in Oregon's Willamette Valley for late summer and fall harvest.

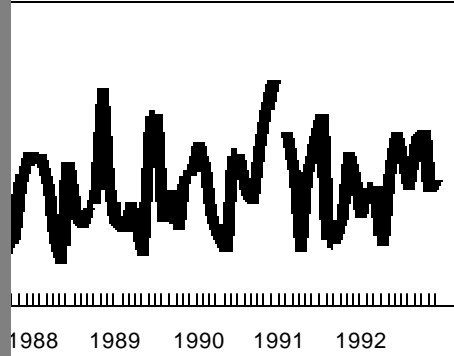
The Census of Agriculture reported 9,128 acres of artichokes in California in 1992, 6,771 acres of which were in Monterey County (Appendix table 2). In addition to Monterey County, the Census reported acreage in Humboldt, Imperial, San Luis Obispo, and San Mateo counties in California. California county agricultural commissioner reports also indicate acreage in Orange, Santa Barbara, and Santa Cruz counties (Appendix table 3).

USDA marketing statistics indicate 2,000 cwt of artichokes were shipped from Arizona in 1994 (USDA, AMS). The Arizona Agricultural Statistics Service, however, does not report any artichoke statistics for Arizona, combining artichoke production with other miscellaneous vegetables. One extension vegetable specialist estimated that there were no more than 20-40 acres of bearing artichokes in Arizona (Rubatzky).

As with Arizona, no production statistics were located for Oregon. An extension vegetable specialist in Oregon estimated that there are 20-40 acres of commercial production in that state (Mansour).

Prices: Grower Prices

Average, 1984-92



Source: AMS, USDA.

Discontinuity results because of no data.

Grower Prices

ex, 1984-92

Mean
Mean + std
mean - std

Source: AMS, USDA.
Current price, percent of centered 12-month average.

Table 3. Artichokes: California f.o.b. prices, monthly averages, 1989-93

Month	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
-----Dollars per 23-pound carton ¹ -----										
January	14.00	25.00	23.50	13.00	10.00	14.67	8.38	16.10	NR	9.00
February	14.00	25.00	20.75	11.50	10.50	15.00	7.50	14.00	17.00	11.75
March	13.00	21.00	16.75	10.00	9.00	11.75	10.20	9.25	13.00	11.75
April	14.00	5.00	5.37	11.00	6.70	6.50	8.00	7.38	5.50	6.00
May	16.00	5.80	5.00	15.00	3.44	4.50	5.00	5.50	13.00	14.00
June	18.00	14.20	11.62	14.00	8.13	14.20	19.00	15.00	15.50	17.13
July	12.00	12.50	9.50	10.00	5.50	8.75	19.00	15.00	19.00	14.60
August	12.00	10.60	11.00	12.00	3.75	8.00	8.60	11.00	6.50	11.50
September	10.00	10.00	9.80	13.00	5.40	10.00	11.38	10.25	6.25	16.70
October	13.50	12.60	12.37	12.00	7.00	10.25	7.63	15.25	9.00	17.35
November	23.5	15.67	18.66	13.00	12.00	21.30	13.00	19.00	15.33	11.35
December	25.00	18.50	20.00	12.00	15.25	12.25	13.00	22.33	13.00	12.60

NR = Not reported.

¹ Size 18-60 prior to 1989. Size 36 from 1989-92.

Source: USDA, AMS. *Agricultural Prices*.

Cultivation and Management Practices

Climatic Requirements

Artichokes produce the highest yields in frost-free areas that have cool, foggy summer climates. Under such conditions, the plant receives adequate vernalization (exposure to cool temperatures) during the winter to promote flower bud production. The cool temperatures during the spring, summer, and fall assure production of compact, tender buds.

Artichoke buds open quickly during hot weather, which destroys the artichoke's tenderness and reduces its flavor. Near-freezing temperatures, on the other hand, cause the buds to develop a blistered, whitish appearance which eventually turns dark. Although the dark color does not impair the taste of the artichoke, it mars its appearance. The industry markets these frost-affected artichokes as "Frost-Kissed" or "Winter-Kissed," promoting them as more flavorful and tender than other artichokes.

The Imperial Star variety has a shorter vernalization requirement than does Green Globe, and is grown as an annual in the California and Arizona desert areas where it is planted in the fall and is harvested in the spring. The plants are destroyed after the spring harvest, and a new crop is planted the following fall.

In Oregon, artichokes are grown as a perennial, and production is targeted for late summer. This is an "off-season" period for California production, and prices for fresh artichokes are usually relatively high at that time. Oregon produces a quality artichoke during its short market window (July and August), but low yields are a drawback to expansion of commercial production.

Soils

The globe artichoke will grow on a wide range of soils, but it produces the highest yields on deep, fertile, well-drained loams. The plant is deep-rooted and should be planted on soils with enough depth to afford adequate area for root development.

At one time, flat fields were preferred for artichoke production because they were better suited for using furrow irrigation than fields with a steep slope. With the adoption of sprinkler irrigation, however, the amount of slope is less of a hindrance, and hillside plantings have become more common.

Propagation

The highest yields and the highest-quality artichokes typically are obtained during the first several years following establishment, as productivity tends to decline with the age of the plant. Growers usually replace plantings after a substantial loss in yield occurs. In California's coastal areas, artichoke fields are normally maintained in perennial culture for 5 to 10 years (De Vos).

Perennial artichokes are normally seed-planted between late August and early September, using transplanted crown divisions or rooted offshoots taken from the bases of established plants. This insures true-to-type plants and uniform chokes.

In the Desert areas, artichokes are seed-planted in late August or early September, and are grown as annuals. Harvest begins in late fall or early spring, depending on the planting date and whether growth regulators are applied to force bud initiation (Mayberry).

California growers in the coastal areas usually plant less than 1,000 plants per acre in perennial plantings. With the advent of improved seed-propagated varieties, growers have begun experimenting with the use of seeds for establishment of new fields. Seed propagation has permitted the use of plant densities of 6,500 or more plants per acre. High-density, seed-propagated plantings reportedly result in higher yields than do the traditional, low-density, vegetatively propagated plantings (De Vos, 1993).

In Oregon, perennial plantings are spaced somewhat closer than in California because they are generally renewed sooner and the plants do not become as large as in California. Cold winters shorten the production life of artichoke plantings in Oregon. A typical spacing in Oregon is 3-4 feet apart, in rows spaced 6-10 feet apart.

Production Cycle

Vegetatively-propagated perennial artichokes are grown primarily in coastal California, while seed-propagated annual artichokes are grown mainly in the low Desert areas of southern California and in western Arizona. Coastal California's mild winters permit the production of artichokes as a perennial crop, and the cool spring, summer, and fall promote artichoke quality. Perennial culture has been desirable because it allows spreading the high costs of establishing vegetatively-propagated artichokes over time. Vegetative propagation was at one time necessary to maintain commercially-acceptable uniformity.

The development of seed-propagated varieties that have commercially-acceptable uniformity permit production of artichokes as an annual crop. Growers can now afford to establish a planting for a single season because seed propagation is less expensive than vegetative propagation. Annual production of seed-propagated artichokes is adapted commercially in the low desert areas, where summers are too hot for artichokes. Desert-grown artichokes are seed-planted in late summer and harvested during the winter and early spring. Desert production ends when the on-set of hot weather lowers quality in the spring.

Some growers in the California coastal areas are currently experimenting with annual culture, but at this time, most continue following perennial culture practices.

The cropping cycle with perennial culture is initiated by cutting off plants 2 to 3 inches below the soil surface to stimulate the development of new shoots. The timing of this "cut-back" operation influences when the artichokes are ready for harvest. Fields intended for fall, winter, and spring production are cut-back between mid-April and mid-June, while fields slated for summer harvest are cut-back in late August or September (De Vos, 1992).

Perennial production is essentially continuous throughout the year, although roughly 70 percent of the crop is harvested between March and mid-May. Fields maintained in the fall-winter-spring production cycle produce the highest yields, and are harvested continuously from September through May. Fields managed for summer harvest begin producing in late May or June, and continue through cut-back in the fall.

Fertilizers

Fertilizer applications are made based on soil test results. Typically, growers apply fertilizers in the range of 150-300 pounds of nitrogen (N) per acre, 50-100 pounds of phosphorus (P_2O_5), and 30-100 pounds of potash (K_2O). Following cut-back, it is common for growers to apply manure, primarily as a source of organic matter.

Irrigation

Artichokes are deep rooted, and when grown in the mild coastal climate, require up to 15 inches of water during the production season. Part of this requirement may need to be provided by irrigation. The amount of irrigation in any given area is based on local weekly evapo-transpiration activity and rainfall.

In the coastal California production areas, most of the annual rainfall of 12-20 inches falls from November through April. As a result, three to five supplemental sprinkler irrigations of 3 to 4 inches each are applied annually. Irrigation is initiated shortly after planting, or about 1 month after cut-back in established fields.

Rotations

Extension specialists recommend planting artichokes in rotation with other crops to lessen potential insect and disease problems. Because of a scarcity of good artichoke land, however, most artichokes in California's central coast areas are grown continuously in the same fields.

Harvesting, Packing, and Storage

Harvesting

Artichokes are hand-harvested by cutting the stem 2 to 4 inches below the base of the bud. Picking crews walk down each row selecting and cutting mature artichokes, which are transported in a canvas bag on each worker's back. Harvest bags are emptied at the ends of rows into pallet-based bins for transport to a packing shed.

The optimum time to harvest is when the artichokes have reached maximum size, but before the bracts begin to separate. The first artichoke to be harvested on a given flower stalk is the large terminal or primary bud. After the primary bud has been picked, secondary and tertiary buds are removed sequentially in subsequent harvests as they reach maturity.

Pickers generally harvest every ten days during fall and winter. The picking interval increases to every four to five days during the spring. It is common for picking crews to harvest a single field more than 30 times in one season (De Vos, 1992).

Approximate yields in California average 450 23-pound cartons per acre, with good yields at 550 cartons per acre for established plantings. Yields of seed-grown plants in Imperial County reportedly range from a low of 300-400 cartons per acre to a high of over 1,000 cartons (Mayberry).

Packing

The artichoke buds are cooled to 40° F as soon as possible after reaching the packing shed to maintain quality. After cooling, the artichokes are inspected visually to remove those with insect injury, mechanical damage, or cosmetic defects. They are then graded mechanically into several size classes and packed by hand in wax-impregnated, corrugated, paper-board cartons. The smaller artichokes and those with surface damage are sent to a canner for processing.

The size grades for artichokes, based on the number of buds packed per carton, are as follows:

Size	Buds per box	Bud diameter
Jumbo	18	over 4.5 inches

Extra large	24	4.0-4.5 inches
Large	36	3.5-4.0 inches
Medium	48	3.0-3.5 inches
Small	60-72	2.75-3.0 inches
Baby	70-120	1.0-2.75 inches.

Baby artichokes are packed "large loose" or "small loose" with the count varying from 70 to 120 buds per box. Sizes 18, 24 and 36 are the most popular in the market, with 18- and 24-counts preferred. More than 90 percent of the fresh-market volume is in the 18- to 60-count range (The Packer). However, as consumers become more familiar with artichokes, they are buying more baby artichokes for fresh use, especially during periods of short supply (Comfort).

Storage

Artichokes are stored at 33° F and at 95 to 100 percent relative humidity. Artichokes of good quality, that are without decay or freezing injury, will keep in good condition for 3-4 weeks at 33° F. Artichokes must be kept refrigerated as they move through the distribution channels.

Marketing Artichokes

All artichokes are grown with the intent of being used for the fresh market, and 70-80 percent of production reportedly is destined for that use (De Vos, 1992, Willey). The remaining artichokes are processed. Processing is the most important outlet for small artichokes, which are used in the preparation of artichoke hearts. Similarly, large artichokes exhibiting cosmetic defects are also processed. The exceptions are those marketed as "Frost-Kissed" or "Winter-Kissed" artichokes.

There are reportedly 17 handlers in California who pack, sell, and ship artichokes (Comfort). Some handlers are grower-shippers who also pack and sell artichokes for other growers. There is at least one marketing cooperative that handles artichokes.

The Desert-grown artichokes compete with those from the central coast, which has limited production during the Desert marketing season. When supplies are disrupted from the central coast, Desert growers realize a high market value for their artichokes. Conversely, when production increases in coastal California in mid-spring, the value of Desert-grown artichokes diminishes rapidly.

Typically, artichoke growers produce other vegetables, such as broccoli, lettuce, and celery. Some shippers reportedly include artichokes in their line of produce primarily as a convenience to buyers.

Costs of Production

Only one cost of production budget for perennial artichokes was located--a 1981 budget for Monterey County. Because of input price inflation since 1981, current costs per acre likely are somewhat higher than the estimates shown in the budget (see the Appendix). However, despite the budget's low estimate of costs per acre, the costs per carton may be plausible for 1995. Artichoke yields have risen in the past 20 years, partly offsetting increased costs. One artichoke specialist indicated that the "break-even price in 1993 under traditional culture was about \$10 per 22-pound box" (De Vos, 1993). The estimated cost in 1981 was \$10.25 to \$12.25 per carton, depending on the yield (see the detailed budget in the appendix).

The production practices and input quantities reported in the 1981 budget appear to be relatively representative for perennial artichokes at the present time. Some of the pesticides mentioned in the budget, however, are no longer used for artichokes and have been replaced by others.

Some observers of the artichoke industry report they expect costs to decline in the future as growers switch to seed-propagated varieties and increasingly produce artichokes as an annual crop (De Vos, 1993). They report that annual planting will boost yields, lower harvesting costs, and reduce the costs of controlling the artichoke plume moth and rodents. A budget for seed-grown artichokes in Imperial County places total costs at \$4,021 per acre in 1995, or \$6.70 per carton for a 600-carton yield (Mayberry).

Production Perils

Excessive Rain

Excessive rain in itself is usually not a serious problem for artichokes. Because most of their rainfall occurs between November and April, California growers routinely create ditches in their fields during the winter to drain away excess water. Flooding as a result of excessive rain, however, can be a serious problem. Excessive rain can also exacerbate the losses caused by high winds, as reportedly occurred in San Mateo County in 1995 (see section addressing excessive wind).

Flooding

Flooding can cause plant losses because of diseases, silting, and erosion. Artichokes will not tolerate standing water for long periods of time. When artichoke roots are submerged for a week or more, the plants become vulnerable to root rot and may be weakened or killed. Flooding during early 1995 caused losses of plantings near the Salinas River due to the erosive active of the flood water, as well as to the smothering of the plants caused by excessive silt deposits (Soffa).

Flood damage can result in a loss of the investment in the plants, as well as a loss of current production. Perennial plantings are typically maintained for a number of years, and flood damage may require re-establishing the plants earlier than normal.

Excessive Wind

By itself, high winds seldom cause serious losses to artichoke plantings. During 1995, however, excessive winds uprooted artichoke plants in San Mateo County, California (Olson). The county experienced heavy rains in February, followed by unseasonably warm weather, which promoted rapid development of the artichoke plants. In March, more rain softened the soil, weakening the roots' anchorage. These heavy rains, accompanied by high winds, uprooted the plants. Yields of some fields were reportedly reduced by as much as 95 percent (Olson).

Frost

Artichokes are susceptible to frost damage, and exposure to sub-freezing temperatures for even brief periods may cause blistering and subsequent browning of the exterior of the bracts. This injury is cosmetically undesirable, but has no adverse effect on culinary quality. "Frost-kissed" or "Winter-kissed" artichokes are those which have been exposed to mild frost.

Excessive Heat

Hot, dry conditions cause artichoke buds to open quickly and destroy the tenderness and taste of the flower buds. For this reason, artichokes grown in the Desert areas are seldom marketable after early April. In Oregon's Willamette Valley, production is targeted for the late summer and early fall to avoid high temperatures during the mid-summer.

Diseases

Fusarium root rot is the most serious disease affecting artichokes, and the most difficult to manage. Curly dwarf and botrytis also affect artichokes, but they are not generally considered limiting to production. Proper rotations, appropriate field selection, sanitation, spacing, fertilization, and irrigation help reduce the risk of disease infections.

Fusarium Root Rot

Fusarium root rot is associated with a root oxygen deficiency, such as occurs when wet soil conditions or flooding exclude air from the soil (Rubatzky). Affected plants become stunted and may die. Growers may lose individual plants or whole sections of a field. Control involves carefully monitoring irrigation to avoid subjecting the plants to long periods of excessively wet conditions.

Curly Dwarf

Curly dwarf is one of several viruses that infect artichoke plantings in California, but it is not generally considered a serious disease (Rubatzky). Viral infections are prevalent in all commercial rootstock. When plants become stressed, viral symptoms appear. Early symptoms of curly dwarf include general curling of the leaves, dwarfing of the plant, and reduced bud production. Buds may become misshapen and remain small.

Because viruses are widespread in commercial rootstock, it is difficult to assess to what extent viruses reduce production. The reason for this is that there are no commercial virus-free plantings to use as a standard against which to measure yield reduction in infected plantings.

Botrytis Disease

Botrytis is a fungal disease affecting artichokes, but it is not generally considered limiting to production. Although it infects both the plant and the flower bud, economic damage is usually limited to the harvested artichokes.

Botrytis is most troublesome during rainy weather, when high humidity and moderate temperatures prevail. The fungus usually invades tissues damaged by insects, frost, or other causes. During long periods of wet weather, a grey or brown fungal growth develops on the invaded plant parts, from which spores are spread by the wind.

Control in the field is not practical, but infection within packed containers may be reduced by removing infected buds in the packing shed, and storing and shipping at low temperatures.

Black Tip

Black tip is a physiological disorder that causes mainly cosmetic damage. The tips of the affected bracts become dark brown (sometimes almost black), dry, and leathery. Although the edible portion of the bud is not affected, the dark color reduces the bud's value for the fresh market.

Insects

Several insect pests require control measures for successful artichoke production. The largest portion of most growers' pest management budgets is expended in controlling the artichoke plume moth.

Artichoke Plume Moth

The adult artichoke plume moth is yellowish-brown, with a wing span of 3/4 inch to 1 inch. It lays its eggs on the undersides of the fuzzy leaves of the artichoke, or on the stems below the buds. The larvae feed on any part of the plant, but the main injury is to the floral heads, which are damaged and made unsightly.

Control measures for the plume moth include the use of insecticidal sprays, pheromone disruption, trap monitoring, and strict sanitation practices. Burying plant debris produced during the cut-back operation or disking it into the soil destroys the larvae and helps reduce the levels of infestation. The artichoke plume moth has not become established in the Desert production areas.

Thistle Butterfly

The larvae of the thistle butterfly, also called the painted-lady butterfly, are dark brown to black, and spiny. They feed mostly on thistles. Although thistle butterflies are seldom a pest of artichokes, they are controlled by the same insecticides used for the artichoke plume moth.

Slugs and Snails

Slugs and snails may rasp off the outer surfaces of the artichoke buds, causing a later blackening of the damaged surfaces, which lowers quality. They also eat jagged holes in the leaves and stems. Slugs are especially injurious during cool, cloudy periods. Slime trails provide evidence of slug activity.

Poison baits may be used to control slug and snail populations.

Leaf Miners and Aphids

Damage caused by leaf miners and aphids can reduce artichoke production and quality. These pests, however, are not likely to become serious enough to cause a crop failure.

Aphids are the most serious problem in the Desert areas, where artichokes are grown from seed. One of the advantages of growing artichokes from seed is that the plants are free of latent viruses that infect plants propagated from crown divisions. Because aphids are sucking insects, however, they can infect virus-free artichokes with a number of viruses that are widespread in the Desert production areas (Schrader).

Rodents

The California vole and the Botta pocket gopher can cause considerable damage to artichoke plants. Both of these rodents feed on the fleshy artichoke roots, which may cause plant death. Voles also may feed on young shoots. Control is achieved by trapping, the introduction of rodenticides into burrows and tunnels, and the use of anticoagulant baits.

Weeds

Weeds compete for water, sunlight, and space, and can be carriers of plant viruses infecting artichokes. In addition to mechanical cultivation, growers can use herbicides in their weed control programs, especially at planting, after cut-back, and during the winter when wet soils and the presence of drainage ditches make cultivation difficult. Proper cultivation, field selection, and rotations reduce the need for chemical weed controls.

Grower Organizations

The Artichoke Advisory Board

The Artichoke Advisory Board represents all artichoke growers in California. It is an industry-funded organization which handles promotion and public relations for the industry (Comfort). Board activities are funded with a 14-cent-per-carton and a \$1.00-per-acre assessment on all commercial producers.

The San Mateo County Farm Bureau

The San Mateo County Farm Bureau represents grower interests for all farmers in San Mateo County, including artichoke producers. Jack Olson, manager of the Bureau, indicated that his organization is working with USDA to establish an artichoke insurance policy (Olson).

Disaster Assistance Payments for Artichokes

Ad hoc disaster assistance payments were made to growers for losses due to natural causes from 1988 through 1993, as well as in 1994.² Artichoke growers received payments in 1988, 1991, 1992, and 1993, with payments for artichoke losses totalling \$82,500 over the four years.

Since artichokes have not been eligible for crop insurance, artichoke growers were required to realize a yield loss of at least 40 percent in order to collect ad hoc disaster assistance. Once a loss qualified for assistance, payments were made at a rate based on the five-year moving average price for artichokes, dropping the high and low years.

Artichoke payments over the four-year period were made to four counties: Monterey, San Mateo, and Sonoma counties in California, and Coos County, Oregon (Table 4). San Mateo artichoke growers received payments in 1991, 1992, and 1993, while growers in the other counties received payments for artichoke losses in only one year in the series. San Mateo growers also received the largest volume of payments, accounting for over one-half (about \$49,000) of the total assistance made for artichoke losses.

The payments received by artichoke growers have been, in general, relatively low compared to the volume of payments received by growers of other crops. Part of the reason for this is that artichokes are comparatively hardy plants that produce over an extended harvest period. They can withstand severe stress and yet survive to produce a considerable crop later in the season. A hard freeze in December 1990, for example, appeared to have destroyed the California artichoke crop, but the plants recovered and produced a typical-size crop the following spring. Although recovery appears less complete than following the 1990 freeze, a substantial amount of California's artichokes survived flooding during the winter of 1995, and produced a crop later in the season. As of the end of November, 1995, artichoke shipments for the year to date from California were about 55 percent of the shipments at the same time in 1994 (USDA, AMS, Oct. 1995).

Payments for artichoke losses in 1995 under the non-insured assistance program (NAP) are expected to exceed historical ad hoc disaster payments. NAP payments are made to growers on an individual basis, but first require that widespread losses occur to trigger eligibility. Heavy rains, flooding, and

² ERS does not yet have the 1994 data, but is in the process of acquisition.

Table 4--Ad hoc disaster payments for artichokes, 1988-93

County	1988	1989	1990	1991	1992	1993	Total
-----Dollars-----							
California:							
Monterey	0	0	0	28,856	0	0	28,856
San Mateo	0	0	0	36,920	8,591	2,375	47,886
Sonoma	4,538	0	0	0	0	0	4,538
Oregon:							
Coos	0	0	0	1,261	0	0	1,261
Total, U.S.	4,538	0	0	67,037	8,591	2,375	82,541

Source: ASCS data files, compiled by the General Accounting Office.

high winds caused damage in some artichoke fields, triggering NAP payments for the 1995 crop.

Although NAP payments may exceed past ad hoc disaster outlays, they are likely to be limited due to several reasons. First, a large share of the acreage in Monterey County is ineligible for payments because many growers have sales (and hence, qualifying gross revenue³) in excess of \$2 million. Second, payments on other qualifying acreage may be limited because growers hit the \$100,000 payment maximum permitted by law. Complete loss of about 70 acres of artichokes would bump a producer against the \$100,000 payment limit (see Table 1).⁴

Data addressing NAP payments by crop for 1995 losses are not yet available, although information exists for aggregate crop categories. For example, payments were approved in October for alfalfa, raspberry, blackberry, and artichoke losses in Monterey County, and are expected to total, at the maximum, about \$6 million for the four crop categories. NAP payments were also approved in October for western San Mateo County for blackberries, strawberries, artichokes, and stock flowers, and are estimated to reach, at the maximum, about \$700,000 in aggregate.⁵

³ Qualifying gross revenue means: 1) with respect to a person who received more than 50 percent of his or her gross income from farming, ranching, and forestry operations, the annual gross income for the calendar year from such operations; and 2) with respect to a person who receives 50 percent or less of his or her gross income from farming, ranching, and forestry operations, the person's total gross income from all sources.

⁴ The acreage needed to reach the \$100,000 payment limitation was calculated using data in Table 1. Specifically, five year averages were used to calculate an expected price (\$40.45 per cwt) and an expected yield (118.2 cwt per acre). For this example, assume that the area is triggered and that the producer has a total loss. Fifty percent of the yield equals 59.1 cwt, and 60 percent of the price equals \$24.27 dollars per cwt, for a per-acre payment of \$1,434. With a \$100,000 payment limitation, a producer with losses only on artichokes and 70 acres in that crop would reach the payment limitation.

⁵ The phrase "at the maximum" is used in this discussion because the dollar value estimates are based on the assumptions that all producers have a 100 percent loss, that all apply, and that they are otherwise eligible for benefits. The payment amount will vary considerably depending on the number of persons exceeding the \$100,000 NAP payment limitation and the number of persons having \$2 million or more in qualifying gross revenue during the past calendar year.

Insurance Implementation Issues

Demand for Insurance

There is a fairly limited potential for artichoke crop insurance because growers are likely to view artichokes as relatively free of production perils. In addition, with only 9,000-10,000 acres nationally, and a crop value of about \$50 million (\$58 million in 1994), the industry offers little opportunity for crop insurance sales.

The bulk of U.S. artichoke production is located in the lower Salinas Valley in Monterey County, where the unique climate presents few production perils. Most growers reportedly feel they can manage the production risks associated with artichoke pests by following recommended cultural practices. Hard freezes, excessive rains, and flooding are the greatest production perils, and damage from these hazards occur rather infrequently. The flooding during the winter and spring of 1995 is described as a once-in-100-year event, and is unlikely to lead growers to insure on a continuing basis at the buy-up coverage levels.

The fact that artichokes are a relatively hardy plant that can recover from extreme stress and produce a crop later in the season is a further reason demand for insurance is likely to be relatively limited. Because artichokes produce over a long period in the principal growing areas, losses at one point in the season represent only a portion of the total yield, and may not qualify the grower for an indemnity. Most of the large growers, therefore, are likely to choose to shoulder the risk of production losses themselves and avoid the cost of insurance. However, because of its nominal cost, growers likely would purchase the catastrophic coverage if artichokes were an insurable crop.

Artichoke growers tend to produce a number of vegetables in addition to artichokes, such as broccoli, cauliflower, celery, and lettuce. This diversification provides a measure of risk reduction against production losses, as well as against low market prices.

Large growers account for the bulk of the artichoke acreage in the Salinas Valley and are not eligible to receive benefits under the Non-Insured Assistance Program (NAP) because their annual gross income (and hence, qualifying gross revenue) exceeds \$2 million. These growers may want to see artichokes become an insurable crop so that they may buy catastrophic insurance coverage, which they could do at a negligible cost.

Moral Hazard

Moral hazard is not likely to be a problem in insuring perennial artichokes. Although prices for fresh-market artichokes typically decline during the spring, when production peaks, processing is a viable secondary market. Processing prices would more than cover variable harvesting costs, so that growers would not typically have a financial incentive to neglect the crop in order to receive insurance payments. An exception may occur if the producer's crop is expected to yield only marginally above the producer's coverage level, and market prices are low relative to the artichoke price election level.

Adverse Selection

Adverse selection would be most likely to occur in cases where artichokes were planted in poorly-drained fields or near rivers where losses may occur because of excessively wet soils. Also, artichokes planted further from the ocean are more likely to incur production losses due to excessive heat or extreme cold than those planted nearer the ocean.

Reference Prices

USDA publishes relatively complete data on artichoke prices, which would serve adequately for setting reference prices. USDA reports a state average price received by growers for artichokes in California (USDA, NASS). In addition, the Federal-State Market News Service reports shipping point prices and publishes an annual summary showing monthly artichoke prices (USDA, AMS).

Yield Data

There should be no problem obtaining grower yield data. The California Artichoke Board assesses all growers on the basis of their volume of production and acreage. The production records used in the operation of the Board's program provide the data needed to determine individual grower's yields.

Shipper records regarding the volume of artichoke deliveries provide further documentation of growers' production. In addition, the County Agriculture Commissioner offices in California record data on each grower's acreage for which pesticides are applied. This information would provide further acreage documentation.

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Appendix table 1. Artichokes: Number of U.S. and California farms, acres harvested, and acres irrigated, 1987 and 1992

	<u>Farms</u>		<u>Harvested acres</u>		<u>Irrigated acres</u>	
	1987	1992	1987	1992	1987	1992
	Number		Acres		Acres	
California	66	63	11,757	9,128	11,757	9,028
Other	--	4	--	64	--	64
U.S.	67	67	--	9,193	--	9,092

-- = Not available.

Source: U.S. Department of Commerce, Bureau of Census. 1992.

Appendix table 2-Farms producing artichokes, production, acres harvested and acres irrigated, 1987 and 1992

1987-----		-----1992-----				-----	
State/County		Acres		---Irrigated---		Acres	
---Irrigated---		Farms	Acres	Farms	harvested	Farms	Acres
Farms	harvested	Farms	Acres	Farms	harvested	Farms	Acres
California		63	9, 128	62	9, 028	66	11, 757
66	11, 757						
Humboldt		4	1	4	1	(N)	(N)
(N)	(N)						
Imperial		8	600	8	600	(N)	(N)
(N)	(N)						
Monterey		18	6, 771	17	6, 671	21	7, 953
21	7, 953						
San Luis Obispo		3	(N)	3	(N)	(N)	(N)
(N)	(N)						
San Mateo		9	716	9	716	18	1, 132
18	1, 132						
All Other		21	(N)	21	(N)	(N)	(N)
Other States		4	64	3	64	(N)	(N)
(N)	(N)						
United States		67	9, 193	65	9, 092	67	(N)
67	(N)						

(N): Indicates "not available" or "not published" to avoid disclosure of individual operations.

Source: U.S. Department of Commerce, Bureau of Census, 1992.

Appendix Table 3--Artichoke acreage, yield, and production in California, selected counties, 1991-93

County	Year	Harvested area	Yield/acre	Production	Price	Value
		Acres	-----Tons-----		-----Dollars-----	
Orange:	1991	1	9.0	9	633	5,700
	1992	67	6.4	430	546	235,000
	1993	66	10.9	721	597	430,660
Santa Cruz:	1991	480	5.4	2,597	497	1,293,000
	1992	529	6.7	3,550	843	2,996,000
	1993	433	4.8	2,098	633	1,330,000
San Mateo:	1991	960	3.4	3,264	879	2,872,000
	1992	960	4.4	4,224	875	3,696,000
	1993	740	5.2	3,848	850	3,271,000
Monterey:	1991	7,545	6.6	50,400	578	29,136,000
	1992	6,910	6.3	43,875	673	29,560,000
	1993	6,410	5.6	36,420	777	28,303,000
Other counties:	1991	815	4.9	4,047	617	2,499,300
	1992	773	--	--	--	1,929,900
	1993	1,280	--	--	--	4,316,100
State:	1991	9,801	6.1	60,317	593	35,806,060
	1992	9,239	5.6	52,079	737	38,416,900
	1993	8,929	4.8	43,087	873	37,650,700

-- = Not available.

Sources: California Agricultural Statistics Service; County Agricultural Commissioner's Reports.

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