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

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Executive Summary

Carrots are grown year-round in the United States, with California accounting for 58 percent of production in 1993. Although far distant in magnitude to California, other states reporting sizeable carrot production include Washington, Michigan, Wisconsin, Texas, Florida, and Colorado.

The total value of the U.S. carrot crop in 1993 was approximately $292 million. About 10 percent of that total represents processed carrots; the remainder is the value of fresh carrots. Carrots are machine-harvested, and can be stored for several weeks after harvest.

Carrot production for both the fresh and processing markets increased during the 1970's and 1980's and has generally increased during the 1990's. With approximately one-third of the market for processed carrots and two-thirds for fresh carrots, 1992 production was at a record high of 3,324.1 million pounds. Production for 1993 was estimated at 3,223.1 and 1994 production is forecast at a lower 3,110 million pounds.

Most carrots are produced for the U.S. domestic market. Slightly more carrots are exported than are imported, with most of the trade taking place with Canada and Mexico. Because carrots can be stored for up to four or six months for fresh use, the supply of carrots is less weather sensitive than that of other perishable vegetables, such as lettuce.

Different varieties of carrots are usually planted depending on their expected use in either the fresh or processing markets. However, carrots which fail to meet fresh market standards may occasionally be diverted for processing use. Processing carrots tend to have higher per acre yields than those destined for fresh market use because all carrots, including the cull carrots, are acceptable for processing. However, processing carrot prices are generally about one-third fresh-market carrot prices.

Carrots are a cool-season crop and can be grown virtually anywhere provided the growing season remains relatively cool. The optimum temperature range is 60 to 70 degrees F. When the air temperature rises above 82 degrees F, plant emergence is poor, top growth is reduced, yields are depressed, and the roots may become strong-flavored. Also, high temperatures increase the woody character and coarseness of the root flesh. Conversely, if the air temperature during the early vegetative period falls below the optimum, long slender roots of much lighter color than typical and unwanted flower stalks (bolters) will appear.

The natural perils that are most likely to result in yield losses vary from area to area and depend partly on the time of year that the production and harvesting activities are occurring. The greatest perils in many states are nematodes and diseases. In the northern carrot-growing states, freeze damage at planting or harvesting and lack of water in the nonirrigated areas are

major concerns. Other natural hazards in carrot production include insect damage, physiological disorders, and fungus-induced forking of the root.

Overall, contacts in carrot-growing areas indicated that the natural perils confronting carrots are not generally as severe as for lettuce, celery, and certain other vegetable crops. Because carrots can be at times "stored in the ground" for several weeks upon maturity, timely harvesting is not as great a concern. Further, carrots are storable over fairly lengthy periods after harvest. Because of their storability, price risks and price variability are not as important to the grower as for lettuce and celery.

Ad hoc disaster data can be used to indicate which carrot-producing areas have received large payments relative to their production. For example, California accounted for about 57 percent of total U.S. carrot harvested acreage between 1988-93, but received only 4 percent of the payments made for carrots over that period. Similarly, Florida accounted for an average 9 percent of harvested acreage, and received virtually no carrot disaster assistance payments over the same period.

In contrast, Michigan and Ohio collected a high proportion of payments relative to production. Michigan accounted for 7 percent of U.S. harvested area over the years 1988-93, and received 31 percent of total carrot payments. Likewise, Ohio had a very small harvested area, and collected 11 percent of carrot disaster payments. Payments were made to at least one Michigan carrot grower in each of the 6 years. The maximum collected in any year in Michigan was $1.1 million (in 1989). In four of the six years, over $350,000 was paid in that state.

These data suggest that, under a potential carrot policy, the probability of yield losses for carrots in the Michigan-Ohio is considerably greater than in California and Florida. Extension contacts in Michigan indicate that, in recent years, either too much or too little rain has been a serious problem resulting in yield losses.

Insurance issues addressed in this report include the possibility of multiple harvests on a unit in several states, and the potential demand for insurance. Demand for insurance may be strongest, as a percent of total carrot acres and of carrot growers, in the northern Midwest area. In this area, not all acres are irrigated, and growers tend to be smaller and less diversified than in California and other major carrot production states.

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Introduction

Carrots are grown year-round in the United States, with California accounting for 58 percent of production in 1993 (USDA, NASS). Although far distant in magnitude to California, other states reporting sizeable carrot production include Washington, Michigan, Wisconsin, Texas, Florida, and Colorado.

The total value of the U.S. carrot crop in 1993 was approximately $292 million. About 10 percent of that total represents processed carrots; the remainder is the value of fresh carrots. Carrots are machine-harvested, and can be stored for several weeks.

This report examines those aspects of the industry that relate to the demand for crop insurance and the feasibility of developing a carrot insurance policy. Insurance issues include: quality loss considerations, the possibility of multiple harvests on a unit in several states, and the potential demand for insurance.

The Carrot Market

Supply

Carrot production for both the fresh and processing markets increased during the 1970's and 1980's and has generally increased during the 1990's. With approximately one-third of the market for processed carrots (Table 1) and two-thirds for fresh carrots (Table 2), 1992 production was at a record high of 3,324.1 million pounds. Production for 1993 was estimated at 3,223.1 and 1994 production is forecast at a lower 3,110 million pounds.

Most carrots are produced for the U.S. domestic market. Slightly more carrots are exported than are imported, with most of the trade taking place with Canada and Mexico. Because carrots can be stored for up to four or six months for fresh use, the supply of carrots is less weather sensitive than that of other perishable vegetables, such as lettuce.

California is by far the major carrot producing state (Table 3). The National Agricultural Statistics Service (NASS) collects data for 13 carrot producing states, with California accounting for 58 percent of production in 1993. California has many climatic zones that provide near optimal conditions for carrot production in one district or another throughout the year. Unlike other states, California produces carrots in roughly equal quantities every month of the year.

Table 1--U.S. carrots for processing: Supply, utilization, and price, farm weight, 1970-94

Year	Supply: Production 1/	Supply: Imports 2/	Supply: Beginning stocks 3/	Supply: Total	Utilization: Exports 2/	Utilization: Ending stocks 3/	Utilization: Total	Per capita use 3/ 4/: Canning	Per capita use 3/ 4/: Freezing	Per capita use 3/ 4/: Total	Season average price 5/: Current dollars 1/	Season average price 5/: Constant dollars 1987
	Million pounds							Pounds			$/ton	
1970	720.4	--	487.4	1,207.8	--	474.6	733.3	1.0	2.6	3.6	28.20	80.34
1971	719.5	--	474.6	1,194.1	--	493.8	700.3	0.9	2.5	3.4	30.50	82.43
1972	703.4	--	493.8	1,197.2	--	380.9	816.3	1.1	2.8	3.9	28.70	73.78
1973	942.7	--	380.9	1,323.6	--	497.0	826.6	1.1	2.8	3.9	28.60	69.25
1974	963.5	--	497.0	1,460.5	--	644.7	815.8	1.0	2.8	3.8	40.10	89.31
1975	659.3	--	644.7	1,304.0	--	543.1	760.9	1.0	2.6	3.5	43.60	88.62
1976	692.5	--	543.1	1,235.6	--	455.4	780.2	1.0	2.6	3.6	39.20	74.95
1977	853.6	--	455.4	1,309.0	--	493.7	815.3	1.0	2.7	3.7	43.70	78.18
1978	845.0	--	493.7	1,338.8	24.1	565.7	749.0	0.9	2.5	3.4	45.70	75.79
1979	924.4	--	565.7	1,490.1	32.5	626.3	831.3	1.0	2.7	3.7	46.50	70.88
1980	718.3	10.6	626.3	1,355.3	34.1	530.2	791.0	0.9	2.5	3.5	53.00	73.92
1981	731.9	11.4	530.2	1,273.5	34.4	446.8	792.3	0.9	2.5	3.4	55.20	69.96
1982	839.7	10.3	446.8	1,296.7	22.0	591.8	682.9	0.8	2.1	2.9	53.10	63.37

1983	787.1	11.9	591.8	1,390.8	12.1	664.4	714.3	0.8	2.2	3.0
57.40	65.83									
1984	799.0	13.2	664.4	1,476.7	15.0	521.0	940.7	1.1	2.9	4.0
61.90	68.02									
1985	742.7	16.3	521.0	1,280.1	10.1	514.0	756.1	0.9	2.3	3.2
63.70	67.48									
1986	747.9	19.3	514.0	1,281.2	11.0	552.7	717.5	0.8	2.2	3.0
61.30	63.26									
1987	782.4	15.4	552.7	1,350.6	15.2	576.7	758.7	0.8	2.3	3.1
58.20	58.20									
1988	763.2	14.4	576.7	1,354.3	32.9	473.9	847.4	0.9	2.5	3.5
65.20	62.75									
1989	917.4	21.6	473.9	1,413.0	2.8	533.0	877.1	1.0	2.6	3.5
60.30	55.58									
1990	883.2	21.3	533.0	1,437.5	7.2	603.2	827.1	0.9	2.4	3.3
64.90	57.28									
1991	860.0	15.4	603.2	1,478.7	9.3	550.4	919.0	1.0	2.7	3.6
64.20	54.55									
1992	1,076.8	22.9	550.4	1,650.1	4.5	736.5	909.1	1.0	2.6	3.6
69.30	57.23									
1993	986.5	21.2	736.5	1,744.3	7.3	659.0	1,078.0	1.1	3.0	4.2
71.70	57.73									
1994f	975.0	20.0	659.0	1,654.0	7.0	647.4	999.6	1.0	2.8	3.8
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-- = Not available. f = ERS forecast.

1/ Source: USDA, National Agricultural Statistics Service. 2/ U.S. Dept. of Commerce, Bureau of the Census. All product-weight data was converted to a fresh weight basis--canned factor is 1.333 and frozen factor is 1.82. 3/ Source: Based on data from the National Food Processors Association and USDA, NASS. 4/ Total utilization is allocated between canning and freezing based on distributions estimated by ERS. 5/ Constant dollar prices for processing carrots were calculated using the GDP implicit price deflator, 1987=100.

Table 2--U.S. fresh carrots: Supply, utilization, and price, farm weight, 1970-94

Year	Supply			Utilization			Season average price 3/	
	Production 1/	Imports 2/	Total	Exports 2/	Total	Per capita use	Current dollars 1/	Constant 1987 dollars
	Million pounds					Pounds	$/cwt	
1970	1,218.2	56.2	1,274.4	50.6	1,223.8	6.0	7.18	20.46
1971	1,287.1	52.6	1,339.7	69.6	1,270.1	6.1	7.21	19.49
1972	1,402.1	51.0	1,453.1	80.2	1,372.9	6.5	7.20	18.51
1973	1,435.7	48.0	1,483.7	63.3	1,420.5	6.7	7.66	18.55
1974	1,473.9	70.1	1,544.0	65.9	1,478.1	6.9	9.38	20.89
1975	1,423.9	60.8	1,484.7	93.0	1,391.7	6.4	8.08	16.42
1976	1,399.7	67.3	1,467.0	69.3	1,397.7	6.4	11.20	21.41
1977	1,216.3	72.6	1,288.9	119.4	1,169.5	5.3	10.00	17.89
1978	1,213.1	72.3	1,285.4	103.4	1,182.0	5.3	10.60	17.58
1979	1,330.8	94.8	1,425.6	100.5	1,325.1	5.9	11.30	17.23
1980	1,393.2	108.7	1,501.9	101.2	1,400.7	6.2	12.30	17.15
1981	1,463.2	87.9	1,551.1	144.0	1,407.1	6.1	11.70	14.83
1982	1,568.5	105.1	1,673.6	140.4	1,533.2	6.6	12.70	15.16
1983	1,523.4	126.7	1,650.1	129.5	1,520.6	6.5	14.40	16.51
1984	1,561.6	161.5	1,723.1	143.3	1,579.8	6.7	11.90	13.08
1985	1,534.5	147.8	1,682.3	134.4	1,547.9	6.5	13.20	13.98
1986	1,606.0	115.0	1,721.0	160.6	1,560.4	6.5	8.65	8.93
1987	2,089.6	98.8	2,188.4	174.1	2,014.3	8.3	10.80	10.80
1988	1,823.5	117.4	1,940.9	164.8	1,776.1	7.2	13.30	12.80
1989	1,981.3	123.6	2,104.9	162.3	1,942.6	7.9	13.60	12.53
1990	2,040.5	122.1	2,162.6	158.7	2,003.9	8.0	12.00	10.59
1991	1,928.8	137.0	2,065.8	179.1	1,886.7	7.5	14.60	12.40
1992	2,247.3	134.3	2,381.6	174.5	2,207.2	8.6	14.50	11.97
1993	2,236.6	121.4	2,358.0	186.5	2,171.5	8.4	11.90	9.58
1994f	2,135.0	130.0	2,265.0	180.0	2,085.0	8.0	--	--

-- = Not available. f = forecast.

1/ Source: USDA, National Agricultural Statistics Service. Production was adjusted by ERS for 1970-81 to account for States not included in NASS surveys. 2/ Source: U.S. Dept. of Commmerce, Bureau of the Census. From 1978-89, exports were adjusted using Canadian import data.

3/ Constant dollar prices were calculated using the GDP implicit price deflator, 1987=100.

Note: Beginning with 1982, production is no longer adjusted since NASS acreage covers the Census of Agriculture area.

Table 3--Carrot acreage, production, and yield, 1991-93 1/

State	Area harvested			Production			Yield		
	1991	1992	1993	1991	1992	1993	1991	1992	1993
	---------Acres----------			--------1,000 cwt-------			--------Cwt--------		
Arizona	1,000	1,500	1,400	160	233	238	160	155	170
California	56,000	60,000	58,000	15,680	18,000	18,560	280	300	320
Colorado	1,600	2,600	2,800	600	949	1,064	375	365	380
Florida	9,000	9,000	7,800	1,035	1,305	1,092	115	145	140
Michigan	6,800	6,700	7,200	1,700	2,278	2,016	250	335	280
Minnesota	1,800	2,200	1,400	549	748	308	305	340	220
New York	1,200	1,300	1,300	516	507	507	430	390	390
Oregon	1,800	2,100	1,400	918	1,113	728	510	530	520
Texas	6,300	6,800	6,500	1,260	1,190	1,138	200	175	175
Washington	6,800	7,400	7,600	3,400	4,218	4,408	500	570	580
Wisconsin	2900	3700	3,900	1,276	1,795	1,404	440	485	360
New Jersey and Ohio	2,300	1,900	2,400	794	905	768	345	476	320
U.S.	97,500	105,200	101,700	27,888	33,241	32,231	286	316	317

Source: 1993 *Vegetable* Summary. USDA, NASS. February 1994.
1/ Includes carrots for fresh market and processing.

Different varieties of carrots are usually planted depending on their expected use in either the fresh or processing markets. However, carrots which fail to meet fresh market standards may occasionally be diverted for processing use. Processing carrots tend to have higher per acre yields than those destined for fresh market use because all carrots, including the cull carrots, are acceptable for processing. However, processing carrot prices are generally about one-third fresh-market carrot prices.

Fresh-market carrots are available year-round with no distinct peak in marketings. The lowest volume is likely to be in the early summer. Carrots for the fresh market are usually sold topped, with the greenery removed. A small quantity is sold as bunched carrots, with their tops. Carrots sold with the tops are more perishable and may be stored for only two weeks, while carrots for the fresh market can be kept for 4 to 6 months, under the right temperature and humidity conditions.

Baby (or shortcut) carrots are a relatively new product. Although official figures are not available, sales have reportedly been successful. Baby carrots are either produced through dense planting and early harvest before they reach full size, or by cutting larger carrots to a smaller size. A Michigan processing plant obtains mature carrots from as far away as California for cutting into baby carrots. There is an increasing demand for baby carrots in the processing market as well as the fresh market.

Most of the states growing carrots sell to both the fresh and processing markets (Table 4). States that sell only fresh market carrots include Arizona, Colorado, and Florida. States producing both fresh-market and processing carrots include California, Michigan, Minnesota, New Jersey, New York, Ohio, Oregon, Texas, Washington, and Wisconsin.

California is the largest shipper of fresh market carrots each month, with the largest volume of shipments during May, June, and July. During these early summer months, certain other states have depleted their stored carrots from the previous fall harvest. At the same time, harvesting of carrots has not yet started, or is just beginning, in Colorado, Michigan, Minnesota, New Jersey, New York, Ohio, Oregon, and Washington.

Imported carrots are brought in throughout the year from Canada and Mexico. The heaviest Canadian shipments are from August through February and the largest Mexican shipments occur from January through June. Small quantities of fresh carrots are also imported from Belgium, Israel, and Panama.

Demand

Carrots are a versatile vegetable and may be consumed raw, cooked, and in combination with other vegetables and meats in salads, fresh prepared foods, and frozen prepared foods. In 1992, the per capita consumption of fresh carrots in the U.S. was 8.6 pounds. Processed carrot consumption was 3.6 pounds per person (Tables 1 and 2). While per capita consumption of processed

Table 4--Production and market value of sales on farms producing carrots, selected states, 1993

State	Production	Value	Carrots, total value	All principal vegetables, total value	Carrots, percent of principal vegetable sales
			Fresh market		
	1,000 cwt	$ per cwt	---------1,000 dollars-------		Percent
Arizona	238	11.30	2,689	382,467	1
California	16,560	11.20	185,472	3,186,224	6
Colorado	1,064	8.60	9,150	133,381	7
Florida	1,092	16.90	18,455	1,269,611	1
Michigan	1,275	12.30	15,683	134,268	12
Minnesota	66	10.00	660	2,252	29
New York	227	16.00	3,632	177,168	2
Oregon	304	23.10	7,022	145,343	5
Texas	618	14.60	9,023	270,048	3
Washington	808	13.60	10,989	155,129	7
New Jersey, Ohio, Wisconsin	114	21.70			
U.S.	22,366	11.90	262,775	5,855,891	4
			Processing market		
	Tons	$ per ton	---------1,000 dollars-------		Percent
California	100,000	97.00	9,700	557,089	2
Michigan	37,050	50.50	1,871	49,352	4
Minnesota	12,120	55.10	668	44,542	1
New York	14,000	52.00	728	41,088	2
Oregon	21,200	61.40	1,302	73,954	2
Texas	26,000	82.30	2,140	20,686	10
Washington	180,000	69.00	12,420	73,201	17
New Jersey, Ohio, Wisconsin	102,890	63.70			
U.S.	493,260	71.70	28,829	859,912	3

Source: 1993 *Vegetable* Summary. USDA, NASS. February 1994.

carrots has remained steady since 1970, utilization of fresh carrots increased 2.6 pounds per capita between 1970 and 1992.

Carrots are a good source of beta-carotene, which the body converts into vitamin A, as well as a source of calcium and phosphorus. Because of their versatility, they can be eaten as an accompanying vegetable with almost any meal or alone as a snack.

Statistical studies (both farm-gate and retail) of the demand relationship between vegetable prices and quantities imply that the farm price for fresh vegetables will rise (fall) by 2.2 to 2.3 percent when farm quantity falls (increases) by 1 percent (Wohlgenant). This may be a credible estimate for the relationship between prices and quantities for carrots because they have characteristics comparable to a number of other fresh vegetables.

Prices

Even though price variability can be substantial, fresh-market carrot prices are generally less variable than lettuce or celery prices. This is because carrots can be stored for longer periods of time and can be marketed throughout the year.

Table 5 shows the monthly variability in grower prices for fresh market carrots for various years. Prices are highest during the late winter months, averaging $13 to $18 per hundredweight, when the supply of stored carrots from the fall harvest are depleted. They are generally lowest during the spring and fall.

The market floor price in California is about $8 per hundredweight, based on estimated harvesting costs of $4 for a 50 pound container. Returns are lower than harvesting and marketing costs at prices lower than about $8.00 per hundredweight, and selling to the fresh market is unprofitable. The f.o.b. price hit the $8.00 floor in May 1990.

Between 1981 and 1992 the prices received by growers for carrots averaged lowest during April and October and highest during January. The wide band encompassing one standard deviation on either side of the mean indicates that there is a lot of variation from year to year in seasonal prices, and that price peaks or price valleys may occur almost any month of the year.

Industry Characteristics

Those characteristics of the carrot industry which hold particular significance with respect to determining the potential demand for crop insurance are: 1) a moderate degree of diversification between carrots and other farm enterprises, especially other vegetables, 2) limited income diversification between farm and off-farm employment, and 3) widespread use of irrigation in many states as a protection against drought. The primary source

Table 5--Carrots: U.S. f.o.b. prices received by growers for fresh market, monthly averages, 1989-93

Month	1989	1990	1991	1992	1993
			$/cwt		
January	12.20	11.70	21.00	18.90	18.00
February	13.00	12.80	13.70	17.10	13.10
March	12.70	14.20	16.30	13.20	11.10
April	15.10	9.80	13.80	12.80	12.60
May	18.20	8.00	13.90	11.70	11.10
June	18.60	10.20	11.10	10.80	10.20
July	20.40	8.70	9.80	16.90	9.00
August	11.00	9.00	10.60	16.60	10.00
September	10.30	10.50	10.90	14.40	10.10
October	10.20	9.90	11.40	12.80	10.20
November	9.10	16.00	19.20	12.00	11.00
December	10.60	16.60	17.80	13.80	11.10
Season	13.45	11.44	14.12	14.25	11.46

Source: USDA, NASS.

of available information on farms producing carrots is the 1987 Census of Agriculture.[1]

Carrot Farms

The U.S. Census of Agriculture reported 1,580 farms with sales of carrots in 1987 (Appendix table 1). California had 16 percent of the farms and 42 percent of the U.S. harvested carrot acreage in 1987. Florida had only 1.5 percent of the farms but 12 percent of the acreage. Michigan, Texas, and Washington each had about 8 percent of the farms and 9 percent, 12 percent, and 6 percent of harvested acreage, respectively.

Many farms growing carrots in 1987 were large operations, with 41 percent (about 641) having total crop sales of $100,000 or more (Appendix table 2). In California, about half the farms with carrots reported crop sales of $500,000 or more, while only 20 percent had sales of less than $25,000. In Texas, 25 percent of the farms with carrots reported total crop sales of $500,000 or more and 69 percent had sales of $100,000 or more. States that had the majority of their growers reporting crop sales of less than $25,000 included Colorado, Minnesota, New York, and Washington.

The most common type of ownership of farms growing carrots was individual or family ownership (Appendix table 3). In most states, partnerships or corporate arrangements (either family-held or other) were more common among the larger farms. Fifty-nine percent of the farms with sales of $100,000 or more reported a partnership or corporate-type ownership.

Seventy-eight percent of the operators on all farms growing carrots reported that farming was their main occupation in 1987 (Appendix table 4). However, of operators on mid-sized farms, with sales between $25,000 to $100,000, only about 14 percent indicated that farming was their main occupation. In contrast, twenty-five percent of operators on small farms, reporting less than $25,000 in crop sales, indicated that farming was their main occupation. About forty percent of all farms reported an operator working off the farm at least 1 day during the year.

In most states, the dollar value of carrot sales is a small percentage of the total dollar value of all principal vegetables (Table 4). In California, fresh market carrot sales account for only 6 percent of all principal vegetable sales and 2 percent of processing market sales. In Minnesota, where fewer vegetables are grown because of a shorter growing season, carrot sales were 29 percent of all fresh market vegetable sales in 1993.

Income Diversification on Carrot Farms

Diversification enhances the ability of carrot producers to manage risk. The more diversified producers are between carrots and other enterprises, the

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[1] Results for the 1992 Census of Agriculture will become available in September 1994.

greater their ability to recover from a loss of carrot income with returns from other crops.

Market sales for carrot growers are often diversified among carrots and other crops, especially other vegetable crops. Of the $827.6 million in crop sales reported by farms growing carrots in the 1987 Census of Agriculture, $583.2 million or 70 percent were from vegetable crops and melons, including carrots (Table 6). The Census does not report the sales of carrots or other vegetables separately. Therefore, the USDA's National Agricultural Statistics Service (NASS) estimate of the 1987 value of carrot production was used. The NASS value of 1987 carrot production was $248.3 million or 30 percent of the total crop sales of farms growing carrots reported in the Census.

A more recent survey that included carrot growers also gives an indication of crop diversity on farms producing carrots. Carrot and vegetable growers in 10 states took part in USDA's 1992 Vegetable Chemical Use Survey. In California, 75 percent of the surveyed farms with carrots also grew other vegetables, and carrots accounted for 39 percent of their total vegetable acreage (Table 7).

The Chemical Use Survey data were examined to assess the likelihood that carrot growers would be familiar with crop insurance. The variety of FCIC insurable crops grown by farms producing carrots may indicate carrot growers' familiarity with crop insurance. According to the Vegetable Chemical Use Survey, 26 percent of the California farms growing carrots also grew onions, 19 percent grew fresh market sweet corn, 15 percent grew sweet corn for processing, 7 percent grew fresh market tomatoes, and 20 percent grew tomatoes for processing (Table 8).

These statistics do not provide any conclusive evidence of familiarity with crop insurance, however, because the FCIC data show a participation rate of just one percent for fresh tomatoes in California, and 22 percent for processed tomatoes (Table 9). Furthermore, the data do not indicate whether or not the insured tomato growers were the ones also growing carrots.

The practice of larger carrot producers, especially in California and Texas where carrots are planted and harvested throughout the year, of scheduling planting and harvesting over a period of weeks or months effectively serves as a risk management technique. Insurable events, such as flooding and excess rain, usually destroy only that part of the crop in the field at the point in time when the event occurs. Losses, consequently, may represent only a small part of the grower's expected carrot sales for the year.

Drought is a risk on nonirrigated carrot acreage. The Census of Agriculture indicated 100 percent of the acreage in California, Colorado, Florida and New Mexico was irrigated in 1987, while more than 50 percent of the acreage was irrigated in Michigan, New Jersey, Oregon, Texas, and Washington. Less than 50 percent of the acreage was irrigated in Minnesota, New York, Ohio, and Wisconsin (Appendix table 1). In certain states, such as Michigan, contacts with extension agents indicate that the use of irrigation on carrot acreage has increased somewhat in recent years.

Table 6--Market value of sales on farms producing carrots, 1987

State	Value of sales			
	All products 1/	All crops 1/	Vegetables & melons 1/	Carrots 2/
	Million dollars			
Arizona	19.1	16.9	15.7	4.2
California	443.5	438.6	306.0	160.8
Colorado	6.4	6.3	5.6	3.4
Florida	54.1	52.2	49.2	11.5
Michigan	44.7	42.9	33.7	14.2
Minnesota	11.8	11.5	7.5	3.2
New York	16.2	14.9	10.3	5.6
Oregon	NR	NR	NR	3.4
Texas	90.3	87.6	71.8	18.5
Washington	34.3	30.8	21.0	10.8
Wisconsin	24.2	23.3	16.3	10.5
U.S.	827.6	794.2	583.2	248.3

NR = not reported.

1/ U.S. Department of Commerce, Census of Agriculture, 1987.
2/ 1989 *Vegetable* Summary. USDA, NASS. June 1990.

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

State	Farms sampled	Carrot farms growing other vegetables	Carrots, percent of total vegetable acreage
	---Number---	---Percent---	---Percent---
Arizona	9	100	9
California	89	75	39
Florida	7	86	32
Michigan	46	85	32
New Jersey	16	100	36
New York	32	100	9
Oregon	19	95	98
Texas	26	81	22
Washington	24	92	46
Wisconsin	20	100	34

Source: USDA, Vegetable Chemical Use Survey, 1992.

Table 8--Insurable crops on farms producing carrots, 1992

State	Farms sampled	Farms growing				
		Onions	---Sweet Corn---		----Tomatoes----	
			Fresh	Processed	Fresh	Processed
	Number	----------Percent----------				
Arizona	9	89	0	0	0	0
California	89	26	19	15	7	20
Florida	7	0	86	0	0	0
Michigan	46	41	22	15	2	17
New Jersey	16	0	69	75	13	88
New York	32	47	59	50	72	0
Oregon	19	5	26	21	0	0
Texas	26	46	15	38	12	27
Washington	24	13	29	33	0	0
Wisconsin	20	80	25	25	0	0

Source: USDA, Vegetable Chemical Use Survey, 1992.

Table 9--Crop insurance participation rates, 1992

State	Farms growing				
	Onions	---Sweet Corn---		----Tomatoes----	
		Fresh	Processed	Fresh	Processed
	----------Percent of insured acres----------				
Arizona	--	--	--	--	--
California	--	--	--	1	22
Florida	--	39	--	15	--
Michigan	9	--	--	--	51
Minnesota	--	--	53	--	--
New Jersey	--	--	--	--	8
New York	19	--	3	--	10
Oregon	5	--	--	--	--
Texas	--	--	--	--	--
Washington	9	--	6	--	--
Wisconsin	--	--	12	--	--

Source: USDA, FCIC. Special participation analyses.
No data indicates insurance not offered or none sold.

Cultivation and Management Practices

Recommended cultivation and management practices provide background information on the growing conditions and production techniques necessary to maintain high carrot yields. Care requirements also provide an indicator of the potential for moral hazard as a problem in offering insurance.

Climate

Carrots are a cool-season crop and can be grown virtually anywhere provided the growing season remains relatively cool. The optimum temperature range is 60 to 70 degrees F. When the air temperature rises above 82 degrees F, plant emergence is poor, top growth is reduced, yields are depressed, and the roots may become strong-flavored. Also, high temperatures increase the woody character and coarseness of the root flesh. Conversely, if the air temperature during the early vegetative period falls below the optimum, long slender roots of much lighter color than typical and unwanted flower stalks (bolters) will appear. The roots are not damaged by mild frosts, but the tops are frost-tender.

Soils

Carrots can be grown on a variety of soil types, but deep, well-drained, sandy loams or organic soils such as muck or peat are the most desirable. In general, light mineral soils and organic soils produce a crop with more uniform, smooth roots and are preferred for fresh-market carrots. Silt loams and clay loams can be used to grow carrots for processing, because shape and smoothness are not so critical as for fresh market carrots. These heavier soils have higher water-holding capacity and usually greater fertility, generally giving higher yields of carrots grown for processing. Nevertheless, carrots will grow well in most soils, provided adequate preparation removes clods, hard lumps, and stones. Poorly drained soils tend to increase the incidence of "hairy roots." Carrots are a moderately salt-tolerant crop.

Carrots require an evenly distributed and abundant supply of moisture over the growing season. They require much higher soil moisture for good emergence than most other vegetables. Even in the areas where irrigation is not usually necessary, supplemental sprinkler irrigation at the correct time can promote seedling emergence, reduce wind erosion, decrease freezing damage, prevent burnoff of young seedlings during extreme heat, and will often increase yields and improve quality.

Cultural Practices

In the West, Southwest, and other areas where irrigation is needed, carrots are planted on raised beds similar to those used for other vegetable crops. The beds are 4 to 8 inches high after smoothing, 40 to 42 inches from center to center, and 18 to 20 inches across the top. The most commonly used seed planters in the irrigated areas produce a band of three or four rows of plants

3 to 6 inches wide. This planting method dispenses with the need to thin, yet produces heavy yields with a minimum of twisted, misshapen roots.

In the East and Middle West, standard spacing is 16 inches between rows for both fresh-market and processing carrots. While the ideal spacing may be closer, 16 inches is a minimum for present-day harvesters.

Carrot seeds are normally covered to a depth of one-eighth to one-half inch, depending on soil type and moisture availability. Carrot seeds are small compared with other vegetable seeds and are generally graded into large and medium. For crop uniformity, growers are encouraged to use sized seed. For fresh market carrots, the seeding rate varies from 2-1/2 to 5 pounds per acre, depending on the season, soil condition, type of planter, and row configuration. For example, in the Salinas Valley of California, 30 to 40 plants per foot of bed are optimal at a seeding rate of 3 pounds of seed per acre, for highest yield of the carrot variety, Imperator.

Planting Dates. Planting dates are usually used as reference time points in specifying insurance sign-up dates and policy closing dates. Most planting dates vary from 2 to 4 months for a planting season for each state (Table 10). By planting and harvesting all year round, California and Texas can extend their marketing period over most of the year. Arizona and Florida produce carrots in spring and winter, and most other states in summer and fall.

Carrots require between 65 and 85 days from planting to maturity, depending on the planting date. For some hybrid varieties, the time from planting to harvest is much shorter than for comparable open-pollinated varieties. Germination requires 6 to 8 days at 68 to 95 degrees F, whereas 10 to 17 days are required at 50 to 59 degrees F.

Thinning. Since hand thinning of carrots is not economically feasible, modified seed planters are used to assure proper seed distribution. Therefore, carrot seed is usually planted to stand with thinning unnecessary.

Fertilization. Carrots require various amounts of nitrogen, phosphorous, and potash, depending on the specific soil type. The normal requirement of mixed fertilizer for organic soils should be low in nitrogen (N), medium in phosphorus (P), and medium-to-high in potash (K). Most mixtures are dependent on the anticipated nitrogen deficit in the soil and whether carrots are grown for processing (where the amounts would be increased) or for the fresh market.

For example, a California grower might apply 64 pounds of N, 57 pounds of P, and 27 pounds of K per acre; a Texas grower might apply 48 pounds of N, 55 pounds of P, and 14 pounds of K; and a Florida grower might apply 38 pounds of N, 102 pounds of P, and 148 pounds of K. Organic soils are often deficient in micronutrients important in carrot production including manganese, boron, and copper. These are either included when the N,P,K is applied or at a later time in a foliar spray.

Table 10--Carrots: Usual planting and harvesting dates, by state

State/ Season	Planting date	Usual harvest date		
		Begins	Most active	Ends
Arizona				
Winter	Aug. 20 - Nov. 31	Oct. 10	Jan. 1 - Mar. 31	Mar. 31
Spring	Dec. 1 - Mar. 1	Mar. 15	Apr. 1 - June 30	July 30
California	----------See Table 15----------			
Colorado	Apr. 1 - July 5	Aug. 1	Aug. 15 - Nov. 30	Dec. 5
Florida				
Spring	Dec. 1 - Mar. 1	Mar. 15	Apr. 1 - June 30	June 30
Winter	Aug. 1 - Nov. 31	Oct. 10	Nov. 1 - Mar. 31	Mar. 31
Michigan				
Summer	Apr. 15 - June 20	July 10	Aug. 5 - Sept. 30	Sept. 30
Fall	June 10 - July 10	Oct. 1	Oct. 1 - Nov. 15	Nov. 25
Minnesota				
Fall-East Central	May 1 - June 25	Aug. 5	Aug. 15 - Oct. 15	Oct. 20
Fall-South Central	May 1 - May 20	Sept. 25	Sept. 30 - Oct. 31	Nov. 20
New York	Mar. 25 - June 30	July 15	Aug. 1 - Nov. 30	Dec. 10
Oregon	Apr. 1 - July 20	July 1	Oct. 1 - Dec. 31	Feb. 28
Texas				
Winter	Aug. 1 - Sept. 30	Nov. 1	Jan. 15 - Feb. 28	Mar. 31
Spring	Nov. 1 - Dec. 31	Mar. 15	Apr. 1 - Apr. 30	June 15
Summer	Mar. 15 - Apr. 30	July 15	Sept. 15 - Sept. 30	Sept. 30
Fall	July 1 - July 31	Oct. 1	Nov. 15 - Dec. 15	Dec. 31
Washington				
Summer	Mar. 15 - Apr. 30	July 30	Sept. 1 - Oct. 1	Oct. 10
Fall	June 15 - July 30	Oct. 1	Dec. 1	Dec. 31
Wisconsin				
Summer	Mar. 15 - Apr. 30	July 30	Sept. 1 - Oct. 1	Oct. 10
Fall	May 15 - June 30	Aug. 15	Aug. 28 - Oct. 5	Nov. 15

Source: USDA, NASS.

Weed control. Carrots are well-adapted to the use of standard chemicals for weed control. Chemical weed control is not a substitute for preplanting irrigation to control weeds or precision cultivation to kill late emerging weeds. Herbicides and some cultivation are necessary to destroy late-emerging weeds and to mulch over soil cracks to prevent weed emergence. Cultivation must be done carefully so that the upper part of the roots is not exposed or damaged.

Irrigation. Carrots require an evenly distributed and abundant supply of moisture over the growing season. In areas where carrots are irrigated, they are sprinkler-irrigated for stand establishment. Since carrots germinate slowly, the beds must be kept moist to prevent crusting. After sprinkling, carrots are normally furrow-irrigated for the remainder of the season.

The total amount of water (rain and irrigation) needed after planting averages 1-1/2 to 3 acre-feet with additional amounts applied as needed, averaging 1-1/2 to 2 acre-feet in cooler areas and 2-1/2 to 3 acre-feet in warmer and dryer areas.

In the Desert Valley area of California, irrigation is applied between 10 to 12 times during the season, and at 7 to 10 day intervals. In the coastal areas of California, 3 to 4 acre-inches are applied at 10 day intervals. Plants stressed for water have small roots, whereas an uneven water supply can cause roots to crack and become malformed. There is also a danger from over-irrigating, particularly during cool weather. Excessive water may cause the orange-red roots to fade or even more seriously, may lead to disease problems.

Rotations. Carrots and other cool-season crops are best grown in rotation with alfalfa and such legume cover crops as sour clover. Other crops that can be used in rotation with carrots are the small grain cereals (barley, wheat, oats), grain sorghum, and some vegetables such as spinach, onions, and sweet corn.

Vegetable crops such as celery, parsley, and beets should be avoided because they aggravate disease problems by encouraging a buildup of the same soil pathogens that are damaging to carrots. However, in some areas carrots can be cultivated continuously on the same land if the soil is fumigated, usually in alternate years. Many of the fumigants that were once used for carrots and other food crops have been banned or restricted.

Harvesting and Packing

Nearly all carrots for both fresh market and processing are machine harvested. A few markets prefer carrots with the tops intact, which are hand harvested, but the labor costs for hand harvesting are not competitive with those for machine-harvested carrots. Most carrots are now shipped without tops because it was found that the tops drew moisture from the roots and hastened shrivelling.

Carrots harvested by machine are first loosened under the row by a lifter device. Then they are elevated out of the soil with belts, which grasp the carrot tops, mechanically cut the tops, and elevate the roots to trucks for bulk transportation. Carrots can also be harvested with a digging harvester.

The roots are loaded in bulk and transported to the packingshed, then washed, sorted, and packed for shipment. The type of shipping container used depends upon the requirements of the receiver. Most of the carrots prepackaged in consumer-unit film bags are shipped in boxes, but some are shipped in 50-pound mesh and polyethylene master bags. Carrots are also shipped in bulk in burlap bags and in bulk-bin boxes. Carrots are hydrocooled upon packaging and then shipped in mechanically-refrigerated trucks or rail cars.

Before carrots are shipped, they are sorted into three sizes: small-to-medium, medium-to-large, and jumbo. Carrots of the small-to-medium size and medium-to-large size must be at least 6 inches long. Sized carrots are then graded to remove culls (carrots that do not meet the size requirements) and conveyed onto a recirculating packing belt. Small-to-medium and medium-to-large sized carrots are commonly packed into one-pound consumer poly bags, while jumbo sized carrots are conveyed into 48 pound bags for institutional markets.

One pound film bags of carrots are usually packed 48 to a master container while two pound bags are packed 24 to a master container. Carrots for sale to institutions (usually the larger sizes) are often packed loose in large polyethylene, mesh, or burlap bags. Topped carrots, with or without sizing, may also be packed loose in burlap bags for shipment to packagers.

A few states have restricted the use of orange mesh line on polyethylene bags of carrots for retail use because the lines alter the appearance of the carrot color. The United Fresh Fruit and Vegetable Association's Fresh Carrot Marketing Committee has agreed upon a carrot bag with a clear window on the back for maximum visibility. Texas shippers are using paper baler bags as well as polyethylene and woven polyolefin ribbon fabric bags for master containers. These all hold 48 one-pound bags, 24 two-pound bags, or 50 pounds of bulk carrots.

Michigan shippers are primarily using the woven plastic mesh bag as well as multi-wall paper baler bags, with the use of cartons as master containers increasing. Some Florida shippers use woven plastic mesh bags as master containers for regular sized carrots. "Carrettes", or short carrots, are packed in a carton which contains 20 twelve-ounce bags.

The storage life of carrots depends on whether the tops are on or off, whether the roots have fully developed, and storage conditions. Bunched carrots keep only as long as their tops, which is about 3 weeks. Roots harvested before full maturation, the kind most generally marketed fresh, store well for at least 1 month if held near 0 degrees C. Near 5 degrees C, the storage life will only be 2 to 3 weeks. Since carrots differ in their susceptibility to decay, some lots may keep twice as long as others under the same conditions.

Fully mature carrots have the longest storage life. Deterioration is minimal after 9 months near 0 degrees C and at high relative humidity (RH). Under most commonly found conditions, between 0 degrees and 5 degrees C and 90 to 95 percent RH, 4 to 6 months is a more realistic expectation. Bitterness can be avoided by low temperatures; however, carrots must still be stored separately from crops that emit ethylene, such as apples or pears. Large quantities of carrots are harvested in the autumn in the northern states for winter storage. These storage supplies are used extensively by food processors.

Carrot breeding research is intended to improve the quality of both the fresh market and the processed product by developing cultivars with uniform internal color, the absence of green shoulders, good flavor, and high sugar and high nutrient content.

Marketing

Most carrots are grown for the fresh market, but a substantial amount is also processed as frozen and canned carrots or used in prepared foods such as soups, juices, and convenience dinners. USDA statistics indicate that approximately two-thirds of total U.S. production is sold for the fresh market, with the remaining one-third sold for processing.

The major varieties of carrots are planted with the intention of either fresh or processing market usage. Since carrots are a dual usage crop, carrots that cannot meet the grade requirements for the fresh market can be sold for processing, but at a loss of revenue. The 1993 season-average price growers received for processing carrots was $71.70 per ton or $3.59 per hundredweight, compared with $238 per ton or $11.90 per hundredweight for fresh market carrots.

While the price for processing carrots is considerably lower, the yields are higher because of fewer size and quality restrictions. USDA yields are not separately available for fresh and processing carrots. The 1993 fresh and processing market carrot crop was estimated at $292 million, with approximately 90 percent of the value from the fresh market and 10 percent from the processing market.

Producers in some cases pack their own carrots and deliver them to a shipper who acts as the sales agent. In other cases, the grower contracts with a packer-shipper for packing services in a piece-rate agreement, or enters into a joint risk-sharing venture. A number of larger producers, however, act as their own shipper and sales agent. Some large scale growers are completely integrated--they both grow and ship.

The primary customers for fresh carrots are chain stores and other retailer-wholesalers, terminal market brokers, wholesale handlers, and the military and other institutions. The major buyers generally have field people in the production areas monitoring quality and the availability of carrot supplies.

Production Costs

Cost of production information is pertinent in assessing the feasibility of crop insurance because the timing of expenditures provides an indication of the magnitude of losses associated with an insurable event occurring at different stages in the growing cycle.

By the time carrots are planted, growers have incurred a substantial amount of preharvest expenses. Some of the preharvest expenses for operations such as pest control, supplemental fertilization, and other cultural practices, however, are incurred throughout the growing period and may not have been incurred if an insurable loss occurs early in the growing season (see Tables 11-13; see Appendix table 6 for detailed California costs).

Preharvest production costs are higher for fresh market carrots than for processing carrots because of increased ground preparation and field care. Harvesting and marketing expenses typically amount to less than half of total production costs, but these expenses usually are not incurred if an insurable loss occurs.

Production Perils

The natural perils that are most likely to result in yield losses vary from area to area and depend partly on the time of year that the production and harvesting activities are occurring. The greatest perils in many states are nematodes and diseases. In the northern carrot-growing states, freeze damage at planting or harvesting and lack of water in the nonirrigated areas are major concerns. Other natural hazards in carrot production include insect damage and physiological disorders.

Freeze

Carrots are a cool-weather crop and relatively cold weather resistant. Since the roots are below the ground's surface, air temperatures have to remain low for an extended time before carrots are permanently damaged. Low temperatures tend to produce long, slender roots of much lighter color than typical. Extended low temperatures subject the plant to bolting and make the plant more susceptible to diseases.

Excessive Rain

Too much rain can lead to root deterioration and a build-up of root-borne diseases and physiological disorders. Excessive moisture can also result in poor quality if wet fields prevent the grower from harvesting on a timely basis. This is not as much of a problem for carrots as some other crops because mature carrots, under optimal conditions, can remain in the ground 4 weeks or longer.

Table 11--Carrots: Estimates of production costs for Michigan and south Texas

	Michigan 1/ (1989)	Texas South District (1993)
	---------Containers/acre 2/--------	
Yield	500	350
	-------------Dollars/acre----------	
Land preparation	250	NA
Expenses during growing period	532	457
Pre-harvest costs	782	457
Harvest	1,482	1,365
Overhead costs	532	88
Total	2,796	1,910
	----------Dollars/container--------	
Per unit costs	5.59	5.46

NA = not available.

1/ 85 percent fresh market; 15 percent processing market.
2/ A container or bag holds 50 pounds.

Source: Michigan State University and Texas A&M University Cooperative Extension Service budgets.

Table 12--Carrots: Minnesota, Oregon, and Washington regional estimates of production costs

	Minnesota 1/	Minnesota 2/	Oregon	Oregon	Washington 3/	Washington 4/
			N.C. Region	Willamette Valley	Columbia Basin	Columbia Basin
	1992	1992	1990	1990	1993	1993
	---Tons/acres---					
Yield	15	30	25	30	30	40
	---Dollars/acre---					
Land preparation	20	20	382	157	263	447
Expenses during growing season	379	322	611	398	655	838
Pre-harvest costs	399	342	993	555	918	1,285
Harvesting and marketing	341	230	227	124	703	508
Overhead costs	NA	NA	123	NA	237	309
Total	740	572	1,343	679	1,858	2,102
	---Dollars/ton---					
Per ton costs	49.33	19.07	53.72	22.63	61.93	52.55

1/ Fresh pack market.

2/ Processing market.
3/ Chanteney variety, processing market.
4/ Imperator variety, fresh and processing market.

Sources: University of Minnesota Southern Experiment Station, Oregon State University Extension Service, and
Washington State University Cooperative Extension.

Table 13--Carrots: County estimates of production costs for California

	California counties	
	Kern (1987)	Imperial (1992)
	----------Containers/acre--------	
Yield	800	800
	----------Dollars/acre----------	
Land preparation	280.25	427.25
Expenses during growing period	908.45	608.78
Pre-harvest costs	1188.70	1036.03
Harvest (per container contract rate)	2720.00 @ $3.40	3200.00 @ $4.00
Overhead costs	41.73	376.32
Total	3950.43	4612.35
	---------Dollars/container-------	
Per unit costs	4.94	5.76

Note: A container or bag holds 50 pounds. For Kern county, overhead costs are, for the most part, included in each specified item. Harvest costs include marketing and selling costs; these costs are not included in the other cost of production tables presented here.

Source: University of California Cooperative Extension Service budgets.

Hail

Hail is not as damaging to carrots as it might be for crops whose salable parts are above ground. If hail is excessive, the carrot tops can be damaged or removed, requiring that the carrots be dug and either marketed before they reach full size or be destroyed. Hail damage can reduce crop value by forcing the grower to market carrots before they mature, and by requiring the grower to sell to the lower-priced processing market rather than for fresh market use.

Excessive Heat

High temperatures at the seedling stage can result in poor emergence and a high incidence of misshapen and unmarketable roots. Prolonged high temperatures during later development of the carrot root not only retard growth and depress yields, but can cause undesirable flavors. Also, high temperatures increase the woody character and coarseness of the root flesh.

In general, planting and harvesting at extreme temperatures are not considered desirable and should be avoided if possible. High temperatures at harvest make marketing of a high-quality product difficult because the roots do not easily regain turgidity after prolonged dehydration, and more cooling is needed to bring them to desirable postharvest temperatures.

Drought

If carrots become too dry and are then irrigated or rain occurs, there can be significant splitting of the roots. Dryness tends to cause the cells to harden and lose elasticity. When water is applied, the carrot core tends to expand while the outer layers do not. The result is splitting, which makes the carrots unmarketable in the fresh market.

Wind

Excessive wind is a minor peril because most of the plant is below the ground. Wind can be a problem while plants are small and emerging, before the roots are established.

Nematodes

Nematodes, small soil-borne plant parasites, are a serious problem in carrot production. They attack the roots, slowing the growth and reducing the size of the mature roots. Although several different plants host nematodes, rotating crops helps reduce infestation. In Florida, the principal method for control is pre-plant flooding. Growers in many areas are concerned that restricted chemical use will impede their ability to control nematodes.

Insects

A number of different insects, if not properly controlled, can cause carrot yield losses. The insects of economic significance for one production area may be different from those which are a threat in other areas. Damage from most insects can be held below an economic threshold with available production practices and insecticides. The insects of greatest economic significance in the major production areas are discussed in the state-specific sections.

Diseases

Carrots are susceptible to a number of plant diseases, caused by viruses, fungi, bacteria, nematodes, or nonpathogenic sources. Some are seedborne and others are soil-borne. Storage and transit diseases can also be a problem. Some diseases are transmitted by insects or microorganisms, others are carried by the wind, irrigation water, or the movement of contaminated soil and equipment.

Eradication of a pathogen once it has invaded the plant is always difficult and usually impossible. Prevention, consequently, is the key in disease control. Plants may be protected by means of chemical treatments applied to the soil, seed, or foliage; by use of disease-free seed or disease resistant varieties; and by weed control.

Weeds

Effective weed control is essential to quality carrot production. Control methods consist of using chemical herbicides, mechanical cultivation, and off-season flooding.

State Analyses

Although there are similarities among production areas in the way carrots are grown, production practices and the perils faced by carrot growers may vary across regions. The following sections analyze the production practices and perils that pertain to the feasibility of offering crop insurance in the major carrot-growing regions.

Arizona

Arizona produces carrots for the fresh market only, selling 238,000 cwt. in 1993, only about 1 percent of U.S. fresh market production. A total of 1,400 acres were harvested, with a yield of 170 cwt. per acre. The total market value for Arizona fresh market carrots was $2.7 million. The 1987 Census did not list Arizona as a carrot production state.

California

California has numerous climatic zones that provide suitable conditions for carrot production in different districts at different times of the year. California supplies carrots mostly to the fresh market. The following discussion, consequently, pertains mainly to fresh-market carrots.

Carrot Production in California

California contributed 53 percent of the nation's carrot output in 1992, producing nearly 1.3 million tons (fresh and processed) from over 67,000 acres[2] and generating $208 million in revenue (Table 14). Carrots ranked fifth in value among the 26 principal vegetables grown in the state, and nineteenth in value among all California agricultural commodities (California Agricultural Statistical Review, 1992).

California carrots are supplied both to fresh and processing markets. During 1992, fresh carrots account for about 86 percent of total California carrot production. California growers harvest throughout the year in one or another areas of the state. Carrot harvesting in California is fairly evenly distributed over the year.

California has shown exceptional growth in carrot production between 1980 and 1992. Output increased four-fold over that period, due to a large increase in acreage and a modest increase in per-acre yield (Table 14). Both fresh carrot and processing carrot acreages have increased substantially.

Production Regions

Kern and Imperial counties are by far the most important carrot-producing regions in California. Kern county alone produces almost 70 percent of California's fresh carrots (Appendix table 5). The combined production of Kern and Imperial counties accounts for more than 90 percent of the state's fresh carrots.

Other fresh-carrot areas include Monterey county, which produces about 3 percent of California's fresh carrots, and San Luis Obispo, Riverside, and Fresno counties.

Processing carrots are mostly produced in Santa Barbara, Monterey, and San Luis Obispo counties. As mentioned earlier, processing carrots produce higher yields on a per acre basis, but generate much lower value than fresh carrots.

This section uses California NASS and County Agriculture Commissioners' data, which are not necessarily consistent with the state data presented elsewhere in this report. However, the county-level data presented in Appendix table 5, and reported in this section, offer considerably greater detail for recent years than is available from other sources.

Table 14--Historical carrot production in California

	Year	Harvested Acreage	Yield/Acre	Production
			---tons---	---tons---
ALL CARROTS (FRESH & PROCESSING)	1980	24,761	23.95	307,907
	1981	25,348	27.00	392,071
	1982	25,368	28.25	424,890
	1983	25,971	21.15	378,319
	1984	27,932	24.33	471,326
	1985	26,159	24.28	551,745
	1986	29,650	25.45	862,235
	1987	39,593	26.90	1,069,126
	1988	44,158	28.73	1,179,808
	1989	50,371	29.56	1,284,802
	1990	50,150	26.58	1,290,630
	1991	51,519	27.55	981,340
	1992	67,185	26.23	1,274,053
FRESH CARROTS [1/]	1984	25,962	18.07	411,121
	1985	24,709	18.77	508,525
	1986	27,595	25.80	810,685
	1987	37,948	23.40	1,019,071
	1988	39,010	23.15	1,002,715
	1989	45,168	21.63	1,091,084
	1990	45,965	22.15	1,158,151
	1991	46,890	19.95	816,204
	1992	61,922	18.25	1,089,938
PROCESSING CARROTS	1984	1,970	30.60	60,205
	1985	1,450	29.80	43,220
	1986	2,055	25.10	51,550
	1987	1,645	30.40	50,055
	1988	5,148	34.30	177,093
	1989	5,203	37.50	193,718
	1990	4,185	31.00	132,479
	1991	4,629	35.15	165,136
	1992	5,263	34.20	184,115

[1/] Data for fresh and processing carrots are not available separately prior to 1984.

Source: County Agricultural Commissioners' Reports, California Agricultural Statistics Service.

Kern county showed a strong growth trend in production between 1980-92, with nearly a six-fold increase in output over the period. However, in Imperial county, the increase in production was most pronounced during the 1980's, and has since leveled off.

Planting and Harvesting Dates

Carrots are produced year-round in California in one production region or another (Table 15). Growers follow a precise schedule of planting to have carrots maturing each week for a continuous flow of product to market.

Production Perils

Weather. Carrots are relatively resistant to cold weather. Carrots are one of a few vegetable crops which can be planted and harvested throughout the winter in the Central Coast area. However, the carrot plant will bolt if subjected to cold for an extended time. At the other extreme, high temperatures can at times result in poor emergence, misshapen and coarse roots, and generally low yields.

Generally, weather problems mostly cause slow and weak growth of the crop. When plant growth is not vigorous, carrots become vulnerable to disease and insect attacks. A serious concern caused by unusually cool and damp weather is the development of fungus diseases.

Diseases. Among carrot diseases, cercospora blight, alternaria blight, black rot, and motley dwarf (in the Salinas area) are found to be economically damaging. Root rots are usually absent under good cultural practices (Greg Browne; UC Cooperative Extension). The following are the more serious disease perils in growing carrots in California:

Alternaria Blight-also known as late blight, is caused by a fungus. It may cause damping-off of seedlings and blight of seedstalks, but fleshy roots are not affected. The fungus is spread in contaminated seed. It can be also spread by wind, water, splashing rains, and tools. The fungus may live over the winter in infected plant debris. Fall plowing and fungicide treatments are used to control this disease.

Cercospora Blight-also known as early blight, is caused by a fungus and occurs commonly with Alternaria blight. Like Alternaria, Cercospora may attack any surface part of the plant, but does not attack the fleshy root. The disease is favored by moist weather. Splashing water from rainfall or sprinklers may spread the disease. If floral parts are infected, the fungus may enter the seed and become a threat to next year's crop. Practical controls are the same as those for alternaria blight.

Black rot-is a seed-borne disease. This disease is mainly a root pathogen but can also cause leaf blight. It may attack the root in the field as well as stored carrots. Black, scablike spots appear in the root and eventually the root decays. Seed treatment is the most effective control method.

Table 15--Dates for carrot planting and harvesting in California

District	Typical planting dates	Typical harvesting dates
Cuyama Valley	March - May	August - mid November
Imperial Valley	mid September - October	March 1 - May 30
Eastern Sierra/ Bishop	May	October
South San Joaquin Valley	November - March 1 July - September 1	May 30 - July 30 November (end) - March 1
Huron (southwest of Fresno)	March	July 30 - August
Shandon (East of San Luis Obispo)	March - May	August 1 - mid November
Salinas (Monterey county)	February	Summer

Note: These schedules are typical but may vary.

Source: G.T. Browne.

Motley dwarf disease-is caused by a virus. Infected carrots have a stunted appearance with small and distorted leaflets. Aphids can transmit the virus. Control includes delay in planting until aphid populations are reduced and use of insecticides. This disease is a serious problem in the Salinas Valley but not in southern California (Greg Browne).

Aster yellows-is spread by leafhoppers (mainly the six-spotted leafhopper). The first symptom is yellowing of young leaves at the center of the crown. The petioles of older leaves eventually break and mechanical harvesting becomes difficult. Yellows reduce the size and quality of the root. Control has been possible by insecticide control of leafhopper vectors and removal of overwintering weed and ornamental host reservoirs along roadways.

Root rots-usually attack stored carrots. They are fungus-caused and include bacterial soft rot, cottony soft rot, gray mold rot, crator rot, fusarium dry rot, and licorice rot. These storage rots usually occur during the transportation or storage period.

Disorders. While diseases are relatively controllable, forking of the root has been prevalent in carrot production, and occurs whenever the taproot is damaged. The damage can be inflicted by various agents or conditions including nematodes, fungi (Pythium-induced forking), excessive nitrogen, and compact soil. Control methods vary depending on the source of the damage.

According to Greg Browne, farm advisor in Kern County, forking is a serious problem to carrot growers, and occurs in almost all carrot production to some extent. When it occurs, carrots are not marketable. The average loss per farm is around one to two percent. However, forking can occur on a wide scale and can result in a serious loss.

Insects. Crickets, grasshoppers, striped flea beetle larvae, and cutworms can be a problem when seedlings emerge. Later, aphids, whiteflies, and spider mites may attack the leaves. Cutworms may attack crowns and have been a major problem in recent years (UC Cooperative Extension). Seed, soil, or insecticide treatment often averts serious insect attacks although localized infestations may occur.

Nematodes. Nematodes are controlled by fumigation or chemicals to prevent carrots from forking. In addition to forking, root-knot nematodes can cause considerable damage. The roots attacked by root-knot nematodes have galls of varying sizes on the tap root. Roots severely infected with root-knot nematodes are often completely decomposed by secondary organisms such as fungi or bacteria. Chemical use restrictions have made nematode control more difficult for growers.

Irrigation Failure. If carrots become too dry and are then irrigated, there may be significant splitting of the roots (UC Cooperative Extension). Dryness causes the cells to harden and lose elasticity. When water is applied, the carrot core tends to expand, while the outer layers do not, resulting in splitting. However, the probability of irrigation failure is very small.

Irrigation Water Issues in California

The continued availability of water for irrigation is a concern in some areas of California. Currently, water costs comprise a small share of total expenses in vegetable production. However, the overall trend is for irrigation water to become less available and more expensive. Irrigation water deliveries to farmers from state and Federal water projects have been cut back in recent years, particularly in the west side of the San Joaquin Valley.

Because carrots are a relatively high-value crop, however, growers are unlikely to withhold water because of a shortage. They would divert water, instead, from lower-value crops such as alfalfa and cotton to carrots in case of water shortages.

Grower-Shipper Arrangements

California's carrot industry is characterized by a high degree of vertical integration. Some large-scale growers are completely integrated. Large growers both grow and ship and are referred to as grower-shippers. They also contract with individual farmers to grow carrots for them to pack and ship. Most medium- or small-size farms have a joint venture with shippers at a fixed rate or by sharing the output on a pre-negotiated term.

In California, carrot operations fall into one of the three broadly defined categories: grower/shipper marketing companies, contract farming, and non-contract farming:

Grower/Shipper Marketing Companies. Grower-shipper operations, which combine the farming and shipping functions, generally manage thousands of acres. Their operations are either diversified into various vegetables or specialized in a single vegetable crop.

In the state as a whole, the manager of the California Fresh Carrot Advisory Board indicated that the 3 largest California carrot growers (Bolthouse Farms, Grimmway Farms, and Yurosek and Sons) currently produce about 70-75 percent of the state's carrot crop. These grower-shippers produce about 50 percent of their output on their own acreage; the other 50 percent is under contract with smaller growers. Several of the very large California growers produce only carrots, or carrots account for a very large part of their business.

Conversations with a farm manager at Grimmway Farms, one of the three largest California packer-shippers, indicated that his firm produced carrots in three locations in California, moving equipment around during the year with the different growing seasons. Their main location is in Kern county, where they have two carrot harvests, one in mid-summer and one in early winter. Their winter production is mainly in the Imperial Valley. Recently, they have begun summer production in the cooler mountain areas east and west of Kern county.

Grimmway Farms has about 90 percent of its acreage in carrots, and 10 percent in green beans. Their main product, which accounts for about 70 percent of their production, is fresh "baby carrots." The firm has its own equipment for cutting and packaging, and also does packing and shipping for other growers in the Kern county area.

The Grimmway Farms manager indicated that he didn't think that their farm would need crop insurance. Carrot production is not as risky as production of some other vegetables, such as lettuce and broccoli, and he indicated that natural perils can be managed. He said that their biggest perils were nematodes and fungal diseases.

Nematodes are controlled by crop rotation and soil fumigation. Grimmway Farms rotates carrots about every three years. They use clover and wheat as rotation crops, but may leave the fields fallow instead.

The owner-manager of Bolthouse Farms in Kern county, another of the three largest California carrot producers, indicated that the greatest risks to their firm included pesticide regulation and the availability of irrigation water. Restrictions on the use of methyl bromide, vipam, and other chemicals was of particular concern. He indicated that they did not need crop insurance if water is available and pesticide use is not restricted further.

Contract Farming. Contract arrangements between individual farmers and grower/shipper companies can take various forms. The company sometimes leases out farmland to individual farmers, shares input expenses (or provides inputs), and supervises management decisions, depending on the individual farmer's land ownership status, financial conditions, and farming experience. However, in most cases, farm output is shared at a pre-negotiated rate.

There are usually two ways to share output. Upon harvest and sales, the shipper often keeps harvesting expenses at the pre-negotiated price and splits the rest as was specified in the contract, either using a predetermined price (at the time of contract) or using the actual sales price. The latter is referred to as an open price contract. The open price contract provides an opportunity to share production as well as market risks.

The open-price, output-sharing contract resembles the typical payment-in-kind, output-sharing contract between the renter and landlord. However, in the case of the grower and shipper, the shipper's role includes harvesting and marketing (not at the retail level but at the shipping point).

According to Greg Browne, about half of the growers in Kern county produce carrots under contracts with grower/shipper companies. Carrot acreage managed by these companies (including land under contract production and their own) amounts to 35,000 to 40,000 acres, which is about 78 to 89 percent of total county carrot acreage.

Independent Farming. This category includes individual farmers who are not engaged in contract farming. These farmers make their own management

decisions and finance their own inputs. However, harvest and marketing are usually done either through a cooperative (if the farmer is a member) or on a contract with a shipper.

For many California carrot producers, it is difficult to accurately separate the risk borne by producers versus that borne by handlers. Although combining growing and shipping could increase overall business risk, these marketing companies are sometimes large enough to absorb market shocks. Further, they are also often diversified across crops and across geographical growing locations, diffusing price risk and production risk.

Colorado

Colorado produces carrots for the fresh market only, selling 1.064 million cwt. in 1993, about 5 percent of the U.S. fresh market. A total of 2,800 acres were harvested, yielding 380 cwt. per acre. The total market value for Colorado fresh-market carrots was $9.1 million. The 1987 Census indicates that there were 28 growers, with seven of those growers operating in Weld county. All of the carrot acreage in Colorado is irrigated.

Florida

Florida produces carrots only for the fresh market. In 1993, Florida produced 5 percent or 1.092 million cwt. of U.S. fresh market carrot output, about 5 percent of the U.S. total. A total of 7,800 acres were harvested in 1993, yielding 140 cwt. per acre. The total market value for Florida fresh market carrots in 1993 was $18.5 million.

Florida has a spring and winter crop, with active harvesting in the spring running from April 1 through June 30, and active winter harvesting extending from November 1 through March 31st.

In Florida, carrots are grown on the organic soils around the southern tip of Lake Okeechobee and near Zellwood in central Florida. The 1987 Census indicated that there were 25 growers, with one-half those growers located in Orange and Lake counties (central Florida). Of those growers, there are 3 or 4 large grower-packers who market most of the carrots. These producers grow a variety of vegetables and other crops, marketing several vegetables as a mix.

Production Practices

Carrots are usually planted December 1 through March 1 for the spring crop and August 1 through November 31 for the winter crop. Florida's carrots are usually grown on muck soils, where flooding is an important measure for control of nematodes, soil-borne diseases, and insects. Florida is one of the few carrot producing states that produces "real" baby carrots from seed, rather than cutting larger carrots into baby carrot sizes.

Harvesting and Marketing

Most carrots are machine harvested, with growers harvesting most of their own acreage and trucking the carrots to the packer-shipper. Florida carrots are harvested by pulling the tops rather than by use of the digging method. Individual growers usually do not have formal contracts, but typically sell to the packer-shipper that they have supplied in previous years.

Production Perils

Excessive rainfall and severe cold are the major natural perils to carrot production in Florida. Excessive rainfall can lead to a buildup of root-borne diseases. Carrots are a cool weather crop and can withstand light frosts. However, freezes can damage the green top and stunt carrot growth, causing problems at harvest if the tops have deteriorated.

Hail is usually not considered to be a production peril for carrots in Florida. Wind damage to small plants is a minor nuisance.

Insects and Diseases

Nematodes are a problem in muck soils, but can be controlled by flooding the field before carrots are planted. In the Everglades area, some growers rotate carrots with rice so that the nematodes are controlled when the rice fields are flooded. Growers can help prevent or control diseases by using treated seed, and using field applications of fungicides when a problem is detected.

Demand for Insurance

There may be less demand for carrot crop insurance from growers in Florida than from those in more northern states. Growers in Florida are larger and more diversified into other vegetables and crops. Florida vegetable producers may at times lose money on one or two of the vegetables sold as a fresh mixture, but continue to grow and market a variety of vegetables to satisfy their markets.

Michigan

In 1993, Michigan was ranked the second-largest state in fresh-market carrot output, producing 1.275 million cwt. of carrots. It was ranked fourth-largest in processing carrot output, producing 37,000 tons of carrots. A total of 7,200 acres were harvested in 1993, yielding 280 cwt. per acre. The market value of Michigan's fresh market carrots in 1993 was $15.7 million, and for processing carrots, $1.9 million.

Michigan has a summer and a fall crop, with active harvesting in the summer running from August 5 through September 30. Active fall harvesting extends from October 1 through November 15th. Most of the fresh market carrots are grown in the southwest part of the state. Processing carrots are grown in the southwest part of the state, as well as in counties further north. The 1987

Census indicated that there were 133 growers in 6 principal counties. Of those growers, there is at least one large producer-packer that also grows carrots in California, Florida, Georgia, and Texas.

Production Practices

Carrots are usually planted April 15 through June 20 for the summer crop and June 10 through July 10 for the fall crop. While carrots have usually been grown on muck soils in Michigan, more production is moving to upland loam soils because of the high costs--of both owning and renting--on muck soils. Carrots grown on loam soils usually require irrigation, but the savings in the land cost more than pay for the added irrigation expense.

Harvesting and Marketing

Most carrots are machine harvested, with growers harvesting most of their own acreage and trucking the carrots to a packer-shipper or processor. Once carrots reach maturity, growers are not concerned with deterioration of the tops due to weather because they harvest the carrots by digging rather than by pulling them.

The majority of Michigan carrots go for the fresh market. Michigan has also entered the baby carrot market and has several facilities that cut the larger carrots into baby carrot sizes. In some cases, carrots are shipped by rail from California for cutting into baby carrots at Michigan facilities.

Fresh-market carrots are packed in 1- or 2-pound packages for the retail market, while cull and processing carrots are usually shipped in 50 pound bags.

The amount of carrots being shipped by handlers in California appears to be the major factor in determining prices in Michigan. Most producers have contracts with packer-shippers before planting, with a minimum price guaranteed for a certain yield and quality. Some of the smaller growers have started their own packingsheds but rely on a shipper to do the selling.

Crop abandonment for Michigan carrots doesn't seem to be a problem. Most people feel that there are enough local markets--for fresh, feed, or processing--that carrots would not be abandoned unless prices were extremely low. In some areas, growers have diversified their carrot acreage with cauliflower and broccoli.

Production Perils

Excessive rainfall is considered one of the most serious production perils in Michigan because of the lack of good drainage in some areas. Bacterial rot or other diseases can become established and the plants eventually die.

Other major production perils in Michigan include high summer temperatures, excessive cold, and drought. Carrots can become bitter tasting and woody if

they are subjected to excessively high temperatures without adequate moisture. Cold temperatures in the spring can reduce emergence and stunt plant growth.

Hail is usually not considered to be a production peril for carrots because, even if the tops are damaged, carrot growth can often continue. Since carrots are harvested by digging in Michigan, the tops are not necessary for pulling at harvest.

Insects and Diseases

Nematodes are a problem on muck soils. Alternaria leaf blight and Cercospora leaf blight, as well as aster yellows, are serious problems in Michigan. Growers can help prevent or control diseases by using treated seed and field applications of fungicides when a problem is detected.

Demand for Insurance

There may be more potential demand for carrot crop insurance from growers in Michigan than from those in California and Florida. Growers in Michigan are smaller, less diversified, and somewhat less likely to irrigate. As a result, income losses if the carrot crop is damaged may represent a larger portion of a Michigan grower's income for the year than in California and Florida.

Minnesota

Minnesota is a small production state in both the fresh-carrot and processing-carrot markets. In 1993, Minnesota accounted for less than 1 percent of U.S. fresh market production, and only 2 percent of U.S. processing market production. A total of 1,400 acres were harvested in 1993, yielding 220 cwt. per acre. The total market value for Minnesota fresh market carrots in 1993 was $660,000 and for processing carrots, was $668,000.

Minnesota has only a summer crop, with active harvesting in the summer running from August 15 through October 31. Most of the state's fresh market carrots are grown in the southern part of the state. The 1987 Census indicated that there were 63 growers in Minnesota.

Production Practices

Carrots are usually planted May 1 through June 25 for the summer crop. Most carrots are grown on organic loam soils, with only about a third of the farms growing carrots on irrigated land.

Harvesting and Marketing

Most carrots are machine harvested, with growers harvesting most of their own acreage and trucking the carrots to a packer-shipper or processor. Once carrots reach maturity, growers are not concerned with deterioration of the tops due to weather because they harvest the carrots by digging rather than by pulling.

The majority of Minnesota carrots go for the processing market, including the dehydration market. There are several large vegetable processing facilities in Minnesota which contract for the majority of the state's carrot acreage.

Minnesota producers are "price takers" for both their fresh and processing carrots. California is the major supplier in the U.S. market and the amount of carrots being shipped by handlers in California appears to be the major factor in determining prices in Minnesota. Most producers have contracts with processors before planting, with a minimum price guaranteed for a certain yield and quality.

In some areas, growers have diversified their carrot acreage with other processing vegetables, such as peas, corn, and beans.

Although vegetable production in Minnesota is grown on a small percentage of the state's crop acreage, Minnesota has a state fruit and vegetable grower's association that promotes and monitors the vegetable industry.

Production Perils

Excessive rainfall, high summer temperatures, excessive cold during the spring, and drought are the major production perils in Minnesota. Excessive rainfall is a serious production peril where drainage is a problem, and bacterial rot and other diseases can become established.

If carrots are subjected to excessively high temperatures without adequate moisture, they can become bitter tasting and woody. Cold temperatures in the spring can damage emergence and stunt plant growth. Hail is usually not considered to be a production peril for carrots.

Insects and Diseases

Alternaria leaf blight, Cercospora leaf blight, and aster yellows are serious problems in Minnesota. Growers use treated seed to help control aster yellows. Field applications of fungicides can be used to control leaf blight infections.

Demand for Insurance

There may be more potential demand for carrot crop insurance from growers in Minnesota than from those in California and Florida. Growers in Minnesota are smaller and less diversified with other vegetables, and they irrigate to a lesser extent. Income losses from crop damage may represent a large portion of a Minnesota grower's income for the year.

New York

New York produces carrots for both fresh and processing markets. New York accounted for 227,000 cwt., or about 1 percent of U.S. fresh market carrots in 1993, and 14,000 tons, or about 3 percent of the U.S. processing market. A total of 1,300 acres were harvested, yielding 390 cwt. per acre. The total market value for fresh and processing market carrots in New York was $4.4 million.

The 1987 Census indicated that there were 118 carrot growers in New York. Only about one-third of the carrot acreage in New York was irrigated in 1987.

New Jersey

New Jersey produces carrots for both the fresh and processing market. Because New Jersey accounts for less than 1 percent of U.S. carrot production, USDA does not publish any production, yield, acreage, and value data for that state alone. The 1987 Census indicated that there were 28 growers in New Jersey, and that about 80 percent of the carrot acreage was irrigated.

Oregon

Oregon produces carrots for both the fresh and processing markets. The state accounted for 304,000 cwt. (about 1 percent) of U.S. fresh market carrot production in 1993, and 21,200 tons (or 4 percent) of U.S. processing carrot production. A total of 1,400 acres were harvested, yielding 520 cwt. per acre. The total market value for Oregon fresh market carrots was $7.0 million, and for processing carrots, it was $1.3 million. The 1987 Census indicated that there were 71 growers in 3 principal counties. About 80 percent of the carrot acreage was irrigated in Oregon in 1987.

Texas

Texas produces carrots for the fresh and processing markets, accounting for 3 percent or 618,000 cwt. of U.S. fresh market carrots in 1993, and 5 percent or 26,000 tons of U.S. processing market production. A total of 6,500 acres were harvested in 1993, yielding 175 cwt. per acre. The total market value for Texas fresh market carrots in 1993 was $9.0 million, and for processing carrots, it was $2.1 million.

Texas and California are the only two states that market carrots throughout the year. There are four time periods when planting usually occurs in Texas: August-September, November-December, March-April, and July. Harvesting occurs approximately 80 days later. Carrots are grown in the same area as celery, in the lower Rio Grande Valley (70 percent) and the San Antonio-Winter Garden area (30 percent).

The 1987 Census of Agriculture indicated that there were 138 growers in 5 principal counties. Most of the carrot acreage is irrigated, with a small amount of processing carrots grown on nonirrigated land.

Harvesting and Marketing

Most carrots in Texas are machine harvested, with growers harvesting most of their own acreage and trucking the carrots to a packer-shipper. Texas carrots are harvested by pulling the tops rather than by the digging method.

Fresh-market carrots are usually packed in 1-pound packages for the retail market, while cull and processing carrots are usually shipped in 50 pound bags.

Production Perils

Excessive rainfall, and to a lesser extent, freeze damage, are the major natural perils for carrot production in Texas. Hurricanes and thunderstorms create the most serious threat from flooding. Excessive water in the fields can lead to a buildup of root-borne diseases and can induce root fading. Carrots are a cool-weather crop and can withstand light frosts. However, freezes can damage the top and stunt growth, causing problems at harvest.

Blowing sand and hot winds were identified as a minor nuisance. Although hail is usually not considered to be a production peril for carrots in Texas, some losses can occur if the tops are severely damaged.

Insects and Diseases

The major insects affecting Texas carrot production are carrot weevils, wire worms, white grubs, aphids, leafhoppers, spider mites, flee beetles, and beet armyworm. The major diseases are Alternaria, Cercospora, powdery mildew, and cotton root. Nematodes are also a problem in some areas of Texas.

Demand for Insurance

There may be less demand for carrot crop insurance from growers in Texas than from those in the more northern states. Growers in Texas are larger and more diversified than growers in northern states. Crop losses affecting carrots, consequently, can better be offset by returns from other crops.

Washington

Washington produces fresh and processing carrots. The state accounted for 808,000 cwt. or 4 percent, of U.S. fresh market carrots in 1993, and 180,000 tons, or 36 percent of U.S. processing carrot production. Washington is the largest carrot processing state. Acres for harvest in the state totalled 7,600 in 1993, with a yield of 580 cwt. per acre. The total market value of Washington fresh carrots in 1993 was $11.0 million, and $12.4 million for processing carrots.

The 1987 Census of Agriculture indicated that there were 123 growers in 4 principal counties. Most of the carrot acreage is irrigated, with a small amount of processing carrots grown on nonirrigated land.

Harvesting and Marketing

Washington carrots are machine harvested, with most of the harvesting done by processor-owned harvesters. Hauling from the fields to the processing facility is done by custom haulers. Carrots are harvested by digging, after the tops are crowned (the tops cut off). Sometimes, sugarbeet harvesters are used. Although harvesting usually ends in November, harvesting can continue into December or January, if the weather permits.

The majority of Washington carrots go to the processing market, with a small amount of fresh carrots cut into baby carrots. Diced carrots are the major processing product. There are 6 to 7 major processors in Washington who contract for carrot acreage, guaranteeing growers a minimum price for a given quality and tonnage.

Production Perils

Production perils in Washington are generally minor. Although carrots are grown in a variety of areas throughout the state, irrigation water and drainage is usually adequate. During the growing season, extreme temperatures are uncommon and very little damaging hail and wind generally occurs. Since carrots are harvested by digging in Washington, the tops are not necessary for pulling at harvest.

Insects and Diseases

Nematodes are a problem in some areas, but if they are detected before the carrots are planted, the ground is fumigated. There are some areas that have cutworms, aster yellows, alternaria leaf blight, and soft rot, but most can be controlled when the problem is identified.

Demand for Insurance

There may be less demand for carrot crop insurance from growers in Washington than in other states because production perils are perceived as minor and because most of the market is for processing carrots.

Wisconsin

In 1993, Wisconsin produced a small amount of fresh market and processing carrots, accounting for less than 1 percent of U.S. production. About 3,900 acres were harvested, with a yield of 360 cwt. per acre. The total market value for Wisconsin carrots was not available in 1993 because Wisconsin production was combined with New Jersey and Ohio.

Wisconsin has a summer and a fall crop, with harvesting of the summer crop running from August through early October, and the fall harvest extending into November. The 1987 Census indicated that there were 92 growers in 3 principal counties. Of those growers, most have small acreages, with about 40 percent of the acreage irrigated.

Production Practices

Carrots are usually planted March 15 through April 30 for the summer crop and May 15 through June 30 for the fall crop. Carrots are usually grown on muck and organic loam soils.

Harvesting and Marketing

Most carrots are machine harvested in Wisconsin, with growers harvesting most of their fresh market acreage first and the processing acreage later. While Wisconsin growers used to crown (cut off the tops) and dig their carrots, they now also use harvesters that pull the carrots with the tops intact.

While the majority of Wisconsin carrots are used for processing, they also supply peeled baby carrots to the fresh market. Approximately 30 percent of Wisconsin's fresh market carrots are cut into baby carrots. Growers in Wisconsin supply the jumbo market with the remainder of their fresh market carrots.

California is the major supplier in the U.S. market and the amount of carrots being shipped by handlers in California appears to be the major factor in determining prices in Wisconsin. Most producers contract with packer-shippers before planting, with a minimum price guaranteed for a certain yield and quality. Growers who market processing carrots pay a voluntary contribution for promotion.

Production Perils

The major production perils in Wisconsin are excessive rainfall, high summer temperatures, excessive cold during the spring, and drought. Excessive rainfall, where good drainage is a problem, can result in bacterial rot or other diseases. Excessively high temperatures without adequate moisture can result in bitter-tasting, woody carrots. Cold temperatures in the spring can damage emergence and stunt plant growth.

Hail is usually not considered to be a production peril for carrots in Wisconsin, even though they are harvested by pulling the tops. If the tops are damaged beyond harvesting by this method, most growers would be able to obtain a dig harvester. Wind can be a problem when the plants are small. Freezing temperatures are not usually a problem because the fresh market carrots, for which quality is of highest importance, are harvested before the processing carrots, which can withstand some quality loss from freeze damage.

Insects and Diseases

Nematodes are a problem on muck soils. Alternaria leaf blight, Cercospora leaf blight, and aster yellows are serious problems in Wisconsin. Growers use treated seed to control aster yellows. Field applications of fungicides are used for leaf blight when a problem is detected.

Demand for Insurance

There may be more potential demand for carrot crop insurance from growers in Wisconsin than from those in California and Florida. Growers in Wisconsin are smaller and less diversified into other vegetables. With about 40 percent of the carrot acres irrigated, Wisconsin growers rely more on favorable weather and moisture conditions.

Ad Hoc Disaster Assistance for Carrots

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 carrot policy. These data may also suggest the areas where the demand for a carrot 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 carrots--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 carrots were based on 65 percent of a 5-year average price, dropping the high and low years.

Disaster assistance payments for carrots totalled $10.3 million over the 1988-93 period, and were made in the categories of fresh carrots, carrots for processing, baby carrots, and carrots for seed. Payments for carrot losses peaked at $3.8 million in 1988, and were over $1.3 million in each of the years 1989, 1991, and 1993. Ad hoc payments made for carrots accounted for about 0.4 percent of the total payments made for specialty crops over the 1988-93 period.

Ad hoc disaster payments for carrots were scattered over a geographically broad area. Forty-three states received payments in at least one of the 6 years. Idaho, Michigan, Minnesota, New Jersey, Oregon, Texas, Washington, and Wisconsin collected payments for carrot losses in all years. Further, payments were reported in a variety of states for which NASS does not collect data on carrots--including Alaska, Hawaii, and Montana.

In total, 246 counties received disaster payments for carrots in at least one of the six years. When counties are ranked by payments, Grant county in Washington state ranked first, receiving $741,000 in carrot payments over the 6-year period. Hardin county, Ohio and Hidalgo county, Texas ranked second and third, receiving $723,000 and $720,000 in payments, respectively. Among the top-10 recipient counties, four were in Michigan, and one each were located in Washington, Ohio, Texas, Wisconsin, New Jersey, and Iowa.

Ad hoc disaster data can be used to indicate which carrot-producing areas have received large payments relative to their production. For example, California accounted for about 57 percent of total U.S. carrot harvested acreage between 1988-93, but received only 4 percent of the payments made for carrots over that period (Table 16). Similarly, Florida accounted for an average 9 percent of harvested acreage, and received virtually no carrot disaster assistance payments over the same period.

In contrast, Michigan and Ohio collected a high proportion of payments relative to production. Michigan accounted for 7 percent of U.S. harvested area over the years 1988-93, and received 31 percent of total carrot payments. Likewise, Ohio had a very small harvested area, and collected 11 percent of carrot disaster payments. Payments were made to at least one Michigan carrot grower in each of the 6 years. The maximum collected in any year in Michigan was $1.1 million (in 1989). In four of the six years, over $350,000 was paid in that state.

These data suggest that, under a potential carrot policy, the probability of yield losses for carrots in the Michigan-Ohio is considerably greater than in California and Florida. Extension contacts in Michigan indicate that, in recent years, either too much or too little rain has been a serious problem resulting in yield losses.

Carrot Insurance Implementation Issues

Crop Abandonment

In the lettuce and celery reports, abandonment and selective harvesting were discussed as issues. That is, when market prices fall below harvesting and marketing costs, the crop may be abandoned for economic reasons. Abandonment occurs because the grower incurs a smaller loss by abandoning the crop than by harvesting and selling. Abandonment for economic reasons would reduce the grower's APH, and distort his or her true production potential unless an in-field yield were estimated for the abandoned acres.

A large California carrot grower indicated that economic abandonment may occur in the event of low carrot prices. However, abandonment is uncommon, and of a different nature than for lettuce and celery. For lettuce and celery, abandonment is often selective, with the largest heads or stalks harvested and the remainder left in the field. Since hand labor is generally used for harvesting these two crops, this selectivity is manual.

Table 16--Disaster assistance payments for carrots, 1988-93

State	Average harvested acreage, 1988-93	Share of U.S. acreage	Total carrot disaster payments, 1988-93	Share of U.S. carrot disaster payments
	--Acres--	--Percent--	--Dollars--	--Percent--
Arizona	1,450	2	0	0
California	56,417	57	447,097	4
Florida	9,100	9	1,633	0
Michigan	6,817	7	3,180,343	31
Minnesota	1,750	2	628,198	6
New York	1,233	1	123,333	1
Ohio	NR	0	1,123,175	11
Oregon	1,508	2	69,513	1
Texas	7,467	8	1,503,355	15
Washington	6,667	7	1,006,022	10
Wisconsin	3,500	4	963,096	9
U.S.	99,708	100	10,312,279	100

NR = not reported.

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

In contrast, carrots are machine harvested. As a result, a grower must make an all-or-nothing decision as whether to harvest or to abandon the entire field. As a practical matter, abandonment in carrots is more often due to nematode or disease problems than to economic factors.

Setting Reference Prices

FCIC provides a reference price (price election) for the insured crop which becomes the basis for assigning value (the price guarantee) to yield losses. The insured grower elects a price guarantee, normally between 30 and 100 percent of the reference price. The reference price needs to be high enough to provide reasonable protection for insuring farmers, but not so high that it provides incentive for crop failure (moral hazard).

FCIC would likely want to offer separate reference prices (as well as separate policies) for fresh carrots and processing carrots. This is because processing carrot prices are typically about one-third the amount of fresh carrot prices.

Using one price for all carrots--whether fresh or processing--could result in over-compensation on processing carrots and under-compensation for fresh-market carrots. Fresh-carrot growers would likely have little incentive to purchase crop insurance because of the low expected compensation for losses. In contrast, if the fresh carrot price applied to processing carrots, moral hazard could likely be a problem for processing carrots.

In addition, reference prices would be best set by state or region. This is because different states harvest at different times during the year, and confront different regional price patterns. USDA does not project carrot prices. Such information would need to be projected based on USDA data on supply and use and contacts with extension agents and the industry.

The discussions in the lettuce and celery reports regarding in-field price determination are also relevant here. However, due to length, they are not repeated.

Multiple Harvests on a Unit

In many northern production areas, carrot growers generally plant and harvest a single crop within the year. Entire fields are harvested at a time. In such areas, the extended (or multiple) harvest situation is not as significant an issue as discussed in the lettuce and celery reports.

In states such as California, however, and in various other states, growers may produce several carrot crops on one parcel of land. Growers in this situation may be reluctant to purchase crop insurance which only guarantees season-average yields because the severity of losses during an interval within the season are concealed by averaging over the season.

One method for dealing with this problem would be to define distinct planting periods and establish different premium rates for each period. With such a plan, growers would be more likely to qualify for indemnity payments when losses occurred to a part of their year's crop because losses for one planting period would not be off-set by normal yields during other periods.

Estimating "Appraised Production"

Carrot yields in the field can be estimated by using a row-sampling procedure. For instance, a sample of perhaps 1/10,0000th of a row could be hand dug, and the volume of carrots recovered converted to a per-acre yield. NASS uses a similar procedure for it's objective yield survey for potatoes, except that the sample units would be sections of a row, rather than a hill of potatoes.

Moral Hazard

There is the potential for moral hazard in carrot insurance, particularly if low market prices result in an indemnity payment producing a higher net return than that obtained from harvesting a crop. As a practical matter, however, moral hazard does not appear likely to be a major problem. 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.

Yield losses to nematodes 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 create a peril for future crops when market prices may be higher.

Individual Yield Data

Individual yield data are available from various cooperative organizations and large grower-shippers. Many of the large grower-shippers not only farm their own acreage, but also contract with smaller growers for production, for whom they may well have production and/or yield data. In addition, organizations such as the California Fresh Carrot Advisory Board indicated that data are available on acreage and yields for large California growers.

The manager of the California Fresh Carrot Advisory Board indicated that his organization collects data for growers who produce 10 million or more pounds of carrots each year, encompassing 10-12 growers and/or packers. The Board recently increased the reporting cut-off to 10 million pounds, up from 100,000 pounds. This action reduced the number of reporting growers and/or packers by only two to three. The Board has collected data for several years in order to fund carrot promotion. In 1994, the "check-off" was 2 cents for every 50 pounds of carrots produced. Minnesota and Wisconsin also conduct promotional efforts that may provide a source of yield data.

Quality Losses and Indemnity Payments

Although it does not appear common, it is possible for a grower divert carrots that have been planted for the fresh market to the processing market if the quality of the carrots turns out to be below fresh market standards. Because more carrots in a field can be acceptable in the processing market than in the fresh market, the processing market yield can be higher than the fresh market yield, although the price for processed carrots is much lower.

That is, a grower's yield could be above the yield guarantee based on fresh market production, and insurance based on yield alone would not be triggered even though the much lower price received for processing carrots would result in lower per acre revenue. To avoid this situation, a "Dollar Plan" endorsement, similar to that used for fresh market tomatoes, may be offered for fresh market carrot production.

Under the fresh market tomato dollar plan endorsement the level of insurance is the greater of the number of cartons harvested multiplied by a specified price per carton or the actual number of cartons sold multiplied by the price received minus allowable costs. In other words, a dollar amount of revenue is being guaranteed rather than a number of pounds or tons of production paid at a price election.

In contrast, processing market policies need not account for potential diversion. These policies could easily take the form of the "yield loss" approach used for processing tomatoes and grain crops.

Demand for Insurance

Participation in carrot crop insurance, relative to the state's production, might be higher in Michigan, Ohio, Minnesota and other states that have received large disaster payments in recent years than in California.

In general, growers in Michigan, Ohio, and certain other northern producing areas rely less on irrigation than in other areas. In addition, producers in these areas generally have a lower value of sales and appear to be somewhat less diversified in the sources of their farm receipts than growers in California and Florida.

Since 1990, FCIC has received requests for carrot insurance from California (5 requests), Florida, Iowa, Minnesota, North Dakota, and Ohio. Although it is expected that smaller growers in California would have an interest in carrot insurance, the percent of carrot acres in that state that would likely be insured is fairly small. In contrast, a larger percent of growers (and acres) would be expected to be insured in the upper Midwest.

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

State and major counties	1987				1982			
	Number of Farms	Harvested Acres	Irrigated Farms	Irrigated Acres	Number of Farms	Harvested Acres	Irrigated Farms	Irrigated Acres
California	250	37,869	250	37,869	221	32,582	221	32,582
Imperial	29	13,186	29	13,186	20	6,343	20	6,343
Kern	63	13,085	63	13,085	44	11,630	44	11,630
Monterey	53	4,505	53	4,505	60	4,832	60	4,832
Riverside	13	2,058	13	2,058	13	4,888	13	4,888
Other	92	5,035	92	5,035	84	4,889	84	4,889
Colorado	28	1,294	28	1,294	36	926	36	926
Weld	7	932	7	932	6	549	6	549
Other	21	362	21	362	30	377	30	377
Florida	25	10,397	25	10,397	29	10,497	29	10,497
Orange	10	6,423	10	6,423	11	6,191	11	6,191
Lake	3	(N)	3	(N)	4	2,988	4	2,988
Other	12	3,974	12	3,974	14	1,318	14	1,318
Michigan	133	7,890	64	4,822	161	6,345	58	3,765
Newaygo	18	1,778	16	1,234	25	2,079	15	1,598
Lapeer	13	1,619	6	916	13	1,329	4	408

2	(N)	Muskegon	3	450	3	396	3	315	
(N)	(N)	Oceana	9	265	3	(N)	(N)	(N)	
(N)	(N)	Eaton	5	261	(N)	(N)	(N)	(N)	
(N)	(N)	Jackson	3	255	1	(N)	3	(N)	
37	1,759	Other	82	3,262	35	2,276	117	2,622	
14	92	Minnesota	63	2,145	20	(N)	62	1,857	
1	(N)	Chisago	3	865	1	(N)	3	(N)	
(N)	(N)	Freeborn	8	587	1	(N)	5	(N)	
1	(N)	Anoka	6	500	1	(N)	8	(N)	
12	(N)	Other	46	193	17	(N)	46	(N)	
16	626	New Jersey	28	257	13	201	43	765	
18	10	New Mexico	10	158	10	158	18	10	
39	251	New York	118	1,002	36	394	136	942	
(N)	(N)	Yates	4	331	(N)	(N)	6	214	
39	251	Other	114	671	36	394	130	728	
8	(N)	Ohio	24	1,747	9	224	44	1,257	
(N)		Henry	5	916	1	(N)	5	970	1
(N)	(N)	Hardin	3	500	1	(N)	(N)	(N)	(N)
8	0	Other	16	331	7	224	39	287	
107	1,806	Oregon	71	1,250	65	971	118	1,918	
3	486	Umatilla	5	302	4	142	3	486	
23	504	Lane	14	276	12	252	25	508	
13	211	Marion	12	198	12	198	14	211	

Other	:	40	474	37	379	:	76	713
68	605							
	:					:		
Texas	:	138	10,612	122	10,522	:	152	12,961
137	12,181							
Hidalgo	:	55	6,632	55	6,619	:	67	6,545
67	6,545							
Uvalde	:	12	792	12	792	:	6	731
6	731							
Zavala	:	5	237	5	237	:	9	463
9	463							
Parmer	:	9	232	9	232	:	4	303
4	303							
Castro	:	5	221	5	221	:	5	637
4	617							
Other	:	52	2,498	36	2,421	:	61	4,282
47	3,522							
	:					:		
Washington	:	123	5,666	93	5,027	:	153	4,338
103	3,380							
Franklin	:	12	1,554	12	1,554	:	10	1,023
10	1,023							
Grant	:	11	1,184	11	1,184	:	17	1,317
17	1,308							
Whatcom	:	11	767	9	602	:	11	550
5	440							
Skagit	:	11	599	4	143	:	12	860
1	(N)							
Other	:	78	1,562	57	1,544	:	103	588
70	609							

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

State and major counties	1987				1982			
	Number of Farms	Harvested Acres	Irrigated Farms	Irrigated Acres	Number of Farms	Harvested Acres	Irrigated Farms	Irrigated Acres
Wisconsin	92	4,551	24	1,781	89	4,376	17	474
Jefferson	8	1,005	2	(N)	6	1,066	4	142
Marquette	4	607	1	(N)	6	565	1	(N)
Manitowoc	8	244	(N)	(N)	19	191	1	(N)
Other	72	2,695	21	1,781	58	2,554	11	332
These States	1,103	84,838	759	73,660	1,262	78,774	803	66,590
United States	1,580	89,393	966	77,561	1,939	83,601	1,049	70,564

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

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Appendix table 2--CARROTS: Size distribution of farms, by sales class, 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 of farms					
Arizona	11	6	1	1	0	3
California	250	124	56	8	13	49
Colorado	28	4	6	2	1	15
Florida	25	13	2	2	0	8
Michigan	133	22	45	12	13	41
Minnesota	63	8	10	2	4	39
New York	118	9	19	14	11	65
Texas	138	35	60	4	5	34
Washington	123	19	22	8	11	63
Wisconsin	92	12	16	16	9	39
Other States	599	31	121	59	57	331
United States	1,580	283	358	128	124	687

Source: 1987 Census of Agriculture.

Appendix table 3--CARROTS: Organizational type of farms, by sales class, 1987

Organizational type	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	8	4	1	0	0	3
California	107	25	26	8	8	40
Colorado	20	0	4	2	0	14
Florida	7	0	0	0	0	7
Michigan	87	4	21	11	12	39
Minnesota	44	0	4	2	3	35
New York	91	2	9	12	9	59
Texas	93	13	38	4	4	34
Washington	96	5	15	7	9	60
Wisconsin	66	1	9	14	7	35
Other States	461	9	63	43	44	302
United States	1,080	63	190	103	96	628
Partnership						
Arizona	0	0	0	0	0	0
California	79	49	18	0	4	8
Colorado	3	1	1	0	1	0
Florida	3	3	0	0	0	0
Michigan	28	9	16	0	1	2
Minnesota	7	3	1	0	0	3
New York	14	1	6	1	1	5
Texas	14	6	8	0	0	0
Washington	9	2	4	0	2	1
Wisconsin	7	1	1	1	2	2
Other States	59	9	22	9	6	13
United States	223	84	77	11	17	34
Corporation						
Family held						
Arizona	2	2	0	0	0	0
California	57	45	10	0	1	1
Colorado	3	2	1	0	0	0
Florida	11	8	2	0	0	1
Michigan	15	8	6	1	0	0
Minnesota	11	5	5	0	1	0
New York	11	5	4	1	1	0
Texas	22	11	10	0	1	0
Washington	18	12	3	1	0	2
Wisconsin	15	8	6	1	0	0
Other States	52	11	30	3	1	7
United States	217	117	77	7	5	11
Other than family held						
Arizona	0	0	0	0	0	0

California	6	5	1	0	0	0
Colorado	1	1	0	0	0	0
Florida	2	2	0	0	0	0
Michigan	3	1	2	0	0	0
Minnesota	1	0	0	0	0	1
New York	1	1	0	0	0	0
Texas	4	4	0	0	0	0
Washington	0	0	0	0	0	0
Wisconsin	2	2	0	0	0	0
Other States	13	0	5	0	4	4
United States	33	16	8	0	4	5
Other						
Arizona	1	0	0	1	0	0
California	1	0	1	0	0	0
Colorado	1	0	0	0	0	1
Florida	2	0	0	2	0	0
Michigan	0	0	0	0	0	0
Minnesota	0	0	0	0	0	0
New York	1	0	0	0	0	1
Texas	5	1	4	0	0	0
Washington	0	0	0	0	0	0
Wisconsin	2	0	0	0	0	2
Other States	14	2	1	4	2	5
United States	27	3	6	7	2	9

Source: 1987 Census of Agriculture.

Appendix table 4--CARROTS: Principal occupation of farm operators, by sales class, 1987

Item	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					
Farming is main occupation						
Arizona	7	6	1	0	0	0
California	228	120	52	7	11	38
Colorado	23	4	6	2	1	10
Florida	21	13	2	2	0	4
Michigan	110	21	45	12	9	23
Minnesota	37	7	8	2	3	17
New York	94	9	19	14	10	42
Texas	109	30	57	3	3	16
Washington	88	19	21	8	9	31
Wisconsin	69	11	15	11	6	26
Other States	442	31	116	58	51	186
United States	1,228	271	342	119	103	393
	Percent of all farms					
Arizona	63.6	54.5	9.1	0.0	0.0	0.0
California	91.2	48.0	20.8	2.8	4.4	15.2
Colorado	82.1	14.3	21.4	7.1	3.6	35.7
Florida	84.0	52.0	8.0	8.0	0.0	16.0
Michigan	82.7	15.8	33.8	9.0	6.8	17.3
Minnesota	58.7	11.1	12.7	3.2	4.8	26.9
New York	79.7	7.6	16.1	11.9	8.5	35.6
Texas	79.0	21.7	41.3	2.2	2.2	11.6
Washington	71.5	15.4	17.1	6.5	7.3	25.2
Wisconsin	75.0	12.0	16.3	12.0	6.5	28.2
Other States	73.8	5.2	19.4	9.7	8.5	31.0
United States	77.7	17.2	21.6	7.5	6.5	24.9
	Number of farms					
Operator days off-farm						
None						
Arizona	6	5	1	0	0	0
California	160	96	34	4	6	20
Colorado	17	4	6	2	1	4
Florida	16	10	2	2	0	2
Michigan	81	20	32	6	8	15
Minnesota	33	5	9	2	1	16
New York	73	4	17	11	8	33

Texas	80	20	41	3	2	14
Washington	65	18	16	4	7	20
Wisconsin	48	8	13	8	4	15
Other States	274	28	91	32	17	106
United States	853	218	262	74	54	245
Any						
Arizona	5	1	0	1	0	3
California	68	20	15	3	6	24
Colorado	11	0	0	0	0	11
Florida	8	2	0	0	0	6
Michigan	42	1	7	4	5	25
Minnesota	29	2	1	0	3	23
New York	40	3	1	3	3	30
Texas	47	9	15	1	3	19
Washington	51	0	4	4	4	39
Wisconsin	34	2	2	6	5	19
Other States	292	2	19	23	36	212
United States	627	42	64	45	65	411

Continued

Appendix table 4--CARROTS: Principal occupation of farm operators, by sales class, 1987--Continued

Item	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					
1 to 99 days						
Arizona	1	0	0	1	0	0
California	24	8	6	1	2	7
Colorado	5	0	0	0	0	5
Florida	0	0	0	0	0	0
Michigan	15	0	3	4	1	7
Minnesota	5	1	0	0	0	4
New York	9	3	1	0	0	5
Texas	16	1	9	0	2	4
Washington	10	0	0	2	1	7
Wisconsin	9	0	1	3	1	4
Other States	111	0	13	14	20	64
United States	205	13	33	25	27	107
100 to 199 days						
Arizona	1	0	0	0	0	1
California	19	5	2	1	1	10
Colorado	4	0	0	0	0	4
Florida	3	1	0	0	0	2
Michigan	11	0	4	0	2	5
Minnesota	8	0	0	0	0	8
New York	7	0	0	1	1	5
Texas	6	1	0	0	1	4
Washington	16	0	2	1	0	13
Wisconsin	8	0	1	3	1	3
Other States	82	0	3	6	9	64
United States	165	7	12	12	15	119
200 days or more						
Arizona	3	1	0	0	0	2
California	25	7	7	1	3	7
Colorado	2	0	0	0	0	2
Florida	5	1	0	0	0	4
Michigan	16	1	0	0	2	13
Minnesota	16	1	1	0	3	11
New York	24	0	0	2	2	20
Texas	25	7	6	1	0	11
Washington	25	0	2	1	3	19
Wisconsin	17	2	0	0	3	12
Other States	99	2	3	3	7	84
United States	257	22	19	8	23	185

Not reported						
Arizona	0	0	0	0	0	0
California	22	8	7	1	1	5
Colorado	0	0	0	0	0	0
Florida	1	1	0	0	0	0
Michigan	10	1	6	2	0	1
Minnesota	1	1	0	0	0	0
New York	5	2	1	0	0	2
Texas	11	6	4	0	0	1
Washington	7	1	2	0	0	4
Wisconsin	10	2	1	2	0	5
Other States	33	1	11	4	4	13
United States	100	23	32	9	5	31

Source: 1987 Census of Agriculture.

Appendix table 5--California carrot production, by county, 1980-92

County	Year	Harvested Acreage	Yield /acre	Total Production	Comments
				--tons--	--tons--
KERN	1980	11,800	11.20	132,000	Data prior to 1985 appear
fresh+proc.	1981	13,600	12.90	176,000	to reflect only fresh market
	1982	13,700	13.70	188,000	yields and production.
	1983	13,200	10.60	140,000	
	1984	14,900	10.90	163,000	
	1985	12,600	23.10	291,000	
	1986	12,816	35.00	449,000	
	1987	18,430	30.00	553,000	
	1988	20,854	27.00	563,000	
	1989	28,304	25.00	708,000	
	1990	29,552	28.50	841,000	
	1991	35,000	28.50	996,000	
	1992	44,822	27.90	1,250,000	
IMPERIAL					
all fresh	1980	6,206	18.00	111,708	All county carrot production
	1981	5,912	19.00	112,623	goes to the fresh market.
	1982	6,412	21.80	139,461	
	1983	10,008	20.80	208,166	
	1984	7,913	23.40	185,322	
	1985	9,472	19.00	180,157	
	1986	10,754	25.00	268,958	
	1987	12,038	25.90	312,025	
	1988	12,813	24.30	311,100	
	1989	12,661	23.80	301,585	
	1990	12,682	19.70	249,642	
	1991	9,959	18.20	180,758	
	1992	15,233	20.40	310,372	
MONTEREY	1980	5,330	18.40	97,980	Production figures represent

fresh+proc.	1981	5,095	18.00	91,535	all carrots supplied to fresh
	1982	4,470	17.60	78,770	and processing markets.
	1983	5,190	13.70	71,145	
	1984	5,810	22.30	129,715	
	1985	6,956	19.70	136,990	
	1986	5,290	18.70	111,910	
	1987	5,095	14.60	100,335	
	1988	5,750	19.80	134,890	
	1989	5,351	20.40	144,730	
	1990	3,180	20.10	76,800	
	1991	3,100	21.30	84,500	
	1992	3,750	24.30	109,950	
fresh	1984	3,840	18.10	69,510	Production figures prior to
	1985	5,506	17.00	93,770	1984 are not available.
	1986	3,235	18.70	60,360	
	1987	3,450	14.60	50,280	
	1988	3,215	19.80	63,650	
	1989	2,601	20.40	53,180	
	1990	1,560	20.10	31,300	
	1991	1,590	21.30	33,800	
	1992	1,540	24.30	37,430	

continued

Appendix table 5--California carrot production, by county, 1980-92, continued

County	Year	Harvested Acreage	Yield /acre	Total Production	Comments
				--tons--	--tons--
Processing	1984	1,970	30.60	60,205	Production figures prior to
	1985	1,450	29.80	43,220	1984 are not available.
	1986	2,055	25.10	51,550	
	1987	1,645	30.40	50,055	
	1988	2,535	28.10	71,240	
	1989	2,750	33.30	91,550	
	1990	1,620	28.10	45,500	

	1991	1,510	33.60	50,700	
	1992	2,210	32.80	75,520	
SAN LUIS OBISPO					
all	1982	897	21.90	19,676	Data prior to 1982 are
	1983	1,270	21.10	26,822	not available.
	1984	1,370	26.00	35,620	Separate data for fresh and
	1985	1,422	32.00	45,504	processing are not available.
	1986	2,218	38.50	85,393	
	1987	3,209	23.00	73,807	
	1988	2,813	26.00	73,138	
	1989	3,480	27.00	93,960	
	1990	3,486	17.00	59,262	
	1991	4,244	18.00	76,393	
	1992	3,531	24.40	86,245	
SANTA BARBARA	1980	835	30.00	25,050	All carrots are supplied to
processing	1981	1,460	31.50	45,990	the processing market.
	1982	1,661	32.80	54,531	
	1988	2,613	40.50	105,853	Data for 1983-87 are not
	1989	2,453	41.70	102,168	available.
	1990	2,565	33.90	86,979	
	1991	3,119	36.70	114,436	
	1992	3,053	35.60	108,595	
RIVERSIDE	1980	5,920	6.61	39,149	
fresh	1981	4,376	13.10	57,458	
	1982	3,595	11.90	42,898	
	1983	2,763	10.90	30,153	
	1984	3,149	19.90	62,799	
	1985	2,637	14.20	37,368	
	1986	1,625	14.20	23,127	
	1987	2,480	13.70	34,046	
	1988	1,743	10.70	18,615	
	1989	1,753	15.70	27,599	
	1990	2,271	10.40	23,709	
	1991	1,331	14.80	19,646	
	1992	1,457	14.20	20,666	

FRESNO					
fresh	1986	2,400	29.00	69,600	Data prior to 1986 are not
	1987	5,000	24.00	120,000	available.
	1988	3,600	30.60	110,000	
	1989	2,450	22.00	53,900	
	1990	1,460	30.00	43,800	
	1991	600	29.70	17,800	
	1992	410	21.70	8,900	

Source: County Agricultural Commissioners' Reports, California Agricultural Statistics Service.