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

Prepared by the Economic Research Service, USDA
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for the Federal Crop Insurance Corporation

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Executive Summary

The U.S. produced an average 7.4 million cwt of cauliflower annually between 1988 and 1993. Eighty-six percent of that total was destined for fresh-market use. The remainder was processed, primarily as frozen product. Cauliflower is produced mainly in California, Arizona, Oregon, and New York. Seventy-eight percent of U.S. production came from California in 1993 and 10 percent from Arizona.

Although the USDA reports acreage and production only for six states (those listed above, plus Michigan and Texas), cauliflower is grown throughout the Northeast and Midwest. The Census reported 38 states (including Alaska and Hawaii) having farms with cauliflower sales in 1987, and ad hoc disaster assistance records indicate that payments were made for cauliflower in 39 states.

Although grown in America since the 18th century, cauliflower has become an important vegetable only since about 1920. Per capita use of fresh and frozen cauliflower increased from an estimated 1.2 pounds (farm weight equivalent) in 1970 to 2.4 pounds in 1993. Per capita use has declined slightly since the peak per capita consumption of 3.2 pounds was reached in 1988.

Month-to-month changes in cauliflower prices are very substantial and create a significant price risk. Even so, cauliflower prices follow a fairly well-defined seasonal pattern. They are typically lowest during May to October, and highest during December. The lowest prices occur during the Summer, when California's production is augmented with cauliflower from the East and Midwest.

The Census reported 1,962 farms with 54,581 acres of cauliflower in 1987. This represents a decrease of 666 farms, and an increase of about 4,400 acres, from 1982 levels. A decline in farm numbers and acreages occurred in the East and Midwest, while farm numbers in the West remained virtually unchanged and harvested area in those states increased. Partial data from the 1992 Census indicate that growth in acreage may have slowed or stopped.

Off-farm employment does not appear to be a major source of diversification for farms growing the bulk of U.S. cauliflower. However, income from other crops, especially other vegetables, is a major source of revenue, accounting for the bulk of farm receipts. Of the $833 million in market sales reported by the 1987 Census for the six major cauliflower states, $644 million was from the sales of vegetables and melons. The estimated value of U.S. cauliflower production in those states was $188 million in 1987.

Cauliflower is a cool-season crop, and produces the best quality heads at temperatures between 58^{o} F and 68^{o} F. Depending on the stage of growth, the cauliflower plant requires 1 to 2 inches of moisture per week. Excessive moisture during the first 2-3 weeks after transplanting increases the incidence of root diseases and may cause cauliflower to "button" (form heads prematurely). Prematurely-formed heads are generally too small to market.

They are also usually yellow, because the plant's leaves have typically not yet developed adequately to protect the curd from direct sunlight.

Cauliflower is the most sensitive of the cole crops to adverse weather. Mature cauliflower plants can withstand temperatures as low as 25° F for several hours late in the Fall without damage to the curd. However, young plants subject to freezing temperatures often "button," or suffer from "blindness"--that is, they do not develop a head.

Warm temperatures can also promote disorders. Cauliflower heads maturing at temperatures above 85° F may suffer from "leafy head," riciness (over-mature florets), discoloration (generally purple or green in color), soft and loose heads, or poor "wrapper leaf" development. Good development of wrapper leaves is needed to assure that the curd maintains its white color.

Cauliflower's large leaves lose moisture at a fast rate and irrigation is often needed to prevent water stress and yield losses. Nationally, 92 percent of the cauliflower harvested acreage was irrigated in 1987, with nearly all acreage irrigated in Arizona, California, Oregon, and Texas. Growers in the East and Midwest rely less on irrigation than in the West. For example, Michigan and New York growers irrigated only about 60- to 65-percent of their acreage in 1987.

The weather-related perils most likely to result in indemnities under a cauliflower policy include excessive rain, excessive heat, excessive cold, wind, and drought. Growers generally report that they can manage insects by following prudent cultural practices. Various diseases, however, particularly rots, may be difficult to control and can cause substantial yield losses when exacerbated by extreme weather conditions.

Ad hoc disaster data can be used to indicate which cauliflower-producing areas received large payments relative to their acreage. The National Agricultural Statistics Service (NASS) does not report cauliflower acreage in Washington and Wisconsin, although those states accounted for an average of 11 to 12 percent of U.S. ad hoc disaster payments made for cauliflower between 1988 and 1993. Similarly, NASS data indicate that Michigan accounted for a relatively large share of payments. In contrast, Arizona and California collected a small share of ad hoc payments relative to their acreage.

Insurance issues addressed in this report include the setting of reference prices, estimating "appraised production," moral hazard, defining "areas" under the Non-insured Assistance Program, and the demand for insurance. Our research suggests that the demand for a cauliflower policy would likely be greatest in Texas, Washington, and in production areas in the East, Midwest, and South. Interest would likely be lowest in California, Arizona, and Oregon, where the majority of the crop is grown.

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Introduction

Cauliflower belongs to the Cruciferae or mustard family and is commonly classified as a cole crop along with broccoli, cabbage, brussels sprouts, kale, and collards. The cauliflower plant produces an edible head consisting of poorly-formed and condensed flowers whose stalks are close-together, short, and fleshy. The ideal head of cauliflower (curd) is pure white and does not have protruding leaves.

Although small amounts of cauliflower are grown throughout the Northeast and Midwest, most U.S. output is produced in California, Arizona, Oregon, and New York. Seventy-eight percent of U.S. production came from California in 1993 and 10 percent from Arizona (Table 1). Twenty-five U.S. counties, thirteen of them in California, were identified as likely to currently be growing 100 acres or more of cauliflower (Table 2).

This report examines those aspects of the cauliflower industry that relate to the demand for crop insurance and the feasibility of developing a cauliflower policy. Cultural practices and production perils are similar for broccoli and cauliflower. However, there are enough differences between the two crops that it was judged appropriate to prepare separate reports. But because of many similarities, the discussion in the two reports at times overlaps.

The Cauliflower Market

Supply

The United States produced an average 7.4 million cwt (740 million pounds) of cauliflower annually between 1988 and 1993 (Table 1). Eighty-six percent of this total was destined for fresh-market use. The remainder was processed, primarily as frozen product. Total U.S. cauliflower production increased rapidly during the 1970's and 1980's, peaking at nearly 7.9 million cwt in 1988. Output has dropped slightly since that time, however, as imports of frozen cauliflower replaced domestic production.

Although the USDA reports acreage and production only for Arizona, California, Michigan, New York, Oregon, and Texas, cauliflower is grown throughout the Northeast and Midwest. Ninety-one percent of the harvested cauliflower acreage reported in the 1987 Census of Agriculture was in the states reported by the USDA. Most of the cauliflower in non-reported states likely reflects small acreages that are grown on diversified vegetable farms for sale in local or regional markets.

Table 1--U.S. cauliflower acreage and production, 1988-93

State	1988	1989	1990	1991	1992	1993
			Acres harvested			
Fresh market and processing:						
Arizona	6,100	6,800	6,400	5,800	7,000	6,500
California	48,000	52,500	51,300	42,000	42,000	43,000
Michigan	1,100	1,200	1,000	1,100	700	700
New York						
Long Island	1,500	1,300	1,200	1,000	900	800
Upstate	1,600	1,400	1,400	1,400	1,500	1,500
Oregon	3,000	3,000	3,500	3,900	3,300	3,100
Texas	1,500	1,500	1,000	900	800	1,000
U.S.	62,800	67,700	65,800	56,100	56,200	56,600
			1,000 Cwt production			
Fresh market and processing:						
Arizona	641	782	672	725	770	644
California	6,240	6,038	6,156	5,460	5,460	5,160
Michigan	61	72	70	72	91	91
New York						
Long Island	180	150	144	160	90	120
Upstate	152	168	168	189	195	225
Oregon	495	540	595	390	363	341
Texas	105	96	50	45	40	75
U.S.	7,874	7,846	7,855	7,041	7,009	6,656
Fresh market:						
Arizona	641	782	672	725	770	644
California	5,340	5,378	5,506	5,110	NR	NR
Other[1]	519	493	442	449	5,391	5,216
U.S.	6,500	6,653	6,620	6,284	6,161	5,860

NR = Not reported.

[1] 1988-91: Michigan, New York, Oregon, and Texas.
1992-93: California, Michigan, New York, Oregon, and Texas.

Source: USDA, NASS.

Table 2--Counties likely to harvest 100 acres or more of cauliflower

State	County (reported acres)[1]	
Arizona	Maricopa (700)	Yuma (5,531)
California	Fresno (1,500)	Imperial (7,253)
	Monterey (22,270)	Orange (590)
	Riverside (1,080)	Santa Barbara (8,620)
	San Benito (270)	Santa Cruz (1,005)
	San Diego (617)	San Joaquin (1,620)
	San Luis Obispo (2,358)	Stanislaus (2,450)
	Ventura (1,317)	
Florida	Hillsborough (400-500)	
Michigan	Allegan (390)	Bay (165)
New York	Suffolk (394)	
Oregon	Clackamas (545)	Linn (241)
	Marion (2,073)	Multinomah (111)
Texas	Hidalgo (282)	
Washington	Skagit (200)	

[1] Reported acres are from various sources and for different years and may not, therefore, accurately reflect current acreage.

Sources: 1987 and 1992 Censuses of Agriculture; Arizona Agriculture Statistics Service; California Agricultural Commissioners' Reports; Havens; Michigan Department of Agriculture; and Gilreath.

The Census of Agriculture reported 38 states (including Alaska and Hawaii) having farms with cauliflower sales in 1987, and records for ad hoc disaster assistance indicate that payments were made for cauliflower in 39 states.

Imports of fresh and frozen cauliflower products accounted for 10 percent of the total U.S. supply in 1993. Almost all imports were frozen cauliflower from Mexico (93 percent) and Guatemala (5 percent). The U.S. imports a small quantity of fresh cauliflower from Canada during July through October, and an even smaller amount from Mexico during November through March.

The United States exported 29 percent of its fresh-market cauliflower production in 1993. Most exports went to Canada and Japan, but the United States also exports fresh cauliflower to Korea, Mexico, the European Union, and other countries.

The long-term rise in U.S. cauliflower production reflects producers' response to growing consumer demand. Of course, short-term variations in the quantity of fresh cauliflower occasionally occur because of weather disruptions in one or more production areas.

Demand

Although grown in America since the 18th century, cauliflower has become an important vegetable only since about 1920 (Seelig). In recent years, per capita use of fresh and frozen cauliflower increased from an estimated 1.2 pounds (farm weight equivalent) in 1970 to 2.4 pounds in 1993 (Tables 3 and 4). Per capita use has declined slightly since the peak per capita consumption of 3.2 pounds was reached in 1988.

Total U.S. cauliflower use in 1993 was 600 million pounds, up from 254 million in 1970 (USDA, ERS). Between 70 and 80 percent of U.S. cauliflower use in recent years has been in the fresh form and 20 to 30 percent has been in the processed form. A small amount of the processed product is pickled, although most is frozen.

Consumer purchases of fresh cauliflower appear to be relatively uniform throughout the year. Fresh-market shipments peak during the Winter and early Spring when most cauliflower originates from Arizona, California, Florida, and Texas. Cauliflower-growing areas in the East and Midwest ship during the Summer and Fall.[1]

The quantity of cauliflower purchased by consumers is likely to be more price sensitive than for some other vegetables, such as celery or lettuce. Although cauliflower is frequently consumed in combination with broccoli, carrots, celery, and other vegetables, the largest quantity of fresh cauliflower likely is served as a main vegetable dish. Consequently, a change in the price of

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[1] Shipment statistics are not reported for all areas and do not, therefore, provide an accurate picture of total supply when the non-reported areas are marketing cauliflower (USDA, AMS).

Table 3--U.S. fresh cauliflower: Supply, utilization, and price, farm weight, 1970-94

Year	Supply			Utilization			Season average price 1/	
	Production	Imports	Total	Exports	Total	Per capita use	Current dollars	Constant 1987 dollars
	Million pounds					Pounds	$/cwt	
1970	151.9	0.1	152.0	--	152.0	0.7	12.40	35.33
1971	143.4	0.8	144.2	--	144.2	0.7	14.50	39.19
1972	175.1	0.1	175.2	--	175.2	0.8	14.60	37.53
1973	160.2	0.3	160.5	--	160.5	0.8	16.40	39.71
1974	168.3	0.2	168.5	--	168.5	0.8	17.80	39.64
1975	197.9	0.3	198.2	--	198.2	0.9	20.00	40.65
1976	224.3	0.7	224.9	--	224.9	1.0	21.30	40.73
1977	238.3	1.3	239.6	--	239.6	1.1	23.20	41.50
1978	193.3	2.9	196.2	20.9	175.3	0.8	26.40	43.78
1979	271.1	4.8	275.9	31.5	244.4	1.1	25.20	38.41
1980	284.6	7.3	291.9	33.6	258.3	1.1	28.20	39.33
1981	351.7	11.2	362.9	48.3	314.5	1.4	30.10	38.15
1982	342.0	10.8	352.8	44.8	308.0	1.3	31.20	37.23
1983	370.4	12.5	382.9	51.4	331.6	1.4	32.00	36.70

1984	481.7	13.5	495.2	64.0	431.2	1.8	31.10	34.18
1985	490.5	16.3	506.8	68.2	438.6	1.8	29.80	31.57
1986	590.6	13.8	604.4	78.5	525.9	2.2	28.80	29.72
1987	592.8	13.8	606.6	89.0	517.6	2.1	28.30	28.30
1988	650.0	14.6	664.6	123.5	541.1	2.2	28.10	27.05
1989	665.3	19.5	684.8	110.0	574.8	2.3	28.10	25.90
1990	662.0	22.1	684.1	128.1	556.0	2.2	25.20	22.24
1991	628.4	17.9	646.3	138.9	507.4	2.0	27.10	23.02
1992	616.1	17.6	633.7	160.5	473.2	1.9	29.10	24.03
1993	586.0	11.2	597.2	168.2	429.1	1.7	31.50	25.36
1994f	610.0	15.6	625.5	156.0	469.6	1.8	--	--

-- = Not available. f = ERS forecast.
1/ Constant dollar prices were calculated using the GDP implicit price deflator, 1987=100.

Source: USDA, ERS.

Table 4--U.S. cauliflower for processing: Supply, utilization, and prices, farm weight, 1970-94

Year	Supply				Utilization			Season average price 1/	
	Production	Imports	Beginning stocks	Total	Exports	Ending stocks	Total	Per capita use	Current dollars	Constant 1987
	Million pounds							Pounds	$/ton	
1970	94.4	0.0	65.1	159.5	--	57.0	102.4	0.5	106.00	301.99
1971	118.2	0.0	57.0	175.2	--	46.3	128.9	0.6	113.00	305.41
1972	137.8	0.0	46.3	184.1	--	70.6	113.5	0.5	116.00	298.20
1973	149.8	0.0	70.6	220.4	--	93.1	127.3	0.6	137.00	331.72
1974	148.0	0.0	93.1	241.1	--	99.0	142.1	0.7	161.00	358.57
1975	124.3	0.0	99.0	223.3	--	94.9	128.4	0.6	169.00	343.50
1976	108.2	0.0	94.9	203.1	--	67.3	135.8	0.6	173.00	330.78
1977	156.1	0.0	67.3	223.4	--	74.0	149.4	0.7	196.00	350.63
1978	199.1	20.3	74.0	293.4	--	123.3	170.0	0.8	213.00	353.23
1979	132.3	14.3	123.3	269.9	--	118.0	151.9	0.7	201.00	306.40
1980	145.4	13.9	118.0	277.4	--	99.3	178.1	0.8	230.00	320.78
1981	173.2	19.4	99.3	291.9	--	82.7	209.2	0.9	242.00	306.72
1982	195.1	29.4	82.7	307.2	--	99.4	207.7	0.9	252.00	300.72
1983	171.0	30.2	99.4	300.6	--	101.9	198.7	0.8	252.00	288.99
1984	187.1	44.1	101.9	333.2	--	108.7	224.5	0.9	266.00	292.31

1985	175.9	52.7	108.7	337.2	--	115.9	221.3	0.9
264.00	279.66							
1986	162.1	60.2	115.9	338.2	--	115.4	222.8	0.9
270.00	278.64							
1987	144.7	83.7	115.4	343.8	--	114.2	229.6	0.9
274.00	274.00							
1988	137.4	71.9	114.2	323.5	--	90.7	232.8	1.0
279.00	268.53							
1989	119.3	85.8	90.7	295.8	--	109.0	186.8	0.8
296.00	272.81							
1990	123.5	88.9	109.0	321.4	--	130.7	190.6	0.8
386.00	340.69							
1991	75.7	68.3	130.7	274.8	--	126.2	148.6	0.6
479.00	406.97							
1992	84.8	60.9	126.2	271.9	--	101.7	170.2	0.7
428.00	353.43							
1993	79.6	76.7	101.7	258.1	--	86.8	171.3	0.7
430.00	346.22							
1994f	100.0	80.0	86.8	266.8	--	95.0	171.8	0.7
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-- = Not available. f = ERS forecasts.
1/ Constant dollar prices were calculated using the GDP implicit price deflator, 1987=100.

Source: USDA, ERS.

cauliflower has a greater effect on the cost of a meal than a change in the price of a vegetable such as lettuce, which is frequently used as a component in a salad or a sandwich. Consumers, therefore, are likely to place greater importance on price when purchasing cauliflower than when purchasing a food such as lettuce.

One statistical study of the relationship between farm-level prices for fresh vegetables as a group and their quantities shows prices rising (falling) about 2 percent for each one percent decline (increase) in quantity (Wohlgenant). In contrast, another study of the relationship between farm-level prices and quantities--this time, for lettuce--suggests that the price of lettuce may change as much as ten percent for each one percent change in quantity (George and King). Because cauliflower is frequently used as a main dish rather than as a component with other foods--the frequent situation for lettuce--its price-quantity relationship is probably more like the estimate for all fresh vegetables than the estimate for lettuce.

Prices

Month-to-month changes in cauliflower prices are very substantial and create a significant price risk, especially for producers of fresh-market cauliflower (Table 5). An exceptional example of month-to-month variation occurred in 1991, when the average grower price rose from $3.40 a carton in February to $12.45 in March, only to fall to $5.75 in April. The unusually high prices in March were due to a supply shortfall in central California, where a severe freeze in December 1990 damaged much of the cauliflower intended for harvest the following March. When March arrived, a shortfall occurred because production had declined seasonally in Arizona and in the Imperial Valley, while the seasonal increase in output from central California was much smaller than typical.

Despite their variability, cauliflower prices follow a fairly well-defined seasonal pattern. They are typically lowest during the May through October period, and highest during December. The lowest prices occur during the Summer, when California's production is augmented with cauliflower supplies from the East and Midwest. Prices rise during November and usually peak during December, when the bulk of production is shifting from central California to the winter areas in the Arizona and southern California deserts and production has declined in the East. Prices usually decline during January and February when the desert areas are in full production, but peak again in March, when supplies from Arizona and southern California decline and central California has not yet reached full output.

Industry Characteristics

Farms with Cauliflower

The U.S. Census of Agriculture reported 1,962 farms with 54,581 acres of cauliflower in 1987. This represents a decrease of 666 farms, but an increase of about 4,400 acres, from 1982 levels (Appendix table 1). A decline in farm

Table 5-- Cauliflower: U.S. f.o.b. prices, monthly averages, 1989-93

Month	1989	1990	1991	1992	1993
	---------Dollars per 25-pound carton-------				
January	5.43	3.65	4.88	4.38	8.15
February	3.53	4.53	3.40	3.58	7.03
March	4.18	3.50	12.45	6.90	7.15
April	5.30	3.28	5.75	4.18	5.93
May	3.85	4.33	4.18	5.50	5.58
June	3.13	3.25	3.53	6.58	6.70
July	5.15	5.63	3.93	5.90	6.13
August	4.48	6.53	5.25	6.85	5.00
September	6.30	7.93	5.78	6.00	9.15
October	6.45	9.25	5.83	6.18	5.60
November	5.80	10.43	7.10	7.63	6.05
December	8.58	9.55	7.35	8.20	7.50

Source: Computed from USDA, NASS.

numbers and acreages occurred in the East and Midwest, while the number of farms in the West (Arizona, California, Oregon, and Washington) remained virtually unchanged and harvested area in those states increased by 6,700 acres. Partial data from the 1992 Census indicate that growth in the West has slowed or stopped, while the acreage and number of farms in the East and Midwest continue to decline.

Virtually all of the cauliflower in Arizona, California, and Texas was irrigated in 1987. Nationwide, about 92 percent of the cauliflower acreage was irrigated in that year.

Except in Arizona, California, and Oregon, a large portion of farms with cauliflower in 1987 were relatively small operations, with less than $100,000 in crop sales (Appendix table 2). Many of the smaller farms appear to grow a mixture of vegetables and sell primarily in local and regional markets.

Seventy percent of the farms with cauliflower in 1987 were either individual- or family-owned operations (Appendix table 3). Among the larger farms (those with $500,000 or more in sales), a partnership or corporate arrangement was the most common. Sixty-four percent of the farms in California with cauliflower had sales of $500,000 or more, and 78 percent of these were classified as partnerships or had a corporate ownership arrangement.

Income Diversification on Farms with Cauliflower

Off-farm employment does not appear to be a significant source of diversification for farms growing the bulk of U.S. cauliflower. Farming was the main occupation for 81 percent of the operators on farms growing cauliflower in 1987 and over half reported no off-farm work (Appendix table 4). Of the 38 percent of the operators who reported at least one day of off-farm work, the majority operated small farms, which likely account for a small share of total cauliflower production. Nearly three-quarters of those with off-farm work, for example, operated farms with $50,000 or less in crop sales.

Income from other crops, especially other vegetables, is a major source of revenue on farms with cauliflower, accounting for the bulk of farm receipts. Of the $833 million in market sales reported by the 1987 Census for Arizona, California, Michigan, New York, Oregon, and Texas farms growing cauliflower, $644 million was from the sales of vegetables (including cauliflower) and melons (Table 6).

The USDA's Crop Reporting Board estimated the value of U.S. cauliflower production in six states listed in Table 6 at $188 million in 1987, 23 percent of all-product sales reported by the Census. The greatest specialization was in Arizona, California, and New York, where cauliflower sales accounted for about a quarter of the sales on farms with cauliflower.

Vegetable acreage reported by growers in a 1992 survey of chemical use also indicates a greater amount of specialization in California than in other states. Twenty-one percent of the total vegetable acreage on surveyed farms with cauliflower in California was planted to cauliflower (Table 7).

Table 6--Market value of sales on farms producing cauliflower, selected states, 1987

State	All Products	All Crops	Vegetables & melons	Cauli-flower	Cauliflower % of all products
	----------Million dollars----------				Percent
Arizona	83.8	83.7	71.3	21.9	26
California	634.9	627.1	500.8	147.2	23
Michigan	17.7	16.9	10.2	2.1	12
New York	33.6	31.4	19.6	8.3	25
Oregon	40.4	39.9	24.5	7.3	18
Texas	22.9	20.7	18.0	0.8	3
6 states	833.3	819.7	644.4	187.6	23

Source: 1987 Census of Agriculture, except for the cauliflower sales category, which is from USDA, NASS, *Vegetables*.

Table 7--Enterprise diversification on farms growing cauliflower, 1992

State	Farms sampled	Cauliflower farms growing other vegetables	Cauliflower, percent of total vegetable acreage
	---Number---	---Percent---	---Percent---
Arizona	14	93	17
California	91	97	21
Michigan	46	98	11
New York	55	98	13
Oregon	38	100	16
Texas	12	100	2

Source: USDA, *Vegetable Chemical Use Survey*, 1992.

USDA's survey of chemical use also provides information on the various specialty crops produced on farms growing cauliflower (Table 8). As shown in the table, a fairly high proportion of the sampled cauliflower farms also produced sweet corn and fresh tomatoes, crops for which FCIC currently offers insurance.

Cultivation and Management Practices

Climate

Cauliflower is a cool-season crop, and produces the best quality heads at temperatures between 58° F and 68° F. Depending on the stage of growth, the cauliflower plant requires 1 to 2 inches of moisture per week. Excessive moisture during the first 2-3 weeks after transplanting (4-5 weeks after direct-seeding) increases the incidence of root diseases and may cause cauliflower to "button" (form heads prematurely). Prematurely-formed heads are generally too small to market. They are also usually yellow, because the plant's leaves have typically not yet developed adequately to protect the curd from direct sunlight (see "Tying" section). If cauliflower roots are under water for over 24 hours, plants generally die.

Cauliflower is the most sensitive of the cole crops to adverse weather. Mature cauliflower plants can withstand temperatures as low as 25° F for several hours late in the Fall without damage to the curd. However, young plants subject to freezing temperatures often "button," or suffer from "blindness"--that is, they do not develop a head.

Warm temperatures can also promote disorders. Cauliflower heads maturing at temperatures above 85° F may suffer from leafy head, riciness (over-mature florets), discoloration (generally purple or green in color), soft and loose heads, or poor "wrapper leaf" development. Good development of wrapper leaves is needed to assure that the curd maintains its white color.

Soil Requirements

A well-drained soil with good moisture-holding capacity is ideal for cauliflower production. Loams, clay loams, and muck soils are the best, although lighter soils can also produce good crops if managed carefully.

Soils are prepared for transplanting small cauliflower plants by broadcasting fertilizer and incorporating herbicide. A slightly rough surface helps reduce sand movement and blasting of the transplants (damage caused by blowing sand). A smoother seedbed is prepared for direct-seed cauliflower than when transplanting. Cauliflower normally germinates and emerges easily unless a hard, sun-baked crust forms on the soil surface following a heavy rain.

Cauliflower should not be planted in soils where cruciferous crops or weeds have grown during the past 3 to 5 years. Cruciferous crops include cabbage, cauliflower, broccoli, kale, kohlrabi, brussels sprouts, Chinese cabbage,

Table 8--Selected specialty crops on farms producing cauliflower, 1992

State	Farms sampled	Farms growing				
		Onions	---Sweet Corn---		----Tomatoes----	
			Fresh	Processed	Fresh	Processed
	Number	Percent				
Arizona	14	29	0	0	0	0
California	91	16	16	13	21	11
Michigan	46	11	67	56	63	2
New York	55	16	67	55	75	0
Oregon	38	11	16	16	0	0
Texas	12	33	50	75	75	0

Source: USDA, *Vegetable Chemical Use Survey*, 1992.

mustards, turnips, rutabagas, and radishes. Cruciferous weeds include wild radish and wild mustards.

Cauliflower is very sensitive to nutrient deficiencies and to situations of low pH. The soil pH should be maintained at 6.5 or higher. Problems with club root disease are more manageable at soil pH levels above 6.8 than when the pH is at a lower level.

Varieties

Cauliflower varieties range from very-early maturing (less than 60 days from transplanting to maturity) to late-maturing (over 100 days). Several varieties are recommended for both fresh-market and processing use. Some varieties are recommended for production across several states, while others are recommended for specific areas. Some, although not all, of the varieties recommended for the West include Snowball Y Improved, Snowball 123, Snowman, Imperial 10-6, and Silverstar 2320.

There are several novelty varieties of cauliflower, including Broccoflower (green cauliflower) and Romanesco.[2] These novelty varieties account for a very minor portion of the market.

Planting

Most cauliflower is transplanted in the field with seedlings that are either greenhouse-grown or field-grown. Some cauliflower also is direct-seeded. Greenhouse-grown transplants (plug plants) are planted with the soil and roots intact. Field-grown transplants are bare-rooted when set in the field. Growers schedule plantings in order to have cauliflower maturing over an extended period of time. Growers in central California harvest cauliflower year round, while in other areas, the season is shortened by excessive summer heat or extreme winter cold (Table 9).

Certified or hot-water-and-fungicide-treated seed is recommended to protect against several serious seed-borne diseases. Hot-water seed treatments are frequently performed by the seed company.

Most cauliflower is planted with two rows to a bed. Bed centers are generally 40 inches apart. The in-row spacings are usually 12-18 inches.

Broccoflower, also known as green cauliflower, is a broccoli-cauliflower hybrid that combines the physical features of cauliflower with the chlorophyll of broccoli. It is handled just like cauliflower in its care and use, and is considered to be more like cauliflower than broccoli. "Romanesco" is a yellow-green decorative cauliflower consisting of tightly packed "turrets."

Table 9--Usual planting and harvesting dates for cauliflower

State	Planting date	Usual harvest date		
		Begin	Most active	End
Winter				
Arizona	Oct. 1-Nov. 1	Jan. 1	Jan. 1-Feb. 15	Mar. 30
California	See Table in California state analysis section.			
Texas	Oct. 1-Nov. 1	Jan. 1	Jan. 1-Feb. 15	Mar. 30
Spring				
California	See Table in California state analysis section.			
Summer				
California	See Table in California state analysis section.			
New York	Apr. 1-June 30	July 1	July 1-Sep. 30	Sep. 30
Fall				
New York	July 1-July 31	Oct. 1	Oct. 1-Nov. 25	Dec. 15
Michigan	June 10-July 20	Aug. 10	Sep. 10-Oct. 20	Nov. 15
Texas	Jul. 15-Aug. 31	Oct. 15	Nov. 15-Nov. 30	Dec. 31

Source: USDA, Statistical Reporting Service.

Note: Dates reported in this table may differ slightly from those reported in the "State Analyses" section. Dates in that section largely reflect personal communication with extension specialists and ASCS county executive directors and may be more location-specific than the dates in this table.

Fertilization

Cauliflower requires moderate-to-large amounts of nitrogen, phosphorus, and potassium. Soils should test for phosphate (P_2O_5) at 150 to 200 pounds per acre and for potash (K_2O) at 300 to 350 pounds per acre. Nitrogen application varies with the cultivar, but at least 150 pounds N per acre is usually recommended. Nitrogen is generally applied at several intervals: 60 pounds is typically applied preplant, with an additional application side-dressed at two 3-week intervals after initial growth begins. Lime application is recommended to maintain soil pH at 6.5 or above.

Cauliflower, like broccoli, is very sensitive to boron deficiency, which can cause hollowing of the stems and browning of the florets. Most forms of boron are very soluble and leach from the soil rapidly. To avoid a deficiency, 3 to 4 pounds of boron per acre can be incorporated into the soil before planting. Boron requirements can be met by applying, during soil preparation, 30 to 40 pounds of borax per acre mixed with fertilizer. Alternatively, 15 to 20 pounds of a soluble form can be sprayed on the soil with the herbicide. Additional boron can be applied during the season, as needed, in a foliar spray.

Other nutrients required for proper cauliflower development include calcium, magnesium, manganese, and molybdenum. Cauliflower is especially sensitive to molybdenum deficiency, and seed treatments containing molybdenum are recommended. The recently-mature leaves of molybdenum-deficient plants are light green or slightly yellow, and leaf margins may curl inward and die. Some leaves may not expand fully, causing a condition called whiptail.

Irrigation

Cauliflower is a heavy user of water, and nearly all acreage is irrigated in Arizona, California, Oregon, and Texas. Nationally, 92 percent of the cauliflower harvested acreage was irrigated in 1987. Growers in the East and Midwest rely less on irrigation than in the West. For example, Michigan and New York growers irrigated only about 60- to 65-percent of their acreage in 1987.

Cauliflower's large leaves lose moisture at a fast rate and irrigation is often needed to prevent water stress and yield losses. Sprinkler irrigation is often used for transplanted cauliflower until the roots become established. Transplanting is a critical time for bare-rooted cauliflower plants, in particular, because their root systems have been disturbed and they cannot take up water efficiently until they become re-established. Once the transplants become established, the field is converted from sprinkler to furrow irrigation.

Tying (Blanching)

Exposure to sunlight discolors the cauliflower curd and can produce off-flavors. While the heads are still small, the upright inner leaves form a protective shade, protecting the curds from direct sunlight. But, in most

varieties, as the heads grow they force the inner leaves apart, exposing the curds to the sun and threatening the quality of the final product.

To protect cauliflower curds from the sun and to maintain the pure white color, the leaves may need to be gathered over the head and tied with rubber bands or string. Cauliflower leaves are tied after a head begins to develop and has reached about 1" in diameter.

Some varieties (self-blanching types) do not need to be tied because they have very long, upright leaves which protect the curd until it is ready for harvest. One such variety is Self Blanche, which has wide, perpendicular leaves. Other varieties, including the Snowball types, may need to be tied for protection from the sun. Transplanting cauliflower so that the plants are close together helps keep the leaves from spreading and exposing the curd to the sun. Because of the high cost of tying, blanching of cauliflower for processing in Oregon is accomplished with plant spacing and the use of varieties which provide good leaf cover (Mansour).

Harvesting

Cauliflower is normally ready for harvest about 60 days after transplanting. Each plant produces just one head. Harvesting begins when about 10 percent of the heads reach market size (5-6 inches in diameter). Because of its delicacy, cauliflower heads are harvested by hand-cutting.

Once harvesting begins, additional cuttings are made at 4-8 day intervals from slow-to-develop plants. A cauliflower field for processing is usually harvested 5-6 times during the harvest period, while a field for fresh-market use is harvested 2-4 times. The number of cuttings depends on market conditions, with additional cuttings made when market prices are unusually high.

Cauliflower grown for processing is placed in bulk bins for transport from the field to the processing plant. Processing cauliflower is usually more mature when harvested than fresh-market cauliflower and must be handled quickly to avoid deterioration. Cauliflower deteriorates more quickly if cut after the curds mature than if it is harvested while the curds are slightly immature.

Packing and Shipping Fresh Cauliflower

Fresh-market cauliflower may be field packed or it may be hauled to a central packing shed where it is graded, trimmed, packed, and precooled.

A common practice for handling fresh-market cauliflower is to film-wrap the heads and pack them into shipping cartons in the field directly after cutting. Large growers may haul the cut heads to a central packing shed where they are graded, trimmed, packed, and precooled. The heads are then transferred to storage, where they are held at 32° F and 95 percent relative humidity until

shipping. Cauliflower is not usually stored for an extended period, but it can be held for up to 3 to 4 weeks in cold storage.

The most common shipping container is a 25-pound carton packed with 12 or 16 film-wrapped, trimmed heads. A popular container in the East is the Catskill or L.I. crate, which holds 45 to 50 pounds.

Cauliflower is transported mainly by truck from production regions to wholesale and retail markets. In 1993, 96 percent of the cauliflower shipped by major domestic suppliers was hauled by truck and 4 percent went by piggyback rail (USDA, AMS). Piggyback rail refers to a truck semi-trailer loaded onto a flatbed rail car. In order to maintain high quality, cauliflower must be held at low-temperatures during transport to market, as well as during retail display.

Marketing

Eighty-eight percent of U.S. cauliflower production was sold for fresh-market use in 1993 (USDA, NASS and Table 1). All of the cauliflower grown in Arizona is destined for the fresh market. However, some cauliflower grown in California and Michigan goes for processing, and processing is a major use for cauliflower in Oregon.

Most fresh-market cauliflower is produced by large grower-shippers. Some is grown under a contractual arrangement between the grower and a fresh-market packer. Under this arrangement, the packer may furnish seed and advance operating capital to the grower. The packer may specify planting dates, which effectively schedule the timing of harvest. Such scheduling assures the packer a supply of raw material to meet expected consumer demand.

Contracting between growers and processors is a customary practice for processing cauliflower production. Processors need a relatively constant supply of raw material to fully utilize their plants. However, cauliflower may sometimes be switched between the fresh and processing markets if the price differential between fresh and processing use warrants the diversion. Cauliflower is a dual-use vegetable, and the same crop may be used for either the processing or fresh markets.

Costs of Production

Cauliflower production involves investments of up $3,400 or more per acre for growing, harvesting, packing, and selling costs (Table 10). In Imperial County, California, variable harvesting and marketing expenses account for 57 percent of the total cost of producing fresh-market cauliflower.[3] In Michigan, harvesting and marketing expenses accounted for a somewhat smaller share (41 percent) than in California.

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[3] Detailed cost of production budgets are presented in Appendix table 6.

Table 10--Cauliflower: Variable harvesting costs, selected states

State	Yield	Variable harvest cost	Total cost	Variable harvest percent of total
	Pounds	$/acre		Percent
Fresh-market:				
Imperial county, California	11,500	1,950	3,415	57
Michigan	10,000	1,166	2,829	41
Processing:				
Oregon	10,000	332	1,108	30

Note: Costs may not be comparable among states because budgets may be for different seasons and may not include the same cost items.

Sources: Cross; Shapley; University of California.

Because they account for a sizeable share of total expenses, costs for harvesting and marketing play a major role in growers' harvesting decisions, especially for fresh-market cauliflower. If market prices fall below expected variable harvesting and marketing expenses, growers may find it more profitable to abandon a portion of their harvestable production than to sell it in the market. On the other hand, if prices are relatively high, growers may try to increase their yield by caring for the plants while slow-to-develop heads grow to marketable size.

For processing cauliflower, harvesting and marketing expenses likely play less of a role in growers' harvesting decisions. Processing cauliflower involves minimal packing and selling costs. As a result, variable harvesting and marketing expenses account for a smaller share of total costs than for fresh-market cauliflower. In Oregon, variable harvesting and marketing expenses for processing cauliflower accounted for about 30 percent of total costs in 1991.

As with other fresh-market vegetables, unusually high or unusually low market prices for cauliflower may affect yields. When prices are relatively low, growers may cut fewer times, reducing planted-acre yields to a lower level than if prices were higher. Yields may rise during periods of higher prices as growers care for the crop in such a way as to get extra cuttings and enhance the yield per acre.

Production Perils

The natural perils that would most likely result in indemnities under a cauliflower policy include excessive rain, excessive heat, excessive cold, wind, and drought. Growers generally report that they can manage insects by following prudent cultural practices. Various diseases, however, particularly rots, may be difficult to control and can cause substantial yield losses when exacerbated by extreme weather conditions. Because cauliflower and broccoli are closely-related plants and are frequently grown in the same areas, both are susceptible to many of the same production perils.

Excessive Rain

The roots of cauliflower, like other vegetable plants, need free oxygen in order to breathe and to take up water. Cauliflower plants will die if the soil in which they are growing becomes saturated for an extended period. If flooding is so severe that the cauliflower curd is submerged, rot-causing pathogens may become established, reducing yields or causing a complete crop loss.

Heavy rains following direct-seeding was reported as a production peril in some areas. Heavy rains can wash away newly-planted seeds. In addition, heavy rains followed by sunny weather causes some soils, especially those with a high clay content, to form a hard surface (crust) which the seedling plants cannot penetrate. Growers may have to replant in such situations, thereby losing their initial investment in seed and other planting expenses.

Excessive Heat

Excessively high temperatures once the plant reaches the mature vegetative phase may delay curd initiation. But after the head starts to develop, high temperatures may result in over-maturity of the curd. Cauliflower heads maturing when temperatures are above 80° F tend to develop soft, loose heads and often suffer disorders such as leafy head, riciness, and poor wrapper leaf development. Over-maturity and poor wrapper leaf development may cause yellowing or purpling of the curd if the head becomes exposed to light. When accompanied by high humidity, excessive heat increases the incidence of bacterial soft rot in cauliflower.

Excessive Cold

Mature cauliflower plants can withstand temperatures as low as 25° F for several hours if the plant has had a period of relative cold prior to the freeze. Freezing temperatures, however, can kill cauliflower if the plants have not had time to acclimate to cold weather.

Cauliflower plants subjected to freezing temperatures when they are young often suffer from disorders known as buttoning (poorly-formed heads that develop prematurely) or blindness (heads that do not form). In addition, a period of relatively cool temperatures (59° F - 60° F) after cauliflower reaches the mature vegetative stage may initiate premature curd development. In this situation, the curds form before enough leaves have differentiated to provide good head cover, resulting in reduced curd quality.

High Winds

High winds, such as those accompanying severe thunderstorms and hurricanes, may cause cauliflower plants to lodge (topple to the ground), exposing the leaves and perhaps the cauliflower curds to the soil. Exposure to the soil increases the opportunity for decay pathogens to become established, which may lead to subsequent yield loss. Lodging may be particularly serious when excessive rain accompanies the high wind. This is because the soil becomes saturated, weakening the plant's anchoring and causing it to topple more easily.

Drought

Cauliflower has large leaves and requires a relatively constant supply of water, especially during periods of warm temperatures. Most cauliflower in the major production areas is grown on irrigated soils, so that drought is not a serious production peril. Some cauliflower is also grown with irrigation in the South, East, and Midwest. For non-irrigated cauliflower in these areas, however, extended periods of dry weather can stunt plant growth and reduce yields. Drought was a major source of crop loss throughout the Midwest and in New York during 1988.

Hail

Hail damage to cauliflower plants can create wounds, which act as an entryway for rot-causing pathogens. Pathogens are pervasive in the field, and any wound, such as a nick or cut from falling hail, can serve as an entry point for rots. Severe hail, of course, can physically destroy a cauliflower plant.

Insects

The principal insect pests of cauliflower include aphids, cabbage maggots, caterpillars (cabbage worms and cabbage loopers), cutworms, flea beetles, thrips, and whiteflies. Insect control is made more difficult for cauliflower and broccoli than for some other crops, such as cabbage, because their compound heads provide partial protection from insecticide applications and are ideal places for insects to escape detection. Insects can damage the leaves, roots, stem, and head of the cauliflower plant.

Aphids

Aphids weaken the cauliflower plant by sucking plant juices and are considered a food adulterant if contained in processed cauliflower. Aphids also transmit virus diseases among plants. Control consists of applying insecticides starting with the first appearance of aphids and continuing at regular intervals as they re-appear.

Cabbage maggots

Cabbage maggots are the larvae of small flies that resemble houseflies. The flies lay eggs on the young plants or on weeds around the plants. The eggs hatch in several days and the maggots chew the stems and bore into the large roots and the lower part of the stalks. Young plants that are invaded by maggots usually wilt and die.

Caterpillars

Caterpillars attack cauliflower by eating the leaves and buds and tunnelling into the heads of older plants. The most destructive species are the cabbage looper and the cabbage worm. Insecticides are used for control.

Cutworms

Cutworms damage young cauliflower plants by feeding on the stem, sometimes severing the plant from its roots. Insecticides are used for control.

Flea beetles

Flea beetles are small, shiny, steel-blue, jumping insects that eat circular holes in the leaves. They are most serious among young cauliflower, but can be controlled with insecticides.

Whiteflies

Sweetpotato whiteflies have recently caused damage to cauliflower seedlings in Arizona and southern California. In large numbers, they sap strength from the plant and slow growth. Whitefly damage delays maturity of the crop by 2-3 weeks, causing growers to miss targeted market opportunities. Growers generally report that they can adequately control whiteflies with insecticides.

Nematodes

Problems with cyst nematodes in cauliflower have been reported in California (Laemmlen). Controls consist of rotating crops and applying nematocides.

Diseases

Club Root

Club root, a fungal disease, attacks the roots of all cole crops. It causes the roots to enlarge and form spindle-shaped galls or "clubs." The growth of clubs inhibits development of a normal root system and blocks the plant's vascular activity. Infected plants eventually die, or may survive in a stunted condition.

Club root incidence can be reduced by using uninfected transplants and by avoiding movement of machinery from infected areas to clean fields. Raising the soil pH by the application of lime also assists in control. Crop rotation is not very effective because resting club root spores can survive in the soil for many years.

Black Leg

Black leg is a fungal disease which may be carried by seed, or may overwinter on plant debris and on alternate host plants. Black leg causes pale spots on the leaves, stems, and roots, which later become ashy-gray with scattered black spots on the surface. The disease destroys the plant's fibrous root system, causing wilting, stunting, and death of affected plants. Mature plants may fall sideways from lack of root anchorage.

Recommended controls consist of using disease-free seed and rotating fields out of cole crops for at least three years.

Black Rot

Black rot is cause by a bacteria that overwinters on crop debris, although infections most often develop from infected seed. Infected young plants usually wilt and die. Black rot infections in older plants cause stunting and small heads. The development of the disease is accelerated by warm temperatures (in the 80^{o} F - 86^{o} F range) and high humidity.

Control of black rot includes the use of seed that has been hot water-treated or assayed and found to be completely free of the disease. Rotating fields out of cole crops for at least 2 years helps avoid re-infestation. Copper sprays applied with a boom sprayer may reduce the spread of black rot organisms in the field (Zandstra).

Soft Rot

Bacterial soft rot is characterized by water-soaked areas on the leaves, stems, or curd which rapidly increase in size and become soft and mushy, with an offensive odor. Infections often occur following chemical, mechanical, pest, or other injury. Soft rot is common in stored cauliflower that has been damaged during harvest.

Controls include planting in rows to promote good air drainage, using care in cultivation to minimize plant injuries, using surface rather than overhead irrigation, and cleaning and spraying storage walls and floors with a copper sulfate solution.

Downy Mildew

Downy mildew, a fungal disease, results in white mildew on the undersides of seedling leaves, with yellowing on the upper side. Later, leaves may become papery and die.

Caused by a fungus, downy mildew overwinters in roots or old diseased plant parts. High humidity, fog, drizzling rains, and heavy dew are conducive to development and spread of the disease. Fungicide applications help prevent spread of the organism in the field. Resistance is being incorporated into the breeding process but, at present, there are no fully-resistant commercial varieties available (Mansour).

Physiological Disorders

Molybdenum Deficiency/Whiptail

Cauliflower is very susceptible to molybdenum deficiency, particularly when grown in highly acidic soils. In younger plants, leaves turn white and wither. In older plants, the leaves turn light green or slightly yellow. Some leaves may not expand fully, causing the condition called whiptail. Blindness may occur, or the curds may not develop into a marketable head.

Molybdenum deficiency can be prevented by maintaining a pH level of 6.5. If a deficiency occurs in the field, application of molybdenum-containing foliar sprays can overcome the problem.

Blindness

Blindness is a condition where the cauliflower growing point dies at an early stage of growth, but the plant remains alive. The leaves become thicker and darker green than normal, but most importantly, the plant does not develop a

head. Blindness is caused by exposure of the young plants to frost or insect damage. Blindness is more common among cauliflower grown in the East than in California.

Buttoning

Any heading that occurs before the plant has attained sufficient vegetative growth to support production of a marketable head (premature heading) is called buttoning. Buttoning is caused by stress on young plants, especially during the first eight weeks of growth. The most common causes of buttoning include: exposure to frost, extended cold temperatures (below 50° F for 5 or more days); use of over-hardened, root-bound, or old (over 6 weeks) transplants; excessively wet or dry conditions, especially immediately after transplanting; inadequate fertilizer, especially nitrogen; and insect, disease, or weed pressure that severely reduces vegetative growth.

Early-maturing varieties are more susceptible to buttoning than those that mature later. The occurrence of buttoning can be minimized if transplants are not exposed to low temperatures. Other precautionary measures include: planting only young, vigorous plants; irrigating after transplanting; maintaining recommended soil pH and nutrient levels; controlling pests; and using full-season cultivars.

Hollow Stem/Browning

Hollow stem results primarily from a boron deficiency, but may be influenced by the presence of excessive nitrogen and rapid growth. Boron deficiency may appear as brown, water-soaked spots on the cauliflower heads, but often there are no external symptoms. In serious cases, hollow stem proceeds upward through the surface of the head, and the internal surface of the cavity becomes brown or black. Bacterial soft rot may develop, causing a soft, odoriferous rot of the head surface and the internal cavity.

Some varieties are more susceptible than others. Hollow stem is less of a problem in the Fall when plants mature slowly than in the Summer, when plant growth is rapid.

Control consists of the use of resistant cultivars, maintenance of correct soil pH, irrigation, the addition of boron, and the use of sufficient, but not excessive, N-P-K.

Leafy head

Leafy head refers to the condition were undesirable small leaves grow from the curd. The cause is a reversion to vegetative growth, prompted by high temperatures and excessive water and nitrogen.

Riciness

Riciness is a condition where individual florets develop and elongate, causing them to look like grains of rice and reducing market quality. In extreme

cases, the florets may turn green. This defect is attributed to high temperatures during curd development and is aggravated by over-maturity. Rapid growth and heavy nitrogen side-dressing also exacerbate this condition. Some varieties are more prone to riciness than others.

Weeds

Weeds become a production peril when they are permitted to grow uncontrolled, and compete with the cauliflower plant for sunlight and water. This situation can lead to reduced yields. Weeds can also host insects and diseases, such as black leg and downy mildew. Growers are advised to cultivate as often as necessary to control weeds while they are still small and have not yet begun to compete with the cauliflower plants.

State Analyses

Arizona

Arizona is the second largest cauliflower-producing state, accounting for about 10 percent of U.S. output in 1993. Arizona's 1993 cauliflower production had a farm value of $21 million. Cauliflower is grown for winter harvest in Arizona, and is marketed from late November through early April. All of Arizona's crop is sold for fresh-market use.

The Census reported 27 farms in Arizona with 6,210 acres of cauliflower in 1987. All of the acreage was irrigated. Most of Arizona's cauliflower is grown in Yuma and Maricopa counties.

Production Perils

Cauliflower growers in Arizona face relatively few weather-related production perils. There have been two floods recently in the Gila Valley, but these created greater yield losses for lettuce than for cauliflower (Wilcox). Downy mildew may be a problem for cauliflower early in the season, but damage can usually be minimized with appropriate control measures.

Arizona farmers received only $6,078 in disaster assistance payments for cauliflower losses between 1988 and 1993, which provides further evidence that growers face relatively few production perils. Total disaster assistance payments to Arizona growers were less than 0.05 percent of the value of the crop.

Demand for Insurance

Arizona growers would not likely be very interested in a cauliflower policy because weather-related perils are not a sizeable risk to cauliflower production. One grower indicated that Arizona producers would not be happy with a crop insurance program that "favored" producers in more risky eastern states. Uncertain returns caused by low prices is a greater concern among Arizona growers than yield losses due to production perils.

California

California produced 516 million pounds of cauliflower in 1993 (78 percent of U.S. production) on 76 percent of U.S. harvested acreage. California's cauliflower had a farm value of $250 million in 1993.

The Census of Agriculture reported 273 farms in California with cauliflower in 1987. Many are large enterprises: Sixty-four percent had sales of $500,000 or more, and 85 percent had sales of $100,000 or more.

The principal commercial growing areas are Monterey, Santa Barbara, and Imperial counties (Appendix table 5 and Appendix map). The Salinas Valley (Monterey County) provided nearly 50 percent of total California production in 1992, with about 40 percent of the harvested acreage. Santa Barbara County (Santa Maria Valley), the second largest cauliflower county, produced about 20 percent of California's production, and Imperial County accounted for about 10 percent. Thirteen counties reported 100 acres or more of cauliflower in 1992.

Although cauliflower is a cool-season crop that has been traditionally grown in the coastal valleys, new, more heat-tolerant varieties now allow it to be grown in locations such as the Imperial and Coachella Valleys (desert areas) during the Winter, and in the San Joaquin Valley during the Fall. Yields, however, are generally higher in the coastal counties than in the Desert and the San Joaquin Valley areas because of the superior ocean climate in the former.

Planting and Harvesting Dates

Cauliflower is grown year-round in one area or another in California (Table 11). The coastal counties (Monterey, Santa Barbara, San Luis Obispo, and Santa Cruz) can produce year-round because the ocean climate prevents winter temperatures in these areas from becoming too cold and the summer temperatures from becoming too hot for cauliflower. Imperial County, in contrast, produces only during the Winter, as temperatures during other seasons are too hot for cauliflower.

Production Perils

Frost damage and excessively high temperatures are the major production perils for cauliflower in California. Although frost usually does not kill the plant, it damages the growing point, causing blindness, a condition in which the plant does not develop a head. Prolonged exposure to excessively high temperatures once curd formation begins speeds up maturation and results in lowered quality. Heads develop a soft, loose curd and may suffer disorders such as leafy head and riciness. Hard freezes and excessive rain also have caused yield losses.

The largest disaster assistance payments for cauliflower in California over the 1988-93 period were made in Tulare County (San Joaquin Valley) in 1990 ($149,771) for yield losses caused by a hard freeze (Bennett). San Joaquin County, also in the San Joaquin Valley, recorded the second-largest disaster

Table 11--Usual planting and harvesting dates for cauliflower in California

Area	Planting	Harvesting	Peak harvest
Monterey	All year	All year	May-July; October-November
Santa Barbara	All year	All year	April-May
Imperial	August-October	December-March	January

Source: Marketing California Cauliflower, 1991; Laemmlen.

payments ($50,040 in 1992, for losses due to prevented planting). Water rationing reduced water deliveries by 75 percent in parts of the San Joaquin Valley in that year. Cauliflower producers in Tulare County also received sizeable disaster payments in 1991 ($33,199, for losses due to excessive heat) and in 1993 ($22,407, for losses due to too much rain).

Producer Organizations

The Central California Vegetable Grower-Shipper Association and the Vegetable Grower-Shipper Association of Santa Barbara and San Luis Obispo Counties fund labor relations and legislative affairs activities with assessments from grower-shippers based on cartons shipped. Although the associations have fresh cauliflower shipment records, these records may differ from actual grower production, which may include processing cauliflower (Angstadt, Quandt).

Demand for Insurance

The demand for a potential cauliflower insurance policy in California is most likely not very great. The president of the Central California Vegetable Grower-Shipper Association said he thought there would be no interest in a cauliflower policy among growers in the Salinas Valley because growers in that area face very few production perils (Angstadt). The Salinas Valley has a relatively mild climate and all of the cauliflower acreage is irrigated. Low cauliflower prices are the greatest risk facing growers in that area.

A spokesman for the Vegetable Grower-Shipper Association of Santa Barbara and San Luis Obispo Counties also indicated that he thought there would not be very much interest in crop insurance for cauliflower, particularly for that grown during the Summer. He did indicate, however, that growers who raise cauliflower during the Winter face more production perils (extreme cold and flooding) than those who grow during the Summer, and that they may have some interest in a cauliflower policy.

In addition to the risk-diminishing effects of a mild climate and the use of irrigation, cauliflower growing in California tends to be substantially diversified with other crops, which further reduces growers' income risk. Any income loss due to reduced cauliflower yields may be partly offset by income from other crops. Also, California growers tend to harvest cauliflower over an extended season, and yield losses during one part of the season represent only a portion of their total crop and may not lower the average yield for the season enough to qualify them for indemnity payments.

Florida

The major cauliflower county in Florida is Hillsborough County in the west central part of the state. Although USDA does not report acreage and production for Florida, the 1987 Census reported 863 acres of cauliflower for the state. The 1992 Census did not report cauliflower acreage, but reported 17 growers, up from 12 in 1987.

The increase in the number of growers appears to reflect truck farmers, who raise a small amount of cauliflower for sale in local markets. The extension vegetable agent who works with growers in Hillsborough County estimates that there were between 400 and 500 acres of cauliflower in that county during the 1993/94 season (Gilreath). Relatively few farmers grow the bulk of Florida's cauliflower.

Florida's cauliflower production appears to have declined since 1987. The Market News Service reported 51,000 cwt of cauliflower shipped out of Florida in 1988. That number was down to 17,000 cwt during calendar year 1993.

The greatest production peril for cauliflower in Florida is excessive rain (Gilreath). Too much rain may kill the plants if the soil remains saturated for an extended period. Excessive rain also increases the incidence of rot diseases, especially when accompanied by warm weather.

Michigan

Michigan accounted for just over 1 percent of U.S. cauliflower production in 1993. The crop had a farm value of $153 million. USDA estimated there were 800 acres of cauliflower planted in Michigan in 1993, of which 700 acres were harvested.

Two counties in Michigan likely raise 100 acres or more of cauliflower (Michigan Department of Agriculture). The largest acreage is in Allegan County in southwest Michigan, with 384 acres in 1992. Bay County in east central Michigan reported 114 acres in 1992.

Cauliflower acreage is declining in Michigan, especially the acreage of fresh cauliflower (Dudek). The Census of Agriculture reported 136 farms with 872 harvested acres in 1992, down from 190 farms and 1,595 acres in 1987.

The bulk of Michigan's cauliflower production is processed, mainly into pickled products (Dudek). Many Michigan growers also raise cauliflower in combination with other vegetables for sale in local and regional markets, but they generally have very small acreages and account for a small share of total production.

<u>Production Perils</u>

Excessive rain and drought are the greatest production perils in Michigan. Michigan received $1.4 million in disaster assistance payments for cauliflower over the 1988-93 period (9 percent of the total value of production), with Allegan County receiving the largest total payments. The largest one-year payments were for yield losses in 1988, with drought identified as the principal cause os loss (Van Buren). Excessive rain and extended wet weather, which caused uncontrolled rot problems, was identified as the major source of yield losses in 1993.

New York

New York accounted for 5 percent of U.S. cauliflower production in 1993, and had an estimated 2,600 planted acres. The Census reported 228 farms with cauliflower in New York in 1992, down from 321 in 1987. About a third of New York's production is on Long Island (Suffolk County), with the remainder grown in "upstate" areas, mostly western New York counties bordering Lake Erie and Lake Ontario.

All of the cauliflower grown on Long Island is sold for fresh-market use. Most is direct marketed at roadside stands or is sold to local supermarkets. Farms on Long Island typically grow less than 2 acres of cauliflower--the largest have about 30 acres. About two-thirds of the acreage is irrigated (1992 Census). Cauliflower production on Long Island has been declining for the past 10-15 years (Sieczka, Moyer).

Cauliflower on Long Island is grown in a rotation following potatoes or grains (wheat or rye), or in rotation with other vegetables. Most of Long Island's cauliflower is transplanted from April through July. The bulk of the harvest is completed by Thanksgiving.

All of the upstate counties in New York reported less than 100 acres of cauliflower in 1992 (1992 Census). Cauliflower in these areas is grown mainly on small farms and is sold in local markets. Cauliflower is grown in combination with cabbage, broccoli, green peppers, snap beans, squash, peas, eggplant, and other vegetables.

Production Perils

The most serious production perils include excessive rain, wind, excessive heat, and drought. Disaster assistance payments were made for cauliflower on Long Island for yield losses in 1988 due to drought, in 1989 due to excessive rains, in 1991 due to excessive wind and rain, in 1992 due to extreme wet and humid conditions, and in 1993 due to hot and dry conditions (Bruno). Yield losses due to excessive moisture are often the result of the uncontrolled growth of rot organisms. The county extension agent for Suffolk County mentioned diamondback moths, cabbage loopers, and downy mildew as insect and disease pests (Moyer).

Nearly 80 percent of the $420,000 made in disaster payments for cauliflower in New York between 1988 and 1993 went to upstate areas. Growers in 25 upstate counties collected payments for cauliflower over that period.

Drought and excessive rain were cited as the major causes of crop losses in Erie and Niagara counties (Conrad, Belscher). Erie and Niagara counties are located in western New York, and border Lake Erie and Lake Ontario. Hail was also cited as a production peril for cauliflower in western New York.

Demand for Insurance

The county extension agent in Suffolk County said that crop insurance was not something that he had heard growers talk about, and that he thought there might not be much demand for insurance on Long Island (Moyer). He said he based this judgment on growers' lack of participation in crop insurance for potatoes.

Notwithstanding the above opinion, it seems likely that growers in New York may be quite interested in purchasing crop insurance because of rather frequent yield losses due to weather-related events. Disaster payments for cauliflower amounted to about 0.3 percent of total crop value on Long Island over the 1988-93 period, and 1.0 percent in upstate counties. The potential demand for insurance, however, is rather small in all counties except Suffolk, because of the small acreages. Only Suffolk County is likely to have 100 acres or more of cauliflower.

Oregon

Oregon produced 34 million pounds of cauliflower in 1993, having a farm value of $8.5 million. The USDA reported 3,200 planted and 3,100 harvested acres of cauliflower in Oregon in that year. Oregon's output has declined slightly since 1991, accompanying a drop in harvested area.

Most of Oregon's cauliflower is grown in Marion County. The 1992 Census also reported 100 acres or more in Clackamas, Linn, and Multnomah counties. Virtually all of Oregon's cauliflower is grown in the Willamette Valley, which extends south from Portland.

Production Perils

Oregon cauliflower growers do not face as serious a set of production perils as growers in the Midwest and East. Nevertheless, yield losses can occur as a result of excessively high temperatures, excessive rains, and hard downpours following direct-seeded planting. Growers face yield risks from insects and diseases, but are able to manage these perils under most circumstances with currently-available pesticides and management practices.

Heavy downpours following direct-seeded planting may result in growers losing their investment in seed (about $100 an acre) and other planting expenses. Heavy rain followed by hot, sunny weather can cause the soil to form a hard crust through which young plants cannot emerge. Usually, growers replant and thereby recover their investment in fertilizer. Hard rain is less of a problem for cauliflower than for broccoli because less of the cauliflower crop is directed-seeded.

Excessive heat causes the cauliflower to mature rapidly and the curds may, consequently, become coarse or ricey. Excessive heat also causes cauliflower to develop leafy head, and contributes to discoloration or yellowing of the curd. Heat, in combination with excessive rain, create ideal conditions for the development of rot diseases.

The risk associated with excessive rain is that disease organisms, which a grower can manage under normal weather conditions, become out of control. Bacterial diseases such as black rot and soft rot are promoted by warm and humid conditions. Cold and excessive moisture promote fungal diseases.

Grower Organizations

The Oregon Processed Vegetable Commission supports research through grower assessments on six processing vegetables, including cauliflower. The Commission has information on the amount of cauliflower delivered to processors, but no information on planted acreage nor on the amount sold for the fresh market.

Demand for Insurance

There may not be very much demand for crop insurance for cauliflower in Oregon because most growers in the Willamette Valley are diversified with a number of other crops and the production perils they face do not generally cause sizeable yield losses (Brewster). The Executive Secretary of the Oregon Processed Vegetable Commission indicated that he had never heard the need for crop insurance mentioned at any of the Commission's meetings and that it was his feeling that there would not be significant participation on the part of Oregon growers (McCulley). The small amount of disaster payments made to Oregon cauliflower growers (less than .05 percent of the value of cauliflower sales) between 1988 and 1993 tend to support these judgements.

Texas

The USDA reported 1,000 harvested acres of cauliflower in Texas in 1993, with a farm value of $900,000. The Census reported the largest acreage in Hidalgo County in 1987, and the bulk of Texas' cauliflower appears to still be in that area. County statistics on cauliflower acreage are not available for recent years in Texas, nor were we able to identify any county other than Hidalgo with 100 acres or more.

Production Perils

Hard freezes, excessive rain, and excessive heat are the major production perils in Texas. The largest disaster assistance payments for cauliflower were in Hidalgo County during the winter of 1989/90 and were for losses resulting from the Christmas freeze in 1989 (Fuqua).

Grower Organizations

The Texas Vegetable Association supports research and promotion for Texas vegetables through assessments on growers. Although it does not have information on individual growers' cauliflower acreage, Association personnel indicated that they would work with FCIC to provide the yield data needed to offer a cauliflower policy (Sellman).

Demand for Insurance

The insurance coordinator for the Texas Vegetable Association indicated that there was a strong demand in Texas for crop insurance for vegetables, including cauliflower (Sellman). Relatively large ad hoc disaster assistance payments made for Texas cauliflower provides further evidence that participation in crop insurance for cauliflower may be relatively high among Texas producers. Disaster assistance payments averaged 1.3 percent of the value of Texas cauliflower production between 1988 and 1993, compared with payments of less than 0.05 percent in other major cauliflower states.

Washington

The Census reported 20 farms and 544 harvested acres of cauliflower in Washington in 1992, down from 43 farms and 2,176 acres in 1987. Most of Washington's cauliflower is grown in Skagit County, west of the Cascade Mountain range. Since this area usually receives abundant rainfall, very little of the crop is irrigated.

As recently as 1990, Skagit County reported 1,200 acres of cauliflower, a large amount of which went for processing. The processing plant closed in 1991, however, and cauliflower acreage has dropped sharply since that time. There currently is only one major grower, and that person is producing for the fresh market. The extension vegetable agent for Skagit County reports there are about 200 acres of cauliflower in 1994 (Havens). The major harvest season for fresh-market cauliflower is from July to October.

The major production perils in Skagit County are excessive cold, flooding, and occasionally, excessive heat. A hard freeze during the Winter of 1989 resulted in the loss of a large part of the winter cauliflower crop in that year. The winter crop was used primarily for processing. Excessive rains in November of 1989 caused severe flooding. And, in 1994, unusually hot, dry conditions reduced the quality of the crop (Havens).

Demand for Insurance

There may be interest among growers in Skagit County in cauliflower insurance because of their experience with losses due to excessive rain and excessive cold in 1989, and due to hot, dry conditions in 1994. The potential demand is limited, however, by the small amount of cauliflower grown in that area.

Wisconsin

Only a small amount of cauliflower is grown in Wisconsin, with the Census reporting 266 acres in 1992. No individual county, however, is likely to have as much as 100 acres (Hartman). Most of the cauliflower is grown in combination with other vegetables on diversified truck farms and is marketed locally or in regional markets.

Despite its small acreage, Wisconsin is mentioned because its production losses illustrate the perils involved in cauliflower production in the

Midwest. Nearly $400,000 in disaster assistance was paid to farmers in Wisconsin for losses to cauliflower between 1988 and 1993. The biggest payments were made in 1988 and in 1992. The losses in 1988 were due to drought while those in 1992 were due to excessive rain and flooding (Rate, Schwartzkoff).

Ad Hoc Disaster Assistance for Cauliflower

Ad hoc disaster assistance legislation was made available for losses of commercially-grown crops in each of the years 1988-93. Ad hoc payments provide an indication of high-loss areas during that period, and may indicate states and counties that would face relatively high risk under a potential FCIC cauliflower policy. These data may also suggest the areas where the demand for a cauliflower crop insurance policy would be relatively high.

Under the 1988-93 legislation, payments were made under the categories of participating program crops, nonparticipating program crops, sugar, tobacco, peanuts, soybeans, sunflowers, nonprogram crops, ornamentals, and at times, aquaculture. Producers without crop insurance--the case for cauliflower--were eligible for payments for losses greater than 40 percent of expected production. If a producer had no individual yield data to use in calculating "expected production," county-level or other data were used as a proxy. Payment rates for cauliflower were based on 65 percent of a 5-year average price, dropping the high and low years.

Disaster assistance payments for cauliflower have been made in the categories of fresh cauliflower, processed cauliflower, and Broccoflower, and totalled about $3.791 million over the 1988-93 period. Payments for fresh cauliflower accounted for $3.354 million (88 percent of the total); for processed cauliflower, $364,500 (10 percent); and for Broccoflower, $73,500 (2 percent).[4]

Payments for fresh and processed cauliflower losses peaked at nearly $1.7 million in 1988, and were about $900,000 in 1989. Payments in all other years totalled less than $350,000. Payments made for cauliflower accounted for about 0.1 percent of all ad hoc assistance for non-program crops (that is, non-price and income support crops) over the 1988-93 period.

Ad hoc disaster payments for cauliflower were scattered over a geographically broad area. For fresh cauliflower, 39 states received payments in at least one of the six years, with six states collecting payments in all years. For processed cauliflower, 8 states collected payments in one of the 6 years; Michigan was the only state receiving payments in all years.

In an ordering of counties, Allegan County, Michigan ranked first in fresh cauliflower payments, receiving $415,565 over the 6-year period. The next three states in the series include: Skagit County, Washington ($411,009); Bay

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Disaster payments for green cauliflower (Broccoflower) were paid only in California, Maine, and Minnesota.

County, Michigan ($243,180); and Outagamie County, Wisconsin ($157,239). A total of 338 counties received payments in at least one of the 6 years for fresh cauliflower yield losses. Five of the top-10 counties were located in Michigan. By state, the largest payments were made to Michigan growers ($1,283,130) and Washington growers ($436,164).

For processed cauliflower, the top-ranked counties in ad hoc payments include Tulare County, California ($66,208); Allegan County, Michigan ($53,802); Joaquin County, California ($50,040); and Oceana County, Michigan ($38,159). A total of 24 counties received payments in at least one of the 6 years for processed cauliflower losses. Five of the top-10 counties were located in Michigan. By state, the largest payments were made to growers in Michigan ($156,795) and California ($116,248).

Ad hoc disaster data can be used to indicate which cauliflower-producing areas received large payments relative to their acreage (Table 12). The National Agricultural Statistics Service (NASS) does not report cauliflower acreage in Washington and Wisconsin, although those states accounted for an average of 11 to 12 percent of U.S. ad hoc disaster payments made for cauliflower between 1988 and 1993. Similarly, NASS data indicate that Michigan accounted for 1.6 percent of U.S. cauliflower harvested acreage over the 6-year period, but accounted for 39 percent of the U.S. ad hoc payments made for cauliflower.

In contrast, Arizona and California collected a smaller share of ad hoc payments relative to their acreage. Arizona accounted for 10.6 percent of U.S. cauliflower acreage over the 1988-93 period and 0.2 percent of cauliflower payments, while California accounted for 76.3 percent of U.S. acreage--and only 8.6 percent of the ad hoc payments.

Disaster payments for the six NASS cauliflower states averaged 0.2 percent of the cauliflower crop value over the 1988-93 period (Table 13). Disaster payments as a percent of crop value were highest in Michigan (9 percent) and lowest in Arizona and California (less than 0.05 percent). The low payments in these latter states reflect the relative absence of weather-related production perils in these states. All of the cauliflower is irrigated in Arizona and California and nearly all of that in Oregon, so that drought is not a production peril. In addition, the weather is relatively moderate during most of the growing season in these major western areas and results in only infrequent yield losses.

Cauliflower Insurance Implementation Issues

Adverse Selection

Adverse selection is always a potential problem in providing crop insurance because of differences in micro-climates, soil types, and typography among fields. Insuring cauliflower would not appear to present any unusual problems with respect to the incidence of adverse selection.

Table 12--Disaster assistance payments for cauliflower (fresh and processed), 1988-93

State	Average cauliflower harvested acreage, 1988-93	Share of U.S. acreage	Total cauliflower disaster payments, 1988-93	Share of U.S. cauliflower disaster payments
	--Acres--	--Percent--	Thousand --Dollars--	--Percent--
Arizona	6,433	10.6	6.1	0.2
California	46,467	76.3	321.0	8.6
Michigan	967	1.6	1,440.0	38.7
Minnesota	NR	NR	94.9	2.6
New York	2,583	4.2	422.9	11.4
Ohio	NR	NR	80.9	2.2
Oregon	3,300	5.4	37.4	1.0
Pennsylvania	NR	NR	74.6	2.0
Texas	1,117	1.8	81.3	2.2
Washington	NR	NR	436.2	11.7
Wisconsin	NR	NR	398.5	10.7
U.S.	60,867	100.0	3,717.7	100.0

NR = not reported.

Note: U.S. total does not include Broccoflower, which is reported in the text.

Sources: USDA, NASS, and ASCS data files, compiled by the General Accounting Office.

Table 13--Cauliflower: Crop value and disaster assistance, selected states, 1988-93

State	Total crop value	Total disaster payments	Disaster payments, percent of crop value
	---1,000 dollars---		Percent
Arizona	20,871	6	*
California	927,306	321	*
Michigan	16,073	1,440	9.0
New York	60,561	423	0.7
Long Island	25,457	87	0.3
Upstate	35,104	336	1.0
Oregon	52,496	37	0.1
Texas	6,124	81	1.3
Six states	1,083,431	2,308	0.2

* Less than 0.05 percent.

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

Setting Reference Prices

FCIC provides a reference price (price election) for the insured crop which becomes the basis for assigning value to yield losses. The insured grower elects a price guarantee, normally between 30 and 100 percent of the reference price.

A reference price for cauliflower should represent the in-field value of the crop, because growers would generally not incur harvesting and marketing expenses on that portion of the yield that was lost. Variable harvesting and marketing expenses account for a relatively large share of total costs for cauliflower (as much as 57 percent for fresh-market cauliflower, although less for processing cauliflower). Using a fresh-market f.o.b. price or a season average price for processing cauliflower could create the situation where growers would realize a higher return from indemnity payments than the market value of the crop. Such a situation may provide incentive for moral hazard.

There are two approaches for deriving an "in-field" reference price. One is to deduct the estimated harvesting costs from a market price. The second is to estimate the cost of production and use it as a proxy for the in-field price. The market price here refers to the grower price and not the retail price.

Market Prices and APH Distortions

A grower's actual production history (APH) is established, where possible, from his or her own production records over the past 4-10 years. For a number of fresh-market vegetables, including cauliflower, variations in past yields may have been due partly to market conditions. If market prices fall below the costs for harvesting and marketing at harvest-time, for example, yields may be lower than normal because the grower only partially harvested or even completely abandoned the crop for economic reasons.[5] Or, if prices are unusually high at harvest-time, the grower may raise the yield above its normal level following management practices that extend the number of harvests. A grower may, for example, extend the number of cuttings by caring for the crop until slow-to-develop heads reach marketable size. If an average yield does not indicate farming ability, APH yields may not provide a satisfactory method for screening a farmer's productivity.

Estimating "Appraised Production"

Appraised production for cauliflower (unharvested, but potential yield at the time of the appraisal) could be estimated by counting and weighing marketable curds in a sample of plots and expanding the plot yields to a per-acre basis. For cauliflower in which the heads have not yet reached marketable size, the

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[5] Economic abandonment occurs because the grower incurs a smaller loss by abandoning the crop than by incurring the expenses for harvesting and marketing and selling at a low price.

yields per plot could be estimated by counting stalks and multiplying by an average or typical yield per stalk. Yields per stalk may need to be adjusted to reflect the number of stalks per plot. Cauliflower plants in fields with higher plant populations tend to develop smaller heads than plants in fields with lower plant populations.

Insuring Price Risk

Several growers cited market risks as the greatest peril. Growers in the western areas (Arizona, California, and Oregon) confront relatively few weather-related production perils and can generally cope with insects and diseases using currently-available pesticides and management practices. Their major peril, especially for fresh-market cauliflower, is market risk caused by price variability.

To make crop insurance attractive to cauliflower producers in the major growing areas, crop insurance may have to contain an element of protection against the risks of low market prices. A revenue insurance plan may protect growers against income falling below some guaranteed minimum, regardless of whether the cause was low yields, low prices, or a combination of both. Such a plan could provide a measure of market-risk protection, while at the same time avoiding indemnity payments to growers who, despite low yields, had a good return because of high market prices.

Market Prices and Moral Hazard

There is potentially a moral hazard concern in insuring cauliflower since the situation sometimes arises where, because of low market prices, an indemnity payment would be higher than the net return from harvesting a crop. In order for moral hazard to arise, a yield loss would need to occur due to some contributing action or lack of action (such as neglecting pest control practices) on the part of the grower.

As a practical matter, however, moral hazard does not appear likely to be a problem in areas having a processing market so long as the price election is based on an in-field price. Grower-induced losses are not likely to occur among growers who have access to the processing market because marketing costs for processing cauliflower are much lower than for the fresh market and economic abandonment may not be a best alternative for these growers. Neither is moral hazard likely to be a problem with growers who market over an extended season because usually only a small part of the season-total crop is abandoned and yield losses during that part of the season may not lower average yields enough to qualify such growers for indemnity payments.

Yield losses due to insects and diseases could occur if a grower neglected to follow prudent pest management practices. It is unlikely that a grower would neglect proper pest management in order to collect an insurance indemnity, however, because a pest buildup may be difficult to eradicate, and could create a peril for future crops when market prices may be higher. In addition, FCIC may not wish to include indemnification for insect and disease

losses in a cauliflower policy because growers generally view these perils as manageable problems with currently available control methods.

Availability of Individual Yield Data

There does not appear to be any readily available source of yield data for the two largest production areas (California and Arizona). California has several grower-shipper associations that collect assessments on the basis of cartons of fresh cauliflower sold, but they do not have a record of production sold for processing nor of planted acreage. In Texas, the Texas Vegetable Association indicated that it could work with growers to obtain historical acreage and production data. In Oregon, the Oregon Processed Vegetable Commission has information on the amount of cauliflower delivered to processors, but no information on the planted acreage nor on the amount sold for fresh-market use.

Demand for Insurance

It is our assessment that growers' interest in multi-peril crop insurance for cauliflower would be greatest in Texas, Washington, and in production areas in the East, Midwest, and South. Interest would likely be lowest in California, Arizona, and Oregon, where about 90 percent of the crop is grown. FCIC has received several inquiries regarding cauliflower insurance, including requests from Minnesota and Nebraska.

Growers in the East face a greater array of weather-related perils (drought, excessive rain, excessive heat, flooding, and hail) than Arizona, California, and Oregon, which increases their need for a risk management tool such as crop insurance. In addition, growers in the East generally face a shorter market window than growers in the West. Consequently, a yield loss at one point in the season represents a larger proportion of total income for eastern growers than for western growers who may grow and market cauliflower over a number of months, or perhaps year-round.

Other Implementation Issues

There do not appear to be any intractable implementation obstacles in developing a policy for cauliflower insurance. The problems encountered in offering cauliflower insurance would likely be about the same as those confronted in insuring fresh-market tomatoes or that would be confronted in developing insurance for lettuce, celery, or broccoli. All are treated as an annual crop in commercial production and present problems such as market-price distortion of yields and highly variable market prices which may create a moral-hazard incentive.

The greatest limitation to offering cauliflower insurance in the eastern states is the lack of sufficient acreage in any one county to justify offering a crop insurance policy. Except for perhaps Hidalgo County in Texas and Hillsborough County in Florida, counties in the eastern states have less than 500 acres of cauliflower. Most have less than 100 acres.

Defining "Areas" for the Non-Insured Assistance Program

The Non-insured Assistance program (NAP) of 1994 Crop Insurance Reform covers crops that are not currently insured by FCIC--including cauliflower until the development of an insurance policy. Under NAP, an "area" must incur at least a 35-percent yield loss in order to trigger assistance payments. The defining of areas for purposes of calculating yield losses will be crucial to determining whether such a program provides equitable disaster relief to producers.

For cauliflower in California, for example, one criteria for defining areas would be the sub-state production region (usually defined by the valley or valleys it lies within). The Salinas Valley, the Imperial Valley, the San Joaquin Valley, and the Santa Maria-Oceana region are each unique production regions, and weather events that cause production losses in one area may have no effect on yields in the others. The 1990 freeze which caused yield losses in central California, for example, had no affect on the yield in Imperial County. NASS crop reporting districts may also include too much climate diversity to serve as NAP areas for cauliflower.

An additional reason for defining different within-state regions is that average yields are quite different from one region to another. Appendix table 5 indicates that the yields in the coastal valleys of California average higher than in the interior areas of the state.

References

Angstadt, Ed. President. Central California Vegetable Grower-Shipper Association. Salinas, California. Personal Communication. August 1994.

Arizona Agriculture Statistics Service. University of Arizona and U.S. Department of Agriculture, cooperating. *Arizona Agricultural Statistics*. Various issues.

Belscher, Marcy. Program Assistant for Disaster Assistance. ASCS office. Erie County, New York. Personal Communication. August 1994.

Bennett, Gene. ASCS office. Tulare County, California. Personal Communication. August 1994.

Bruno, Sue. County Executive Director. ASCS office. Suffolk County, New York. Personal Communication. August 1994.

Brewster, Tom. County Executive Director. ASCS office. Marion County, Oregon. Personal Communication. August 1994.

California Department of Food and Agriculture. California Agriculture Statistics Service. *County Agricultural Commissioners' Annual Reports*. 13 issues for 1980-1992. Sacramento.

California Department of Food and Agriculture. California Agriculture Statistics Service. *Marketing California Cauliflower, 1991.* Dot Map. Sacramento.

Conrad, Karen. Program Assistant for Disaster Assistance. ASCS office. Niagara County, New York. Personal Communication. August 1994.

Cross, Tim, John Burt, and Dan McGrath. *Enterprise Budget for Cauliflower, Willamette Valley Region*. EM-8377. Oregon State University Extension Service. Reprinted May 1991.

Dudek, Thomas. Michigan Cooperative Extension Service. Ottawa County, Michigan. Personal Communication. August 1994.

Federal-State Market News Service. U.S. Department of Agriculture and California Department of Food and Agriculture cooperating. *Marketing California Cauliflower 1991*. March 1992.

Fuqua, Shirley. Program Assistant. ASCS office. Hidalgo County, Texas. Personal Communication. August 1994.

George, P.S. and G.A. King. *Consumer Demand for Food Commodities in the United States With Projections for 1980*. Giannini Foundation Monograph Number 26. University of California. March 1971.

Gilreath, Phyllis. Extension Vegetable Specialist. Manatee County, Florida. Personal Communication. August 1994.

Hartman, Paul. Extension Vegetable Specialists. University of Wisconsin. Personal Communication. August 1994.

Havens, Dyvanne. Extension Vegetable Specialist. Skagit County, Washington. Personal Communication. September 1994.

Laemmlen, Frank. Farm Advisor. Santa Barbara County, California. Personal Communication. August 1994.

Mansour, William. "Cauliflower." Unpublished material. 1994.

McCulley, John. Executive Secretary. Oregon Processed Vegetable Association. Personal Communication. August 1994.

Michigan Department of Agriculture, Michigan Agricultural Statistics Service. *Michigan Rotational Survey Vegetables - 1992*. January 1994.

Moyer, Dale. County Extension Agent. Suffolk County, New York. Personal Communication. August 1994.

Quandt, Rick. Vegetable Grower-Shipper Association of Santa Barbara and San Luis Obispo Counties. Personal Communication. September 1994.

Rate, James. County Executive Director. ASCS office. Brown County, Wisconsin. Personal Communication. August 1994.

Schwartzkoff, Lynn. Program Assistant. ASCS office. Outagamie County, Wisconsin. Personal Communication. August 1994.

Seelig, R.A. *Vegetable Facts and Pointers: Cauliflower*. United Fresh Fruit and Vegetable Association. April 1967.

Sellman, Charles. Insurance Coordinator. Texas Vegetable Association. Personal Communication. August 1994.

Shapley, Allen E., Edgar L. Strong, and Thomas A Dudek. *Costs of Producing Cauliflower in Western Michigan*. Ag. Econ. Staff Paper No. 86-48. Michigan State University. June 1986.

Sieczka, Joe. Horticulturalist. Cornell University Research Station. Riverdale, New York. Personal Communication. August 1994.

University of California. Cooperative Extension Service. Division of Agriculture and Natural Resources. "Cauliflower Projected Production Costs, Imperial County 1992-93." 1993.

U.S. Department of Agriculture, Agricultural Marketing Service. *Fresh Fruit and Vegetable Shipments*. FVAS-4. Calendar Year 1993. May 1994.

U.S. Department of Agriculture. Agricultural Stabilization and Conservation Service. Disaster Assistance Data Files, 1988-93. Compiled by the General Accounting Office.

U.S. Department of Agriculture. *1992 Vegetable Chemical Use Survey.*

U.S. Department of Agriculture, Economic Research Service. *Vegetables and Specialties Situation and Outlook Report*. VGS-263 (Yearbook issue). July 1994.

U.S. Department of Agriculture. National Agricultural Statistics Service. *Vegetables*. Annual summaries.

U.S. Department of Agriculture. National Agricultural Statistics Service. *Agricultural Prices*. Annual summaries.

U.S. Department of Agriculture. Statistical Reporting Service. *Usual Planting and Harvesting Dates for Fresh Market and Processing Vegetables.* Agricultural Handbook No. 507. February 1977.

U.S. Department of Commerce. *Census of Agriculture, 1987*. (Including special runs requested by USDA, ERS.)

U.S. Department of Commerce. *Census of Agriculture, 1992*. Various State reports.

Van Buren, Mark. County Executive Director. ASCS office. Allegan County, Michigan. Personal Communication. August 1994.

Wilcox, Mark. Extension Agent. Yuma County, Arizona. Personal Communication. August 1994.

Wohlgenant, Michael. "Demand for Farm Output in a Complete System of Demand Functions," *American Journal of Agricultural Economics*. Vol. 71. pp. 241-252. 1989.

Zandstra, Bernard, H. *Commercial Vegetable Recommendations--Cole Crops: Broccoli, Brussels Sprouts, Cabbage, Cauliflower*. Extension Bulletin E-1591. Michigan State University. June 1988.

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Appendix table 1--Farms producing cauliflower and acres harvested and irrigated, 1982 and 1987

State/County	1987				1982			
		Acres	---Irrigated---			Acres	---Irrigated---	
	Farms	harvested	Farms	Acres	Farms	harvested	Farms	Acres
California	273	36,397	273	36,397	275	33,537	275	33,537
Monterey	88	15,372	88	15,372	101	17,606	101	17,606
Santa Barbara	37	4,113	37	4,113	27	5,088	27	5,088
Imperial	26	3,977	26	3,977	4	487	4	487
Ventura	22	2,612	22	2,612	34	3,431	34	3,431
San Luis Obispo	14	2,455	14	2,455	7	762	7	762
Santa Cruz	16	2,029	16	2,029	15	933	15	933
Stanislaus	6	788	6	788	5	380	5	380
San Joaquin	9	693	9	693	12	648	12	648
Riverside	7	412	7	412	4	281	4	281
Other	48	3,946	55	4,358	70	4,202	66	3,921
Arizona	27	6,210	27	6,210	20	3,639	20	3,639
Yuma	20	5,531	20	5,531	6	2,824	6	2,824
Other	7	679	7	679	14	815	14	815
Oregon	115	3,437	108	3,211	118	2,493	99	2,140
Marion	56	2,190	55	2,188	49	1,499	46	1,414
Clackamas	14	454	13	404	19	425	15	389
Multnomah	13	291	10	193	16	314	7	(N)
Linn	8	253	6	177	3	1	3	1
Other	24	249	24	249	31	254	28	336
Washington	43	2,176	25	81	50	1,834	22	102
Skagit	14	2,038	2	(N)	12	1,570	(N)	(N)
Other	29	138	23	81	38	264	22	102
Michigan	190	1,595	79	963	286	1,420	100	634
Allegan	14	508	13	404	24	447	12	178
Gratiot	13	195	6	81	8	65	5	35
Oceana	11	166	4	78	9	78	5	36
Bay	8	151	5	104	15	119	5	78
Macomb	28	93	5	17	46	140	10	71
Other	116	482	46	279	184	571	63	236
New York	321	1,551	147	1,022	478	2,251	235	1,689
Suffolk	97	749	74	655	152	1,301	137	1,223
Erie	42	234	21	177	49	264	18	145
Other	182	568	52	190	277	686	80	321
These States	969	51,366	659	47,884	1,227	45,174	751	41,741
United States	1,962	54,581	1,071	50,431	2,628	50,168	1,271	45,264

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

Source: 1987 Census of Agriculture.

Appendix table 2--Size distribution of farms producing cauliflower, 1987

State	All farms	Total value of crop sales: $500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
	Number	Percent of farms				
Arizona	27	93	7	0	0	0
California	273	64	21	3	6	6
Florida	12	25	8	25	0	42
Michigan	190	3	21	19	15	42
New York	321	9	24	18	14	41
Oregon	115	25	48	12	3	12
Texas	33	15	33	6	6	39
Washington	43	23	19	9	7	42
Other	948	2	16	14	18	50
U.S.	1,962	14	21	13	14	38

Source: 1987 Census of Agriculture.

Appendix table 3--Organizational type of farms growing cauliflower, by sales class, 1987

Organizational type and state	All farms	Total value of crop sales: $500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Number of farms				
Individual or family						
Arizona	10	9	1	0	0	0
California	106	39	31	7	13	16
Florida	8	1	1	2	0	4
Michigan	159	3	27	29	28	72
New York	236	2	40	40	37	117
Oregon	63	7	28	12	3	13
Texas	24	3	5	1	2	13
Washington	33	5	6	4	3	15
Other	742	4	86	96	137	419
U.S.	1,381	73	225	191	223	669
Partnership						
Arizona	2	2	0	0	0	0
California	81	70	6	1	3	1
Florida	0	0	0	0	0	0
Michigan	21	2	6	6	1	6
New York	60	2	25	13	8	12
Oregon	16	6	9	0	0	1
Texas	2	0	1	1	0	0
Washington	4	1	2	0	0	1
Other States	121	4	33	26	22	36
U.S.	307	87	82	47	34	57
Corporation						
Family held						
Arizona	11	10	1	0	0	0
California	79	64	15	0	0	0
Florida	2	2	0	0	0	0
Michigan	10	0	7	1	0	2
New York	22	5	11	4	1	1
Oregon	36	16	18	2	0	0
Texas	1	1	0	0	0	0
Washington	6	4	0	0	0	2
Other	61	7	30	10	4	10
U.S.	228	109	82	17	5	15

continued

Appendix table 3--Organizational type of farms growing cauliflower, by sales class, 1987, continued

Organizational type and state	All farms	Total value of crop sales: $500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Number of farms				
Corporation						
Other than family held						
Arizona	4	4	0	0	0	0
California	4	3	1	0	0	0
Florida	0	0	0	0	0	0
Michigan	0	0	0	0	0	0
New York	0	0	0	0	0	0
Oregon	0	0	0	0	0	0
Texas	1	0	1	0	0	0
Washington	0	0	0	0	0	0
Other	9	0	2	1	4	2
U.S.	18	7	4	1	4	2
Other						
Arizona	0	0	0	0	0	0
California	3	0	3	0	0	0
Florida	2	0	0	1	0	1
Michigan	0	0	0	0	0	0
New York	3	0	0	1	0	2
Oregon	0	0	0	0	0	0
Texas	5	1	4	0	0	0
Washington	0	0	0	0	0	0
Other	15	0	3	2	3	7
U.S.	28	1	10	4	3	10

Source: 1987 Census of Agriculture.

Appendix table 4--Principal occupation of operators on farms growing cauliflower, by sales class, 1987

Organizational type and state	All farms	$500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Total value of crop sales				
		Number of farms				
Farming is main occupation						
Arizona	24	22	2	0	0	0
California	254	168	54	7	12	13
Florida	7	3	0	3	0	1
Michigan	139	3	38	33	23	42
New York	255	9	74	52	41	79
Oregon	108	27	55	14	3	9
Texas	23	5	11	2	2	3
Washington	34	10	8	4	2	10
Other	744	14	149	124	154	303
U.S.	1,588	261	391	239	237	460
		Percent of all farms				
Arizona	88.9	81.5	7.4	0.0	0.0	0.0
California	93.1	61.5	19.8	2.6	4.4	4.8
Florida	58.3	25.0	0.0	25.0	0.0	8.3
Michigan	73.2	1.6	20.0	17.4	12.1	22.1
New York	79.5	2.8	23.1	16.2	12.8	24.6
Oregon	93.9	23.5	47.8	12.2	2.6	7.8
Texas	69.8	15.2	33.3	6.1	6.1	9.1
Washington	79.2	23.3	18.6	9.3	4.7	23.3
Other	78.5	1.5	15.7	13.1	16.2	32.0
U.S.	80.9	13.3	19.9	12.2	12.1	23.4
		Number of farms				
Operator days off-farm						
None						
Arizona	18	17	1	0	0	0
California	196	137	43	5	5	6
Florida	6	3	0	3	0	0
Michigan	93	3	26	27	15	22
New York	183	8	58	33	31	53
Oregon	87	27	47	7	1	5
Texas	18	3	10	1	2	2
Washington	26	8	6	2	2	8
Other	493	11	114	88	94	186
U.S.	1,120	217	305	166	150	282

continued

Appendix table 4--Principal occupation of operators on farms growing cauliflower, by sales class, 1987, continued

Organizational type and state	All farms	$500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Total value of crop sales				
		Number of farms				
Operator days off-farm						
Any						
Arizona	7	7	0	0	0	0
California	64	33	7	2	11	11
Florida	6	0	1	0	0	5
Michigan	86	2	12	8	10	54
New York	124	1	15	19	15	74
Oregon	24	2	6	5	2	9
Texas	13	1	1	1	0	10
Washington	15	1	2	2	1	9
Other	409	3	33	44	67	262
U.S.	748	50	77	81	106	434
1 to 99 days						
Arizona	2	2	0	0	0	0
California	16	10	0	0	4	2
Florida	0	0	0	0	0	0
Michigan	22	1	4	3	1	13
New York	31	0	8	9	5	9
Oregon	9	1	3	3	0	2
Texas	2	0	1	0	0	1
Washington	6	1	1	2	0	2
Other	149	1	21	22	33	72
U.S	237	16	38	39	43	101
100 to 199 days						
Arizona	1	1	0	0	0	0
California	11	5	2	2	1	1
Florida	3	0	0	0	0	3
Michigan	16	0	4	2	2	8
New York	26	0	3	5	5	13
Oregon	6	0	1	2	1	2
Texas	3	0	0	0	0	3
Washington	2	0	1	0	1	0
Other	111	1	7	12	18	73
U.S.	179	7	18	23	28	103

continued

Appendix table 4--Principal occupation of operators on farms growing cauliflower, by sales class, 1987, continued

Organizational type and state	All farms	Total value of crop sales: $500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
	Number of farms					
200 days or more						
Arizona	4	4	0	0	0	0
California	37	18	5	0	6	8
Florida	3	0	1	0	0	2
Michigan	48	1	4	3	7	33
New York	67	1	4	5	5	52
Oregon	9	1	2	0	1	5
Texas	8	1	0	1	0	6
Washington	7	0	0	0	0	7
Other	149	1	5	10	16	117
U.S.	332	27	21	19	35	230
Not reported						
Arizona	2	1	1	0	0	0
California	13	6	6	1	0	0
Florida	0	0	0	0	0	0
Michigan	11	0	2	1	4	4
New York	14	0	3	6	0	5
Oregon	4	0	2	2	0	0
Texas	2	1	0	0	0	1
Washington	2	1	0	0	0	1
Other	46	1	7	3	9	26
U.S.	94	10	21	13	13	37

Source: 1987 Census of Agriculture.

Appendix table 5--Cauliflower acreage, yield, and production in California, selected counties, 1980-92

County	Year	Harvested Acres	Yield	Production
			Tons/acre	Tons
Monterey	1980	18,180	4.68	85,130
	1981	18,870	5.52	104,170
	1982	24,060	5.16	124,165
	1983	22,780	5.26	119,810
	1984	24,060	5.42	131,696
	1985	23,760	5.47	132,570
	1986	25,150	5.58	148,940
	1987	23,110	5.92	186,590
	1988	19,680	8.07	132,100
	1989	17,841	6.71	124,150
	1990	22,530	6.96	156,300
	1991	23,040	6.94	163,870
	1992	22,270	7.11	154,900
Fresno	1984	1,026	6.07	3,180
	1985	1,200	3.40	4,080
	1986	955	4.00	3,820
	1987	2,400	5.71	13,700
	1988	1,500	6.13	9,200
Imperial	1984	1,006	8.19	8,239
	1985	1,989	6.15	12,232
	1986	3,187	5.09	16,217
	1987	5,640	4.92	27,762
	1988	7,507	4.27	32,027
	1989	8,761	4.32	37,848
	1990	8,683	5.25	45,561
	1991	8,399	4.66	39,121
	1992	7,253	4.37	31,688
Orange	1980	1,598	7.75	12,385
	1981	1,267	4.93	6,246
	1982	684	5.86	4,008
	1983	785	4.70	3,690
	1984	827	5.50	4,549
	1985	155	5.85	907
	1986	246	4.74	1,166
	1987	288	3.13	901
	1988	403	7.92	3,192
	1989	569	8.90	5,064
	1990	609	5.50	3,350
	1991	844	5.50	4,642
	1992	590	5.14	3,033

continued

Appendix table 5--Cauliflower acreage, yield, and production in California, selected counties, 1980-92, continued

County	Year	Harvested Acres	Yield	Production
			Tons/acre	Tons
Riverside	1980	174	3.47	604
	1981	180	4.74	853
	1982	310	4.61	1,429
	1983	592	4.99	2,955
	1984	663	3.86	2,562
	1985	726	5.84	4,238
	1986	615	4.46	2,744
	1987	784	4.80	3,760
	1988	948	3.94	3,739
	1989	903	4.06	3,666
	1990	802	5.60	4,491
	1991	742	4.43	3,285
	1992	922	5.20	4,793
San Benito	1980	400	4.10	1,640
	1981	210	4.38	920
	1982	420	5.69	2,390
	1983	300	9.00	2,700
	1984	400	11.60	4,650
	1985	200	7.10	1,420
	1986	275	6.60	1,815
	1987	300	6.40	1,920
	1988	225	7.20	1,620
	1989	252	11.70	2,948
	1990		no data available	
	1991	493	5.72	2,820
	1992	270	6.88	1,858
San Diego	1980	338	7.10	2,400
	1981	520	8.50	4,420
	1982	650	8.50	5,525
	1983	577	8.00	4,616
	1984	735	8.00	5,880
	1985	660	9.20	6,072
	1986	604	10.20	6,161
	1987	620	8.10	5,022
	1988	512	7.90	4,045
	1989	650	6.50	4,225
	1990	970	6.49	6,300
	1991	615	6.01	3,696
	1992	617	6.21	3,832

continued

Appendix table 5--Cauliflower acreage, yield, and production in California, selected counties, 1980-92, continued

County	Year	Harvested Acres	Yield	Production
			Tons/acre	Tons
San Joaquin	1985	1,820	4.49	8,170
	1986	537	5.01	2,690
	1987	773	4.32	3,340
	1988	991	4.98	4,940
	1989	1,210	4.69	5,670
	1990	1,400	4.28	5,990
	1991	560	2.95	1,650
	1992	740	4.47	3,310
San Luis Obispo	1980	625	5.94	3,711
	1981	615	6.07	3,736
	1982	588	7.39	4,343
	1983	1,009	5.57	5,625
	1984	1,234	6.47	7,990
	1985	1,690	6.77	11,449
	1986	2,643	7.12	18,831
	1987	2,547	6.84	17,415
	1988	2,261	7.35	16,618
	1989	1,923	7.31	14,062
	1990	1,854	7.74	14,345
	1991	2,202	7.69	16,928
	1992	2,358	7.96	18,776
Santa Barbara	1980	6,110	4.86	29,692
	1981	6,675	5.51	36,790
	1982	4,985	6.58	32,824
	1983	6,924	5.50	38,082
	1984	7,585	6.11	46,356
	1985	7,477	6.43	48,065
	1986	6,365	6.71	42,731
	1987	7,466	6.97	52,038
	1988	7,500	6.87	51,541
	1989	8,722	7.23	63,063
	1990	9,596	6.89	66,132
	1991	8,676	7.40	64,163
	1992	8,920	7.30	65,078

continued

Appendix table 5--Cauliflower acreage, yield, and production in California, selected counties, 1980-92, continued

County	Year	Harvested Acres	Yield	Production
			Tons/acre	Tons
Santa Cruz	1980	925	5.64	5,220
	1981	1,494	6.05	9,035
	1982	1,336	4.89	6,535
	1983	1,105	5.73	6,327
	1984	513	4.38	2,247
	1985	491	5.46	2,680
	1986	613	8.63	5,290
	1987	1,043	6.90	7,196
	1988	810	6.40	5,184
	1989	568	6.21	3,527
	1990	1,064	6.90	7,341
	1991	636	6.80	4,325
	1992	1,005	8.79	8,833
Stanislaus	1981	455	4.24	1,930
	1982	503	4.00	2,010
	1983	450	3.98	1,790
	1984	715	4.29	3,070
	1985	996	4.53	4,510
	1986	1,280	4.31	5,520
	1987	1,152	4.00	4,610
	1988	875	4.20	3,675
	1989	1,173	4.02	4,720
	1990	1,600	3.40	5,440
	1991	2,150	3.50	7,530
	1992	2,450	3.65	8,940
Ventura	1980	2,034	5.02	10,203
	1981	2,655	5.36	14,231
	1982	2,769	6.08	16,834
	1983	2,497	4.82	12,036
	1984	2,508	4.98	12,490
	1985	2,642	6.30	16,645
	1986	1,186	4.70	5,579
	1987	1,035	4.46	4,619
	1988	2,131	6.42	13,671
	1989	1,494	5.11	7,638
	1990	886	6.19	5,484
	1991	1,052	5.76	6,057
	1992	1,317	6.79	8,938

Source: California Agricultural Commissioners' Reports.