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

Prepared by the Economic Research Service, USDA
in cooperation with the University of California

for the Federal Crop Insurance Corporation

August 3, 1994

Contributors: Diane Bertelsen (202) 219-0887
Robert Dismukes (202) 219-0028
Joy Harwood (202) 501-8554
Fred Hoff (202) 219-1288
Hyunok Lee (916) 752-3508
Agapi Somwaru (202) 219-0812
Glenn Zepp, coordinator (202) 501-7703

Table of Contents

Executive Summary

U.S. growers harvested 125.3 million pounds of fresh asparagus in 1993, with a total crop value reported at $163 million. Asparagus is grown in most temperate areas of the U.S., although the majority of commercial production is located in California, Washington, and Michigan. Other commercial growing areas include Illinois, Indiana, Maryland, Minnesota, New Jersey, and Oregon.

About 57 percent of U.S. asparagus production was destined for fresh-market use in 1993. Virtually all of the asparagus grown in California is sold for the fresh market, and a portion of Michigan and Washington output is sold to the fresh market. Output in the minor production areas is sold almost exclusively for fresh-market use.

Fresh-market asparagus prices demonstrate a very pronounced seasonal pattern. They are highest at the beginning of the season (January-March) and at the end of the season (August-September) when shipment volume is smallest. During the high-price periods, southern California (the Imperial Valley) is the principal shipper. Fresh-market prices are generally lowest in mid-season (April-May) when shipment volume is greatest and harvest is peaking in central California, Washington, Michigan, and other states.

Income diversification--from off-farm employment and crop diversification--enhances the ability of asparagus growers to manage risk. According to the Census, over half of the 3,033 farms with asparagus sales in 1987 reported the operator working off the farm at least one day, and 30 percent reported the operator working off-farm 200 days or more. Further, asparagus growers appear generally well-diversified with other crops.

Asparagus is a perennial crop that has a life expectancy of up to 30 years, although the life of most commercial plantings is less than 20 years. An asparagus bed produces a small crop one year after crowns (the underground part of the plant) are transplanted. However, a bed is only partially productive the first three years after transplanting. Commercial fields receiving average care yield their largest output at 5 to 7 years of age in California. Plantings in Michigan reportedly produce their maximum yields at 5 to 12 years of age. Beyond that time, yields tend to decline.

The crop cycle for established asparagus consists of: 1) a 4-8 week harvest in the spring and early summer, 2) a summer fern growth (or re-establishment) period during which the plant re-stocks its energy reserves in the roots and crown, and 3) a rest period brought on by cold weather or drought.

In the spring, spear growth occurs when soil temperatures reach 50^{o} F. Daily average temperature affects the rate of growth of the spears. For example, the asparagus shoot requires 5 days to produce a 6-inch spear with daily average temperatures of 53^{o} F. In contrast, at 78^{o} F, a shoot will reach 6 inches in about 1.9 days. Although spears grow faster at higher temperatures, extremely high temperatures also promote early branching of the shoot.

Late spring frost is the most common weather-caused peril reported in all major production areas. Asparagus is one of the first plants that emerges in the spring, with harvest beginning as soon as spears reach marketable length. As a result, asparagus is quite vulnerable to frosts. Frost damages or kills any spears that have emerged from the soil, making them worthless, and slows the development of new spears.

Other perils include extended cool weather, excess heat, excess moisture, hail, insects, and diseases. These perils can reduce the current year's production during the harvest season. They can also reduce fern growth during the re-establishment period, and thus, diminish yields in subsequent production years. Asparagus is fairly drought-tolerant, with roots that can reach a depth of 15-20 feet in sandy soils.

The multi-year effect of natural perils on yields, as described above, has implications for the offering of an asparagus crop insurance policy. In order to avoid adverse selection--growers taking out insurance after an event occurred that reduced future yield prospects--it may be necessary to require that growers insure for a period of years. A minimum step in reducing adverse selection would be to define the crop year as beginning with fern growth in one year, extending through the conclusion of harvest the following year.

Other insurance issues addressed in this report include: setting reference prices, estimating "appraised production," and the demand for insurance. One key issue is determination of the actual production history calculation, as expected yield varies with the maturity of the asparagus bed.

Our assessment is that asparagus is not as good a candidate for insurance as the previous specialty crops we have examined. The insurance issues noted above make policy development difficult, but not insurmountable. Further, there are questions concerning the potential demand for an asparagus policy. The largest demand is likely to occur in Michigan and other midwestern and eastern areas because weather-related losses appear to be more frequent in these areas than in California and Washington. However, even in these areas, it is questionable as to how often a grower would experience a loss of the 25-percent or more that would be required to collect an indemnity.

Ad hoc disaster assistance data can be used to provide a further indication of areas of expected high losses, as well as the demand for insurance. Michigan and Illinois collected a relatively large share of ad hoc disaster payments for asparagus relative to their acreage. However, overall, ad hoc disaster assistance payments to asparagus growers in the nine USDA-reported states amounted to only 0.2 percent of the value of crop, compared to 2.4 to 6.6 percent for major field crops.

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

Introduction

Asparagus is an herbaceous perennial, valued for the succulent shoots (spears) which are used fresh, canned, and frozen. It has been grown in American gardens since the earliest settlements were established. Commercial plantings were first made about 1860 (Ehlert and Seelig).

Asparagus is grown in most temperate areas of the United States, although the majority of commercial production is located in California, Washington, and Michigan (Table 1). Other commercial growing areas are located in Illinois, Indiana, Maryland, Minnesota, New Jersey, and Oregon. The 1987 Census of Agriculture reported asparagus acreage in 38 states. In 1993, the reported value of the U.S. asparagus crop was $163 million (USDA, NASS).

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

The Asparagus Market

Supply

U.S. fresh asparagus production peaked in the late 1980's, and has declined slightly since that time (Table 2). The 1993 fresh asparagus crop is estimated at 125.3 million pounds, down about 16 percent from the 1989 peak. The amount of total production going for the fresh market (57 percent of the 1993 crop) is far larger than that destined for canning (32 percent) and freezing (11 percent). (See Tables 2, 3, and 4).

Imports account for a significant, and an increasing, share of the total U.S. supply of asparagus. Imports of fresh asparagus rose from 32 million pounds in 1988 to nearly 70 million pounds in 1993, and imports of frozen asparagus rose from about 1 million to about 5 million pounds. Canned asparagus imports have declined, however, from about 7 million pounds to 4 million. In 1993, 24 percent of total U.S. asparagus supplies were imported, mostly from Mexico.

The United States also exports a substantial amount of fresh asparagus, and a small amount of canned asparagus. In 1993, the United States exported 23 percent of its asparagus production, mostly fresh product to Canada, Japan, and Europe.

The domestic harvest of fresh-market asparagus begins with small volumes from southern California during December and January. Supplies increase as the season extends north to central California during February and March, peaking during April and May when central California, Washington, Michigan, and other

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

State	1988	1989	1990	1991	1992	1993
			Acres harvested			
Fresh market and processing						
California	40,100	37,500	35,900	33,500	34,000	34,500
Illinois	820	800	790	789	810	760
Michigan	22,500	23,000	23,500	23,500	19,500	19,000
New Jersey	1,700	1,500	1,400	1,400	1,000	900
Washington	32,000	32,000	32,000	29,000	27,500	25,500
Other [1/]	3,790	3,710	4,010	3,620	3,310	2,890
U.S.	100,910	99,510	95,600	91,800	86,120	83,550
			Production			
			1,000 cwt			
Fresh market and processing						
California	1,163	1,088	1,041	938	986	932
Illinois	12	13	17	16	13	11
Michigan	248	253	259	259	273	285
New Jersey	34	38	32	24	23	23
Washington	896	1,024	1,020	957	990	893
Other [1/]	69	79	78	59	66	60
U.S.	2,422	2,495	2,447	2,253	2,351	2,204
Fresh market						
Michigan	42	33	51	53	32	34
New Jersey	34	38	32	24	23	23
Washington	253	324	280	333	310	253
Other [1/]	1,153	1,097	1,072	967	1,011	943
U.S.	1,481	1,492	1,435	1,377	1,376	1,253

[1/] Indiana, Maryland, Minnesota, and Oregon.

Source: USDA, NASS.

Table 2--U.S. fresh asparagus: 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	Constant 1987 dollars 1/
	Million pounds					Pounds	$/cwt	
1970	97.4	--	97.4	6.8	90.6	0.4	22.30	63.53
1971	85.8	--	85.8	7.2	78.6	0.4	29.20	78.92
1972	94.7	--	94.7	10.1	84.6	0.4	26.70	68.64
1973	88.0	7.3	95.3	10.5	84.8	0.4	31.10	75.30
1974	84.9	9.1	94.0	10.9	83.1	0.4	33.40	74.39
1975	91.5	8.5	100.0	11.1	88.9	0.4	34.00	69.11
1976	96.2	8.2	104.5	10.4	94.0	0.4	38.10	72.85
1977	76.7	7.1	83.8	9.8	74.0	0.3	47.00	84.08
1978	71.7	5.0	76.7	12.6	64.1	0.3	52.20	86.57
1979	64.8	6.7	71.5	15.1	56.4	0.3	64.40	98.17
1980	78.9	7.2	86.1	19.2	66.9	0.3	58.10	81.03
1981	82.1	8.8	90.9	19.5	71.4	0.3	70.50	89.35
1982	89.4	16.1	105.5	17.9	87.6	0.4	--	--
1983	98.0	20.2	118.2	16.9	101.3	0.4	--	--

1984	104.3	14.3	118.6	22.6	96.0	0.4	73.70
80.99							
1985	115.2	18.0	133.2	22.3	111.0	0.5	79.30
84.00							
1986	138.7	24.1	162.8	17.6	145.1	0.6	70.60
72.86							
1987	138.8	28.4	167.2	29.7	137.5	0.6	65.60
65.60							
1988	148.1	32.3	180.4	37.8	142.6	0.6	70.50
67.85							
1989	149.2	34.5	183.7	42.6	141.1	0.6	68.20
62.86							
1990	143.5	43.8	187.3	39.4	147.9	0.6	68.60
60.55							
1991	137.7	52.4	190.1	37.2	152.9	0.6	78.90
67.03							
1992	137.6	57.7	195.3	42.3	153.0	0.6	85.40
70.52							
1993	125.3	69.3	194.6	46.9	147.8	0.6	91.90
73.99							
1994f	133.5	59.8	193.4	44.5	148.8	0.6	--
--							

-- = Not available. f = ERS forecast.
1/ Source: USDA, National Agricultural Statistics Service. Production was adjusted by ERS for
1970-81 to account for States not included in NASS estimates. Production for 1982 and 1983
estimated by ERS. 2/ Source: U.S. Dept. of Commerce, Bureau of the Census. After 1979, U.S.
exports were adjusted using Canadian import data. 3/ Constant dollar prices were calculated
using the GDP implicit price deflator, 1987=100.

Source: USDA, ERS.

Table 3--U.S. asparagus for canning: Supply, utilization, and price, farm weight, 1970-94

Year	Supply				Utilization			Season average price 4/	
	Production 1/	Imports 2/	Beginning stocks	Total	Exports 2/	Ending stocks 3/	Total	Per capita use	Current dollars	Constant 1987 dollars 1/
	Million pounds							Pounds	$/short ton	
1970	129.8	3.1	54.9	187.8	8.9	56.9	122.0	0.6	381.00	1,085.47
1971	134.4	6.6	56.9	197.9	8.9	58.4	130.6	0.6	419.00	1,132.43
1972	123.4	12.0	58.4	193.8	5.3	59.9	128.6	0.6	457.00	1,174.81
1973	123.6	15.3	59.9	198.8	4.5	57.6	136.7	0.6	486.00	1,176.76
1974	149.4	10.8	57.6	217.8	4.8	100.3	112.6	0.5	532.00	1,184.86
1975	86.4	9.8	100.3	196.5	6.1	64.3	126.1	0.6	516.00	1,048.78
1976	82.5	7.4	64.3	154.2	3.4	34.5	116.2	0.5	560.00	1,070.75
1977	96.9	12.9	34.5	144.3	3.2	41.7	99.4	0.5	650.00	1,162.79
1978	86.5	7.0	41.7	135.1	4.1	46.6	84.4	0.4	755.00	1,252.07
1979	78.9	6.3	46.6	131.8	5.0	54.4	72.4	0.3	893.00	1,361.28
1980	69.1	9.8	54.4	133.3	5.5	44.8	83.0	0.4	816.00	1,138.08
1981	69.9	5.0	44.8	119.7	6.0	26.8	86.8	0.4	941.00	1,192.65
1982	68.9	5.6	26.8	101.3	3.3	31.9	66.1	0.3	--	--
1983	67.9	3.6	31.9	103.4	2.9	31.2	69.3	0.3	--	--

1984	66.9	8.0	31.2	106.2	2.6	28.4	75.2	0.3
927.00	1,018.68							
1985	67.7	6.4	28.4	102.5	1.9	31.4	69.2	0.3
951.00	1,007.42							
1986	58.7	6.2	31.4	96.2	1.7	24.2	70.3	0.3
925.00	954.59							
1987	66.3	7.2	24.2	97.7	3.2	30.3	64.2	0.3
944.00	944.00							
1988	65.9	6.7	30.3	102.9	4.4	17.3	81.2	0.3
997.00	959.58							
1989	77.7	4.1	17.3	99.1	3.8	20.4	74.9	0.3
937.00	863.59							
1990	76.7	2.4	20.4	99.5	4.7	20.2	74.7	0.3
991.00	874.67							
1991	70.8	2.2	20.2	93.1	3.8	18.6	70.7	0.3
951.00	807.99							
1992	77.3	2.0	18.6	97.9	3.9	20.3	73.7	0.3
936.00	772.91							
1993	70.8	4.1	20.3	95.2	4.0	18.6	72.6	0.3
991.00	797.91							
1994f	73.0	2.7	18.6	94.3	3.9	19.2	71.2	0.3
--	--							

-- = Not available. f = ERS forecast.

1/ Source: USDA, National Agricultural Statistics Service. Production data for 1982-83 estimated by ERS.

2/ Source: U.S. Dept. of Commerce, Bureau of the Census. Converted to fresh weight basis using a conversion factor of 1.22. 3/ Calculated based on data from the National Food Processors Association. Assumes 23.4 pounds per case. 4/ Constant dollar prices were calculated using the GDP implicit price deflator, 1987=100.

Source: USDA, ERS.

Table 4--U.S. asparagus for freezing: Price, supply, and utilization, farm weight, 1970-94

Year	Supply				Utilization			Season average price 3/	
	Production 1/	Imports 2/	Beginning stocks	Total	Exports 2/	Ending stocks 1/	Total	Per capita use	Current dollars
	Million pounds							Pounds	$/short ton
1970	51.3	--	25.2	76.5	0.3	15.8	60.4	0.3	354.00
1971	61.4	--	15.8	77.2	0.2	20.9	56.1	0.3	376.00
1972	73.5	--	20.9	94.4	0.3	41.6	52.5	0.2	410.00
1973	44.9	--	41.6	86.5	0.4	33.7	52.4	0.2	427.00
1974	28.6	--	33.7	62.3	0.4	22.5	39.4	0.2	493.00
1975	40.3	--	22.5	62.8	0.5	17.6	44.7	0.2	469.00
1976	55.8	--	17.6	73.4	1.1	15.7	56.6	0.3	501.00
1977	49.8	--	15.7	65.5	1.0	19.1	45.4	0.2	614.00
1978	29.5	1.0	19.1	49.6	0.0	9.9	39.8	0.2	816.00
1979	48.1	1.7	9.9	59.7	0.0	22.0	37.6	0.2	911.00
1980	19.7	2.5	22.0	44.3	0.0	15.3	29.0	0.1	852.00
1981	19.4	0.8	15.3	35.5	0.0	10.7	24.8	0.1	984.00
1982	19.1	0.8	10.7	30.6	0.0	17.0	13.6	0.1	--
1983	18.7	2.3	17.0	38.0	0.0	12.2	25.8	0.1	--

1984	18.4	1.0	12.2	31.7	0.0	10.9	20.8	0.1	993.00	1,091.21
1985	30.8	1.1	10.9	42.7	0.0	17.3	25.5	0.1	909.00	962.92
1986	25.5	1.9	17.3	44.7	0.0	21.9	22.8	0.1	933.00	962.85
1987	29.5	0.4	21.9	51.7	0.0	23.4	28.3	0.1	904.00	904.00
1988	28.2	0.9	23.4	52.5	0.0	22.1	30.4	0.1	1,060.00	1,020.21
1989	22.6	0.4	22.1	45.2	0.0	25.9	19.2	0.1	1,020.00	940.09
1990	24.5	1.8	25.9	52.2	0.0	22.1	30.2	0.1	978.00	863.20
1991	16.8	2.3	22.1	41.2	0.0	18.6	22.6	0.1	973.00	826.68
1992	20.1	3.6	18.6	42.2	0.0	7.8	34.4	0.1	994.00	820.81
1993	24.3	5.4	7.8	37.5	0.0	14.8	22.7	0.1	1050.00	845.41
1994f	20.4	3.8	14.8	38.9	0.0	13.7	25.2	0.1	--	--

-- = Not available. f = ERS forecast.
1/ Source: USDA, National Agricultural Statistics Service. Data for 1982-83 estimated by ERS.
2/ Source: U.S. Dept. of Commerce, Bureau of the Census. All product-weight data in this table has been converted to a fresh-weight basis using a factor of 1.92. 3/ Constant dollar prices were calculated using the GDP implicit price deflator, 1987=100.

Source: USDA, NASS.

states are harvesting. Shipments decline during June and the season ends in early July A small amount of fresh-market asparagus is harvested in central and southern Californi during the summer and fall.

Demand

Asparagus accounts for only about one-quarter of one percent of U.S. total vegetable consumption, which includes potatoes, sweetpotatoes, mushrooms, and dry beans and peas (USDA, ERS). Per capita use of asparagus (in all its forms) has been virtually unchanged over the past 20 years, at around 1.0 pound.

Asparagus is used in its fresh form and is also canned and frozen. It can be served in salads, soups, hot dishes, and in combination with various sauces. The whole spears ma be served or they may be cut into pieces.

A seasonal peak in fresh use occurs during the spring. This is a result of its ready availability during that period, and relative scarcity during other periods, rather tha any shift in consumer demand.

Unlike a number of other perishable vegetables, the quantity of asparagus demanded appears to change quite easily when its price changes. A given change in price, for example, is associated with a more than proportional opposite change in the quantity demanded. Conversely, a smaller-than-proportional change in price is associated with a given change in quantity supplied.

This characteristic is referred to as an elastic demand. One statistical study estimated that a 1-percent increase in per capita quantity of fresh asparagus is associated with a 0.36 percent decrease in the grower price (French and Willett).

Prices

Fresh-market asparagus prices demonstrate a very pronounced seasonal pattern. They are highest at the beginning of the season (January-March) and at the end of the season (August-September) when shipment volume is smallest. During the high-price periods, southern California (the Imperial Valley) is the principal shipper. Fresh-market price are generally lowest in mid-season (April-May) when shipment volume is greatest (Table 5). These lower prices correspond with the peak harvest period in central California, Washington, Michigan, and other states.

The low prices during October of 1992 and 1993 probably reflect the effects of a glut o fresh asparagus in specialty markets due to increased production from the Imperial Valley and rising imports. The demand for fresh asparagus outside the high-volume spring season is as an out-of-season item largely in specialty stores. Mini-supply peaks during October of 1992 and 1993 flooded this specialty market and resulted in unusually low prices.

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

	1989	1990	1991	1992	1993
	--------Dollars per 30-pound carton-------				
January	42.00	36.00	33.00	33.60	33.00
February	39.30	31.50	26.73	24.06	32.40
March	25.29	22.77	28.53	24.09	23.55
April	15.75	16.86	21.39	26.61	32.10
May	16.77	19.47	19.53	23.16	23.73
June	23.79	20.91	27.69	30.60	31.80
July	24.00	23.97	19.50	27.90	30.60
August	--	33.60	--	24.75	23.07
September	--	--	--	25.59	26.88
October	--	--	--	18.18	16.47
November	--	--	--	--	--
December	--	--	--	--	--

Source: Computed from USDA, NASS.

Although there may be rather large year-to-year variations in prices at the beginning and end of the season, prices during mid-season are relatively consistent across years. Mid-season prices are closely tied to the price for processing asparagus. If fresh-market and processing prices diverge very far during harvest in Washington and Michigan (the principal processing states), asparagus is diverted from fresh to processing use, thereby maintaining the prices for the two uses in close alignment. Prices for a large portion of processing asparagus production are negotiated prior to the beginning of the season and do not change very much from year to year.

Industry Characteristics

Some of the more salient aspects of the asparagus industry which have significance in assessing the demand for crop insurance include:

- A relatively large proportion of farm operators producing asparagus who depend on farming for their principal source of income,
- Widespread use of irrigation in California and Washington, which reduces drought risks in those areas, but limited irrigation use in Michigan and other eastern states, and
- Substantial diversification in the enterprise mixes on asparagus farms that spreads income risk over several crops.

The primary sources of available information on farms producing asparagus are the 1987 Census of Agriculture and USDA's 1992 Vegetable Chemical Use Survey.[1]

Asparagus Farms

The Census of Agriculture reported 3,033 farms with sales of asparagus in 1987 (Appendi table 1). The largest number of farms and the majority of the acreage were in California, Washington, and Michigan. The Census also reported 1,000 acres or more of asparagus in Arizona, Minnesota, New Jersey, and Oregon. USDA reports asparagus statistics for all of the above states, except Arizona (see Table 1).

The majority of farms growing asparagus in California in 1987 were relatively large operations: 52 percent had sales (from all crops) of $500,000 or more and 74 percent had sales above $100,000 (Appendix table 2). In Washington, 11 percent of farms with asparagus sales reported having total crop sales of $500,000 or more and 48 percent had sales greater than $100,000. In contrast, Michigan farms with asparagus were substantially smaller in terms of crop sales than those in California and Washington. Only 2 percent of Michigan farms with asparagus had total sales of $500,000 or more in 1987, while 75 percent had sales of less than $50,000.

[1] Results for the 1992 Census of Agriculture were not available for all states at the time this report was prepared.

In terms of organizational structure, individual or family ownership was the most frequent type of arrangement among farms with asparagus in Michigan and Washington in 1987, while partnerships and corporate arrangements were more common in California (Appendix table 3). Partnerships and corporate arrangements (either family held or other) were more typical among the larger farms than among the smaller ones. One hundred and sixty of the 209 farms with sales of $500,000 or more reported a partnershi or corporate-type organizational structure.

Income Diversification on Asparagus Farms

Income diversification enhances producers' ability to manage risk. Sources of income diversification on asparagus farms include: 1) diversification with off-farm employment, and 2) diversification of receipts from asparagus with other farm enterprises.

Off-farm income is a more important source of diversification for small farms than for larger farms. Sixty-four percent of all farm operators growing asparagus in 1987 reported that farming was their main occupation (Appendix table 4). Over half of the farms, however, reported the operator working off the farm at least one day in 1987 and about 30 percent reported the operator working off the farm 200 days or more. Most of those operators working off the farm 200 days or more were from farms with total sales of less than $25,000.

Market sales for asparagus growers are substantially diversified between asparagus and other crops. Of the $614 million in market sales reported by the Census for farms growing asparagus in 1987, $310 million were sales from vegetable crops including asparagus (Table 6). The USDA's Crop Reporting Board estimated the value of asparagus production at $136 million in 1987, which is about 22 percent of total sales reported b the Census for farms with asparagus.[2] The greatest specialization occurred in Washington, where asparagus accounted for 36 percent of total farm sales on farms producing asparagus.

Vegetable acreage reported by growers in a 1992 survey of chemical use in 10 states indicates that asparagus accounted for a relatively large share of their total vegetabl acreage, particularly in Michigan and Washington. In those states, asparagus accounted for 60 and 66 percent, respectively, of total vegetable acreage on farms growing asparagus (Table 7).[3]

The chemical use survey also provides information on the crops grown on farms producing asparagus. Fresh sweet corn and fresh tomatoes are insurable

[2] Although Crop Reporting Board asparagus data do not include all states reported by the 1987 Census, its coverage includes states that accounted for 94 percent of 1987 Census acreage.

[3] The survey included vegetable farms in Arizona, California, Florida, Georgia, Illinois, Michigan, New Jersey, New York, North Carolina, and Texas.

Table 6--Market value of sales from farms producing asparagus, 1987

State	All Products	All Crops	Vegetables & melons	Asparagus	Asparagus % of all products
	Million Dollars				Percent
California	273	273	176	75	27
Illinois	6	6	3	1	17
Michigan	63	56	25	14	22
New Jersey	21	20	16	2	10
Washington	112	108	43	40	36
Other	138	102	47	4	3
U.S.	614	565	310	136	22

Note: The category "other" is computed as the U.S. total minus listed states.

Source: 1987 Census of Agriculture and USDA, NASS.

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

State	Farms sampled	Asparagus farms growing other vegetables	Asparagus, percent of total vegetable acreage
	---Number---	---Percent---	---Percent---
California	53	51	45
Illinois	60	63	34
Michigan	97	50	60
New Jersey	54	81	16
Oregon	14	36	47
Washington	85	33	66

Source: USDA, Vegetable Chemical Use Survey, 1992.

specialty crops that were produced on farms growing asparagus (Table 8). The Oregon an Washington farms sampled were less likely to produce currently-insurable specialty crop than in the other asparagus-producing states.

Cultivation and Management Practices

Asparagus is a perennial crop belonging to the plant group called Liliacaea. The asparagus plant has a relatively long life expectancy ranging up to 30 years, although the life of most commercial plantings is less than 20 years. The life of an asparagus bed (or plantation) depends on natural conditions and the care given to the bed.

An asparagus bed produces a crop one year after the crowns (see below) are transplanted However, it is only partially productive for the first three years after transplanting. A bed generally produces about 10 percent of its maximum yield in the second year (the year after transplanting), about 50 percent in the third year, and 80 percent in the fourth year. Commercial fields receiving average care yield their largest output at 5 to 7 years of age in California (California Asparagus Commission). Asparagus plantings in Michigan reportedly produce their maximum yields at 5 to 12 years of age (Foster).

The crop cycle for established asparagus consists of: 1) a 4-8 week harvest in the spring and early summer, 2) a summer fern growth (or re-establishment) period during which the plant re-stocks its energy reserves in the roots and crown, and 3) a rest period brought on by cold weather or drought.

Virtually all the asparagus grown in the United States is classed as green asparagus. White (blanched) asparagus production is common in Asia and Europe. Fresh white asparagus, however, is rare in U.S. markets. White asparagus is produced by avoiding exposure of the young spears to light. The traditional method for excluding light is t mound the soil over the plant row to an 8- to 10-inch height. Once the tip of the soil mound starts to crack, an asparagus knife is thrust into the mound, cutting off the spear before it is exposed to light. Otherwise, culture and pest control are similar t green asparagus.

Climate

Asparagus is a native of temperate regions and cultivation is most successful where either low temperatures or drought stop growth of the plant, providing it with a rest period. Areas with monthly average temperatures of 60º-75º F and a winter dormant perio produce the best crops. Asparagus is not grown successfully in the South, where extrem heat and plentiful rainfall permit the continuation of shoot growth late in the season, thereby depriving the plant of the dormant period needed for successful production the subsequent year. Successful crops are produced in warm, irrigated areas, including the Imperial Valley of California, where irrigation water is withheld to slow vegetative growth and provide a rest period.

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

State	Farms sampled	Farms growing				
		Onions	---Sweet Corn---		----Tomatoes----	
			Fresh	Processed	Fresh	Processed
	Number	----------Percent----------				
California	53	11	6	2	15	15
Illinois	60	0	57	0	47	0
Michigan	97	4	28	14	23	0
New Jersey	54	0	57	36	63	4
Oregon	14	29	7	0	0	0
Washington	85	11	4	1	0	0

Source: USDA, Vegetable Chemical Use Survey, 1992.

Spear growth occurs when soil temperatures reach 50° F (Sims, et. al.). Daily average temperature affects the rate of growth of the spears. For example, the asparagus shoot requires 5 days to produce a 6-inch spear with daily average temperatures of 53° F. In contrast, at 78° F, a shoot will reach 6 inches in about 1.9 days. Although spears grow faster at higher temperatures, extremely high temperatures also promote early branching of the shoot. Shoots at 100° F branch at 2 to 3 inches above the ground, while at 59° F they branch at 30 to 40 inches. Early branching is an undesirable characteristic.

Soil Requirements

Asparagus grows best in deep, well-drained, loamy sand, sandy loam, or loam soils. Heavy clay soils which drain slowly and are difficult to penetrate may result in a large percentage of poor spears and relatively short-lived beds. Sandy soils produce earlier crops because they warm faster in the spring. A slightly acid soil with a pH of 6.0-6. is preferred for asparagus production.
Asparagus is relatively salt-tolerant. Consequently, it is grown successfully in desert areas of California where the salt level of the soil is quite high.

Varieties

The asparagus industry is undergoing a major change, from the planting of open-pollinated varieties (such as Mary Washington, Martha Washington, and Viking KB3) to the planting of hybrid varieties with enhanced yield potential. A number of the new hybrid varieties consist of all-male or nearly all-male plants that have evolved from research at Rutgers University in New Brunswick, New Jersey. Some of these recommended hybrids include Jersey Giant, Jersey Price, Jersey King, Jersey Knight, Jersey Gem, and others.

The primary asparagus variety in California is the hybrid UC 157. Other California varieties include UC 72, the 800 series, Brock's Special, and Ida-Lea (Sims, et. al.). UC 157, released in the fall of 1975 for commercial use, exhibits earliness in production, multi-spear initiation, uniformity in color and size, and greater total production than other varieties (University of California, 1977). Brock's Special was developed for the hot, desert growing conditions of the Imperial Valley.

All-male hybrids produce only male plants and thus produce no seeds. As a result, food that goes into fruit production in dioecious varieties is stored in the roots of all-male varieties and provides added vigor for spear production the following spring. Test results in Washington and Michigan indicate that the all-male hybrids may produce double the yields of standard cultivars such as Mary Washington (Dean). Another advantage of all-male hybrids is that no problems with seedling asparagus occur in established fields because the plants produce no seeds (Zandstra, Dean).

Planting

Asparagus is established in the field by transplanting 1-year-old crowns (the underground portions of the plant). Crowns are grown from seed planted in nursery beds. Growers may produce their own crowns or purchase them from nurseries specializing in crown production. Although asparagus can be seed-planted in the field, the use of 1-year-old crowns results in a more uniform stand and reduces the time from planting to the first harvest. Once established, an asparagus planting may be harvested for 12 to 15 years, or longer.

Asparagus crowns are transplanted in most growing areas from early spring through mid-summer, depending on climate conditions. In California, transplanting is done from February through April in the desert regions, from March through May in the lower San Joaquin Valley and the Delta, and from April through July in the cooler coastal areas (Sims, et. al.).

Asparagus crowns are transplanted 6 to 12 inches apart in rows that are 4 to 5 feet apart. Crowns are covered with only 2-3 inches of soil at planting time. They are planted in 8-10 inch deep farrows. As the young plants grow, the farrows are filled in during the first growing season until the field is level.

Weed control is especially important in newly-planted asparagus because the young plant grow slowly and compete poorly with weeds. Failure to control weeds adequately during establishment may permanently reduce the vigor of the stand. Cultivation and herbicide are used in weed control. Weed control is more difficult in new plantings than in established beds because young asparagus plants are more sensitive to herbicides and cultivation.

Fertilization

Asparagus has relatively high fertilizer requirements during the establishment period because the developing crown and root storage system have large nutrient requirements. Less fertilization is needed after the first two or three seasons than during the establishment period because nutrient removal in the harvested spears is relatively low (Dean).

Irrigation

Asparagus is a fairly drought-tolerant crop because of its deep and extensive root system and, therefore, is not a heavily irrigated crop. Nevertheless, its roots should not be deprived of moisture for long periods during the growing period. Virtually all of the asparagus in California and Washington is irrigated (see Appendix table 1). A small percent of asparagus production in Michigan is irrigated. Irrigation promotes fern top growth in asparagus and increases the buildup of energy for the subsequent crop.

Harvesting

Asparagus cannot be harvested during the year that the crowns are planted because the plants must be allowed to grow and develop a strong storage root system. Sometimes, growers may harvest five or six times during the year following transplanting if the plants are particularly vigorous. Good vigor is essential for second-year harvesting, however, because harvesting too soon stresses the plant and reduces future yields. The Michigan Agricultural Extension Service recommends waiting until the third year to star harvesting.

Asparagus harvesting (cutting) in California and Washington is done with a special knif which cuts the young spears just below the soil surface. In Michigan, asparagus is "snapped off" by hand without the use of a knife. Hand snapping may be faster and less costly than cutting, but it also may result in less uniformity in the cut spears.

Michigan's asparagus is processed primarily as "cuts and tips" where uniformity of the spears is less important than in situations where the final product is in whole-spear form. Washington asparagus is processed primarily as whole spears.

Asparagus spears grow rapidly and require frequent cutting, especially if the temperature is high. Early in the season, the shoots may require cutting only every third day, but as the growth becomes more active it may be necessary to cut twice a day especially if the asparagus is growing on very light, warm soil. A typical harvesting schedule consists of cutting 2 or 3 times a week, for about a 6-8 week period.

Harvesting ends early enough to allow an extended season for fern growth. During the fern growth (or re-establishment) period, plants accumulate food reserves for the next cutting season. Cutting may be stopped before the latest recommended harvesting date i there is an appreciable reduction in spear diameter. Table 9 shows typical harvesting dates for asparagus, by state, as reported by USDA.

Packing and Shipping Fresh Asparagus

Asparagus is one of the most perishable vegetable crops. Thus, proper cooling is essential in the storage and shipping stages to avoid weight loss and reduced quality. If cooling does not occur quickly, asparagus loses natural sugars and some of its flavor. In addition, spears can become tough due to the formation of woody tissue, and decay is more likely to develop. Asparagus is usually maintained at a temperature between 34º F and 37º F and a relative humidity of 90 to 95 percent during storage and shipping. If rapidly cooled and held under such conditions, asparagus may be kept for maximum of 3 weeks.

There are generally two types of packaging for fresh asparagus--bunch pack and loose pack. Bunch packs consist of various different bunch weights, spear sizes, and crate weights. In contrast, loose-packed spears are trimmed to the desired length (usually eight or nine inches) and placed in a crate, each of which contains 30-32 pounds. In California, as much as 80 percent of the state's production is packed out loose in 30-pound crates (University of California, 1993).

Stalk size is designated according to the diameter, measured at the widest portion of the spear. Sizes include Jumbo--13/16-inch and larger; Large--

Table 9--Usual planting and harvesting dates for asparagus

State	Planting date	Usual harvest date		
		Begin	Most active	End
California	See table in California state analysis section.			
Delaware	Apr. 10-May 10	Apr. 20	May 1-June 15	June 30
Indiana	Mar. 15-Apr. 15	Apr. 20	May 1-June 20	June 25
Illinois	Mar. 15-Apr. 15	Apr. 25	May 1-June 15	June 30
Iowa	Mar. 15-Apr. 15	Apr. 25	May 1-June 15	June 20
Maryland	Apr. 10-May 10	Apr. 20	May 1-May 31	June 30
Michigan	Apr. 1-Apr. 30	Apr. 25	May 1-June 20	June 30
Minnesota	Apr. 25-May 14	May 14	May 19-July 2	July 2
New Jersey	Mar. 15-May 15	Apr. 20	May 1-June 20	July 10
Oregon	Mar. 1-Apr. 30	Apr. 10	Apr. 15-June 15	June 30
Virginia	Feb. 1-Mar. 15	Apr. 10	May 1-May 10	June 10
Washington	Apr. 1-June 1	Apr. 15	May 6-June 3	June 30

Source: USDA, Statistical Reporting Service.

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

7/16-inch and larger;, Standard--3/8-inch and larger; and Small--1/4 - 3/8 inch (Vance Publishing Corp.).

Marketing

About 57 percent of U.S. asparagus production was destined for fresh-market use in 1993 (USDA, NASS). Virtually all of the asparagus grown in California is sold for the fresh market, and a portion of Michigan and Washington output is sold to the fresh market. Output in the minor production areas is sold almost exclusively for fresh-market use.

Although producers in Michigan and Washington sell most of their asparagus for processing use, when fresh-market prices rise sufficiently, they divert some asparagus from processing use to fresh use. Consequently, during the main harvesting season, fresh and processing asparagus prices maintain a relationship roughly equivalent to the additional costs for packing and selling fresh-market asparagus.

Grower bargaining associations negotiate prices for processing asparagus in Washington and Michigan. In Washington, the Washington-Oregon Asparagus Growers Association is th growers' bargaining agent. In Michigan, the grower bargaining agent is the Asparagus Growers Division of the Michigan Agricultural Commodities Marketing Act (MACMA). MACMA represents roughly 85 percent of the volume of processing asparagus in Michigan and the negotiated price effectively becomes the industry price that season. Similarly, in Washington, the association price effectively becomes the industry price even though on large processor, Green Giant, does not purchase its asparagus through the association.

There are no Federal marketing orders for asparagus. California, Michigan, and Washington have state asparagus commissions which fund promotion, as well as production and marketing research, with grower assessments based on the amount of production. The commissions also support foreign market development and promotion through "Asparagus USA". Asparagus USA is a consortium of the California, Michigan, and Washington asparagus commissions, which administer the program on a rotational basis.

Costs of Production

Variable harvesting and marketing expenses account for a substantially larger share of total costs in fresh-market asparagus production than in processing asparagus production. Estimated harvesting and marketing expenses accounted for nearly three-quarters of the total costs of producing fresh-market asparagus in Imperial County, California in 1993 (Table 10).[4] Because marketing expenses for processing asparagus are substantially lower than for fresh-market asparagus (processing asparagus has minimal packing and selling

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

Table 10--Asparagus: Variable harvesting costs, selected states [1/]

State	Yield	Variable harvest cost	Total cost	Variable harvest percent of total
	Pounds/acre	---------$/acre--------		Percent
Imperial county, California	4,500	3,000	4,082	73
Michigan	1,400	276	1,057	26
Washington	4,000	1,019	2,184	47

[1/] Costs may not be comparable among states because budgets may be for different seasons and may not include the same cost items. Costs for California are for fresh asparagus production in Imperial County. Costs for Michigan and Washington are for processing asparagus.

Sources: Joshua, et. al., 1994; Kelsey, 1989; University of California, 1993.

expenses), the variable costs of harvesting constitute a substantially smaller share of total costs for processing asparagus than for fresh-market. Harvesting expenses for processing asparagus account for about one-quarter of total costs in Michigan and about one-half in Washington.

As with other fresh vegetables, variable harvesting and marketing expenses for asparagu play a role in growers' decisions about when to stop harvesting which could, consequently, have an effect on annual yield. If the asparagus price falls below harvesting and marketing expenses and the end of the harvest season is approaching, growers may stop cutting sooner and yields would be lower than if prices were higher. On the other hand, if prices are relatively high as the end of the season approaches, growers may try to extend harvesting to take advantage of the higher price.

Growers have limited flexibility, however, in altering yields by adjusting the number o cuttings. They may be reluctant to stop cutting early because if prices subsequently rise, they can not resume harvesting and take advantage of the higher prices. On the other hand, growers are reluctant to extend the harvest by very many cuttings because o the possibility of jeopardizing the vigor of the bed and lowering yields in future seasons.

Production Perils

The greatest peril to asparagus production is frost or freeze damage during the harvest season that kills the spears, making that portion of the crop unmarketable. Other perils include extended cool weather during the harvest season, excessive heat during the harvest season, excessive moisture, hail, insects, and diseases. Of course, perils can reduce the current year's production during the harvest season. In addition, peril can also reduce fern growth during the re-establishment period, and thus, diminish production in subsequent years.

Frosts and Freezes

Late spring frost is the most common weather-caused peril reported in all major production areas. Asparagus is one of the first plants to emerge in the spring, with harvest beginning as soon as spears reach marketable length. As a result, asparagus is quite vulnerable to frosts. Frosts are more prone to occur early in the harvest period when yield per cutting is usually highest and the damage in terms of reduced yield, consequently, is greatest.

Frost damages or kills spears that have emerged from the soil, making them worthless, and slows the development of new spears, delaying future production for several days. As a result, the season's output is reduced by more than the amount of the frost-damage spears.

Growers in Michigan can lose up to 40 percent of their crop if they experience several frosts during the same season, although a 10-20 percent loss is more typical (Myers, Neibauer, Zandstra). Michigan growers usually take 15-25 cuttings during a 6-week harvest season. Growers estimate that they typically lose 2-3 of these cuttings following a spring frost.

The location of the field is important in assessing the risk of frost damage. Low-lyin areas are more frost-prone (they are more likely to develop "frost pockets") than highe elevations, and asparagus planted in such fields is likely to suffer larger yield losse than asparagus planted at higher elevations. On higher fields, cold air tends to flow to lower elevations on cold nights.

Extended Cool Weather

Cool weather slows down the asparagus plant's physiology and reduces the number of spears that reach marketable size during the harvest period. However, cool weather is not generally perceived as a major peril. It would not be likely to cause an asparagus yield loss sufficient to result in a crop insurance claim.

Extreme Heat

Excessive heat during the harvest season speeds-up the pace of spear development, thereby disrupting the steady harvesting schedule. Heat speeds the rate of spear growt and makes it hard for growers to harvest as fast as needed to realize maximum yield. I addition, if day-time temperatures are in the 85^{o}-90^{o} F range for a week or more, the plants branch out (develop side shoots) before the spears are long enough to harvest.

Drought

Asparagus is a relatively drought-resistant plant, with roots that can reach a depth of 15-20 feet in sandy soils. However, extreme drought can reduce the current year's yield. It can also reduce the amount of energy stored by the plant during fern growth, reducing the subsequent year's yield. Because asparagus in California and Washington i grown on irrigated land, drought is not considered a production peril in those states. However, drought can reduce yields in the Midwest and in Eastern states.

Some disagreement exists among industry experts as to the severity of drought as a production peril. For example, ASCS contacts in Michigan indicated that drought was th cause of asparagus ad hoc disaster payments made in Oceana and Van Buren counties durin 1988, the year with the largest payments over the 1988-93 period (Garcia, Gavrin). However, extension horticulturalists at Michigan State University were dubious that the reduction in the current year's yield would approach the 40 percent needed in order to have collected disaster payments in that year (Myers, Neibauer, Zandstra).

Excess Moisture

Excess moisture can be a serious production problem if the planting is not on a sufficiently well-drained soil. Asparagus roots cannot tolerate being submerged for extended periods of time without killing the plant. Excess moisture can also lead to root rots and other diseases.

Hail

The occurrence of hail during the harvest season can damage the tender, unharvested spears, scarring them and making them unmarketable for either fresh or processing uses. Yield loss due to hail would probably be limited to less than 15 percent of the normal harvest because the damage is limited to just those spears which have emerged. A growe

would not likely lose more than two-to-three cuttings out of an eight-week season to hail damage.

Insects

Asparagus beetles and cutworms are the most widespread insects affecting asparagus production. Other asparagus insects include asparagus aphids, symphylans (garden centipedes), and wireworms.

Asparagus beetles. There are several species of asparagus beetle, but the "common" asparagus beetle causes the most serious problems. The common asparagus beetle lays it eggs in the spring on spears or ferns. The presence of eggs, larvae, or larval feeding injury on spears is considered a contaminant and results in the affected spears being culled. Harvesting on a timely basis and preventing over-maturity are the best control measures (Cantaluppi).

Larvae feeding on the fern can seriously injure newly-established beds and reduce the vigor of established stands. The beetle can be controlled during the fern stage with insecticide sprays.

Cutworms. As with the asparagus beetle, there are several types of cutworms. Cutworms may injure the asparagus spears by feeding on the tips or they may injure the side of the spear by feeding at or just below the soil line, sometimes severing it completely. Cutworm feeding causes distorted and twisted spear growth.

Some evidence suggests an association between weeds in the asparagus field and cutworm infestations. This is an additional reason for weed control (Dean).

Asparagus aphids. Asparagus aphid infestations result in marked stunting of fern growth. The greatest damage occurs to young plants. Seedlings and 1-year-old plants may be killed by infestations. Older plants show a range of responses, from moderate weakening of the plants to essentially no effect.

The asparagus aphid has a large number of natural enemies. Ladybird beetles, parasitic wasps, syrphid larvae, and lacewing larvae feed on colonies of asparagus aphids. The likelihood of natural enemies providing adequate protection to prevent aphid toxin from harming the plant, however, is unlikely. The best protection against the asparagus aphid is the use of chemical pesticides.

Symphylans. Symphylans are small, white, centipede-like animals with nocturnal (night-time) habits. They feed on asparagus roots, sometimes devouring small roots entirely and puncturing holes in larger roots. Infestations generally are associated with heavy (silt or loam) soils. Cultivation to dry out the surface soil of beds may reduce injur to the plants by driving the insects deeper into the soil (Sims, et. al.).

Thrips. Thrip infestations can cause damage to young nurseries, direct-seeded new plantings, seedling-transplanted fields, and new 1-year-old crown plantations. Thrips remove moisture form the fern, weaken its vigor, and can kill the tops of small seedlings. Control consists of monitoring the thrip populations and the use of pesticides (Sims, et. al.).

Diseases

The most serious asparagus diseases are asparagus rust, fusarium wilt, and fusarium crown rot. Stemphylium purple spot, a fungus disease, and several viruses are also production perils for asparagus.

Asparagus rust. Asparagus rust, a fungus disease, reduces plant vigor and causes ferns to age prematurely, reducing storage reserves in the crown and thereby lowering yields the following season. Asparagus rust is serious in humid areas, especially during year having excessive rainfall.

Asparagus beds should not be planted in areas with poor air drainage or where dew occur frequently, since moisture on the plant's foliage encourages rust development. Preventing growth of volunteer plants during the cutting season and isolating seedling beds from commercial fields also helps in the control of rust. Varieties that are resistant or moderately-resistant retard rust development, and include Delmonte 361, Jersey Giant, Jersey Centennial, and UC 157. Fungicide applications may be necessary t prevent the disease from becoming established in the field (Dean).

Fusarium wilt and Fusarium crown rot. Fusarium wilt and fusarium crown rot are widespread problems that cause premature decline of asparagus stands. Plant stress, other virus infections, high soil temperature, and light soils increase the incidence o disease. Common causes of plant stress include over-cutting, drought, over-watering, insect injury, inadequate weed management, and soil compaction.

Control measures consist of treating seed before planting and not planting asparagus in old beds which are infected with the Fusarium disease. Care during tillage to avoid wounding fleshy roots and crowns helps eliminate avenues for infection.

Stemphylium Purple Spot. Stemphylium purple spot is a fungus that sometimes causes small, slightly-sunken spots on asparagus spears just prior to harvest. The fungus needs moist conditions from dew, rain, or sprinkler irrigation to infect plants. Symptoms are most severe during the early part of the harvest season following wet weather and cool temperatures, and disappear when rainfall ceases and temperatures warm

Control consists of destroying overwintering sources of inoculum such as old, infected ferns and plant debris. Planting cover crops that reduce windblown sand may also aid i disease control

Viruses.

Three viruses--the tobacco streak virus, asparagus virus-1 and asparagus virus-2--represent production perils in growing asparagus. Alone, each of these can reduce vigo or productivity. In certain combinations (such as asparagus virus-1 and asparagus virus-2), however, they cause plants to decline or die, diminishing the stand and lowering yields.

Careful attention to weed (including volunteer asparagus) and insect control helps in the control of viruses. Using seed with a low incidence of the asparagus virus-2 also helps in reducing plantation decline.

Weeds

Weeds (including volunteer asparagus) compete with asparagus for water, nutrients, and light and interfere with harvest efficiency. Weeds also serve as a host for insects an diseases.

Weed control consists of careful attention to cultivation. Herbicide sprays also are available for weed control.

State Analyses

Although there are similarities among areas in the way asparagus is grown, each area ha unique production practices and confronts a unique set of perils. The following sectio analyzes the production practices and perils specific to the major asparagus-growing regions, and examines the potential demand for an asparagus insurance policy.

California

California is the nation's leading state in asparagus production, and accounts for over 40 percent of U.S. asparagus output. California harvested 34,500 acres of asparagus in 1993, and produced 932,000 hundredweight at a total value of $84 million. Asparagus is grown over a wide range of climatic zones in California, from cool coastal areas to extremely hot desert climates (see Appendix table 5 and the Appendix map).

Average yields vary substantially from area to area within California (Appendix table 5). The highest average yields are reported in Monterey county, where cooler summer temperatures and a long growing season permit a long harvesting period. The Monterey production area also has more virgin soils (soils on which asparagus has not previously been grown) on which to grow asparagus than the Delta area. Soils on which asparagus has previously been grown can be infected with diseases, and plantings on such soils never reach the same productivity as asparagus planted on virgin soil.

At the present, California's asparagus is marketed almost exclusively to the fresh market (California Asparagus Commission). Prior to 1980, however, about half of the asparagus produced in California was canned or frozen (French and Willett). Processing has declined in California since 1980 and the Northwest (primarily Washington state) ha replaced California as the dominant processing region.

Production Perils

The principal weather-related production perils in California include spring frost, excessive rains, unusually high temperature during the harvest period, and excessive wind.

Weather-related. Spring frost is the major risk to asparagus production in California (DePaoli). Frost usually causes a 3- or 4-day loss in the harvesting schedule. If freezing temperatures are persistent, more days may be lost (Bacchetti).

Excessive rain during harvest-time may encourage disease development. Diseases such as phytophthora rot (spear slime) and crown rot are usually caused by over-irrigation or

excessive rainfall. Rain during harvest-time also delays harvesting and could result i partial losses due to branching.

Excessive wind may cause curvature of the spears (University of California, 1993). Asparagus which is badly crooked is marked with the designation "crooks" by the California Food and Agricultural Codes (Federal-State Marketing News Service). Crooked asparagus is of substantially lower market value.

Diseases. Fusarium wilt is the most serious asparagus disease in California (Bacchetti). No production area of California is immune from fusarium wilt.

Phytophthora crown rot also can be potentially damaging if it affects the plant during the harvest season (Channey). Phytophthora is aggravated by exceptionally wet winters. It can be controlled through the application of fungicides in mid-winter, ahead of the harvest season.

Asparagus rust is most prevalent in the damp coastal areas of California, but may also cause problems in humid inland areas. Prevention consists of well-spaced irrigation use, wide row spacings, and orientation of the planting with the prevailing wind direction. Several fungicides are effective at preventing the development of rust in California.

Insects. The main pest problems affecting California asparagus include asparagus aphids, garden centipedes, thrips, asparagus beetles, and cicadas. A serious aphid infestation occurred in Riverside county during 1988 and 1989, destroying as much as 85 percent of the county's asparagus crop. A number of farmers switched out of asparagus production following that incident and Riverside's production never fully recovered, remaining at about 15 percent of the pre-infestation level (Chanla).

Asparagus beetles, although found wherever asparagus is grown, are usually not a seriou pest in California.

The garden centipede is chiefly a problem with white asparagus in California. As California has cut back its white asparagus production, the importance of this pest has declined.

Although some cicada infestations have occurred, the extent to which they damage the asparagus crop appears to be limited to minimal feeding on the roots while the nymphs are in the soil.

Harvesting Dates

The peak harvest season in California is March through the early part of June. Althoug a small amount of asparagus is harvested in the fall in the Imperial and Central valleys, fall harvest is a very small part of California's production. The following harvest dates apply to the various areas of California:

Producing regions	Harvest period [1/]	Peak harvest

Delta, Central San Joaquin area	March 1 - June 20	April
Salinas area (Monterey county)	March 10 - July 15	April, May
Imperial area	Jan. 15 - April 15	Feb., March
Los Angeles and Orange counties	March 1 - June 15	April, May

[1/] Small quantities are also harvested during August-October in the central San Joaquin and Imperial Valley areas.

Source: California Agricultural Statistics Service.

Sources of Individual Yield Data

The California Asparagus Commission funds its asparagus research and promotion activities on the basis of grower assessments on production (16.5 cents per 30 pound carton). The Commission reports it has production and acreage records for its growers and that individual-grower yield series could be developed from these data (DePaoli).

Demand for Insurance

The demand for an asparagus policy among California growers is likely to be low (DePaoli). The weather-related production perils faced by California asparagus growers do not typically cause significant losses. The most serious peril is early spring frost, which destroys only the spears that have emerged from the ground--usually 2-4 days of cuttings out of an 8-week harvest. Privately-offered commercial crop insurance for asparagus was offered at times in the past, but grower participation was low (DePaoli).

Michigan

Michigan ranks a distant third among asparagus-growing states, after California and Washington. The state accounted for 13 percent of U.S. output in 1993. Michigan harvested 19,000 acres of asparagus in 1993, and produced 285,000 hundredweight at a total value of $17 million.

The largest number of growers and the majority of Michigan's acreage is located in the west central and southwestern parts of the state in the counties bordering Lake Michigan. Oceana and Mason counties contained the largest acreage in 1992 (Michigan Department of Agriculture). Substantial amounts of asparagus are also grown in Allegan Berrien, Cass, Manistee, Muskegon, Ottawa, and Van Buren counties.

Lake Michigan moderates the effects of the weather, benefitting asparagus production in the adjoining counties. It reduces the incidence of yield-diminishing late frosts and it helps reduce the effects of high temperatures, which can shorten the harvest period. Although the moderating effect declines with distance from the Lake, it is judged to be important in asparagus production at least 20 miles inland (Myers).

The Census of Agriculture reported 881 farms in Michigan with asparagus sales in 1987. The Michigan Department of Agriculture, however, reported only 580 growers in 1992 (Michigan Department of Agriculture).

The average size of Michigan asparagus operation in 1992 was 34 acres (Michigan Department of Agriculture). The average processing asparagus acreage was 47 acres, compared with 9 acres for fresh-market acreage. Some growers marketed both fresh and processing asparagus. Asparagus growers in the west central production area tend to have larger operations than in southwest Michigan.

The county extension agent in Oceana county in west central Michigan, the major asparagus-growing county in Michigan, indicated that asparagus operations in his county ranged from a couple of acres to about 1,000 acres (Myers). He said farmers in his are with 50 or more acres of asparagus probably represented the most efficient operations.

Eighty-nine percent of Michigan's asparagus production was for processing in 1992 and 1 percent for the fresh market. The largest amount of processing asparagus in Michigan i used for canning--only a small fraction is frozen (Neibauer).

Asparagus yields in Michigan depend on the age of the planting. New plantations are planted to hybrids, which are higher-yielding than the older varieties. Mary Washington, the principal older variety, accounted for 38 percent of Michigan's

asparagus acreage in 1992. Jersey Giant, Jersey Knight, and Syn 4-56 are three of the leading new varieties. Jersey Giant and Jersey Knight are all-male varieties; not all of the new plantings, however, are of the all-male type.

Asparagus tends to be the main business for growers in the west central area (Myers). Typically, asparagus growers in the west central counties also produce fruits (cherries and, to a lesser extent, apples and peaches) and in some cases, vegetables, such as zucchini, peppers, and snap beans. Asparagus operations are smaller in the southwest and are usually grown in combination with other vegetables and, in some cases, fruits.

Production Perils

Late spring frost is the major production peril for asparagus in Michigan. Other peril are extreme heat, excessive moisture, drought, insects, and diseases (Garcia, Gavrin, Neibauer, Zandstra).

Weather-related. Michigan growers take 15-25 cuttings during a 6-week harvest season and estimate that they lose 2-3 of these cuttings following a spring frost.

One specialist said that there were more damaging spring frosts in the southwest Michigan production area in 1994 than in any other year he could remember. He judged that yields may have been reduced on some low-lying asparagus fields by as much as 40 percent, while on higher fields with better air drainage, yields may have been reduced by only 10 percent (Zandstra).

Extreme heat toward the end of the cutting season occasionally reduces yields in Michigan, although this peril is not considered a serious production risk.

Drought is also a production peril in Michigan. ASCS county offices indicated that the disaster payments made for asparagus in Oceana and Van Buren counties during 1988 were the result of drought-caused losses.

Excessive moisture. Excessive rainfall does not generally reduce current-season asparagus yields in Michigan. Asparagus is planted on relatively well- drained, sandy soils which are able to dissipate excessive rain fairly well.
However, excessive rainfall can cause immediate yield losses if the asparagus is plante on poorly-drained soils. Asparagus roots, like those of many other plants, need free oxygen for respiration, and will die if deprived of air for very long.

The main problem associated with excessive rain occurs in future seasons. An excessively wet season can result in a high incidence of asparagus rust, which reduces the yield in the subsequent season. Excessive soil moisture also promotes the development of fusarium root rot, which cause the plantation to decline (the plants die at an early age (Myers, Zandstra).

Hail. Hail can cause the loss of one to two cuttings because it damages spears which have broken through the soil, making them unmarketable. Hail damage, however, is not a important source of yield loss for asparagus in Michigan (Myers, Zandstra).

Insects and disease. Insects, such as the asparagus beetle and cutworms, are productio perils for Michigan asparagus, but losses are generally preventable if the grower

follows recommended production practices. The major disease problems are fusarium crow rot and asparagus rust.

Demand for Insurance

The demand for asparagus crop insurance among Michigan growers is likely to be fairly low because the production perils they face do not generally cause total crop losses over the season (Kelly, Foster). The production risks that exist (primarily late sprin frost) result in the loss of only a portion of the crop. Hail is a production risk in Michigan, but asparagus growers do not generally buy hail insurance.

Sources of yield data

The Michigan Asparagus Advisory Board funds research and promotion activities for Michigan asparagus through assessments on its growers based on production. However, th Advisory Board does not have a corresponding record of acreage which could be used to compute yields (Foster).

New Jersey

New Jersey produced 23,000 hundredweight of asparagus in 1993, about 1 percent of U.S. production. Asparagus operations in New Jersey are concentrated in Gloucester and Sale counties in the southwestern part of the State. Some plantings are also located in Burlington county, with the remainder scattered throughout the state. Asparagus in New Jersey is grown mainly on fine, sandy loam soils. All of the New Jersey asparagus crop is sold for the fresh market, with a significant portion sold through roadside markets.

The Census of Agriculture reported 179 farms in New Jersey with asparagus in 1987. An extension horticulturalist at Rutgers estimates there are over 100 farms remaining toda (Garrison). Most growers have one to two acres of asparagus. About 900 acres of asparagus were harvested in the state in 1993 (USDA, NASS). Virtually all new planting in New Jersey are with the all-male hybrids developed by the Rutgers Experiment Station

Most New Jersey growers produce crops other than asparagus, including other vegetable crops. Consequently, they typically have irrigation equipment available. However, asparagus is generally irrigated in New Jersey only during the first two years of growth, when the crop is becoming established.

The harvest season lasts six to eight weeks, from mid-April to mid-June. Growers may harvest every other day during periods with cool temperatures, and as often as twice a day during periods with unusually warm temperatures. On average, asparagus in New Jersey is harvested about 5 times a week.

Production Perils

The major peril to asparagus production in New Jersey is frost and freeze damage. Othe perils include hail, drought, and excessive wind.

Weather-related. The major New Jersey peril is frost and freeze damage during harvest, usually limited to the first two weeks of the harvest season. Typically, 3-7 days of harvesting will be lost to freeze damage (Garrison).

Hail damage is also a peril. Hail during the harvest season can cause the loss of several days of harvesting. In addition, hail during fern growth in July and August (the re-establishment period) can reduce the next year's yield by up to 50 percent.

Drought during the re-establishment period can also reduce the subsequent season's yield. Drought during the harvest period is generally not a problem because New Jersey typically gets adequate rainfall at that time. Excess moisture is not a production peril in New Jersey, except in low-lying areas.

Excessive wind can reduce yields if blowing sand damages the tender spears. Sand-damaged spears develop a crooked shape and have little or no market value. Excessive wind can also break off asparagus stalks during the re-establishment period, reducing the plant's energy buildup and lowering the yield in the subsequent season.

Insects and diseases. Various insects and diseases are production perils in New Jersey but they can generally be controlled with recommended management practices. One particular problem, however, is asparagus rust. This disease is promoted by excessive dew or mist between mid-August and mid-September, and results in reduced yields the following year.

Illinois

Illinois produced 11,000 cwt of asparagus in 1993, about 0.5 percent of U.S. asparagus output. The Census of Agriculture reported 62 farms in Illinois with asparagus sales i 1987. The average size of most Illinois asparagus operations is one to two acres (Cantaluppi). There are some larger operations, mostly located in northern Illinois.

Asparagus production in Illinois is located around population centers and most is sold locally for the fresh market. Many growers sell their production through roadside stands, farmers' markets, and pick-your-own. There is also a processing plant at Princeville in northern Illinois which buys asparagus.

Harvesting typically starts about April 20 and lasts through early June. Most harvesting is done by hand with the picker walking through the field. Some operations, usually those larger than one acre, use a picking aid on which the worker lies on his o her stomach and snaps off the harvestable spears as the machine moves down the row.

Production Perils. The major peril in Illinois is late spring frost. Other perils include excess moisture, drought, and hail.

Weather-related. The major production peril affecting asparagus production in Illinois is spring frost. Frost kills the spears which have emerged but also slows future production for several days. Consequently, production is reduced by more than the amount of the frost-damaged spears.

Excess moisture can be a serious production problem if the planting is not on a sufficiently well-drained soil. Asparagus cannot tolerate being submerged for extended periods of time without killing the plant. Excess moisture can also lead to root rots.

Drought and hail are also production perils. Asparagus is relatively drought- tolerant but extended dry weather during fern growth reduces the amount of energy re-stored to the roots and diminishes the yield during the subsequent year.

Insects and diseases. Various insects and diseases are production perils in Illinois, but they can generally be controlled with recommended management practices.

Washington

Washington accounted for about 30 percent of U.S. asparagus acreage and 40 percent of U.S. production in 1993 (USDA, NASS). USDA reported 25,500 harvested acres in Washington in 1993, down from 32,000 in 1989. The decline in acreage was somewhat larger than the rise in average yield over this period, and production declined by more than 10 percent. Washington produced 89 million pounds of asparagus in 1993 with an average farm value of $55 million.

Washington's asparagus is located in the Yakima and Columbia River valleys in south central Washington. Franklin and Yakima are the major producing counties, accounting for about three-quarters of Washington's total output. Other asparagus-producing counties reported by the Washington Department of Agriculture are Adams, Benton, Grant, and Walla Walla counties.

The Census of Agriculture reported 483 farms growing asparagus in Washington in 1987. The Washington Asparagus Commission reported 380-400 members in 1994 (Webring). Asparagus operations range in size from less than an acre to several hundred acres (Folwell).

Washington grows asparagus primarily for processing use. An estimated 70 percent of th crop is sold for processing use, with the remaining 30 percent destined for the fresh market.

The harvest period in Washington is about eight weeks, running from late April to about June 20. Asparagus is cut about every three days early in the season when the weather is cool and the spears are growing slowly. As the ground warms up later in the season and spear growth accelerates, asparagus may be cut daily.

Production Perils

As in other states, the major peril to asparagus production in Washington is spring frost. Other perils include excessive wind and hail.

Weather-related. The major weather-related production peril is late spring frost. Other weather perils are excessive wind and hail (Van Denburgh). Excessive wind is a peril when asparagus is planted on sandy soils, which are found mainly in lower Yakima county and the Columbia Basin in Washington. Wind-blown sand injures the asparagus spear on its windward side, causing it to grow crooked rather than straight. There is no market for crooked asparagus.

Damage from frost, excessive wind, or hail are not likely to reduce asparagus yields enough in Washington to qualify a grower for an insurance indemnity. Yields losses fro any of these risks are estimated to typically be in the 5- to 10- percent range.

Insects and diseases. Uncontrolled insect infestations, diseases and excessive weed growth also are production perils in Washington. All of these, however, are risks over which the grower has a great deal of control.

Demand for Insurance

The demand for a potential asparagus policy in Washington is likely to be low because damage from weather-related perils typically does not cause losses of such magnitude that a grower would quality for an indemnity payment. Weather perils usually damage only that portion of the crop that has already emerged from the ground, but that has no yet been harvested (about two- to three-day's growth). Consequently, the loss consists only of a two- or three-day yield out of an eight-week harvest season.

Some production perils, such as uncontrolled weeds growth, diseases, and viruses, can result in early decline or complete loss of the plantation. However, growers generally have a great deal of control over these perils. The director of communications for the Washington Asparagus Commission indicated that crop insurance has not been an issue which the commission has discussed in recent years (Webring).

Sources of Yield Data

There are two asparagus organizations in Washington. The Washington Asparagus Commission funds asparagus promotion and production and marketing research and represents the interests of Washington asparagus growers. The commission's activities are supported by assessments on all growers based on the amount of production. An estimate of a grower's production could be made from assessments, but there is no recor of acreage associated with the production from which yields could be estimated (Webring).

The Washington-Oregon Asparagus Growers Association is a grower bargaining cooperative which negotiates with processors for the prices paid for processing asparagus. The association represented 155 growers in 1994. There are five processors in Washington, but not all of the processors negotiate with the association (Folwell). At least one processor, Green Giant, does not purchase its asparagus through the association. The Washington-Oregon Asparagus Growers Association keeps records on members' production, but does not record the acreage from which the production was harvested.

Ad Hoc Disaster Assistance for Asparagus

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

Disaster assistance payments for asparagus (fresh and processed) totalled $2.5 million over the 1988-93 period. Payments for fresh asparagus accounted for 65 percent of the total and payments for processed asparagus accounted for 35 percent. Payments for total (fresh and processed) asparagus losses peaked at $1.05 million in 1988, and were over $325,000 in 1989 and 1993. Payments made for asparagus accounted for about 0.06 percent of all ad hoc assistance for non-program crops (that is, non-price and income support crops) over the 1988-93 period.

Ad hoc disaster payments for asparagus were scattered over a geographically broad area. For fresh asparagus, 27 states received payments in at least one of the six years, with 6 states collecting payments in all years. For processed asparagus, 5 states collected payments in one of the 6 years, with Michigan and Oklahoma receiving payments in all years. Payments for asparagus were reported in a variety of states for which NASS does not collect asparagus statistics--including Missouri, Oklahoma, and Virginia.

In an ordering of counties, Morrison county, Minnesota ranked first in fresh asparagus payments, receiving $140,000 over the 6-year period. The next three states in the series include: Grant county, Washington ($127,000); Saline county, Missouri ($106,188); and Kern county, California ($86,624). A total of 207 counties received payments in at least one of the 6 years for fresh asparagus yield losses.

For processed asparagus, the top-ranked counties in ad hoc payments include the Michigan counties of: Van Buren ($196,238); Oceana ($122,306); Manistee ($109,154); and Berrien ($66,449). Of the ten top-ranked counties, eight were located in Michigan and two in Washington. A total of 27 counties received payments in at least one of the 6 years for processed asparagus losses.

Ad hoc disaster data can be used to indicate which asparagus-producing areas received large payments relative to their acreage (Table 11). Michigan accounted for an average 23.6 percent of asparagus harvested acreage over the 1988-93 period, and received 35.5 percent of ad hoc asparagus payments. Similarly, Illinois accounted for 0.9 percent of U.S. asparagus acreage between 1988 and 1993, and received over 4 percent of the payments made for that crop.

In contrast, California and Washington collected smaller shares of ad hoc payments relative to their acreage. California accounted for 39 percent of asparagus acreage and 3.5 percent of payments, while Washington accounted for 32 percent of U.S. acreage and 12 percent of payments.

Disaster payments for the five NASS asparagus states averaged 0.2 percent of the total U.S. asparagus crop value over the six years (Table 12). Disaster payments as a percent of crop value were highest in Illinois (2 percent) and lowest in California and Washington (less than 0.05 percent). The low payments in California and Washington reflect the relative absence of weather-related production perils in these States. All of California's and Washington's asparagus is irrigated so drought is not a production peril. In addition, spring temperatures may be less variable (less chance of a frost once asparagus harvest has begun) in California and Washington than in Michigan and Illinois.

Asparagus Insurance Implementation Issues

Adverse Selection and Multiple-Year Insurance

If FCIC decides to offer crop insurance for asparagus, it may be necessary to offer a multiple-year policy. A number of asparagus production perils have little or no effect on the current season's yield, but can cause substantial yield loss in subsequent years. Extreme drought, severe hail damage to the fern growth, stalk breakage due to excessive wind, and disease buildup, for example, may not reduce the current seasons's yield, but they disrupt the plant's energy build-up during fern growth and can substantially reduce yield during subsequent harvests. In order to avoid adverse selection--growers taking out insurance after an event occurred that reduced future yield

Table 11--Disaster assistance payments for asparagus (fresh and processed), 1988-93

State	Average asparagus harvested acreage, 1988-93	Share of U.S. acreage	Total asparagus disaster payments, 1988-93	Share of U.S. asparagus disaster payments
	--Acres--	--Percent--	Thousand --Dollars--	--Percent--
California	35,917	38.7	87.8	3.5
Illinois	793	0.9	105.4	4.3
Massachusetts	NR	NR	89.0	3.6
Michigan	21,833	23.6	877.8	35.5
Minnesota	NR	NR	207.9	8.4
Missouri	NR	NR	121.7	4.9
New Jersey	1,317	1.4	50.8	2.1
Oklahoma	NR	NR	75.9	3.1
Virginia	NR	NR	87.1	3.5
Washington	29,333	31.6	297.0	12.0
Wisconsin	NR	NR	243.1	9.8
Other states	3,555	3.8	229.6	9.3
U.S.	92,748	100.0	2,473.1	100.0

NR = not reported.

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

Table 12--Asparagus: Crop value and disaster assistance, selected states, 1988-93

State	Total crop value	Total disaster payments	Disaster payments, percent of crop value
	----1,000 dollars----		Percent
California	465,315	87.8	*
Illinois	5,402	105.4	2.0
Michigan	90,784	877.8	1.0
New Jersey	13,574	50.8	0.4
Washington	328,950	297.0	*
Other states	23,263	240.1	1.0
Total	927,288	1,659.0	0.2

* Less than 0.05 percent.
"Other states" include Indiana, Maryland, Minnesota, and Oregon.

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

prospects--it may be necessary to require that growers insure for a period of years.

A minimum step in reducing adverse selection would be to define the crop year as beginning with the fern growth in one year and extending through the conclusion of harvest the following year (perhaps July 1 through June 30 in Washington and Michigan). Defining the crop season in this way would help rule out adverse selection for some perils, but not all. Because asparagus is a perennial crop, the yield-reducing effects of an adverse event can extend over several seasons, and sometimes for the life of the plantation.

Setting Reference Prices

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

A reference price for asparagus probably should represent the in-field value of the crop, because growers would generally not incur the expenses for harvesting and marketing on that portion of the yield that was lost. Variable harvesting and marketing expenses account for a relatively large share of total costs for asparagus (perhaps as much as 75 percent for fresh asparagus and 25-50 percent for processing asparagus). Using a fresh-market f.o.b. price or a season average price for processing asparagus could create the situation where growers would realize a higher return from indemnity payments than the market value of the crop. Such a situation would provide undue incentive for moral hazard.

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

Actual Production History (APH) and Plantation Maturity

A complicating factor in determining a producer's APH is that yields vary with the age of the plantation. Yields usually rise during the first 2 or 3 harvest years as the plantation matures. This stage is followed by several years of a yield plateau and then several years of declining yields until the production no longer justifies the cost for maintaining the plantation and harvesting the asparagus. Consequently, the age of the plantation needs to be taken into account in developing an average yield.

The "rule of thumb" used by the California Asparagus Commission to project production on the basis of the age distribution of plantings illustrates the relationship between yield and age of planting. The commission uses 600 pounds per acre for the first harvest year, 3,100 pound for the 2nd through 6th year, 2,300 pounds for the 7th through the 9th year and 1,620 pounds harvests after the 9th year (DePaoli). This schedule of yield-age

relationship would be different for individual growers because of soil, climate, and management differences.

Another complicating factor in determining actual production history is that yields for the new "all-male" varieties average higher than for the older open-pollinated varieties. Most new asparagus plantations are planted with the newer hybrid varieties. APH yields for plantings of the open-pollinated varieties would need to be discounted from the average for the newer hybrids.

Because of the bearing pattern of asparagus and the fact that new varieties have substantially higher expected yields, an APH in which past years are averaged to obtain an expected yield may have to be adjusted for plantation age and plant variety. An alternative to using an average APH for the plantation may be to offer separate policies based on: 1) the establishment years, 2) prime-production years, and 3) declining years, each with different rates and coverages.

Estimating "Appraised Production"

Estimating appraised production for asparagus (harvestable, but unharvested yield) would require taking into account not only the age of the plantation (see the "Actual Production History and Plantation Maturity" section), but also the number of cuttings already taken or the number of cutting days remaining in the season.

An appropriate formula for estimating unharvested yield would be: APH multiplied by a "remaining-season" adjustment. A gross remaining-season adjustment would be the percentage of the normal harvest season remaining when cutting ceased. This factor would tend to over estimate appraised production, however, because yield per day usually declines as the season comes to an end. A refinement to the remaining-season adjustment would account for the higher yields per day at the beginning of the season.

Insuring Price Risk

There would likely be less interest among asparagus growers in a revenue insurance policy than among growers of most other perishable commodities. Price variability during most seasons appears to be less of a risk in asparagus growing than for other perishable vegetables such as lettuce. Most of the asparagus crop is harvested during April and May when prices are relatively stable from year-to-year compared with prices for other fresh vegetables. The reason for this relative stability is that asparagus can be diverted between fresh and processing uses, and the processing price more or less acts as a floor for the fresh price during the peak harvest (see the "Prices" section). Processing asparagus prices, on the other hand, are arrived at through pre-season bargaining and remain relative stable within the season.

Market Prices and Moral Hazard

Low market prices are not as likely to be an incentive for moral hazard with an asparagus insurance policy as with some other perishable vegetables because asparagus prices tend to be more predictable than prices for vegetables such as celery and lettuce. In addition, growers have less flexibility in neglecting an asparagus crop than with celery and lettuce.

Availability of Individual Yield Data

Individual acreage and production data are available for California growers through the California Asparagus Commission. The availability of individual yield data appears to be less readily available in Washington and Michigan. Although the grower associations in Washington and Michigan fund their research and promotion activities on the basis of grower assessments on production, they do not maintain records of the acreage which would be needed to calculate individual grower's yields.

Demand for Insurance

Our assessment is that asparagus does not seem like a very good candidate for insurance relative to the other specialty crops we have examined. There is not likely to be very much demand for multiple-peril insurance by asparagus growers, especially in the two largest production areas (California and Washington), because growers do not face production perils that result in the loss of a large portion of their yield. Disaster assistance payments to asparagus growers in the nine USDA-reported states amount to only 0.2 percent of the value of crop, compared to 2.4-6.6 percent for major field crops (Table 13).

The largest potential demand is likely to occur in Michigan and other midwestern and eastern areas because weather-related yield losses appear to be more frequent in these areas than in the western states. Despite the relatively larger losses in the eastern and midwestern states, it does not appear that crop insurance would be an important risk-management tool for growers in these states because production losses due to weather causes account for a relatively small share of grower returns. In Michigan, for example, disaster assistance payments between 1988 and 1993 averaged only 1 percent of the value of the asparagus crop (see Table 12).

A further indicator of the potential demand for an asparagus policy derives from FCIC records on requests for insurance. Unlike the other specialty crops we have examined, these records indicate that FCIC has received no requests for an asparagus policy since 1990.

Table 13--Disaster assistance and crop insurance payments as a percent of crop value, selected crops, 1988-92

Crop	Disaster payments	Crop insurance payments	Total	1992 crop insurance participation
	-------Percent of crop value--------			--Percent--
Corn	1.7	1.2	2.9	29
Soybeans	1.4	1.0	2.4	24
Wheat	3.3	3.3	6.6	41
Asparagus	0.2	NA	0.2	NA

NA = not applicable.

Note: Asparagus data reflect 1988-93, and states for which NASS collects information. Data for other crops reflect 1988-92, and all states.

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

References

Bacchetti, Burt. Director. California Asparagus Commission. Personal communication. July 1994.

California Agricultural Statistics Service. *Marketing California Asparagus, 1991*. Sacramento, California.

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

California Asparagus Commission. Testimony before the U.S. International Trade Commission. Investigation #332-307. 1991.

Cantaluppi, Carl. Research and Extension Horticulturalist. Ohio State University-Piketon Research and Extension Center. (Formerly at the University of Illinois). Personal communication. July 1994.

Chanla, Jennifer, County Agricultural Commissioner's Office. Riverside County, California. Personal communication. July 1994.

Channey, William. Farm Advisor. University of California Cooperative Extension Service. Salinas, California. Personal communication. July 1994.

Dean, Bill B. *Washington Asparagus Production Guide*. Publication EB-997. Washington State University.

DePaoli, William. Manager. California Asparagus Commission. Stockton, California. Personal communication. July 1994.

Ehlert, G.R. and R.A. Seelig. *Fruit & Vegetable Pointers: Asparagus*. United Fresh Fruit and Vegetable Association. Washington D.C. October 1966.

Federal-State Market News Service. "Marketing California Asparagus, 1991." U.S. Department of Agriculture and the State of California. March 1992.

Folwell, Raymond. Agricultural Economist. Washington State University. Pullman, Washington. Personal Communication. July 1994.

Foster, Harry. Manger. Michigan Asparagus Advisory Board. Personal Communication. August 1994.

French, Ben C., and Lois Willett. *An Econometric Model of the U.S. Asparagus Industry*. Giannini Research Report Number 340. University of California. September 1989.

Garcia, Juan. Oceana County Executive Director. USDA, ASCS. Shelby, Michigan. Personal communication. July 1994.

Garrison, Steve. Horticulturalist. Rutgers University. Personal communication. July 1994.

Gavrin, Debbie. Program Assistant. Van Buren County ASCS office. Paw Paw, Michigan. Personal communication. July 1994.

Halfacre, R. Gordon, and John A. Barden. *Horticulture*. McGraw-Hill. 1979.

Joshua, Troy, Raymond Folwell, and Dan Holmes. *Asparagus Establishment and Production Costs in Washington, 1994*. Washington State University Extension Bulletin 1779. 1994.

Kelly, John. Extension Horticulturalist. Michigan State University. Personal communication. July 1994.

Kelsey, Myron, P. and Uta Kniese. *Cost of Producing Asparagus in Western Michigan*. Extension bulletin E-1327. Cooperative Extension Service. University of Michigan. October 1989.

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

Myers, Norman. Extension Agent. Oceana County, Michigan. Personal communication. July 1994.

Neibauer, James. District Extension Vegetable Agent. Benton Harbor, Michigan. Personal communication. July 1994.

Sims, William L., Frank D. Souther, and Robert J. Mullen. *Growing Asparagus in California*. University of California, Division of Agriculture and Natural Resources. Leaflet 21447. 1988.

University of California, Cooperative Extension Service. Division of Agriculture and Natural Resources. *Asparagus Production in California*. Bulletin 1882. February 1977.

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

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

U.S. Department of Agriculture. Economic Research Service. *Vegetables and Specialties Situation and Outlook Yearbook 1993*. TVS-260. July 1993.

U.S. Department of Agriculture. National Agricultural Statistics Service. *Agricultural Chemical Usage: Vegetables, 1992 Summary*. Ag Ch 1(93). June 1993.

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

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

U.S. Department of Commerce. Bureau of the Census. Import-Export data files. Various years.

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

Vance Publishing Corporation. *The Packer 1993: Produce Availability and Merchandising Guide.* Vance Publishing Corporation. Overland Park, Kansas. 1993.

Van Denburgh, Roy. Cooperative Extension Vegetable Specialist. Yakima County, Washington. Personal communication. July 1994.

Webring, Margaret. Director of Communications. Washington Asparagus Commission. Personal communication. July 1994.

Zandstra, Bernard. Extension Horticulturalist. Michigan State University. Personal communication. July 1994.

Zandstra, Bernard, John F. Kelly, Mary Hausbeck, Edward Grafius, and Hugh C. Price. *Commercial Vegetable Recommendations: Asparagus*. Extension Bulletin E-1304. Michigan State University. January 1992.

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

State/County	1987				1982	
	Farms	Acres harvested	---Irrigated--- Farms	Acres	Farms	Acres ---Irrigated--- harvested	Farms	Acres
California	175	35,012	175	35,012	154	34,718	154	34,718
San Joaquin	62	18,645	62	18,645	67	18,943	67	18,943
Monterey	15	3,873	15	3,873	14	4,363	14	4,363
Riverside	26	2,688	26	2,688	18	1,456	18	1,456
Imperial	12	2,448	12	2,448	4	1,727	4	1,727
Yolo	6	666	6	666	8	1,256	8	1,256
Solano	5	595	5	595	(N)	(N)	(N)	(N)
Other	49	6,097	49	6,097	43	6,973	43	6,973
Washington	483	26,266	483	26,266	475	29,878	475	29,878
Franklin	124	10,225	124	10,225	100	6,380	100	6,380
Yakima	242	9,890	242	9,890	256	10,680	256	10,680
Walla Walla	41	3,044	41	3,044	45	9,212	45	9,212
Grant	24	1,953	24	1,953	23	1,294	23	1,294
Other	52	1,154	52	1,154	51	2,312	51	2,312
Michigan	881	23,426	62	1,009	935	19,517	50	458
Oceana	293	12,371	7	176	313	9,496	2	(N)
Van Buren	121	2,679	6	274	188	3,328	6	265
Mason	75	2,096	2	(N)	56	923	2	(N)
Manistee	24	815	3	(N)	18	559	4	37
Allegan	27	677	4	39	26	479	4	(N)
Berrien	60	673	6	62	81	882	4	(N)

Other	281	4,115	34	458	253	3,850
28	156					
Minnesota	52	2,302	24	567	34	(N)
15	31					
Illinois	62	728	6	12	52	3,259
6	16					
Arizona	23	1,911	23	1,911	9	17
9	17					
Yuma	14	1,775	14	1,775	(N)	(N)
(N)	(N)					
Other	9	136	9	136	9	17
9	17					
New Jersey	179	1,653	46	553	142	1,599
37	519					
Gloucester	43	642	9	222	37	473
5	27					
Cumberland	15	369	5	49	14	364
3	(N)					
Salem	25	298	6	128	22	222
5	87					
Other	96	344	26	154	69	540
24	405					
Oregon	38	1,314	38	1,314	26	759
26	759					
Umatilla	24	908	24	908	16	734
16	734					
Other	14	406	14	406	10	25
10	25					
These States	1,831	91,884	851	66,632	1,775	86,488
766	66,380					
United States	3,033	97,335	1,162	67,939	2,639	97,202
962	67,467					

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

Source: 1987 Census of Agriculture.

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

State	Farms	Total value of crop sales: $500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
	Number	Percent of farms				
Arizona	23	13	0	9	39	39
California	175	52	22	3	3	20
Illinois	62	3	18	19	5	55
Indiana	64	5	17	9	12	57
Maryland	50	0	16	12	20	52
Michigan	881	2	13	11	13	62
Minnesota	52	6	6	4	13	71
New Jersey	179	6	21	8	12	53
Oregon	38	16	11	16	21	37
Washington	483	11	37	15	12	25
Other States	1,026	3	11	10	10	67
U.S.	3,033	7	17	11	11	54

Source: 1987 Census of Agriculture.

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

Organizational type and state	All farms	$500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Total value of crop sales				
		Number of farms				
Individual or family						
Arizona	7	0	0	0	0	7
California	71	19	18	3	2	29
Illinois	47	0	6	11	3	27
Indiana	51	0	6	3	8	34
Maryland	41	0	5	4	7	25
Michigan	742	2	76	69	105	490
Minnesota	42	1	3	1	7	30
New Jersey	142	3	22	11	19	87
Oregon	25	3	2	4	3	13
Washington	352	13	117	61	48	113
Other	843	6	56	78	85	618
U.S.	2,363	47	311	245	287	1,473
Partnership						
Arizona	2	2	0	0	0	0
California	54	32	12	2	3	5
Illinois	10	1	2	0	0	7
Indiana	6	1	2	1	0	2
Maryland	6	0	2	2	2	0
Michigan	98	3	26	20	9	40
Minnesota	7	0	0	1	0	6
New Jersey	20	5	8	3	2	2
Oregon	11	2	2	2	4	1
Washington	59	5	31	8	8	7
Other	104	3	22	18	12	49
U.S.	377	54	107	57	40	119
Corporation						
Family held						
Arizona	14	1	0	2	9	2
California	40	34	5	0	0	1
Illinois	4	0	3	1	0	0
Indiana	6	2	3	0	0	1
Maryland	2	0	1	0	1	0
Michigan	36	8	13	5	3	7
Minnesota	2	2	0	0	0	0
New Jersey	15	2	8	1	1	3
Oregon	2	1	0	0	1	0
Washington	68	31	31	4	1	1
Other	61	17	24	6	4	10
U.S.	250	98	88	19	20	25

Continued

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

Organizational type and state	All farms	Total value of crop sales: $500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
	Number of farms					
Corporation						
Other than family held						
Arizona	0	0	0	0	0	0
California	8	5	3	0	0	0
Illinois	1	1	0	0	0	0
Indiana	0	0	0	0	0	0
Maryland	1	0	0	0	0	1
Michigan	1	0	0	0	0	1
Minnesota	1	0	0	0	0	1
New Jersey	0	0	0	0	0	0
Oregon	0	0	0	0	0	0
Washington	2	2	0	0	0	0
Other	5	0	4	0	1	0
U.S.	19	8	7	0	1	3
Other						
Arizona	0	0	0	0	0	0
California	2	1	0	0	0	1
Illinois	0	0	0	0	0	0
Indiana	1	0	0	1	0	0
Maryland	0	0	0	0	0	0
Michigan	4	0	0	0	0	4
Minnesota	0	0	0	0	0	0
New Jersey	2	0	0	0	0	2
Oregon	0	0	0	0	0	0
Washington	2	0	0	0	0	2
Others	13	1	3	3	0	6
U.S.	24	2	3	4	0	15

Source: 1987 Census of Agriculture.

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

Item and state	All farms	$500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Total value of crop sales				
		Number of farms				
Farming is main occupation						
Arizona	18	3	0	2	9	4
California	154	89	35	5	4	21
Illinois	41	2	11	11	2	15
Indiana	32	3	9	4	6	10
Maryland	30	0	7	6	9	8
Michigan	469	11	112	79	82	185
Minnesota	30	2	3	2	7	16
New Jersey	121	10	36	14	16	45
Oregon	29	6	3	6	7	7
Washington	353	49	168	49	37	50
Other	652	26	106	101	78	341
U.S.	1,929	201	490	279	257	702
		Percent of all farms				
Arizona	78.1	13.0	0.0	8.7	39.1	17.3
California	88.1	50.9	20.0	2.9	2.3	12.0
Illinois	66.1	3.2	17.8	17.7	3.2	24.2
Indiana	50.1	4.7	14.1	6.3	9.4	15.6
Maryland	60.0	0.0	14.0	12.0	18.0	16.0
Michigan	53.3	1.2	12.8	9.0	9.3	21.0
Minnesota	57.7	3.8	5.8	3.8	13.5	30.8
New Jersey	67.5	5.6	20.1	7.8	8.9	25.1
Oregon	76.3	15.8	7.9	15.8	18.4	18.4
Washington	73.0	10.1	34.8	10.1	7.7	10.3
Other	63.5	2.5	10.3	9.8	7.6	33.2
U.S.	63.6	6.6	16.2	9.2	8.5	23.1
		Number of farms				
Operator days off-farm						
None						
Arizona	9	1	0	1	4	3
California	118	72	26	4	3	13
Illinois	26	2	6	8	1	9
Indiana	23	2	8	3	3	7
Maryland	22	0	6	3	6	7
Michigan	322	6	81	48	52	135
Minnesota	20	2	1	2	4	11
New Jersey	88	10	31	9	10	28
Oregon	22	4	3	5	4	6
Washington	234	45	127	22	21	19
Other	422	21	82	66	32	221
U.S.	1,306	165	371	171	140	459

Continued

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

Item and state	All farms	$500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Total value of crop sales				
		Number of farms				
Any						
Arizona	6	0	0	0	2	4
California	45	12	8	0	2	23
Illinois	34	0	4	3	2	25
Indiana	40	1	3	1	5	30
Maryland	26	0	1	3	4	18
Michigan	516	5	28	36	58	389
Minnesota	32	1	2	0	3	26
New Jersey	78	0	5	5	10	58
Oregon	13	0	1	0	4	8
Washington	216	3	40	46	33	94
Other	562	4	24	35	61	438
U.S.	1,568	26	116	129	184	1,113
1 to 99 days						
Arizona	0	0	0	0	0	0
California	10	3	2	0	0	5
Illinois	8	0	3	0	1	4
Indiana	6	0	1	0	0	5
Maryland	7	0	0	3	1	3
Michigan	103	4	19	19	16	45
Minnesota	8	0	2	0	2	4
New Jersey	21	0	3	4	4	10
Oregon	4	0	1	0	3	0
Washington	71	1	24	19	8	19
Other	152	2	18	27	19	86
U.S.	390	10	73	72	54	181
100 to 199 days						
Arizona	2	0	0	0	2	0
California	15	4	2	0	1	8
Illinois	7	0	1	1	0	5
Indiana	13	1	2	1	3	6
Maryland	5	0	1	0	2	2
Michigan	99	1	6	7	15	70
Minnesota	5	0	0	0	0	5
New Jersey	6	0	0	0	0	6
Oregon	5	0	0	0	0	5
Washington	39	0	4	9	14	12
Other	130	1	2	6	22	99
U.S.	326	7	18	24	59	218

Continued

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

Item and state	All farms	$500,000 or more	$100,000 to $499,999	$50,000 to $99,999	$25,000 to $49,999	Less than $25,000
		Total value of crop sales				
		Number of farms				
200 days or more						
Arizona	4	0	0	0	0	4
California	20	5	4	0	1	10
Illinois	19	0	0	2	1	16
Indiana	21	0	0	0	2	19
Maryland	14	0	0	0	1	13
Michigan	314	0	3	10	27	274
Minnesota	19	1	0	0	1	17
New Jersey	51	0	2	1	6	42
Oregon	4	0	0	0	1	3
Washington	108	2	14	18	11	63
Other	278	1	2	2	20	253
U.S.	852	9	25	33	71	714
Not reported						
Arizona	8	2	0	1	3	2
California	12	7	4	1	0	0
Illinois	2	0	1	1	0	0
Indiana	1	0	0	1	0	0
Maryland	2	0	1	0	0	1
Michigan	43	2	6	10	7	18
Minnesota	0	0	0	0	0	0
New Jersey	13	0	2	1	2	8
Oregon	3	2	0	1	0	0
Washington	33	3	12	5	3	10
Other	42	2	3	4	9	24
U.S.	159	18	29	25	24	63

Source: 1987 U.S. Census of Agriculture.

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

County	Year	Harvested Area	Yield	Production	Price	Comments
		Acres	Tons/acre	Tons	$/ton	
San Joaquin	1980	16,821	1.08	18,233	1,101	From 1986 on, all production goes to the fresh market. Prior to 1986, data are unspecified.
	1981	17,059	1.02	17,400	1,219	
	1982	16,055	0.93	14,900	1,276	
	1983	16,701	1.02	17,000	1,144	
	1984	18,700	1.40	26,200	1,069	
	1985	18,100	1.47	26,600	1,052	
	1986	20,100	1.07	21,500	1,185	
	1987	17,500	1.17	20,500	918	
	1988	16,800	1.62	27,200	1,294	
	1989	18,100	1.50	27,200	1,108	
	1990	19,300	1.23	23,800	1,055	
	1991	18,700	1.44	26,900	1,341	
	1992	16,500	1.45	23,900	1,692	
Contra Costa	1980	1,740	0.78	1,360	1,050	-1986:unspecified 1987-: Fresh use
	1981	1,650	1.05	1,730	1,041	
	1982	1,740	0.63	1,090	1,360	
	1983	1,570	0.86	1,358	1,398	
	1984	1,800	1.31	2,353	1,233	
	1985	2,560	1.29	3,300	891	
	1986	2,470	1.24	3,063	1,167	
	1987	2,340	0.97	2,270	1,270	
	1988	2,180	1.17	2,550	883	
	1989	2,270	1.39	3,160	1,210	
	1990	1,640	1.13	1,860	1,207	
	1991	1,510	1.51	2,280	1,548	
	1992	1,650	1.26	2,080	1,566	
Imperial	1980	2,807	1.35	3,789	1,956	Unspecified for all years.
	1981	2,251	1.49	3,351	1,964	
	1982	1,892	1.62	3,058	2,150	
	1983	2,161	1.41	3,047	2,318	
	1984	2,127	1.10	2,340	1,888	
	1985	2,523	1.30	3,289	1,972	
	1986	3,527	1.61	5,673	1,733	
	1987	3,821	1.77	6,776	1,893	
	1988	3,935	1.93	7,581	2,062	
	1989	4,347	1.93	8,390	2,565	
	1990	4,516	2.15	9,701	2,615	
	1991	5,961	1.53	9,126	2,041	
	1992	5,216	1.86	9,680	2,074	

Continued

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

County	Year	Harvested Area	Yield	Production	Price	Comments
		Acres	Tons/acre	Tons	$/ton	
Kern						
	1986	1,132	1.51	1,710	1,084	Unspecified
	1987	1,466	1.30	1,910	1,112	for all years.
	1989	853	2.34	2,000	1,491	No data were
	1990	861	2.50	2,150	1,250	available for
	1991	693	1.57	1,090	1,772	1980-85 & 1988.
	1992	840	1.18	991	1,963	
Monterey	1980	2,411	1.93	4,650	1,511	Fresh use for
	1981	2,770	2.10	5,810	1,534	1984-87.
	1982	2,440	2.34	5,720	1,363	Unspecified for
	1983	2,880	2.13	6,140	1,567	all other years.
	1984	3,150	1.73	5,445	1,485	
	1985	3,256	2.20	7,163	1,367	
	1986	3,330	2.64	8,805	1,382	
	1987	4,140	3.17	13,135	1,105	
	1988	3,880	3.28	12,740	1,141	
	1989	4,990	3.10	15,450	995	
	1990	4,830	3.21	15,500	1,077	
	1991	4,535	2.89	13,100	1,464	
	1992	4,820	2.53	12,200	1,396	
Orange	1980	646	1.47	951	1,665	Unspecified for
	1981	631	1.84	1,160	1,830	all years.
	1982	614	2.11	1,293	1,931	
	1983	754	1.88	1,418	1,834	According to the
	1984	754	1.90	1,433	2,066	Ag. Commissioner,
	1985	854	2.03	1,734	1,800	urbanization is
	1986	890	2.26	2,011	1,702	responsible for
	1987	781	2.96	2,312	1,332	the drop in
	1988	651	3.46	2,250	1,291	output in 1990.
	1989	644	3.54	2,282	1,387	
	1990	467	2.07	968	1,230	
	1991	142	2.96	420	1,601	
	1992	21	1.52	32	1,122	

Continued

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

County	Year	Harvest Area	Yield	Production	Price	Comments
		Acres	Tons/acre	Tons	$/ton	
Riverside	1980	839	1.56	1,307	1,879	Unspecified for
	1981	956	1.53	1,463	1,834	all years.
	1982	1,480	1.95	2,883	1,801	
	1983	2,238	2.17	4,864	2,015	
	1984	2,238	1.08	2,417	1,747	
	1985	3,324	1.36	4,532	2,007	
	1986	5,989	1.04	6,199	2,063	
	1987	5,912	1.43	8,425	2,115	
	1988	5,912	0.93	5,498	1,235	
	1989	655	1.17	766	2,594	
	1990	519	2.33	1,207	1,735	
	1991	466	1.52	706	1,913	
	1992	405	1.74	705	2,058	
Sacramento	1980	631	1.20	757	820	Unspecified for
	1981	1,300	1.50	1,950	800	all years.
	1982	1,430	2.10	3,000	940	
	1983	1,350	1.80	2,430	1,400	
	1984	1,770	1.50	2,660	1,198	
	1985	1,680	0.90	1,510	1,200	
	1986	1,220	0.90	1,100	1,200	
	1987	1,360	1.00	1,360	1,200	
	1988	1,390	0.90	1,250	1,300	
	1989	700	0.80	560	1,300	
	1990	820	1.00	820	1,200	
	1991	750	0.90	675	1,200	
	1992	800	1.00	800	1,400	
Yolo	1980	835	0.84	700	1,024	Unspecified for
	1981	1,036	0.72	746	1,056	all years.
	1982	1,060	0.47	498	1,305	No data were
	1983	1,474	0.46	678	1,170	available for
	1984	1,535	0.75	1,151	1,215	1992.
	1985	907	1.17	1,063	990	
	1986	990	0.87	865	1,135	
	1987	785	1.24	973	1,174	
	1988	660	1.59	1,050	1,300	
	1989	575	1.04	598	1,212	
	1990	585	1.19	696	1,059	
	1991	210	0.85	179	1,101	

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