# Celery: 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

June 9, 1994

Contributors: Diane Bertelson (202) 219-0883
Robert Dismukes (202) 219-0840
Joy Harwood (202) 219-0840
Fred Hoff (202) 219-0883
Hyunok Lee (916) 752-3508
Agapi Somwaru (202) 219-0812
Glenn Zepp, coordinator (202) 219-0883

## Table of Contents

## Executive Summary

Celery is grown year-round in the United States, with California and Florida producing 90 percent of the total output in 1993. Other states reporting commercial celery production are Michigan, New York, Ohio, and Texas. The total value of the U.S. celery crop was $285 million in 1993.

While U.S. celery production has risen about 15 percent between 1970 and 1993, domestic per capita use has been fairly steady. Exports have more than doubled in the past 20 years and accounted for about 14 percent of U.S. production in 1993. Most exports go to Canada. Imports account for only a small share of U.S. consumption, about 2 percent in 1993.

Most U.S. celery is sold in the fresh market, but a portion is processed for use in prepared foods such as soups, juices, and convenience dinners. Celery must be harvested within a few days after reaching marketable sizes or its quality deteriorates. Growers schedule plantings so as to have a uniform quantity of celery reaching marketable size each week. The quantity available can vary substantially, however, depending upon the actual amount reaching maturity. Unexpected weather, especially high or low temperatures, can speedup or slowdown the rate at which celery matures.

Celery prefers a long, cool growing season, especially cool nights, and an abundant uniform supply of moisture, usually provided by irrigation. The best monthly average growing temperature is 60-70 degrees, and the maximum monthly average is 70-75 degrees. Temperatures above 70-75 degrees, especially in the month preceding harvest, reduces vegetative growth and quality. Average temperatures below 40-55 degrees for several days when plants are young can induce premature seeding (bolting) later as the plants approach marketable size.

Because of the temperature requirements, commercial celery production is limited during the winter to California, Florida, and south Texas. Most summer production occurs in the coastal valleys of California, but parts of Michigan, New York, and Ohio also grow commercial summer crops.

Celery requires more frequent irrigation than most other vegetable crops because of its shallow root system. Most celery in California is furrow irrigated, although sprinkler irrigation may be used during early growth to insure that transplants become established. Sprinkler irrigation is avoided when the crop approaches market maturity because it increases the hazard of late blight disease. During the growing season, irrigation is applied at 1-3 week intervals, depending on the stage of plant development and the weather. The crop is irrigated more frequently as harvesttime approaches.

The natural perils that are most likely to result in yield losses vary from area to area and depend partly on the time of year that the production and harvest activities are occurring. The greatest perils during the winter are freeze damage and excessive moisture. Other natural hazards in celery production are hail, insect and disease damage, and physiological disorders.

Celery is a cold hardy plant and light frosts do little or no damage to the mature crop. Hard freezes, however, can cause severe economic losses. A freeze in Florida in late December 1989 damaged or destroyed much of the celery planted at the time. Celery shipments dropped sharply during January, but recovered to normal levels by the end of February. The freeze played a key role in Florida's average yield for the 1989/90 season dropping 13 percent from the year before. Freezing temperatures destroy some celery in Michigan almost every fall, but the economic loss is usually minimal because most of the crop is harvested by the time the first hard freeze occurs.

Too much rain causes wet fields that can lead to crop losses from a build up of root-borne disease and physiological disorders. Excessive moisture can also result in poor quality due to over-maturity if wet fields prevent the grower from harvesting. The harvest window for rapidly growing celery extends for only 6-8 days, after which the plants become pithy and marketable yield declines.

Contacts in virtually all celery production areas cited market risks as the celery grower's greatest peril. Growers, they report, can manage insect and disease risks by following prudent pest management practices and can generally deal with weather-related losses because usually only part of the season's crop is damaged by natural perils.

Historical ad hoc disaster payments for celery provide an indication of high-loss areas and may indicate areas that would face relatively high risk under a FCIC celery policy. Disaster assistance payments for celery totalled $1.2 million between 1988 and 1993. Payments for celery peaked at $363,000 in 1989, and were over $150,000 in each of the years 1990, 1991, and 1993. Ad hoc payments made for celery accounted for far less than 1 percent of the total payments made for specialty crops over the 1988-93 period.

Ad hoc disaster payments for celery were scattered over a geographically broad area. Fifteen states received payments in at least one of the 6 years. Michigan collected payments for celery losses in all years. New York collected payments in all years except 1989. California, with about 63 percent of harvested U.S. celery acreage, received only 5 percent of celery disaster payments. In contrast, Michigan, with about 8 percent of U.S. celery acreage, received 73 percent of celery disaster payments.

A major issue with celery is the question of how to insure an extended-season crop for which yields, risks, perils, and expected market prices may differ for different parts of the season. Growers with extended seasons may be reluctant to purchase crop insurance which only guarantees season-average yields because the severity of losses during an interval within the season can be concealed by averaging over the season. One method for dealing with this extended-season problem would be to define distinct planting periods for intervals having similar yield expectations and production risks, and establish different premium rates for each period.

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

## Introduction

Celery was first produced commercially in the United States in Kalamazoo, Michigan in the late 1800's (Berger et. al., Rose). From Michigan, commercial production spread to Florida and later to California. Today, six states account for most of the commercially grown celery in the United States (Table 1).

Celery is grown year-round in the United States, with California and Florida producing 90 percent of total output in 1993 (USDA, NASS). Other states reporting commercial celery production are Michigan, New York, Ohio, and Texas. The Census of Agriculture reported a small celery acreage in several other states in 1987. The total U.S. value of the 1993 celery crop was $285 million.

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

## The Celery Market

### Supply

U.S. celery production rose 15 percent between 1970 and 1993, from 1,581 million pounds to 1,821 million (Table 2). Exports rose from 93 million pounds in 1970 to 255 million in 1993. Fourteen percent of U.S. celery production was exported in 1993, mostly to Canada. Celery imports, also, have increased since 1970. Although the percentage increase in celery imports during this period is rather impressive, imports accounted for only about 3 percent of domestic consumption in 1993. Most imports are from Mexico, Canada, and Guatemala.

Most U.S. celery is sold in the fresh market, but a portion is processed for use in prepared foods such as soups, juices, and convenience dinners. The proportion of the total supply used for processing may be increasing with the increase in popularity of frozen convenience foods.

A small amount of celery is marketed as fresh processed (diced celery and pre-cut celery sticks) which may be packaged for either the institutional or retail trade.

Celery must be harvested within a relatively few days after reaching marketable size or it will have to be abandoned because its quality deteriorates. Consequently, growers schedule plantings so as to have a uniform quantity of celery reaching marketable size each week.

Table 1--Celery acreage, production, yield, and value by state, 1991-93

| State | 1991 | 1992 | 1993 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|---|
| | Planted acres | | | Harvested acres | | |
| California | 21,400 | 21,400 | 21,000 | 20,900 | 20,800 | 21,000 |
| Florida | 8,200 | 8,000 | 7,400 | 7,400 | 7,600 | 7,100 |
| Michigan | 3,100 | 2,800 | 2,800 | 2,900 | 2,700 | 2,700 |
| New York | 380 | 320 | 230 | 380 | 300 | 220 |
| Ohio | 350 | 200 | 200 | 330 | 180 | 200 |
| Texas | 1,100 | 1,400 | 1,200 | 1,100 | 1,300 | 1,100 |
| U.S. | 34,530 | 34,120 | 32,830 | 33,010 | 32,880 | 32,230 |
| | Yield | | | Production | | |
| | cwt | | | 1,000 cwt | | |
| California | 670 | 670 | 640 | 14,003 | 13,940 | 13,440 |
| Florida | 385 | 415 | 405 | 2,849 | 3,154 | 2,876 |
| Michigan | 420 | 460 | 420 | 1,218 | 1,242 | 1,134 |
| New York | 460 | 450 | 300 | 175 | 135 | 66 |
| Ohio | 440 | 310 | 450 | 145 | 56 | 90 |
| Texas | 635 | 550 | 550 | 699 | 715 | 605 |
| U.S. | 578 | 585 | 563 | 19,089 | 19,242 | 18,211 |
| | Value | | | Total value | | |
| | $/cwt | | | 1,000 dollars | | |
| California | 10.30 | 12.10 | 14.60 | 143,739 | 168,575 | 195,874 |
| Florida | 13.20 | 12.40 | 20.40 | 37,607 | 39,110 | 58,670 |
| Michigan | 10.30 | 14.10 | 12.40 | 12,515 | 17,547 | 14,014 |
| New York | 16.80 | 40.30 | 36.90 | 2,940 | 5,441 | 2,435 |
| Ohio | 10.20 | 13.50 | 12.10 | 1,479 | 756 | 1,089 |
| Texas | 10.60 | 7.50 | 20.60 | 7,409 | 5,363 | 12,463 |
| U.S. | 10.80 | 12.30 | 15.60 | 205,689 | 236,792 | 284,545 |

Source: USDA, NASS.

Table 2--U.S. fresh celery: Supply, utilization, and price, farm weight, 1970-93

| Year | Supply | | | Utilization | | | Season average price 3/ | |
|---|---|---|---|---|---|---|---|---|
| | Production 1/ | Imports 2/ | Total | Exports 2/ | Total | Per capita use | Current dollars 1/ | Constant 1987 dollars |
| | Million pounds | | | | | Pounds | $/cwt | |
| 1970 | 1,581.1 | 1.7 | 1,582.8 | 92.8 | 1,490.0 | 7.3 | 5.67 | 16.15 |
| 1971 | 1,618.4 | 0.7 | 1,619.1 | 109.0 | 1,510.1 | 7.3 | 4.98 | 13.46 |
| 1972 | 1,612.5 | 2.0 | 1,614.5 | 117.4 | 1,497.1 | 7.1 | 6.76 | 17.38 |
| 1973 | 1,713.4 | 0.9 | 1,714.3 | 111.2 | 1,603.1 | 7.6 | 6.16 | 14.92 |
| 1974 | 1,675.6 | 0.7 | 1,676.3 | 104.1 | 1,572.2 | 7.4 | 5.82 | 12.96 |
| 1975 | 1,615.4 | 1.2 | 1,616.6 | 116.8 | 1,499.7 | 6.9 | 7.72 | 15.69 |
| 1976 | 1,725.4 | 1.2 | 1,726.7 | 122.0 | 1,604.6 | 7.4 | 8.10 | 15.49 |
| 1977 | 1,690.4 | 1.3 | 1,691.7 | 140.0 | 1,551.7 | 7.0 | 8.71 | 15.58 |
| 1978 | 1,755.7 | 5.5 | 1,761.3 | 169.6 | 1,591.6 | 7.2 | 12.30 | 20.40 |
| 1979 | 1,796.8 | 4.7 | 1,801.5 | 183.3 | 1,618.2 | 7.2 | 9.33 | 14.22 |
| 1980 | 1,904.2 | 4.9 | 1,909.0 | 196.5 | 1,712.6 | 7.5 | 9.11 | 12.71 |
| 1981 | 1,901.4 | 7.4 | 1,908.8 | 200.3 | 1,708.5 | 7.4 | 10.80 | 13.69 |
| 1982 | 1,953.6 | 10.2 | 1,963.8 | 203.1 | 1,760.7 | 7.6 | 10.20 | 12.17 |
| 1983 | 1,866.6 | 10.4 | 1,877.0 | 198.6 | 1,678.4 | 7.2 | 13.70 | 15.71 |
| 1984 | 1,914.6 | 7.2 | 1,921.8 | 201.3 | 1,720.5 | 7.3 | 12.20 | 13.41 |
| 1985 | 1,872.9 | 12.8 | 1,885.7 | 207.0 | 1,678.7 | 7.0 | 10.30 | 10.91 |
| 1986 | 1,797.9 | 15.0 | 1,812.9 | 213.9 | 1,599.0 | 6.6 | 12.00 | 12.38 |
| 1987 | 1,811.7 | 27.4 | 1,839.1 | 211.2 | 1,628.0 | 6.7 | 11.10 | 11.10 |
| 1988 | 1,961.7 | 32.5 | 1,994.2 | 222.2 | 1,772.0 | 7.2 | 11.90 | 11.45 |
| 1989 | 2,027.6 | 43.0 | 2,070.6 | 221.9 | 1,848.7 | 7.5 | 13.20 | 12.17 |
| 1990 | 1,981.6 | 40.7 | 2,022.3 | 222.7 | 1,799.5 | 7.2 | 10.80 | 9.53 |
| 1991 | 1,908.9 | 42.9 | 1,951.8 | 245.1 | 1,706.7 | 6.8 | 10.80 | 9.18 |
| 1992 | 1,924.2 | 32.7 | 1,956.9 | 256.6 | 1,700.3 | 6.7 | 12.30 | 10.16 |
| 1993 | 1,821.1 | 38.3 | 1,859.4 | 255.2 | 1,604.2 | 6.2 | 15.60 | 12.56 |
| 1994f | 1,885.0 | 38.0 | 1,923.0 | 260.0 | 1,663.0 | 6.4 | --- | --- |

--- = Not available. f = forecast.

1/ Source: USDA, National Agricultural Statistics Service. Production was adjusted by ERS for 1970-81 to account for States not included in NASS estimates. 2/ Source: U.S. Dept. of Commerce, Bureau of the Census. From 1978-89, exports were adjusted using Canadian import data. 3/ Constant dollar prices were calculated using the GDP implicit price deflator, 1987=100.

A fundamental characteristic of celery supply is that the quantity available for sale can vary substantially from week-to-week depending on the amount reaching maturity. Unusual weather conditions, especially unusually high or low average temperatures, can speedup or slowdown the rate at which celery matures and thereby disrupt growers' plans for a uniform supply. Celery matures slowly if weather is unusually cool during the growing period, resulting in a temporary short-fall in planned supply. When temperatures during the growing period are warmer than usual, celery matures ahead of schedule resulting in actual availability exceeding planned supply. Excessive periods of rain also may disrupt growing operations in some areas, causing supplies to deviate from planned output.

**Demand**

Per capita use of celery in all forms, including fresh and processed, remained relatively flat between 1970 and 1992 at around 7 pounds, although it is estimated closer to 6 pounds in 1993 (Table 2). The major varieties of celery can be sold for either fresh market or processing which adds, in some cases, to the marketing flexibility of the crop.

Raw celery is used as a salad ingredient or as an appetizer. When cooked, celery can be served as a main vegetable dish or, more often, as part of a mixed vegetable dish. Celery is also frequently used as a flavoring in soups, stews, and, particularly, in turkey stuffing. Celery leaves can be dried and used as an herb, as can celery seed (Sackett). Due to its unique flavor and texture, celery does not have any close substitutes.

Because many users view celery as a vital accompaniment in cooking or in salads and are reluctant to use substitutes, they are slow to alter the quantity demanded when price changes. As a result, a given change in price is associated with a less-than proportional change in the quantity demanded. Conversely, a larger-than-proportional change in price is associated with a given change in the quantity supplied. This characteristic is referred to as an inelastic demand. One statistical study of the relationship between farm-level prices for fresh vegetables as a group and farm quantities show price rising (falling) 2.2 to 2.3 percent for each one percent decline (increase) in quantity (Wohlgenant). For celery, the percentage change in price associated with a one-percent change in quantity is likely even greater than for fresh vegetables as a group.

**Prices**

Highly variable prices are a direct consequence of the inelastic demand and the variable supply of celery. Figure 1 show that celery prices may vary substantially from month to month. The average f.o.b. price, for example, rose from $4.25 per crate during February 1992 to $20.68 during February 1993 (Table 3).

Although there is no strong seasonal pattern to price variations, celery prices tend to peak during January and again during April and May. The January peak may be due to the transition in California harvests from the

Table 3--Celery: U.S. f.o.b. prices, monthly averages, 1989-93

| Month | 1989 | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|
| | ----------$/crate[1]---------- | | | | |
| January | 7.88 | 11.99 | 8.13 | 4.38 | 13.42 |
| February | 8.44 | 8.53 | 8.12 | 4.25 | 20.68 |
| March | 4.94 | 3.83 | 4.94 | 5.77 | 15.47 |
| April | 9.27 | 4.25 | 7.08 | 8.73 | 9.08 |
| May | 13.67 | 8.70 | 12.09 | 9.03 | 9.56 |
| June | 9.95 | 5.38 | 8.20 | 7.50 | 5.15 |
| July | 11.21 | 5.27 | 8.96 | 6.79 | 6.25 |
| August | 7.81 | 4.52 | 3.91 | 7.18 | 6.35 |
| September | 4.96 | 5.43 | 4.58 | 8.28 | 7.93 |
| October | 6.14 | 6.54 | 4.74 | 7.38 | 8.16 |
| November | 7.83 | 8.53 | 6.15 | 7.48 | 6.53 |
| December | 6.61 | 6.59 | 4.92 | 8.86 | 7.82 |
| Season | 8.23 | 6.63 | 6.82 | 7.14 | 9.70 |

[1]Monthly average for California, Florida, and Michigan. Sixty-pound crate, 2-1/2 dozen size.

Source: USDA, AMS.

northern to southern areas. Transition periods sometime result in price peaks when shipments from one area decline before those from another area reach full volume. The April-May peak may be due to the southern California harvest winding down before the northern areas reach full volume.

## Industry Characteristics

Some characteristics of the celery industry that are likely to affect the demand for crop insurance are: 1) the extent of diversification between celery and other farm enterprises, 2) the amount of diversification between farm income and off-farm employment, 3) the extent to which growers manage risk by harvesting and marketing celery over an extended season, and 4) the use of irrigation as a protection against drought and early spring frosts. The primary source of available information on industry characteristics is the 1987 Census of Agriculture.

### Celery Farms

The U.S. Census of Agriculture reported 377 farms with sales of celery in 1987 (Appendix table 1). Forty percent of the farms and 62 percent of the harvested acreage was in California. Florida, Michigan, and Texas also reported substantial celery acreage in 1987.

The majority of farms growing celery in 1987 were relatively large operations; 66 percent had sales of $100,000 or more (Appendix table 2). In California, 75 percent of the farms with celery reported having crop sales of $500,000 or more. Only 14 operations reported sales of less than $100,000 in that state. In Florida, all ten of the farms with celery reported having sales of $500,000 or more.

In terms of organizational structure, individual or family ownership was the most frequent type of arrangement among farms with celery in 1987 (Appendix table 3). Partnerships or a corporate arrangement (either family held or other) were more common among the larger farms than among the smaller ones. Forty-nine percent of the farms growing celery and with sales of $500,000 or more reported a corporate-type organizational structure.

Ninety percent of the farm operators growing celery in 1987 reported that farming was their main occupation (Appendix table 4). Only 96 of the 377 farms reported an operator working off the farm at least 1 day.

### Income Diversification on Celery Farms

Diversification enhances celery producers' ability to manage risk. The more diversified producers are between celery and other enterprises, the greater their ability to recover from a loss of celery income with returns from other crops. Celery growers in the major producing areas also manage risk by marketing their crop over an extended season. This provides the opportunity to recoup losses of part of the crop with returns from the remainder of the crop.

Market sales for celery growers are substantially diversified among celery and other crops, especially with other vegetable crops. Of the $681 million in market sales reported by the Census of Agriculture for farms growing celery in 1987, $621 million were sales from vegetable crops including celery (Table 4). The USDA's Crop Reporting Board estimated the value of celery production at $198 million in 1987, which is about 29 percent of sales reported by the Census for farms with celery.[1]

Celery and vegetable acreage reported by growers in a 1992 survey of chemical use on vegetable farms in 10 states corroborates Census statistics that celery producers diversify among celery and other vegetable crops (Table 5). In California, for example, 100 percent (55 of the 55 farms) reporting celery also planted other vegetables, and celery accounted for only 12 percent of the total vegetable acreage on those farms.

The variety of crops grown by farms producing celery may indicate celery growers' familiarity with crop insurance. According to the Vegetable Chemical Use Survey, 20 percent of California farms growing celery also grew fresh tomatoes, a currently insurable vegetable crop, and 11 percent grew processed tomatoes (Table 6). FCIC data show a participation rate of just 1 percent for fresh tomatoes in California, but 22 percent for processed tomatoes (Table 7). However, it is unknown how many tomato or other insured producers also grow celery.

The practice by celery producers, especially in California and Florida, of scheduling planting and harvesting over a period of weeks or months acts as a form of risk management. Insurable events, such as floods, freezes, excess rain, and high winds, usually destroy only that part of the crop in the field at the point in time when the event occurs. Losses, consequently, may represent only a small part of the growers' expected sales for the year.

Almost all U.S. celery is grown on irrigated land. The Census of Agriculture indicated that all of the acreage in California, Florida, Ohio, and Texas, and virtually all of the acreage in Michigan, was irrigated in 1987 (Appendix table 1).

## Cultivation and Management Practices

Celery is a member of the parsley family and is commonly classified as a petiole crop (Yamaguchi). It is naturally a biennial plant which produces only vegetative growth (including the edible stalk or petiole) the first year. Celery is harvested during the first year of growth, about 90 days after transplanting. If allowed to grow to the second year, the stem elongates, after a period of exposure to cold temperatures, to produce a shrubby plant and a seed head.

---

[1] Although the Crop Reporting Board does not include celery in all the states reported by the Census of Agriculture, its coverage of commercial production is virtually the same as the Census because the amount omitted in the non-included states is so small as to have a negligible effect on the U.S. total.

Table 4--Market value of sales on farms producing celery, 1987

| State | Farms | Value of sales | | | |
|---|---|---|---|---|---|
| | | All products | All Crops | Vegetables & melons | Celery[1] |
| | | Million dollars | | | |
| California | 151 | 438 | 438 | 411 | 136 |
| Florida | 10 | 105 | 105 | 81 | 43 |
| Michigan | 56 | 17 | 17 | 16 | 13 |
| Ohio | 8 | 11 | NR | NR | 2 |
| Texas | 7 | 80 | 80 | 79 | NR |
| Other | 145 | 30 | NR | NR | NR |
| United States | 377 | 681 | 679 | 621 | 198 |

NR = not reported.
[1] NASS estimate from NASS *Vegetables* summary.

Sources: U.S. Dept. of Commerce, Census of Agriculture; celery sales from *Vegetables*, USDA, National Agricultural Statistics Service. The category "other" is computed as the U.S. total minus listed states.

Table 5--Enterprise diversification on farms growing celery, 1992

| State | Celery farms sampled | Celery farms with other vegetables | Celery acreage as share of total vegetable acreage |
|---|---|---|---|
| | Number | Percent | Percent |
| California | 55 | 100 | 12 |
| Florida | 6 | 100 | 38 |
| Michigan | 26 | 100 | 54 |
| New York | 5 | 100 | 29 |
| Texas | 2 | 100 | 22 |

Source: Vegetable Chemical Use Survey, 1992.

Table 6--Insurable crops on farms producing celery, 1992

| State | Farms sampled | Farms growing: Onions | Sweet Corn: Fresh | Sweet Corn: Processed | Tomatoes: Fresh | Tomatoes: Processed |
|---|---|---|---|---|---|---|
| | Number | Percent | | | | |
| California | 55 | 18 | 11 | 11 | 20 | 11 |
| Florida | 6 | 0 | 50 | 0 | 0 | 0 |
| Michigan | 26 | 50 | 8 | 4 | 4 | 0 |
| New York | 5 | 60 | 80 | 20 | 60 | 0 |
| Texas | 2 | 100 | 0 | 100 | 0 | 0 |

Source: USDA, Vegetable Chemical Use Survey, 1992.

Table 7--Crop insurance participation rates, 1992

| State | Onions | Sweet Corn: Fresh | Sweet Corn: Processed | Tomatoes: Fresh | Tomatoes: Processed |
|---|---|---|---|---|---|
| | Percent of insurable acres | | | | |
| California | -- | -- | -- | 1 | 22 |
| Florida | -- | 39 | -- | 15 | -- |
| Michigan | 9 | -- | -- | -- | 51 |
| New York | 19 | -- | 3 | -- | 10 |

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

**Climate**

Celery prefers a long, cool growing season, especially cool nights, and an abundant, uniform supply of moisture, usually provided for in commercial acreage by irrigation. The optimum monthly average growing temperature is 60° to 70°F, and the maximum monthly average is 70° to 75°F. Temperatures above 70° to 75°F, especially in the month preceding harvest, reduces vegetative growth and quality. Average temperatures below 40° to 55°F for several days when the plants are young can induce premature seeding (bolting) as plants approach harvestable size, in which the stem elongates and develops flower buds.

Celery's exacting temperature requirements limit commercial production during the winter to California, Florida, and south Texas. Most summer production occurs in the coastal valleys of California, but parts of Michigan, New York, and Ohio also grow commercial summer crops.

**Soil Requirements**

Celery can be grown commercially on loams, clay loams, and on peat or muck soils that are well drained. Large amounts of plant nutrients are needed for succulent, "string-free" quality celery. An acre of celery removes approximately 300 pounds of nitrogen (N), 70 pounds of phosphorous (P), and 60 pounds of potassium (K) from the soil. Depending upon the availability of nutrients in the soil, 200-400 pounds of N, 100 pounds of P and 160 pounds of K are applied to the crop. About half the N and all of the P and K are applied before or at the time of planting and the remainder is side-dressed during the growing period.

High soil moisture is necessary for succulent and tender stalks, especially during the last month of growth. About 30 inches of water are required to raise a quality crop of celery to maturity.

**Planting**

Celery may either be direct seeded in the field or transplanted when plants are about 4-6 inches in height (2-2½ months after seeding). Virtually all commercial production in the United States is transplanted. Growers prefer transplanting because: 1) the erratic germination behavior of celery makes seeding to stand highly risky and potentially unprofitable, and 2) lengthy exposure to cool temperatures during its juvenile stage may cause the celery plant to bolt (enter its second-year, seed-producing stage during the first year), thereby reducing or eliminating its commercial value. The longer celery is exposed to bolt-triggering temperatures the greater will be the number of plants affected by premature seeding.

Mechanical transplanters are used, unless fields are too wet and then transplanting is done by hand. Hand planting requires about 40 man-hours per acre in California. Whether the soil is dry or moist, transplanting is followed immediately by irrigation to assure survival of the young plants.

**Planting Dates**

Planting dates are usually used as reference time points in specifying insurance sign-up dates and policy closing dates. Growers usually plant celery over a period of months in order to have crop maturing for an extended marketing period (Table 8).

**Fertilization**

Although a complete fertilizer (nitrogen, phosphorus, and potassium) can be used for celery, nitrogen has the most pronounced effect on growth. In general, total amounts of nitrogen applied vary from 200 to 400 pounds in California where production is on mineral soils. Less nitrogen is needed in Florida because microbiological activity releases nitrogen from the decaying organic soil.

**Irrigation**

Celery requires more frequent irrigation than most other vegetable crops because of its shallow root system. Most celery in California is furrow irrigated, although sprinkler irrigation may be used during early growth to insure that the transplants become established. Sprinkler irrigation is avoided when the crop approaches market maturity, if possible, as it increases the hazard of late blight disease. During the growing season, irrigation is applied at 1-3 week intervals, depending on the stage of plant development and weather. The crop is irrigated more frequently as harvesttime approaches.

## Harvesting and Packing

Three principal systems are used for harvesting celery in the United States: 1) hand-cut and field-pack, 2) hand-cut with packing on mobile packingsheds called "mule trains," and 3) machine cutting and packinghouse packing. In the hand-cut and field-pack system workers cut, trim, and place the celery in shipping crates in the field. With the mule train system, workers hand cut the celery and place it on a conveyor belt which carries it to a self-propelled packingshed. The mule train moves through the field harvesting 10 to 12 rows at a time.

In mechanical cutting, one and two row harvesters cut off the tops and roots and then elevate the stalks into a wagon. They are then taken to a packinghouse where they are washed, trimmed to a uniform length (usually about 14 or 15 inches), the outer petioles removed, and packed in crates or cartons.

Celery is sized according to size of the stalk measured as dozens and half-dozens of stalks (1½ to 8 dozen) that fill a standard wirebound crate. Wirebound crates measure approximately 11 x 14½ x 19¾. Although the billing weight for crated celery is 60 pounds, packed crate weights may range from 55 to 75 pounds.

Table 8--Celery: Usual planting and harvest dates, by State

| State | Planting date[1] | Usual harvest date | | |
|---|---|---|---|---|
| | | Begin | Most active | End |
| California | See Table 11 | | | |
| Florida | Aug 1.-Apr. 15 | Oct 25 | Nov. 15-Jun. 1 | Jul. 10 |
| Michigan | Apr. 15-Jul. 31 | Jun. 25 | Jul. 10-Nov. 1 | Nov. 15 |
| Ohio | Mar. 25-Jul. 15 | Jun. 15 | Jul. 1-Oct. 31 | Nov. 15 |
| Texas | Aug. 1-Mar. 15 | Nov. 1 | Nov. 15-May 15 | Jun. 1 |

[1]Dates celery planted/transplanted in field.

Source: USDA, SRS.

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.

The outer petioles removed in the packinghouse may be cut into pieces and placed into bulk packages for sale to processors for use in soups, juices, and convenience dinners. Petioles removed in field packing fall to the ground and remain in the field.

Maintaining quality requires rapid removal of field heat from the packed celery. Most crate-packed celery is hydrocooled and most carton-packaged celery is vacuum cooled as soon as possible following harvest.

## Marketing

Most celery is grown for the fresh market, but a substantial amount also is processed for use in prepared foods such as soups, juices, and convenience dinners. Although official USDA celery statistics do not separate fresh and processing use, one recent study indicates that approximately 80 percent of total U.S. production is sold in the fresh market (Berger, et. al.).

The major varieties of celery can be sold for either fresh market or processing. This provides those growers having facilities for preparing celery for processing with some flexibility for deciding between the fresh and processing market near harvest time. The amount of flexibility is limited, however, because processors usually contract with packers for a certain tonnage and celery diverted from fresh use may exceed the contracted amount.

Producers in some cases pack their own celery and deliver it to a shipper who acts as the sales agent. In other cases, the grower contracts with a packer-shipper for packing services in a piece-rate agreement, or enters into a joint risk-sharing venture. A number of larger producers, however, act as their own shipper and sales agent. Practical storage is limited to just a few days due to celery's perishability.

The primary customers for fresh celery are chain stores and other retailer-wholesalers, terminal market brokers, wholesale handlers, and the military. Celery sold for processing is washed and cut into slices, stalks, or pieces before delivery to the processor. The major buyers generally have field people in the production areas monitoring quality and the availability of supplies.

The volume of shipments from California is the major factor determining celery prices in all the production areas. Prices in California are established through negotiations between chain store buyers and celery handlers based on current supplies and demand (Berger, et. al.). The buying and pricing activities of the buyers for the four to five leading national supermarket chains reportedly have a large influence on the price of celery in California. The majority of California's celery is produced by large-scale producer-handlers who appear to have substantial knowledge of the current market situation. There are a few small-scale marketing cooperatives in California, but they account for a relatively small share of the market.

Marketing cooperatives or exchanges coordinate celery marketing in Michigan and Florida. Marketing in Florida also is regulated by a Federal Marketing Order which provides for marketing allotments, minimum quality, and container requirements. In Michigan, celery sold under the Michigan Seal of Quality must meet or exceed the U.S. Extra No. 1 grade.

## Costs and Returns

Cost of production information is pertinent in assessing the feasibility of crop insurance because the timing of expenditures provides an indication of the magnitude of losses associated with an insurable event occurring at different stages in the growing cycle. Cost of production data also illustrate that the value of celery in the field is much less than its value at the first delivery point, a situation which can create the potential for moral hazard.

By the time celery is planted, growers have incurred a substantial amount of the preharvest expenses. Some of the preharvest expenses for operations such as pest control, supplemental fertilization, and other cultural practices, however, are incurred throughout the growing period and would not represent a sunk cost if an insurable event occurred before the crop reached the harvestable stage.

Harvesting and marketing expenses typically amount to over half of total production costs (Table 9), but these expenses usually are not incurred if an insurable loss occurs[2]. Consequently, FCIC may want to provide insurance protection only for expenses actually incurred. The in-field value of celery would not include the value of harvesting and marketing expenses.

## Production Perils

The natural perils that are most likely to result in yield losses vary from area to area and depend partly on the time of year that the production and harvesting activities are occurring. The greatest perils during the winter are freeze damage and excessive moisture. Other natural hazards in celery production are hail, insect and disease damage, and physiological disorders.

### Freeze

Celery is a cold hardy plant and light frosts do little or no damage to the mature crop. Hard freezes, however, can cause severe economic losses. A freeze in Florida in late December 1989 damaged or destroyed much of the celery planted at the time. Celery shipments dropped sharply during January, but recovered to normal levels by the end of February. The freeze played a

---

[2] Detailed cost of production estimates for celery in Monterey, Ventura, and Santa Barbara/San Luis Obispo counties in California are presented in Appendix table 6.

Table 9--Celery: State and county estimates of production costs and returns

| Item | California counties | | | Florida | Michigan |
|---|---|---|---|---|---|
| | Ventura (1990) | Monterey (1986) | Santa Barbara/ San Luis Obispo (1988-89) | Everglades area (1991) | Ottawa County (1990) |
| | ----------Cartons/acre---------- | | | | |
| Yield[1] | 1,000 | 1,000 | 1,175 | 630 | 750 |
| | ----------Dollars/acre---------- | | | | |
| Operating costs: | | | | | |
| Land preparation | 147 | 206 | 156 | 240 | 205 |
| Growing | 2,027 | 2,645 | 2,358 | 1,571 | 1,022 |
| Overhead[2] | 760 | 600 | 704 | 580 | 335 |
| Pre-harvest | 2,934 | 3,451 | 3,218 | 2,391 | 1,562 |
| Harvesting[3] | 4,160 | 4,250 | 4,089 | 1,903 | 2,596 |
| Total | 7,094 | 7,701 | 7,307 | 4,294 | 4,158 |
| ($/carton) | 7.09 | 7.70 | 6.21 | 6.82 | 5.54 |

[1] A carton weighs 60 pounds. [2] Includes land costs, interest on operating expenses, and office and business expenses. [3] Harvest rates per carton: California, $3.48; Florida, $3.02; Michigan, $3.46.

Source: Cooperative Extension Service budgets, selected states.

Note: Data may not exactly match that in Appendix table 6. Data in this table were summarized to gain the greatest consistency among area and state comparisons.

key role in Florida's average yield for the 1989-90 crop year dropping 13 percent from the year before.

Freezing temperatures destroy some celery in Michigan almost every fall, but the economic loss is usually minimal because most of the crop is harvested by the time the first hard freeze occurs.

**Excessive Rain**

Too much rain causes wet fields which can lead to crop losses from a build up of root-borne disease and physiological disorders. Excessive moisture can also result in poor quality due to over-maturity if wet fields prevent the grower from harvesting on a timely basis. The optimum harvest window for rapidly growing celery extends for only 6-8 days, after which the plants become pithy and the marketable yield declines. Pithiness in celery is a disorder that is usually a result of over-maturity and is often seen in fields that are not harvested at the optimum time.

**Hail**

Hail pits the celery stalk, creating scars and increasing the opportunity for disease organisms to enter the plant. Hail may damage the stalk at any age. Growers do not have any way of protecting against hail. Hail damage tends to be localized and losses can range from insignificant to damage to a grower's total crop.

**Extended Cold Weather**

Celery is a biennial which normally produces foliar growth the first year and seed stalks the second. However, celery plants may form seed stalks (bolt) the first year if exposed to temperatures below 55$^{o}$F for 7 days or longer (Zandstra, et. al.). Bolting destroys the commercial value of a celery stalk. The number of bolting plants increases as the duration of exposure to cold temperature increases. The cold effect accumulates in the plants, but sunshine and warm temperatures immediately after the cold exposure may reverse the effects of cold temperatures if the apical bud has not already differentiated into a flower bud. Some cultivars are more susceptible to bolting than others.

**Excessive Heat**

Celery plants will tolerate considerable heat after they are established in the field, but during the last month or so preceding harvest, temperatures should average no more than 60$^{o}$F to 70$^{o}$ F. Average temperatures above 70-75$^{o}$F during the month preceding harvest reduces vegetative growth and quality.

**Drought**

Celery is a shallow-rooted crop and is, therefore, very susceptible to drought. It requires 1 to 2 inches of water per week throughout the growing season to maintain optimum growth and should only be grown where irrigation is

available (Zandstra, et. al.). Hot, dry periods without water reduce growth and may induce a physiological disorder called blackheart.

**Wind**

Excessive wind can be a minor peril. Usually considered more a nuisance than a hazard, wind can blow light muck soil onto the celery stalks where it subsequently becomes caught between the petioles. Growers can usually deal with the dirty celery by extra washing at the time of packing.

**Insects**

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

**Diseases**

Celery is susceptible to a number of plant diseases. Diseases may be due to virus, fungi, bacteria, nematodes or nonpathogenic sources. Some are seed-borne and others are soil-borne. Some diseases are transmitted by insects or microorganisms, others are carried by the wind, irrigation water, or the movement of contaminated soil and equipment.

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

**Weeds**

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

**Nematodes**

Nematodes, small soil-borne plant parasites, are a serious problem in celery production. They attack celery roots, slowing growth of affected plants and reducing the size of mature stalks. Although several different plants host nematodes, rotating crops helps reduce infestation. In Florida, the principal method for control is pre-plant flooding.

**Physiological Disorders**

A number of physiological disorders can reduce the commercial value of celery. Most of these are traceable to nutritional deficiencies or imbalances. Certain environmental factors, however, also may contribute to physiological disorder losses. Practically all losses occur during the last three weeks of the approximately 90 day field growing period. Controls must be preventative, not curative (Guzman, et. al.).

## State Analyses

Although there are similarities among production areas in the way celery is grown, each area requires some unique production practices and confronts a unique set of perils. The following sections analyze the production practices and perils specific to the major celery-growing regions, and that pertain to the feasibility of offering crop insurance.

### California

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

#### Celery Production in California

California contributed 72 percent of the nation's celery output in 1992, producing over 0.8 million tons of celery from 25,000 harvested acres and generating $178 million in revenue (Table 10).[3] Celery ranked eighth in value among the 26 principal vegetables grown in the state, and 28th in value among all agricultural commodities. Production increased 37 percent between 1980 and 1992, due to increases in harvested acreage and per acre yield (Table 10).

#### Production Regions

Ventura, Monterey and Santa Barbara counties are the major celery counties, producing a combined total of 87 percent of California's output in 1992. Ventura produced 43 percent; Monterey, 33 percent; and Santa Barbara, 11 percent. The remainder of California's celery is grown in San Luis Obispo (5%), Orange (2.5%), San Benito (2%), and Santa Cruz (1%) counties, and in localized areas in Santa Clara, Riverside, and San Diego counties (1%).

---

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

Table 10--Historical celery production in California

| Year | Harvested Acreage | Yield/Acre | Production | Value |
|---|---|---|---|---|
| | | ---tons--- | ---tons--- | ---$/ton--- |
| 1980 | 22,283 | 27.06 | 602,873 | 172 |
| 1981 | 21,741 | 28.54 | 620,417 | 217 |
| 1982 | 23,274 | 28.61 | 665,829 | 196 |
| 1983 | 21,206 | 26.50 | 562,009 | 251 |
| 1984 | 22,550 | 28.12 | 634,180 | 237 |
| 1985 | 21,761 | 29.14 | 634,172 | 182 |
| 1986 | 21,837 | 31.20 | 681,251 | 210 |
| 1987 | 21,257 | 32.64 | 693,806 | 212 |
| 1988 | 20,396 | 31.95 | 636,958 | 232 |
| 1989 | 22,941 | 31.20 | 705,131 | 233 |
| 1990 | 24,580 | 31.53 | 775,034 | 227 |
| 1991 | 23,803 | 31.94 | 760,303 | 198 |
| 1992 | 25,286 | 30.95 | 824,266 | 216 |

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

Production increased in all counties (except for San Diego county) between 1980 and 1992 (Appendix table 5). Rising yields, in general, contributed more to the increase in production than growth in acreage.

Because of their favorable geography and climate, the Oxnard district (Ventura county) and the Salinas Valley (Monterey county) are the two most important celery growing regions. The climate of the Oxnard plain is unique in its mildness throughout the year and in its Mediterranean rainfall pattern. Almost no rain occurs from the middle of April to the middle of October, and irrigation is necessary. The hazard of losing a crop during this period because of adverse weather is quite low. Although the area provides temperatures suitable for year-round production, there is a risk of celery stalks bolting in the spring attributable to the low temperatures during late December, January, and February when the plants are young (Brendler).

The Salinas Valley, with large areas of highly productive alluvial soil, is bounded by the Santa Lucia Mountain Range on the west and the Gabilan Range on the east. The northern end of the Valley opens to the sea at Monterey Bay. The prevailing winds during the summer are from the ocean, producing cool weather and fog. This unique geophysical setting provides the Valley with an almost ideal climate for summer production of cool-season vegetable crops which require cool temperatures at night. Precipitation is inadequate for intense crop production, consequently crops are irrigated. Virtually all of the irrigation water is pumped from aquifers, which are recharged from the flow of the Salinas River.

Planting and Harvesting Dates

Celery is produced year-round in California in one production region or another (Table 11). Growers plant (or transplant) on a precise schedule to have celery maturing each week for a continuous flow of product to market. Planting and harvest dates are, however, limited in each celery growing area by climatic restrictions and by regional legal restrictions designed to control the western celery mosaic disease.

Celery-Free Periods

To control the western celery mosaic disease, celery-free periods during which no celery can be grown have been established in some of the coastal regions. The celery-free periods are: from July 15 to August 4 in Los Angeles county; January 1 to February 14 in San Luis Obispo county; January 1 to January 31 in Monterey county; and July 15 to August 4 in Ventura county. The celery-free period regulation is enforced by the County Agricultural Commissioner.

Production Perils

Weather. While weather is key for celery growing, the probability of extremely cold weather, which would seriously damage the crop, is low during the time celery is grown. The most serious threat from weather is that an extended cold spell when plants are young can induce bolting (premature seeding), which lowers or destroys the commercial value of the mature plant.

Table 11--Dates for celery planting and harvesting in California

| Harvest season | Planting dates | Harvest dates | | | Areas/ Counties[1] |
|---|---|---|---|---|---|
| | | Begin | Peak | End | |
| Winter | Aug.-Nov. | Dec.1 | Jan.-Mar. | Mar. 31 | SOUTH COAST: Orange, San Diego, Ventura |
| Spring | Nov.-Mar. | Apr.1 | May.-Jun. | Jun. 30 | SOUTH COAST: Orange, Ventura<br><br>CENTRAL COAST: Santa Barbara, Monterey, San Luis Obispo |
| Summer | Apr.-Jun. | Jul.1 | Jul.-Aug. | Sep. 30 | CENTRAL COAST: Monterey, Santa Barbara, San Luis Obispo, Santa Cruz, Santa Clara |
| Fall | Jul.-Sep. | Oct.1 | Nov.-Dec. | Dec. 31 | CENTRAL COAST: Monterey, Santa Barbara, San Luis Obispo<br><br>SOUTH COAST: Ventura, San Diego, Orange |

[1] Celery is produced almost entirely in the Oxnard district in Ventura county, the Oceano district in San Luis Obispo county, the Santa Maria-Guadalupe district in Santa Barbara county, and the Salinas-Watsonville district in Monterey and Santa Cruz counties.

Source: Sims, et al.

Bolting is a potential problem in any California celery crop which matures from mid-March through late June. Unusually cool and damp weather is also a concern because it favors the development of late blight disease, which can cause considerable production loss.

Other natural perils in growing celery are drought, wind, unusually warm or cold weather, hail, and flood. Earthquakes may also be included as a production peril. Losses from earthquake could occur due to damage to water distribution systems or roads and bridges that prevented irrigating or field access at critical times.

In general, direct losses from perils such as drought, wind, unusually warm weather, hail, flood, and earthquake are rare in California and growers do not perceive them as serious risks in celery production. Furthermore, unlike field crops, the season for celery is spread over several months and the loss of part of the crop can be offset by returns during the remainder of the season.

Diseases. Among the celery diseases affecting California celery, late blight, celery mosaic, and fusarium yellows are considered to be the most serious. Generally, growers in California can prevent or control diseases by systematically resorting to seed treatment, seedbed/field sanitation, and field application of fungicides. The following are the more serious disease perils in growing celery in California:

Late Blight-also known as "Septoria Leaf spot," is caused by a fungus, Septoria appiicola. Late blight is the most common disease and probably the most economically damaging among all celery diseases (Brendler). The disease's development is favored by cool, moist weather and is prevalent on fall, winter, and early spring crops. Splashing water from rainfall, overhead sprinklers, or moving equipment may spread the disease. The fungus may live in infected celery for as long as 18 months. Since the fungus is seed-borne, nursery treatments or, most effectively, the use of pathogen-free seed is the best way to control the disease. A hot-water seed treatment is commonly used to reduce the incidence of late blight in celery.

Fusarium yellows-is caused by a soil borne fungus, Fusarium oxysporum f. apii. Symptoms are lagging growth and yellowing of foliage. The incidence of fusarium yellows is high in summer, but low in winter. The disease first appears in a circular location within a field. In subsequent years the affected area enlarges and the number of infected plants increases. Reoccurrence of the disease in the field within a few years is common. Once Fusarium yellows is found in a celery field it is advisable to discontinue growing celery in that field (Brendler). Some resistant varieties are available but do not ensure satisfactory control.

Celery mosaic-is a viral disease whose symptoms include clearing of the veins, mottling, and cupping of the leaflets. This is a highly destructive disease spread by aphids. To control celery mosaic, celery-free periods have been established in Los Angeles, Ventura, San Luis Obispo, and Monterey counties. Mosaic is much less serious in the interior valleys than in the coastal areas.

Pink rot-also known as Sclerotinia rot, is a fungal disease favored by cool, moist conditions. It commonly occurs in the late stages of development in the lower part of the stem. It is usually found in fields that have been over-watered. Control involves spraying fungicides on the lower portion of the celery and on surrounding soils 7-8 weeks before harvest.

Aster yellows-is spread by leafhoppers (mainly the six-spotted leafhopper). Control has been possible by controlling leafhopper vectors in some areas.

Early blight-similar to late blight, is also caused by fungus. Its development is favored by warm weather and high humidity. Early blight has not been a serious problem in California.

Insects. Although localized infestations may occur, insect and mite pests infrequently cause significant damage to celery in California. The following are some of the more significant of the insect pests in growing celery in California:

Leafminers-are present in all production areas. Celery is most susceptible to leafminer infestation during its first three weeks in the field. Infestation results in slow plant maturation and reduced yields. Control of leafminers has not been easy, in part because of its ability to rapidly develop resistance to insecticides (Brendler). Cultural prevention methods include use of resistant varieties, and proper selection of both field location and adjacent crops.

Cabbage loopers-are also present in all areas of production. During late fall, winter, and early spring, cool temperatures help most celery crops withstand early light looper feeding.

Beet armyworm-is present in all production areas. Due to the potential explosive nature of this insect, low populations can be tolerated only during the cooler planting seasons. Summer and fall harvest crops need close monitoring to assure that beet armyworm does not become established.

Nematodes-damage is rare during the cooler part of the year. However, fields with celery growing during the warmer season need to be fumigated if this pest is suspected (Brendler).

Production Costs

The Cooperative Extension Service of the University of California periodically estimates costs of production for representative celery farmers in leading producing areas in California. Sample production costs were $6.21 per carton in Santa Barbara/San Luis Obispo counties, $7.09 in Ventura county, and $7.70 in Monterey county (Table 9). Detailed estimates are presented in Appendix table 6.

Variable harvesting and marketing expenses account for more than half of the total production costs for celery, indicating their importance in growers' harvesting decisions. If, as occasionally happens, market prices are lower

than variable harvesting and marketing expenses at harvesttime, growers may minimize their losses by abandoning a portion of their crop.

Cost estimates generated by the California Celery Research Advisory Board from a cost of production survey in 1989 were in the same range as those developed by the Cooperative Extension Service. Using a yield assumption of 1,043 cartons per acre, for example, the Celery board's costs per carton ranged from $6.80-$8.90.

Irrigation Water Issues in California

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

Another important water issue relates to salt water intrusion in the Salinas Valley. Sea water has been creeping into the Salinas Valley aquifer for more than 50 years because of heavy use of groundwater for irrigation. Since the 1930's, 120 wells west of Salinas have been closed because of salt water problems. The rate of sea water encroachment increased during the last 5 years due to extended drought. Currently farmers in the Salinas Valley must operate with a mandatory ground water management plan which establishes upper pumping limits, mandated use of water meters, and ground water extraction fees.

Growers-Shipper Arrangements

Because celery is a perishable product, precise coordination is needed between growers and shippers to assure swift and timely harvesting and marketing (packing, shipping, and selling). California's celery industry is characterized by a relatively few, large, vertically-integrated firms which grow, harvest, pack, sell, and ship. These firms are referred to as grower-shippers and coordination is handled internally by such firms. These firms bear the full risk of yield losses.

In contrast, most small- or medium-size farms either grow celery for a shipper at a fixed rate (price) per acre or under an output-sharing arrangement. Farmers who grow for a shipper at a fixed rate receive their payment regardless of the eventual yield and the risks of price and yield variability are shifted to the packer-shipper. Although not very common, this type of contract provides the grower with an assured revenue and operating capital, since the payments are made during the growing season.

Farmers who grow for a shipper under an output-sharing arrangement share production and market risks with the packer-shipper. The extent of risk-

sharing under such contracts depends, of course, on the arrangements negotiated in each individual contract.

Demand for Crop Insurance for Celery

Crop insurance participation would likely be quite low among California celery growers, particularly with a policy that protected against yield loss alone. Growers perceive their major risk as being low market prices due to industry-wide overproduction. Yield perils in growing celery are considered relatively minimal. Even so, FCIC has received several requests for celery insurance from California. Perhaps a policy, such as a revenue insurance plan, that protected against low returns, regardless of whether it was due to low prices or production losses, would be of more interest to California celery growers.

Partly because of celery's shorter growing season, production perils are usually less of a risk in growing celery in California than for producing field crops. Losses due to hail, wind, excess rainfall, and extreme temperature are uncommon in California because the climate in the major celery growing areas is usually highly predictable. Drought is not a big risk in California celery production because of the use of irrigation. Further, growers can generally control losses from celery insects and disease through careful attention to pest control.

Celery growers in California are more concerned about excessive production and low prices than about yield losses. Excessive production results in market gluts which drive prices down and reduce total income. Celery growers as a group generally have higher incomes when there is an industry-wide production shortfall than when there is full production because higher market prices more than offset the smaller quantity.

**Florida**

Florida is constrained by its hot and humid summers to producing celery during the winter-spring market window. Although most of Florida's celery goes to the fresh market, some is used for processing.

The Florida Industry

Florida is the second-largest celery producing state, harvesting 7,100-7,600 acres annually during the past three years. The farm value of Florida's celery output was $59 million in 1993; Florida accounted for 16 percent of total U.S. celery production in that year (Table 1).

Most celery in Florida is grown on organic soils around the southern tip of Lake Okeechobee (Palm Beach county), known as the Everglades area, and near Zellwood in central Florida. A small acreage is grown in Sarasota county in west Florida. Planting and harvesting in the Zellwood area usually continues 2 weeks to a month longer than in the Everglades area.

According to the Florida Celery Committee, there were only 7 celery growers in Florida during the 1993/94 season, producing an estimated 5 million 60-pound

crates of celery (Florida Celery Committee). The 1987 Census of Agriculture reported 10 celery growers harvesting 8,078 acres.

Three or four growers produce about 90 percent of the celery grown in Florida. These producers grow a mix of vegetables and other crops. Several celery producers grow a large acreage of sugarcane. Most of the celery operations are vertically integrated in that they grow, pack, and sell their own celery.

Production Practices

Careful soil preparation is more important in Florida celery production than for most crops. After soils are plowed, disked and leveled, they are flooded to control nematodes, soil-borne disease, and insects. A schedule of 4 weeks of flooding, 2 of drying, and 4 of flooding is recommended. After flooding, the land is again plowed, disked, leveled, and mole-drained (a sub-soiling operation which facilitates sub-surface irrigation), and fertilized.

Celery plants in Florida are germinated in seed beds and transplanted to the field at 8 to 12 weeks of age (Guzman, et. al.). Seeding begins in June and continues to February. Transplanting begins by August 1 and continues into April.

A typical spacing is 24 inches between rows and 6-8 inches between plants within rows. Closer spacing can raise per acre yields, but disease incidence is more severe with closer spacing and quality may suffer.

Immediately following transplanting, the young celery plants are irrigated with overhead sprinklers, and water in lateral irrigation ditches is kept as high as possible to help them become established. After the plants recover from the shock of transplanting, the water level in the lateral ditches is lowered and irrigation is limited to sub-surface infiltration. The network of ditches and canals used to maintain the sub-surface irrigation water table also is used for rapid drainage after heavy rains. Excessive water damages the roots of the celery stalk and retards growth. All celery in Florida is grown on land on which the grower can regulate the sub-irrigation water table.

Celery in Florida reaches market maturity in about 90 days following transplanting. Plants may mature in as little as 80 days during the fall and late spring when the rate of growth is fastest. Maturity may require as much as 105 days during the winter because of the cooler temperatures.

Harvesting

Harvesting spans from November to the middle of July, but the most active period is from mid-December to June 1 (FASS).[4] Producers in the Everglades

---

As indicated in the note to Table 8, slight inconsistencies exist between NASS's *Usual Planting and Harvesting Dates* and extension specialists' indications.

area like to begin shipping in time to participate in the Thanksgiving market.

Both hand cutting and machine cutting systems for harvesting are common in Florida, and packing is done both in mobile packing sheds and in permanent packinghouses.

A large amount of Florida's celery (usually the 4-dozen and 6-dozen stalks-per-box, or smaller-sized) is pre-packaged in cellophane or polyethylene bags. This celery, called hearts, is thoroughly washed, stripped of suckers, leaves, and damaged petioles, cut to uniform lengths of 8-10 inches, and packaged with two or three "hearts" per bag.

Marketing

Celery in Florida is grown primarily for the fresh market and most is sold for fresh-market use. At least one producer, however, sells some celery for processing. That sold for processing contains the byproduct (trimmings) from the fresh market packing.

Marketing of celery in Florida is coordinated by the Florida Celery Exchange and a Federal Marketing Order (Kilmer). The Exchange, a sales cooperative whose members are celery growers and celery sales firms (shippers), assesses day-to-day supply and demand and sets the f.o.b. price. The Exchange sells all the celery produced in Florida.

The Marketing Order, which requires the compliance of all producers in the regulated area, specifies marketing allotments for each shipper based on past production, with provisions for new growers and expansion by established producers. These allotments act to limit the amount of celery produced to near the amount which the industry judges it can profitably market during the season. Shipping holidays (periods during which producers can not ship celery) can be decreed by the Marketing Order if celery markets experience a temporary glut.

Competition with California in the national celery market limits the ability of the Celery Exchange to raise prices to member growers by restricting supplies. California produces and markets celery year round and the quantities shipped from California significantly affect producer-shipper prices in Florida and vice versa. Any effort on the part of Florida producers to raise price by restricting marketings would result in higher prices for California producers and, eventually, larger supplies from California.

Prices

Prices are set by the Celery Exchange based on current supply and demand conditions. The amount of celery being shipped by handlers in California appears to be the major factor in determining prices in both Florida and Michigan.

Although the Federal Marketing Order fairly well matches seasonal supply with expected demand, short term market gluts can develop due to abnormal weather

or demand conditions. Under such situations, growers may not harvest a portion of their current supply or they may divert additional celery to processing. Usually less that 10 percent of the planted celery acreage remains unharvested for various reasons.

Production Perils

Excessive rainfall, severe cold, and hail damage are the major natural perils to celery production in Florida. Wind damage was identified as a minor nuisance, while drought has not been a problem because sufficient water has always been available for irrigation (Schueneman, Talbott). Insects, diseases, nematodes, physiological disorders, and weeds generally are viewed as production problems which growers can control with proper management practices.

Excessive rainfall. Too much rain causes wet fields which can lead to a buildup of root-borne disease and crop losses. Excessive moisture can result in poor quality in mature celery if the grower can not get into the field to harvest on a timely basis. Excessive rains may occur several times during the year causing variable damage, depending on the celery stalk's stage of development.

Extreme low temperatures. Celery is a cold hardy plant and light frosts do little or no damage to the crop. The Florida Everglades area typically experiences three such frosts a year.

Hard freezes, however, can cause severe economic losses. A freeze in late December 1989 damaged or destroyed much of the celery planted at the time. Celery shipments dropped sharply during January, but recovered to normal levels by the end of February. The freeze played a key role in Florida's average yield for the 1989-90 crop year dropping 13 percent from the year before.

Hail. Growers in Florida experience some hail damage almost every year. Hail pits the celery stalk, creating scars and increasing the opportunity for disease organisms to enter the plant. Hail may damage the stalk at any age. Growers do not have any way of protecting against hail. Hail damage tends to be localized and only a few hundred acres out of the 7,000-8,000 grown in Florida are damaged each year. Losses can range from insignificant to damage to a grower's total crop.

Wind damage. Excessive wind is a minor peril, considered more a nuisance than a hazard. The wind blows the light muck soil onto the celery stalks where it subsequently becomes caught between the petioles. Growers can usually deal with the dirty celery by extra washing at the time of packing.

Drought. Drought has not been a problem for celery production in Florida as sufficient water has been available to provide sub-surface irrigation.

Insects. Wireworms, mole crickets, cutworms, other caterpillars, serpentine leafminers, and aphids are insects that may damage celery in Florida. Damage

from garden fleahoppers, flea beetles, and red spider mites occur only occasionally. Control requires an integrated program of sanitation measures, weed control, pre-plant flooding, and chemical treatment (Guzman, et. al.).

**Michigan**

Michigan is the third largest celery producing state, harvesting between 2,700-2,900 acres annually during the past three years. The farm value of Michigan's celery output in 1993 was $14 million, and Michigan's output accounted for 6 percent of U.S. celery production in that year (Table 1).

The largest acreage of celery in Michigan is in the southwest part of the State, but substantial acreage also is reported in other areas. Harvesting extends from June-November, but peaks during July and August. Production is for both the fresh market and for processing.

Celery growers in Michigan have, on average, smaller operations than in other major production areas. The Michigan Department of Agriculture reported 41 celery growing operations in 1992 planting an average of 52 acres (Michigan Dept. of Agriculture). The agricultural extension agent in Ottawa county indicated that celery operations in the county ranged from about 20 to about 100 acres (Dudek).

Production Practices

Celery is transplanted into the field from about April 1 through July 30. Growers plant enough celery each day to meet packingshed capacity for one day.

Celery is planted in rows 30-34 inches apart in Michigan, with 6 to 7 inches between plants. If celery is grown specifically for hearts, plant spacings can be reduced to 4½-5 inches.

Celery grows faster during warm weather so plantings mature closer together during warm spells. This sometimes results in more celery than intended or more than the market can absorb being ready for harvest during the middle and late summer. The market sometimes becomes glutted, causing prices to drop below harvesting and packing costs, and in some cases, celery may be abandoned in the field.

Harvesting

Mechanical harvesting of celery is common in Michigan. Some full-sized celery is cut by hand and trimmed in the field and some of the early celery, grown specifically for hearts, is cut by hand.

The most common pack sizes in Michigan are 2, 2½, 3, 4, or 6 dozen stalks per box. The smallest stalks are packed in plastic sleeves as hearts, with 1, 2 or 3 hearts per sleeve. Two dozen sleeves are packed in boxes with a net weight of 24-30 pounds.

Marketing

Fresh market sales is the largest outlet for Michigan celery, but processing uses are more important for Michigan growers than for producers in other areas. Seventy-four percent of Michigan's celery was sold for fresh market use and twenty-six percent for processing in 1992 (Michigan Dept. of Agriculture).

Two-thirds to three-fourth of Michigan celery is marketed through the Michigan Celery Promotion Cooperative (Frens).

Michigan producers are "price takers" for the larger sizes of celery (that is, celery with fewer stalks per box) that they ship. California is the major supplier in the U.S. market and the amount of celery being shipped by handlers in California appears to be the major factor in determining prices in Michigan. Michigan, however, is a major supplier of the smaller sizes during the summer and can occasionally avoid market gluts and low prices by diverting some celery to processing. A number of producers have processing contracts and can divert some celery to the processing use during market gluts. However, the processing option may not provide complete flexibility in switching between fresh and processing because there are limits to the amount of additional celery processors can handle.

Availability of Yield Data

The manager of Michigan's major marketing cooperative indicated that planted and harvested acreage and production data are available for its growers, and that individual yield data could be easily compiled for a 10-year history (Frens). Approval by the cooperative's board of directors would be needed to release these data.

Production Perils

Excessive rainfall, hail damage, freezing temperatures, high summer temperatures, excessive cold during the spring, and drought are the major production perils in Michigan.

Excessive rainfall. Excessive rain is considered one of the most serious production perils in Michigan. Flooding can kill celery plants that stand in water for more than a couple of days. Bacterial rot or other diseases, such as pink rot, can become established and the plants eventually die. A county extension agent in Michigan cited a flooding incident in September 1986 that destroyed 20 to 30 percent of the celery crop that year (Dudek). Since the incident was in September, a large portion of the crop had already been harvested, but all celery in the field at the time of the flood was lost.

Hail. Hail occasionally results in losses to celery in Michigan. Losses from the occurrence of hail can range from minor to complete.

Freezing Temperatures. Celery is damaged when temperatures fall below 25$^{o}$F. Because losses due to freezing happen at the end of the season almost every

year, the size of such losses is relatively small. This is because most celery is already harvested when fall freezes occur. Some freeze-damaged celery can be diverted to processing if the grower has a processing contact.

Excessively high temperatures. Celery stops growing at temperatures above 90 degrees, delaying harvest and disrupting the harvesting schedule.

Excessive low temperatures. Extended low temperatures in the spring can induce premature seeding. Growers in Michigan manage this problem by using plastic or paper to form tunnels over their early-planted celery. Tunnels are not needed for celery planted after May (Dudek).

Drought. Most celery in Michigan is irrigated and drought, therefore, is not a problem.

Insects and diseases. Celery is susceptible to a number of insect pests and diseases in Michigan, but growers probably consider fusarium yellows the most serious problem at the present. Fusarium yellows decimated the Michigan celery industry during the 1940's until resistant cultivars were discovered. A new race of Fusarium yellows appeared in California in about 1960, and spread to Michigan in the late 1970's. It is currently found in most celery-growing areas of the state. Infected plants are stunted, may be yellow, and appear to be deficient in nutrients. Young plants may die if there is a severe infestation. Once soil is infested, the only effective control is to use yellows-resistant varieties. Several cultivars with moderate resistance are available, but other, more resistant varieties are being developed.

Demand for Insurance

There appears to be more potential demand for celery crop insurance from growers in Michigan than from those in California and Florida. Growers in Michigan are smaller and less diversified into other vegetables than those in California and Florida. Income losses from crop damage early in the season may represent a large portion of a Michigan grower's income for the year. Celery requires a large cash investment in planting and growing expenses, and the availability of crop insurance could aid some producers in obtaining production credit.

**Texas**

Texas is the fourth largest celery producing state, harvesting between 1,100-1,300 acres annually during the past three years. The farm value of Texas celery output was $12 million in 1993, and Texas accounted for 3 percent of total U.S. celery production in that year (Table 1).

Celery in Texas is grown almost exclusively in Hidalgo county in the lower Rio Grande Valley. Harvesting usually extends from November-May, but peak production occurs December-April. Texas celery is primarily for the fresh market.

There are only a handful of celery growers in Texas. One contact estimated that the largest grower accounted for 1/2 to 3/4 of Texas celery production (Cotner), and that this same grower was also a major producer in Florida. The 1987 Census of Agriculture reported 9 farms in Texas producing celery.

Natural Perils

The principal natural perils in Texas are excessive rainfall, freeze damage, and hail damage. Other hazards in growing celery in Texas include losses to insects and diseases, and salt toxicity.

Excessive rain. Hurricanes create the most serious threat from flooding, but local thunderstorms also can cause flooding. Flooding due to excessive rain can cause widespread damage after celery plants are set in the field in the fall. Flooding can actually kill young celery plants, requiring the grower to replant or causing the celery planting to be abandoned. An abandoned planting probably would be replanted to another crop such as carrots in order to salvage the fertilizer. Economic losses from flooding can be substantial, however, because a large part of the cost of growing celery is expenses for plants and transplanting.

Lesser damage can occur when rains that saturate soils for several days disrupt celery's growth and cause physiological disorders later in the season. Excessive moisture also creates ideal conditions for the establishment of pathogens making disease control more difficult.

Freeze damage. Losses to the mature crop from freezing is probably the peril with the greatest economic significance in Texas. One University researcher with the Texas Agriculture Experiment Station judged that a major crop loss due to a winter freeze would occur once every 10 years (Miller). Only a portion of the total crop would likely be lost because harvesting is spread over several months. A severe freeze would likely occur during December or January and destroy only that portion of the celery crop not already harvested.

Hail. Hail losses occur occasionally in Texas. Total losses usually are not large, but severe damage can occur to individual plantings.

Insect damage. Leafminers can severely injure celery foliage in south Texas. The larvae tunnel in leaf tissue, causing product contamination and stunted plants. Leafminers usually can be controlled with currently available insecticides. Although leafminers reportedly are developing resistance to the current insecticides in some areas of the country, this has not been reported as a problem in Texas.

Salt toxicity. Soluble salts buildup in irrigation water during extended dry periods and can subsequently accumulate in irrigated soils. Celery is a salt-sensitive crop and concentration of salts in the soil results in stunted growth or dying of the celery plant. Salt toxicity usually becomes a problem only after several years of extended dry weather during which rainfall is insufficient to leach the accumulated salt from the soil. Insuring against

losses due to salt toxicity would create the risk of adverse selection because growers know at the beginning of the season whether salt accumulation in the soil is becoming excessive.

**Ohio**

Ohio produced less that one-half of one percent of U.S. celery output in 1993. The Census of Agriculture reported 8 farms in Ohio with 315 acres of celery in 1987. The largest acreage is located on organic muck soils in Huron county in the north central part of the State. Celery is grown as part of a mix of vegetables.

The major perils in celery production in Ohio are fusarium infested soils, hail, frost damage to young plants in the spring, and excessive heat during the summer (Gastier). Growers deal with the fusarium problem by selecting fusarium-resistant cultivars. Hail is a potentially serious threat to celery and other vegetables during the summer in Ohio.

## Ad Hoc Disaster Assistance for Celery

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

Disaster assistance payments for celery totalled $1.2 million over the 1988-93 period, and were made in the categories of fresh celery and celery for processing. Payments for celery losses peaked at $363,000 in 1989, and were over $150,000 in each of the years 1990, 1991, and 1993. Ad hoc payments made for celery accounted for far less than 1 percent of the total payments made for specialty crops over the 1988-93 period.

Ad hoc disaster payments for celery were scattered over a geographically broad area (Figure 3). Fifteen states received payments in at least one of the 6 years. Michigan collected payments for celery losses in all years. New York collected payments in all years except 1989. Further, payments were reported in a variety of states for which neither NASS nor the Census collects data on celery--including Georgia, Minnesota, and Pennsylvania.

In a ranking of counties, Ottawa county, Michigan ranked first in payments, receiving $234,000 over the 6-year period. Allegan county, Michigan and Lapeer county, Michigan received $187,000 and $120,000 in payments, respectively. Among the top-10 recipient counties, seven were in Michigan, and one each were located in California, Florida, and New York.

Ad hoc disaster data can be used to indicate which celery-producing areas have received large payments relative to their production. For example, California accounted for about 63 percent of total U.S. celery harvested acreage between 1988-93, but received only 5 percent of the payments made for celery over that period (Table 12). Similarly, Florida accounted for an average 23 percent of harvested acreage, and 4 percent of celery disaster assistance payments over the same period.

In contrast, Michigan collected a high proportion of payments relative to production. Michigan accounted for 8 percent of U.S. harvested area over the years 1988-93, and received 73 percent of all celery disaster payments. Michigan celery growers collected payments in each of the 6 years. The minimum collected in any year in Michigan was $27,000 (in 1992); the maximum was $342,000, in 1989. These data suggest that the probability of yield loss in Michigan is greater than in California and Florida.

## Celery Insurance Implementation Issues

### Multiple Harvests in the Growing Season

A major issue with celery, and with several other fresh vegetables, is the question of how to insure an extended-season crop for which the yields, risks, perils, and expected market prices may differ for different parts of the season. Growers with extended seasons may be reluctant to purchase crop insurance which only guarantees season-average yields because the severity of losses during an interval within the season are concealed by averaging over the season.

Virtually all celery growers schedule planting over a number of months in order to ensure an extended harvest period. An insurable event that causes severe losses to a portion of the crop, however, may not qualify growers for indemnity payments because normal output for the remainder of the crop raises the season-average yield above the yield guarantee. In Florida, for example, freezes occasionally destroy nearly all the celery that would have been harvested during a portion of the season while reducing the season-average yield by only 10 or 20 percent.

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

Table 12--Disaster assistance payments for celery, 1988-93

| State | Average harvested acreage, 1988-93 | Share of U.S. acreage | Total celery disaster payments, 1988-93 | Share of U.S. celery disaster payments |
|---|---|---|---|---|
| | --Acres-- | --Percent-- | --Dollars-- | --Percent-- |
| California | 21,600 | 63 | 59,474 | 5 |
| Florida | 7,717 | 23 | 50,040 | 4 |
| Michigan | 2,867 | 8 | 846,100 | 73 |
| New York | 353 | 1 | 59,009 | 5 |
| Ohio | 293 | 1 | 26,540 | 2 |
| Texas | 1,367 | 4 | 39,439 | 3 |
| U.S. | 34,182 | 100 | 1,159,570 | 100 |

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

**Setting Reference Prices**

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

An appropriate reference price for celery may be a pre-harvest, or "in-field" price, because the grower does not bear the normal harvesting and marketing expenses when a crop failure occurs. An in-field price is similar to the "on-tree" price which is used as a reference price in insuring tree crops. An in-field price may be obtained directly if a field market exists, but more likely a price would have to be calculated.

Two possible formulas for calculating "in-field" reference prices are: 1) actual market price minus estimated harvesting and marketing expenses, and 2) estimated total production expenses minus estimated harvesting and marketing expenses. The market price refers to the "free-on-board" (f.o.b.) shipping-point price, not a retail price.

The market-price approach reflects the crop's value based on potential market returns, while the production-cost approach attempts to measure the value of production inputs. The market-price approach should result in a larger value than the production-expense approach in most years because it embodies grower returns for risk bearing and management into the estimate of the in-field price. Because the market-price approach accounts for returns to risk and management, it may provide a more equitable measure of the economic loss from crop failure than the production-expense approach.

The data are readily available for computing in-field prices after the crop has been harvested and marketed. Weekly f.o.b. prices are reported by the U.S. Department of Agriculture's Market News Service and harvesting costs are easily identifiable because harvesting and marketing are frequently contracted with a shipper at a specified contract fee.

The production-expense approach, based on county-level data, is likely a feasible alternative for estimating in-field prices because production practices and expenses are fairly standard among farms within a county. County-level measures (such as representative enterprise budgets) may provide a reasonable approximation of the costs for production inputs such as seed, fertilizer, chemicals, and labor.

FCIC would need projections of the in-field price prior to the season in order for growers to make a price selection at the time they sign up for insurance. The USDA does not project celery prices. One method for projecting a celery price is to calculate an average for a recent period (perhaps 5 or 10 years). Using an average price to project in-field value, however, will almost certainly result in a figure which, during some periods within the season, is substantially higher than the actual value of the crop. At times during the

season, when there is a glut of celery on the market, the actual in-field value may fall to zero (the market price falls so low that "you can't give a field away"). If the projected in-field value were higher than the actual value of the crop, growers with crop insurance may have an economic incentive for a crop loss, thus raising concern about moral hazard.

**Actual Production History**

The actual production history (APH) for insured farmers is established from their production record over the past 4-10 years. But, in the celery industry, the rate of harvest is related to market conditions, and production per planted acre varies more than if yield fluctuations were caused by natural conditions alone. If market prices fall below the costs for harvesting and marketing when celery is mature, the crop may be abandoned for economic reasons. Economic abandonment occurs because the grower incurs a smaller loss by abandoning the crop than by harvesting and selling.

Low harvest rates caused by a weak market (either for a year or for continuous years) would lower the production guarantee by lowering the APH yield. With a low production history, a situation may arise where 75 percent of the APH (the maximum guarantee which growers may currently insure) does not provide an adequate production guarantee. This could discourage growers from participating in crop insurance.

Since an average of celery yields may not indicate farming ability, APH yields may not provide a satisfactory method for screening farmers' productivity as is done in the yield classification method used in the premium rate calculation for field crops. With field crops, there are nine classifications of APH yields, and higher yields are associated with lower premium rates. Calculating premium rates by discounting on the basis of APH yields may not be an adequate method for screening productivity in the case of celery.

**Estimating "Appraised Production"**

There is no widely accepted method for estimating appraised production for celery. It is possible to make a pretty good estimate of celery yield by knowing the number of stalks in the field and the size distribution of the stalks. The reason for this is that celery is sized according to the number of stalks needed to fill a standard carton. An experienced grower reportedly can look at a field and judge the yield within a few cartons by observing the uniformity of the stand and the size of the stalks.

Modification of two methods used for fresh market tomatoes may provide a workable procedure for an insurance adjuster to estimate an in-field celery yield. The modified procedure consists of: 1) estimating the number of surviving plants per acre on the basis of row samples, 2) multiplying the number of surviving plants by an average size distribution of marketable stalks, and 3) converting to cartons per acre using the appropriate number of stalks per carton for each size category.

A schedule of average percentage size distribution of stalks would be needed for different production areas because the percentage may be quite different from one area to another. For example, in California, where yields average 600-700 cartons an acre, the percent of larger size stalks would average higher than in Florida or Michigan, where yields of 400-500 cartons are more typical.

**Insuring Price Risks**

Contacts in virtually all production areas cited market risks as the celery grower's greatest peril. Growers, they report, can manage insect and disease risks by following prudent pest management practices and can generally deal with weather-related losses because usually only a part of the season's crop is damaged by natural perils. The situation which growers seem to have the hardest time dealing with is, having produced a perfectly good yield, to sell at less than their cost of production or even to abandon part or all of the crop because of low market prices. To make crop insurance attractive to celery growers, especially in California, and perhaps some other areas, a policy may have to contain an element of protection against the risks of low market prices. A revenue insurance plan may provide such protection.

With a revenue insurance plan, celery growers could insure against income falling below some guaranteed minimum, regardless of whether the cause was low yields, low prices, or a combination of both. Such an insurance plan could provide a measure of market-risk protection, while at the same time avoiding indemnity payments to growers who, despite low yields, had a good return because of high market prices.

**Moral Hazard**

There is the potential for moral hazard in celery insurance since the situation sometimes arises where, because of low market prices, an indemnity payment would be higher than the net return from harvesting a crop. As a practical matter, however, moral hazard does not appear likely to be a major problem with celery. In order for moral hazard to arise, a yield loss would need to occur due to some contributing action or lack of action (such as neglecting pest control practices) on the part of the grower. Such grower-induced losses are not likely to occur because the major perils in celery production are weather-related over which the grower has no influence.

Yield losses to insects and diseases could occur if a grower neglected to follow prudent pest management practices. It is unlikely that a grower would neglect proper pest management in order to collect an insurance indemnity, however, because a pest buildup may be difficult to eradicate and create a peril for future crops when market prices may be higher. In addition, crop insurance for celery may not need to include indemnification for insect and disease losses because growers generally view these perils as manageable problems with currently available control methods.

**Micro-Climates and Adverse Selection**

Variations in micro-climates within production areas could result in different celery growers facing substantially different risks, raising the possibility of problems with adverse selection. In Michigan for instance, celery is grown on muck soils which tend to be in low lying areas. Since some fields are more subject to flooding than others, growers with celery in flood-prone fields may be more likely to participate in crop insurance than growers with fields less subject to flooding.

**Individual Yield Data**

The manager of Michigan's major marketing cooperative indicated that planted and harvested acreage and production data are available for its growers, and that individual yield data could be easily compiled for a 10-year history. Approval by the cooperative's board of directors would be needed to release these data.

The Florida Celery Marketing Order regulates the quantity marketed by all shippers in the state and collects data on the quantity marketed by individual growers in the administration of this order. The release of these data would, of course, require grower approval.

In California, the California Celery Research Board, a state Marketing Order, supports celery research and promotion with assessments based on individual growers' production. In addition, a substantial amount of California's celery is grown by larger grower-shippers who are reported to have detailed production records.

**Demand for Insurance**

Participation in celery crop insurance might be higher in Michigan than in California and Florida--even though requests for celery insurance have been sent to FCIC from California and Florida, but not Michigan. In general, growers in Michigan may have fewer risk management options than in Florida and California. Michigan growers, for example, appear to be less diversified in the sources of their farm receipts than growers in California and Florida. Celery accounted for an estimated 80 percent of sales on Michigan farms with celery in 1987 compared with only 33 percent in California and 53 percent in Florida. A yield loss in the celery enterprise, therefore, would have a smaller impact on total farm sales in California and Florida than in Michigan.

Growers in all three major growing areas usually can use a long marketing period to help manage production risks because losses at one point in the season can be partly made up with sales during the remainder of the season. Large grower-shippers sometimes extend their season by growing celery in several states or regions within a state. For such growers, a loss of a portion of their crop in one region represents only a small share of their total output for the season.

In Michigan, however, there may be less opportunity for extended harvesting than in Florida and California. The normal harvesting period in Michigan runs for about four months (July through October), while in Florida it spans about seven months (November through June). In California, the length of the shipping season varies from region to region, but growers in the two biggest areas, Monterey and Ventura Counties, have relatively long shipping seasons. Some of the larger grower-shippers in Florida and California extend their shipping season by producing in several states or several regions within the state.

## References


Berger, Leslie, Tom Hebert, Donald Ricks, and James Shaffer. *The U.S. Celery Production and Marketing Subsector: An Evaluation of Market Coordination Performance*. Agricultural Economics Report No. 517. Department of Agr. Econ. Univ. of Michigan, East Lansing. October 1988.

Brendler, Robert. *Costs and Practices in Ventura County For Lima Beans and Vegetables*. University of California Cooperative Extension Service. June 1990.

Buxton, Boyd M., and Shannon Reid Hamm. "Seasonal Farm Price Patterns for Selected U.S. Vegetable Crops," *Vegetables and Specialties Situation and Outlook Yearbook*. TVS-246. Econ. Res. Serv., USDA. November, 1988.

California Department of Food and Agriculture. *California Agriculture Statistical Review 1992*. Sacramento, California. July 1993.

Cotner, Sam. Extension Vegetable Specialists, Texas A&M University. Personal communication. March 30, 1994.

Dickey, Dana. California Celery Research Advisory Board. Personal communication. April 1994.

Dudek, Thomas A. Michigan Cooperative Extension Service. Ottawa county Michigan. Personal communication. March 30, 1994.

Florida Agricultural Statistics Service. Florida Agricultural Statistics *Vegetable Summary, 1991-92*. May 1993.

Florida Celery Committee. Marketing Policy 1993-94 Season, Marketing Order 967. Orlando. 1993.

Frens, Duane. Manager, Michigan Celery Promotion Cooperative. Personal communication. March 30, 1994.

Gastier, Ted. Ohio State University Cooperative Extension Service. Huron county, Ohio. Personal Communication. April 4, 1994.

Guzman, V.L., et. al. *Celery Production on Organic Soils of South Florida*. Ag. Exp. Sta. Bul. 757. Florida Agricultural Experiment Station, IFAS, U. of FL. September, 1973.

Huffman, J.W., Kurt Schulbach, and E.A. Yeary. *Sample Costs to Produce Celery in Monterey County - 1986*. University of California Cooperative Extension Service. 1986.

Kilmer, Richard L. *A Review of the Current Pricing Systems of Celery, Sweet Corn, and Potatoes*. Econ. Info. Rept. 171. Food And Resource Economics Department, Agricultural Experiment Station, IFAS, U. of FL. November 1982.

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

Miller, Marvin. Plant pathologists, Texas A&M University Experiment Station at Weslaco. Personal Communication. March 30, 1994.

Rose, G. Norman. *Celery Production in Florida--A Historic Data Series*. Economics Report 69. Food and Resource Econ. Dept., Agricultural Experiment Stations, IFAS, Univ. of Florida, Gainesville. May 1975.

Sackett, Clarice and Judy Murray. *Fruit & Vegetable Facts & Pointers-Celery*. United Fresh Fruit and Vegetable Association. Washington, D.C. March 1977.

Schuenemen, Thomas. Palm Beach County Extension Agent. Florida Cooperative Extension Service. Personal Communication. February 23, 1994.

Sims, William, James Welch, Vincent Rubatzky, "Celery Production in California." Leaflet 2673. Division of Agricultural Sciences. University of California. September 1977.

Smith, Scott A. and Timothy G. Taylor. *Production Cost for Selected Vegetables in Florida, 1991-1992*. Circular 1064. Florida Cooperative Extension Service, IFAS, University of Florida.

Snyder, N.J. and L.M. Valenzuela. *Sample Costs to Produce Celery--1988-89, Santa Barbara and San Luis Obispo Counties*. University of California Cooperative Extension Service. 1988.

State of California. California Agricultural Commissioner's Report. Various issues.

Talbott, George. Manager, Florida Celery Exchange. Personal Communication. April 19, 1994.

U.S. Department of Agriculture. Agricultural Marketing Service. *Fresh Fruit and Vegetable Prices*. Annual issues.

U.S. Department of Agriculture. Agricultural Marketing Service. Unpublished price data.

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

U.S. Department of Agriculture. California Agricultural Statistics Service. County-level data on celery acreage, production, and other variables. Various years.

U.S. Department of Agriculture. Economic Research Service. *Vegetables and Specialties Situation and Outlook*. Various issues.

U.S. Department of Agriculture. Federal Crop Insurance Corporation. Special participation analyses (Dan Orr). 1994.

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

_____. *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. Export and import data files. Various years.

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

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

Yamaguchi, Mas. *World Vegetables: Principles, Production, and Nutritive Values*. An AVI Book Published by Van Nostrand Reinhold.

Zandstra, Bernard H., Thomas A. Dudek, Edward J. Grafius, Melvyn L.Lacy, and Darryl D. Warncke. *Commercial Vegetable Recommendations, Celery*. Ext. Bul. E-1308. Michigan State University. December 1986.

**Celery Contacts**

California:

Robert Brendler
Farm Advisor
Ventura County
805-645-1456

Dana Dickey
Manager
California Celery Research Advisory Board
Dinuba, California (Fresno county)
209-591-0434

John Inman
Farm Advisor
Monterey County
408-758-4637

Steve Koike
Farm Advisor
Monterey County
408-758-4637

Vincent Rubatzky
Crop Specialist
University of California at Davis
916-752-1247

Grower-Shipper Vegetable Association of Central California
Salinas, California
805-422-8844

Grower-Shipper Vegetable Association of Santa Barbara and San Luis Obispo counties
Guadalupe, California
805-343-2215

Western Grower Association
Sacramento, California
916-446-1435

Florida:

Tom Schueneman
Vegetable Extension Agent
Palm Beach County (Everglades area)
Belle Glade, Florida
(407) 996-1655

George Talbott
Florida Celery Exchange
(407) 894-2911

Michigan:

Bernie Zandstra
Vegetable Extension Specialists
Michigan State University
(517) 353-6637

Duane Frens
Manager
Michigan Celery Promotion Cooperative
(616) 669-1250

Tom Dudek
Ottawa County Extension Agent
(616) 846-8250

Alan Shipley
Vegetable Cost of Production Researcher
Department of Agricultural Economics
Michigan State University
(517) 353-4380

Texas:
Marvin Miller
Plant Pathologist
Texas A&M Experiment Station
Weslaco, Texas
(512) 968-5585

Sam Cotner
Extension Horticulturalist
Texas A&M University
College Station, TX
(409) 845-7341

Merritt Taylor
Extension Farm Management
Texas A&M Agricultural Experiment Station
Weslaco, TX
(512) 968-5581

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

| State and major counties | 1987 | | | | 1982 | | | |
|---|---|---|---|---|---|---|---|---|
| | Number of Farms | Harvested Acres | Irrigated Farms | Irrigated Acres | Number of Farms | Harvested Acres | Irrigated Farms | Irrigated Acres |
| California | 151 | 22,468 | 151 | 22,468 | 177 | 23,311 | 177 | 23,311 |
| Ventura | 32 | 10,921 | 32 | 10,921 | 50 | 10,072 | 50 | 10,072 |
| Monterey | 53 | 6,081 | 53 | 6,081 | 51 | 7,500 | 51 | 7,500 |
| Santa Barbara | 24 | 2,509 | 24 | 2,509 | 17 | 1,779 | 17 | 1,779 |
| San Luis Obispo | 11 | 931 | 11 | 931 | 21 | 1374 | 21 | 1374 |
| San Benito | 8 | 649 | 8 | 649 | (N) | (N) | (N) | (N) |
| Santa Cruz | 8 | 490 | 8 | 490 | 7 | 375 | 7 | 375 |
| San Diego | 5 | (N) | 5 | (N) | 13 | 615 | 13 | 615 |
| Other | 10 | 887 | 10 | 887 | 18 | 1,596 | 18 | 1,596 |
| Florida | 10 | 8,078 | 10 | 8,078 | 15 | 9,588 | 15 | 9,588 |
| Palm Beach | 4 | 6,298 | 4 | 6,298 | 8 | 7,795 | 8 | 7,795 |
| Other | 6 | 1,780 | 6 | 1,780 | 7 | 1,793 | 7 | 1,793 |
| Michigan | 56 | 2,914 | 50 | 2,848 | 70 | 3,518 | 56 | 3,358 |
| Ottawa | 20 | 778 | 18 | 723 | 33 | 1,095 | 27 | 988 |
| Kent | 7 | 322 | 7 | 322 | 6 | 311 | 6 | 311 |
| Muskegon | 4 | 258 | 4 | 258 | 5 | 362 | 5 | 362 |
| Allegan | 8 | 250 | 8 | 250 | 4 | 155 | 4 | 155 |
| Lapeer | 4 | (N) | 2 | (N) | 4 | (N) | 2 | (N) |
| Other | 13 | 1,306 | 11 | 1,295 | 18 | 1,595 | 12 | 1,542 |
| Ohio | 8 | 315 | 7 | 315 | 11 | 444 | 8 | 438 |
| Texas | 9 | 1,288 | 9 | 1,288 | 5 | 869 | 5 | 869 |
| Hidalgo | 5 | 1,225 | 5 | 1,225 | 5 | 869 | 5 | 869 |
| Other | 4 | 63 | 4 | 63 | 0 | 0 | 0 | 0 |
| Five states above | 234 | 35,063 | 227 | 34,997 | 278 | 37,730 | 261 | 37,564 |
| United States | 377 | 36,478 | 324 | 36,317 | 451 | 39,445 | 373 | 39,171 |

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

Source: 1987 Census of Agriculture.

Appendix table 2-CELERY: Size distribution of farms, by sales class, 1987

| State | All farms | Total value of crop sales | | | | |
|---|---|---|---|---|---|---|
| | | $500,000 or more | $100,000 to $499,999 | $50,000 to $99,999 | $25,000 to $49,999 | Less than $25,000 |
| | Number of farms | | | | | |
| California | 151 | 114 | 23 | 6 | 6 | 2 |
| Florida | 10 | 10 | 0 | 0 | 0 | 0 |
| Michigan | 56 | 11 | 29 | 8 | 3 | 5 |
| Ohio | 8 | 2 | 4 | 0 | 1 | 1 |
| Texas | 9 | 7 | 0 | 0 | 1 | 1 |
| Other States | 143 | 12 | 36 | 26 | 19 | 50 |
| United States | 377 | 156 | 92 | 40 | 30 | 59 |

Source: 1987 Census of Agriculture.

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

| Organizational type | All farms | Total value of crop sales: $500,000 or more | $100,000 to $499,999 | $50,000 to $99,999 | $25,000 to $49,999 | Less than $25,000 |
|---|---|---|---|---|---|---|
| | | Number of farms | | | | |
| Individual or family | | | | | | |
| California | 46 | 25 | 11 | 4 | 4 | 2 |
| Florida | 0 | 0 | 0 | 0 | 0 | 0 |
| Michigan | 26 | 0 | 12 | 7 | 2 | 5 |
| Ohio | 5 | 0 | 4 | 0 | 0 | 1 |
| Texas | 3 | 1 | 0 | 0 | 1 | 1 |
| Other States | 110 | 5 | 20 | 22 | 17 | 46 |
| United States | 190 | 31 | 47 | 33 | 24 | 55 |
| Partnership | | | | | | |
| California | 45 | 38 | 4 | 1 | 2 | 0 |
| Florida | 2 | 2 | 0 | 0 | 0 | 0 |
| Michigan | 16 | 4 | 10 | 1 | 1 | 0 |
| Ohio | 1 | 1 | 0 | 0 | 0 | 0 |
| Texas | 1 | 1 | 0 | 0 | 0 | 0 |
| Other States | 18 | 2 | 7 | 3 | 2 | 4 |
| United States | 83 | 48 | 21 | 5 | 5 | 4 |
| Corporation | | | | | | |
| Family held | | | | | | |
| California | 58 | 50 | 7 | 1 | 0 | 0 |
| Florida | 5 | 5 | 0 | 0 | 0 | 0 |
| Michigan | 14 | 7 | 7 | 0 | 0 | 0 |
| Ohio | 1 | 1 | 0 | 0 | 0 | 0 |
| Texas | 4 | 4 | 0 | 0 | 0 | 0 |
| Other States | 14 | 5 | 8 | 1 | 0 | 0 |
| United States | 96 | 72 | 22 | 2 | 0 | 0 |
| Other than family held | | | | | | |
| California | 2 | 1 | 1 | 0 | 0 | 0 |
| Florida | 3 | 3 | 0 | 0 | 0 | 0 |
| Michigan | 0 | 0 | 0 | 0 | 0 | 0 |
| Ohio | 0 | 0 | 0 | 0 | 0 | 0 |
| Texas | 1 | 1 | 0 | 0 | 0 | 0 |
| Other States | 0 | 0 | 0 | 0 | 0 | 0 |
| United States | 6 | 5 | 1 | 0 | 0 | 0 |
| Other | | | | | | |
| California | 0 | 0 | 0 | 0 | 0 | 0 |
| Florida | 0 | 0 | 0 | 0 | 0 | 0 |
| Michigan | 0 | 0 | 0 | 0 | 0 | 0 |
| Ohio | 1 | 0 | 0 | 0 | 1 | 0 |
| Texas | 0 | 0 | 0 | 0 | 0 | 0 |
| Other States | 1 | 0 | 1 | 0 | 0 | 0 |
| United States | 2 | 0 | 1 | 0 | 1 | 0 |

Source: 1987 Census of Agriculture.

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

| Item | All farms | Total value of crop sales: $500,000 or more | $100,000 to $499,999 | $50,000 to $99,999 | $25,000 to $49,999 | Less than $25,000 |
|---|---|---|---|---|---|---|
| | Number of farms | | | | | |
| Farming is main occupation | | | | | | |
| California | 143 | 108 | 22 | 5 | 6 | 2 |
| Florida | 10 | 10 | 0 | 0 | 0 | 0 |
| Michigan | 53 | 10 | 29 | 8 | 3 | 3 |
| Ohio | 6 | 2 | 3 | 0 | 1 | 0 |
| Texas | 8 | 7 | 0 | 0 | 1 | 0 |
| Other States | 120 | 12 | 36 | 25 | 15 | 32 |
| United States | 340 | 149 | 90 | 38 | 26 | 37 |
| | Percent of all farms | | | | | |
| California | 94.8 | 71.5 | 14.6 | 3.3 | 4.0 | 1.4 |
| Florida | 100.0 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Michigan | 94.7 | 17.9 | 51.7 | 14.3 | 5.4 | 5.4 |
| Ohio | 75.0 | 25.0 | 37.5 | 0.0 | 12.5 | 0.0 |
| Texas | 88.9 | 77.8 | 0.0 | 0.0 | 11.1 | 0.0 |
| Other States | 84.0 | 8.4 | 25.2 | 17.5 | 10.5 | 22.4 |
| United States | 90.2 | 39.5 | 23.9 | 10.1 | 6.9 | 9.8 |
| | Number of farms | | | | | |
| Operator days off-farm | | | | | | |
| None | | | | | | |
| California | 105 | 80 | 14 | 3 | 6 | 2 |
| Florida | 7 | 7 | 0 | 0 | 0 | 0 |
| Michigan | 41 | 9 | 23 | 6 | 1 | 2 |
| Ohio | 5 | 2 | 2 | 0 | 1 | 0 |
| Texas | 7 | 5 | 0 | 0 | 1 | 1 |
| Other States | 86 | 10 | 29 | 17 | 12 | 18 |
| United States | 251 | 113 | 68 | 26 | 21 | 23 |
| Any | | | | | | |
| California | 37 | 28 | 7 | 2 | 0 | 0 |
| Florida | 2 | 2 | 0 | 0 | 0 | 0 |
| Michigan | 9 | 0 | 4 | 2 | 1 | 2 |
| Ohio | 3 | 0 | 2 | 0 | 0 | 1 |
| Texas | 1 | 1 | 0 | 0 | 0 | 0 |
| Other States | 44 | 1 | 3 | 7 | 4 | 29 |
| United States | 96 | 32 | 16 | 11 | 5 | 32 |

continued

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

| Item | All farms | Total value of crop sales: $500,000 or more | $100,000 to $499,999 | $50,000 to $99,999 | $25,000 to $49,999 | Less than $25,000 |
|---|---|---|---|---|---|---|
| | Number of farms | | | | | |
| Operator days off-farm | | | | | | |
| Any-continued | | | | | | |
| 1 to 99 days | | | | | | |
| California | 10 | 9 | 1 | 0 | 0 | 0 |
| Florida | 0 | 0 | 0 | 0 | 0 | 0 |
| Michigan | 5 | 0 | 3 | 1 | 0 | 1 |
| Ohio | 0 | 0 | 0 | 0 | 0 | 0 |
| Texas | 0 | 0 | 0 | 0 | 0 | 0 |
| Other States | 18 | 1 | 3 | 2 | 0 | 12 |
| United States | 33 | 10 | 7 | 3 | 0 | 13 |
| 100 to 199 days | | | | | | |
| California | 5 | 3 | 1 | 1 | 0 | 0 |
| Florida | 1 | 1 | 0 | 0 | 0 | 0 |
| Michigan | 2 | 0 | 1 | 1 | 0 | 0 |
| Ohio | 1 | 0 | 0 | 0 | 0 | 1 |
| Texas | 0 | 0 | 0 | 0 | 0 | 0 |
| Other States | 7 | 0 | 0 | 2 | 2 | 3 |
| United States | 16 | 4 | 2 | 4 | 2 | 4 |
| 200 days or more | | | | | | |
| California | 22 | 16 | 5 | 1 | 0 | 0 |
| Florida | 1 | 1 | 0 | 0 | 0 | 0 |
| Michigan | 2 | 0 | 0 | 0 | 1 | 1 |
| Ohio | 2 | 0 | 2 | 0 | 0 | 0 |
| Texas | 1 | 1 | 0 | 0 | 0 | 0 |
| Other States | 19 | 0 | 0 | 3 | 2 | 14 |
| United States | 47 | 18 | 7 | 4 | 3 | 15 |
| Not reported | | | | | | |
| California | 9 | 6 | 2 | 1 | 0 | 0 |
| Florida | 1 | 1 | 0 | 0 | 0 | 0 |
| Michigan | 6 | 2 | 2 | 0 | 1 | 1 |
| Ohio | 0 | 0 | 0 | 0 | 0 | 0 |
| Texas | 1 | 1 | 0 | 0 | 0 | 0 |
| Other States | 13 | 1 | 4 | 2 | 3 | 3 |
| United States | 30 | 11 | 8 | 3 | 4 | 4 |

Source: 1987 Census of Agriculture.

Appendix table 5-California Celery Production, by County, 1980-1992

| County | Year | Harvest Acreage | Yield /acre | Total Production | Unit price | comments |
|---|---|---|---|---|---|---|
| | | | --tons-- | --tons-- | --$/ton-- | |
| Ventura | 1980 | 9,934 | 26.40 | 262,655 | 175 | |
| | 1981 | 10,011 | 30.00 | 300,630 | 221 | |
| | 1982 | 10,793 | 30.20 | 326,057 | 217 | |
| | 1983 | 10,290 | 27.50 | 283,181 | 225 | |
| | 1984 | 11,079 | 28.00 | 310,323 | 279 | |
| | 1985 | 10,976 | 27.60 | 303,421 | 162 | |
| | 1986 | 11,075 | 29.10 | 321,950 | 197 | |
| | 1987 | 9,615 | 33.60 | 323,256 | 246 | |
| | 1988 | 10,650 | 30.90 | 329,086 | 247 | |
| | 1989 | 11,100 | 29.50 | 327,739 | 261 | |
| | 1990 | 11,242 | 31.40 | 353,181 | 239 | |
| | 1991 | 10,528 | 31.90 | 335,933 | 227 | |
| | 1992 | 11,723 | 30.20 | 353,528 | 223 | |
| Monterey | 1980 | 6,430 | 27.90 | 179,700 | 184 | |
| | 1981 | 6,200 | 25.70 | 159,545 | 219 | |
| | 1982 | 6,240 | 25.70 | 160,330 | 168 | |
| | 1983 | 5,590 | 23.90 | 133,810 | 338 | |
| | 1984 | 5,510 | 28.80 | 158,675 | 169 | |
| | 1985 | 5,410 | 32.20 | 174,035 | 226 | |
| | 1986 | 5,942 | 34.90 | 207,330 | 226 | |
| | 1987 | 6,205 | 32.60 | 201,995 | 189 | |
| | 1988 | 4,449 | 34.00 | 151,285 | 223 | |
| | 1989 | 5,085 | 33.10 | 168,520 | 204 | |
| | 1990 | 7,290 | 32.90 | 240,095 | 222 | |
| | 1991 | 6,929 | 32.80 | 227,230 | 176 | |
| | 1992 | 7,510 | 36.50 | 274,000 | 232 | |
| Santa Barbara | 1980 | 2,800 | 27.50 | 77,000 | 159 | |
| | 1981 | 2,710 | 28.00 | 75,880 | 198 | |
| | 1982 | 2,932 | 28.50 | 83,562 | 163 | |
| | 1983 | 2,320 | 25.40 | 58,928 | 234 | |
| | 1984 | 3,021 | 26.00 | 78,697 | 198 | |
| | 1985 | 2,772 | 29.70 | 82,404 | 168 | |
| | 1986 | 2,599 | 31.90 | 82,888 | 192 | |
| | 1987 | 2,792 | 33.10 | 92,413 | 164 | |
| | 1988 | 2,378 | 33.00 | 78,478 | 196 | |
| | 1989 | 3,478 | 32.10 | 111,538 | 211 | |
| | 1990 | 3,092 | 28.80 | 89,002 | 209 | |
| | 1991 | 2,627 | 31.80 | 83,431 | 168 | |
| | 1992 | 2,724 | 33.40 | 90,914 | 186 | |

continued

Appendix table 5-California Celery Production, by County, 1980-1992, continued

| County | Year | Harvest Acreage | Yield /acre | Total Production | Unit price | comments |
|---|---|---|---|---|---|---|
| | | | --tons-- | --tons-- | --$/ton-- | |
| San Luis Obispo | 1980 | 1,269 | 26.30 | 33,349 | 145 | |
| | 1981 | 1,267 | 29.40 | 37,288 | 231 | |
| | 1982 | 1,359 | 29.80 | 40,566 | 152 | |
| | 1983 | 638 | 31.40 | 20,059 | 238 | |
| | 1984 | 1,053 | 32.70 | 34,429 | 173 | |
| | 1985 | 890 | 33.00 | 29,370 | 175 | |
| | 1986 | 767 | 34.20 | 26,231 | 222 | |
| | 1987 | 796 | 34.80 | 27,701 | 161 | |
| | 1988 | 1,053 | 35.10 | 36,992 | 220 | |
| | 1989 | 1,156 | 34.00 | 39,327 | 229 | |
| | 1990 | 1,113 | 32.70 | 36,428 | 198 | |
| | 1991 | 1,313 | 34.20 | 44,865 | 163 | |
| | 1992 | 981 | 39.20 | 38,465 | 203 | |
| Orange | 1980 | 750 | 25.00 | 18,758 | 173 | |
| | 1981 | 686 | 29.00 | 19,900 | 213 | |
| | 1982 | 782 | 28.50 | 22,287 | 321 | |
| | 1983 | 1,134 | 25.80 | 29,235 | 171 | |
| | 1984 | 1,117 | 29.50 | 32,952 | 301 | |
| | 1985 | 929 | 25.80 | 23,931 | 155 | |
| | 1986 | 985 | 28.50 | 28,073 | 195 | |
| | 1987 | 540 | 25.60 | 13,802 | 190 | |
| | 1988 | 437 | 28.80 | 12,581 | 230 | |
| | 1989 | 459 | 29.50 | 13,559 | 258 | |
| | 1990 | 594 | 31.70 | 18,818 | 209 | |
| | 1991 | 628 | 36.40 | 22,847 | 211 | |
| | 1992 | 690 | 30.20 | 20,845 | 214 | |
| Riverside | 1986 | 90 | 23.30 | 2,093 | 195 | Data prior |
| | 1987 | 65 | 24.00 | 1,560 | 400 | to 1986 |
| | 1988 | 160 | 30.00 | 4,800 | 397 | were not |
| | 1989 | 182 | 28.60 | 5,214 | 240 | available. |
| | 1990 | 110 | 27.00 | 2,973 | 309 | |
| | 1991 | 310 | 9.15 | 2,837 | 207 | |
| | 1992 | 269 | 17.10 | 4,592 | 137 | |

continued

Appendix table 5-California Celery Production, by County, 1980-1992, continued

| County | Year | Harvest Acreage | Yield /acre | Total Production | Unit price | comments |
|---|---|---|---|---|---|---|
| | | | --tons-- | --tons-- | --$/ton-- | |
| San Benito | 1980 | 128 | 30.00 | 3,840 | 80 | Data for |
| | 1981 | 130 | 30.00 | 3,900 | 88 | 1984-86 |
| | 1982 | 175 | 27.50 | 4,810 | 120 | were not |
| | 1983 | 235 | 20.90 | 4,900 | 126 | available. |
| | 1987 | 714 | 24.10 | 17,207 | 181 | |
| | 1988 | 450 | 29.90 | 13,455 | 164 | |
| | 1989 | 665 | 36.80 | 24,472 | 170 | |
| | 1990 | 664 | 29.40 | 19,522 | 197 | |
| | 1991 | 781 | 32.50 | 25,382 | 145 | |
| | 1992 | 450 | 34.80 | 15,664 | 239 | |
| San Diego | 1980 | 582 | 28.30 | 16,471 | 138 | |
| | 1981 | 357 | 32.00 | 11,424 | 204 | |
| | 1982 | 452 | 31.10 | 14,057 | 170 | |
| | 1983 | 695 | 33.00 | 22,935 | 231 | |
| | 1984 | 380 | 33.20 | 12,611 | 206 | |
| | 1985 | 299 | 34.90 | 10,435 | 222 | |
| | 1986 | 123 | 33.20 | 4,084 | 764 | |
| | 1987 | 194 | 34.00 | 6,596 | 220 | |
| | 1988 | 30 | 39.60 | 1,188 | 242 | |
| | 1989 | 51 | 36.00 | 1,836 | 253 | |
| | 1990 | 86 | 36.00 | 3,100 | 249 | |
| | 1991 | 106 | 34.10 | 3,615 | 275 | |
| | 1992 | 64 | 36.80 | 2,355 | 275 | |
| Santa Clara | 1988 | 61 | 32.00 | 1,952 | 215 | Data prior |
| | 1989 | 125 | 36.00 | 4,500 | 120 | to 1988 |
| | 1990 | 170 | 30.00 | 5,100 | 235 | were not |
| | 1991 | 160 | 25.00 | 4,000 | 125 | available. |
| | 1992 | 160 | 30.00 | 4,800 | 200 | |

continued

Appendix table 5-California Celery Production, by County, 1980-1992, continued

| County | Year | Harvest Acreage | Yield /acre | Total Production | Unit price | comments |
|---|---|---|---|---|---|---|
| | | | --tons-- | --tons-- | --$/ton-- | |
| Santa Cruz | 1980 | 390 | 28.50 | 11,100 | 184 | |
| | 1981 | 380 | 31.20 | 11,850 | 245 | |
| | 1982 | 541 | 26.20 | 14,160 | 221 | |
| | 1983 | 304 | 29.50 | 8,961 | 290 | |
| | 1984 | 390 | 16.60 | 6,493 | 417 | |
| | 1985 | 301 | 24.70 | 7,426 | 225 | |
| | 1986 | 256 | 33.60 | 8,602 | 258 | |
| | 1987 | 336 | 27.60 | 9,276 | 188 | |
| | 1988 | 271 | 26.40 | 7,141 | 280 | |
| | 1989 | 300 | 28.10 | 8,426 | 264 | |
| | 1990 | 219 | 31.10 | 6,815 | 240 | |
| | 1991 | 421 | 24.10 | 10,163 | 229 | |
| | 1992 | 436 | 23.60 | 10,283 | 265 | |

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