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

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Executive Summary

U.S. watermelon production reached 3.67 billion pounds in 1993, up 1 percent from the prior year and up about 41 percent from watermelon output in 1981. Florida, California, Texas, and Georgia, respectively, are the leading watermelon-producing states, accounting for two-thirds of U.S. output. Although Florida is the leading producer, the largest gains in output between 1981 and 1993 occurred in California and Georgia.

U.S. watermelon production is highly seasonal, peaking from May through August and declining through December. The season begins with production from Florida, followed by output from Arizona, Texas, California, and the southeastern and south-central states. Florida is the only domestic source of watermelons from December through April, and then only in small quantities. Although Florida growers harvest watermelons during virtually every month, the peak harvest occurs during May, June, and early July.

U.S. watermelon consumption has increased modestly in recent years, rising from about 12 pounds per person during the early 1980's to about 14 pounds during the early 1990's. The rise in consumption may be due partly to increased availability of imported watermelons in the U.S. off-season, and the increased use of watermelon in restaurants and deli salad bars. The development of "seedless" watermelons has increased their appeal to some consumers who disliked the seeds in seeded watermelons.

Considerable variability exists in watermelon prices within the year, due mostly to seasonal changes in the volume of production. The prices that growers receive early in the season, when Florida is the principal source of domestic watermelons, may reach 10-15 cents a pound. Prices usually reach their lowest point, at around 4-5 cents a pound, during July and August, when watermelons are available from a wide number of sources.

According to the Census of Agriculture, there were 10,706 farms with 220,244 harvested acres of watermelons in 1992. Forty-six percent of U.S. watermelon acreage was irrigated in 1992. All of California's and Arizona's acreage was irrigated, as was 73 percent of Florida's acreage. There is a significant amount of non-irrigated watermelon acreage in other southern and midwestern states, which is susceptible to yield losses during periods of drought.

Watermelons prefer a long, warm growing season and are, therefore, produced primarily in the southern half of the United States. The optimum average temperature for growing watermelon is 70° F to 85° F, but they can tolerate average temperatures as high as 95° F. Watermelons are relatively tolerant of high humidity and can be grown in both humid and arid conditions.

Watermelons prefer well-drained, sandy loam soils which are slightly acidic or neutral, with a pH in the 6.0 to 7.0 range. Watermelons will also do well on other types of soils as long as adequate water is available and good drainage is provided. Currently, approximately 50 varieties of watermelons are produced commercially in the United States. The new seedless hybrid varieties are particularly growing in popularity.

Watermelon can be either direct-seeded or transplanted. When direct-seeding is used, growers overplant and then thin to the desired number of plants per acre after the young plants have become established. The high cost of seed--compounded by overplanting--has led to the increased use of transplants. Transplanting is the standard method for planting the seedless varieties because of high seed costs and because they tend to be harder to establish by direct seeding than the seeded varieties. The use of transplants not only reduces seed costs, it also offers the potential for an earlier harvest.

Watermelons are cut from the vine, rather than being pulled or broken off. Harvesting crews typically consist of 2 or 3 cutters, 4 to 6 loaders, 2 stackers, and one truck driver. The cutters select ripe melons and cut and place them along in-field roadways. Loaders pick up and pass the harvested melons to stackers located on a wagon or field truck. The melons are then hauled out of the field to a waiting over-the-road tractor-trailer for bulk loading or to a nearby packingshed for bin- or carton-packing.

Because watermelons in a given field ripen at different times, growers need to harvest several times to achieve maximum yields. The first harvest yields the largest and highest-quality melons. Size and quality generally decline with successive harvests and costs rise because the harvesting crew must glean a larger area to collect a load of melons.

The major production perils affecting watermelons include excessive rain, excessive heat, and, in non-irrigated areas, drought. Excess rain during any stage of growth can reduce watermelon yields. Excessive heat and direct sunlight increase the likelihood of yield losses due to sunscald or sunburn, which causes yellowing of the rind. Drought may reduce watermelon yields by diminishing plant growth, limiting the development and size of the melons, and can exacerbate losses due to sunscald.

Bacterial fruit blotch, a relatively new watermelon disease in the United States, is also a major concern. It is thought to be a seedborne disease, and its symptoms include brownish scabs and eventual souring of the flesh. Yield losses can be substantial in infected fields. The disease is thought to be more serious in humid areas than in drier production areas. Since the disease appears to be seedborne, some seed companies have withdrawn their seed from the market because of concerns over liability for crop losses. The watermelon industry is working with the seed companies to establish an effective protocol for certifying disease-free seed.

Our assessment is that watermelon is a good candidate for multiple-peril crop insurance. There is likely to be a substantial demand for insurance among growers in the central and eastern U.S. growing areas, as these growers face a considerable array of production perils, particularly when compared with Arizona and California growers. Overall, the National Watermelon Association's position is that they would like for watermelons to become a "full partner" in crop insurance in the same manner as the major field crops.

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Introduction

Watermelon is an annual vine crop grown for its large, juicy, sweet fruit. It belongs to the botanical family Cucurbitaceae (gourd family), which includes cucumbers, muskmelons, squash, and pumpkins.

Watermelon is a warm-weather crop and is grown commercially across the western and southern United States. The U.S watermelon crop had a farm value of $252 million in 1993 (USDA, NASS).

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

The Watermelon Market

Supply

USDA reported 36,740 thousand cwt (3.67 billion pounds) of U.S. watermelon production in 1993, up 1 percent from the prior year and up about 41 percent from watermelon output in 1981 (Table 1). Florida, California, Texas, and Georgia, respectively, are the leading watermelon-producing states, accounting for two-thirds of 1993 output (Table 2).[1] Although Florida is the leading producer, the largest gains in output between 1981 and 1993 occurred in California and Georgia.

U.S. watermelon production is highly seasonal, peaking from the May through August period and declining through December. The season begins with production from Florida, followed by output from Arizona, Texas, California, and the southeastern and south-central states. Florida is the only domestic source of watermelons from December through April, and then only in small quantities. Although Florida growers harvest watermelons during virtually every month, the peak season occurs during May, June, and early July.

Imports, primarily from Mexico, account for most watermelon supplies from December through April. Nearly 6 percent of the total U.S. supply was imported in 1993.

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[1] A gap exists in U.S. production statistics between 1981 and 1992 because USDA's National Agricultural Statistics Service discontinued collection of watermelon data during that period. NASS statistics do not account for all watermelon output because production is reported for only 17 states. The bulk of U.S. output is likely accounted for, however, as Census data indicate that 87 percent of the harvested watermelon acreage was located in the 17 NASS watermelon states in 1987.

Table 1--U.S. watermelon: Supply and utilization, 1970-94 1/ 2/

Year	Supply			Utilization			Season average price	
	Production 1/	Imports 3/	Total	Exports 3/	Total	Per capita use	Current dollars	Constant 1987 dollars 4/
	Million pounds					Pounds		
1970	2,737.3	119.1	2,856.4	91.2	2,765.2	13.5	2.21	6.30
1971	2,709.4	113.2	2,822.6	114.7	2,707.9	13.0	2.51	6.78
1972	2,528.0	159.1	2,687.1	103.0	2,584.1	12.3	2.50	6.43
1973	2,617.0	168.5	2,785.5	86.3	2,699.2	12.7	2.95	7.14
1974	2,346.6	166.5	2,513.1	92.9	2,420.2	11.3	3.83	8.53
1975	2,439.5	145.6	2,585.1	114.7	2,470.4	11.4	4.00	8.13
1976	2,645.9	191.5	2,837.4	84.3	2,753.1	12.6	3.27	6.25
1977	2,688.5	175.3	2,863.8	84.7	2,779.2	12.6	3.44	6.15
1978	2,527.0	199.6	2,726.6	79.9	2,646.7	11.9	3.99	6.62
1979	2,407.6	219.1	2,626.7	61.9	2,564.8	11.4	4.55	6.94
1980	2,271.6	205.7	2,477.3	51.9	2,425.4	10.7	6.59	9.19
1981	2,612.8	125.7	2,738.5	58.8	2,679.6	11.7	6.09	7.72
1982	2,733.9	237.4	2,971.4	73.9	2,897.4	12.5	5.63	6.72
1983	2,534.0	186.2	2,720.3	69.5	2,650.8	11.3	6.47	7.42

1984	3,190.5	283.4	3,474.0	65.3	3,408.7	14.4	5.34	5.87
1985	3,043.8	220.0	3,263.8	44.5	3,219.3	13.5	4.94	5.23
1986	2,929.6	197.4	3,127.0	58.2	3,068.8	12.8	6.24	6.44
1987	2,893.1	307.6	3,200.7	48.1	3,152.7	13.0	7.13	7.13
1988	3,115.5	262.4	3,377.9	59.0	3,319.0	13.5	6.50	6.26
1989	3,094.9	359.9	3,454.8	85.2	3,369.6	13.6	5.23	4.82
1990	3,187.1	228.6	3,415.7	94.4	3,321.4	13.3	6.66	5.88
1991	3,097.4	230.9	3,328.3	101.8	3,226.5	12.8	8.87	7.54
1992	3,631.0	211.4	3,842.4	212.1	3,630.3	14.2	5.94	4.91
1993	3,674.0	216.2	3,890.2	215.4	3,674.8	14.2	6.85	5.52
1994f	3,680.0	249.4	3,929.4	210.0	3,719.5	14.3	--	--

-- = not available. f = ERS forecast.

1/ Source: USDA, National Agricultural Statistics Service. Includes any processing uses. From 1982 to 1991, production estimated by ERS. Estimates based on available state data adjusted to the national level.

2/ Season average price data estimated by ERS from 1982-91. 3/ Source: U.S. Dept. of Commerce, Bureau of the Census. 4/ Deflated by the GDP implicit price deflator, 1987=100.

Table 2--U.S. watermelon production, by state, selected years

State	1980	1981	1986	1987	1988	1989	1990	1991	1992	1993
	1,000 cwt									
Florida	7,863	8,085	8,749	7,238	9,213	8,500	9,000	7,011	9,000	8,325
California 1/	3,018	2,526	3,726	4,359	3,971	4,316	3,879	4,276	6,000	7,350
Texas 2/	3,405	4,629	5,320	4,600	6,000	5,000	6,750	6,000	5,280	5,040
Georgia	2,590	2,904	--	--	--	--	--	--	5,270	4,200
Arizona	572	679	1,350	1,534	1,500	1,976	1,748	1,732	1,782	2,015
Indiana	770	944	--	--	--	--	--	--	1,550	1,736
Missouri	288	481	--	--	--	--	--	--	1,460	1,260
North Carolina	600	554	456	651	714	962	1,568	1,581	1,263	1,230
Oklahoma	210	840	--	--	--	--	--	--	737	1,100
South Carolina	1,068	1,265	1,417	2,188	1,402	2,098	2,048	1,300	920	840
Alabama	747	1,055	--	--	--	--	--	--	346	819
Delaware	320	347	357	305	573	486	792	812	399	720
Arkansas	80	320	--	--	--	--	--	--	700	612
Mississippi	735	1,020	--	--	--	--	--	--	720	585
Maryland	450	479	990	768	606	484	783	702	473	527
Louisiana	--	--	--	--	--	--	--	--	330	273
Hawaii	14	16	143	138	189	135	148	141	80	108
Oregon	--	--	--	--	--	--	--	--	--	--

Illinois	--	--	--	--	--	--	--	--	--	--
Iowa	--	--	--	--	--	--	--	--	--	--
New Jersey	--	--	--	--	--	--	--	--	--	--
Virginia	--	--	--	--	--	--	--	--	--	--
Washington	--	--	--	--	--	--	--	--	--	--
Total U.S. 3/	22,716	26,128	--	--	--	--	--	--	34,871	36,740
9-State Total	17,488	19,579	22,508	21,781	24,168	23,956	26,716	23,555	25,197	26,155
Percent of U.S	77	75	--	--	--	--	--	--	72	71

-- = Estimates not available. Estimates are also not available for the 1982-1985 period.

1/ California data for 1986 to 1991 are from the California County Agricultural Commissioners' Reports.

2/ 1988-91 production is estimated based on the percent change in annual Agricultural Marketing Service shipment data.

3/ The U.S. total was discontinued from 1982 through 1991. Totals for 1980 and 1981 do not include Hawaii. The states included in the U.S. total vary over time.

Sources: USDA, National Agricultural Statistics Service and State Statistical Service Offices.

Demand

Watermelon consumption is seasonal, rising with the onset of warm weather, peaking around July 4th, and declining during the summer and fall. Watermelons are a traditional 4th of July special among grocery stores.

U.S. watermelon consumption has increased modestly in recent years, rising from about 12 pounds per person during the early 1980's to about 14 pounds during the early 1990's (Table 1). The rise in consumption may be due partly to increased availability of imported watermelons during the winter and spring, when the volume of U.S. production is small. The increased use of watermelon in restaurants and deli salad bars also may have contributed to the increase. The development of "seedless" watermelons has increased their appeal to some consumers who disliked the seeds in seeded watermelons.

The United States exported nearly 6 percent of its watermelon output in 1993. Canada was the major foreign market, receiving 98 percent of U.S. exports.

Prices

There is considerable variability in watermelon prices within the year, due mostly to seasonal changes in the volume of production. The prices that growers receive early in the season, when Florida is the principal source of domestic watermelons, may reach 10-15 cents a pound, depending on supply conditions in Florida (Table 3 and Figure 1). Prices usually reach their lowest point, at around 4-5 cents a pound, during July and August, when watermelons are available from a wide number of sources.

Watermelon prices follow a very distinct seasonal pattern during the primary U.S. shipping season, declining during May and June as shipment volume increases, remaining relatively flat through August, and strengthening during September when supplies dwindle (Figure 2). Prices for October through March are not shown in Figure 2 because of the low volume of domestic production during this period.

Industry Characteristics

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

- A significant amount of watermelon acreage is not irrigated in the southern and midwestern states, making yield losses due to drought more likely than in Arizona and California, where watermelons are universally irrigated.

- Watermelon farms in the South tend to be smaller operations, and receive a larger percentage of their farm income from watermelons, than farms in California and Arizona. Because of greater specialization, southern growers may have more interest in watermelon crop insurance as a risk management tool than growers in Arizona and California.

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

Month	1989	1990	1991	1992	1993
			$/cwt		
January	NR	NR	NR	NR	NR
February	NR	NR	NR	NR	NR
March	NR	NR	NR	NR	NR
April	NR	8.81	8.81	NR	NR
May	8.83	6.71	10.43	NR	14.02
June	5.38	6.69	6.60	5.64	7.83
July	5.97	6.71	4.77	3.99	5.89
August	4.58	5.55	4.77	4.43	5.72
September	5.60	4.50	4.00	6.38	NR
October	NR	NR	NR	NR	NR
November	NR	NR	NR	NR	NR
December	NR	NR	NR	NR	NR

NR = Not reported.

Source: Computed from USDA, AMS.table 3

- Two-thirds of all watermelon growers indicated that farming was their main occupation. Growers with farming as their main occupation are more likely to be interested in insurance as a risk management instrument than those for which farming is a secondary occupation.

The primary sources of available information on farms producing watermelons are the 1992 Census of Agriculture, a special tabulation of the 1987 Census for farms with watermelons, and USDA's 1992 Vegetable Chemical Use Survey.[2]

Farms with Watermelons

The Census of Agriculture reported 10,706 farms with 220,244 harvested acres of watermelons in 1992 (Appendix table 1). Texas reported both the largest number of farms and the greatest acreage. Other states reporting 500 or more farms with watermelons in 1992 included Alabama, Florida, Georgia, North Carolina, and South Carolina.

Forty-six percent of U.S. watermelon acreage was irrigated in 1992. All of the production in California and Arizona was irrigated and 31 percent of the acreage in Texas. Seventy-three percent of Florida's acreage was irrigated. Although much of the watermelon acreage in other southern and midwestern states is irrigated, there is a significant amount of non-irrigated acreage, which is susceptible to yield losses during periods of extreme drought.

The majority of farms with watermelons are relatively small, but the majority of watermelon production appears to be from medium- and larger-size operations. According to the 1987 Census of Agriculture, 59 percent of the farms producing watermelons had total crop sales of less than $25,000 (Appendix table 2). The largest number of small watermelon farms tends to be located in the southern states. Alabama, Arkansas, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Texas, and Virginia each reported more than half of their farms had crop sales of less than $25,000 in 1987. The major watermelon states (Arizona, California, Florida, Georgia, and Texas) all report a substantial number of farms with crop sales of $100,000 or more.[3]

Eighty-five percent of farms with watermelons in 1987 were individually- or family-owned operations (Appendix table 3). Partnerships accounted for about 11 percent of the operations and corporate farming accounted for about 3 percent. The individual- and family-owned classifications are the most common type of operation among smaller farms. Partnerships and corporate operations were more common among the larger farms.

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[2] State reports from the 1992 Census of Agriculture were not available for all states at the time this report was prepared.

[3] Crop sales exceeding $100,000 does not necessarily translate into a large watermelon enterprise because watermelons may account for only part of total crop sales.

Farming was the main occupation of the operators on two-thirds of the watermelon farms in 1987 (Appendix table 4). Operators with off-farm work tended to be concentrated among farms with sales of less than $50,000.

Income Diversification on Farms with Watermelons

Although two-thirds of farm operators indicated that farming was their main occupation, off-farm employment appears to be an important source of income diversification for a number of watermelon growers, particularly on farms with less than $50,000 of crop sales. Operators on 47 percent of all watermelon farms indicated that they worked off the farm at least one day during 1987, and 34 percent worked off the farm for 100 days or more. For a number of such operators, growing watermelons may be a part-time or sideline enterprise that supplements their off-farm income.

Returns from other enterprises provide a significant source of income diversification for farms with watermelons. Of the $773 million in market sales reported by the 1987 Census for farms growing watermelons in Arizona, California, Delaware, Florida, Maryland, South Carolina, and Texas, only 21 percent was from the sales of watermelons (Table 4). Watermelon sales accounted for about 25-30 percent of the market value of sales in Florida and Texas, but only 10 percent in Arizona and California.

USDA's 1992 survey of vegetable farms provides further evidence of diversification on farms with watermelons. Of the 121 farms sampled in Florida, all grew other vegetables or melons in addition to watermelons (Table 5).[4] In other states, at least a third of all survey farms with watermelon also produced other vegetables.

Cultivation and Management Practices

Climate

Watermelons prefer a long, warm growing season and are, therefore, produced primarily in the southern half of the United States. The optimum average temperature for growing watermelon is 70° F to 85° F, but they can tolerate average temperatures as high as 95° F. A temperature of 85° F is considered optimal for quick germination and emergence of the young plants (Nonnecke). Watermelons are relatively tolerant of high humidity and can be grown in both humid and arid conditions (Ware and McCollum). Leaf diseases, however, tend to be more destructive in humid climates.

Watermelons are very sensitive to prolonged exposure to low temperatures, and usually suffer from reduced vigor when temperatures fall below 50° F for an

[4] The high percentage of farms in Florida with both vegetables and melons may have been the result of the sampling technique, which focused more heavily on farms in south Florida, where the production of watermelons in combination with other vegetables is a common practice.

Table 4--Market value of sales on farms producing watermelons, selected states, 1987

State	All products	All crops	Vegetables & melons	Water-melons	Watermelons, % of all products
	---------	-----1,000 dollars----------			Percent
Arizona	77,543	65,873	28,725	7,869	10
California	216,960	214,223	130,375	22,231	10
Delaware	22,147	7,210	3,982	1,922	9
Florida	245,707	223,858	159,831	68,254	28
Maryland	25,738	14,679	9,067	7,409	29
South Carolina	32,729	25,751	9,184	8,664	26
Texas	152,206	131,958	80,580	43,010	28
Seven states	773,030	683,552	421,744	159,359	21

Sources: All data are from the 1987 Census of Agriculture, except for watermelon sales, which are computed from production and prices reported in Allred, et. al.

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

State	Farms sampled	Farms growing both watermelons and other vegetables	Watermelons, percent of total vegetable acreage
	Number	Percent	Percent
Arizona	32	39	23
California	65	38	19
Florida	121	100	71
Georgia	163	63	92
North Carolina	97	48	58
Texas	143	44	83

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

extended period (Rutledge). Watermelon seeds germinate poorly when the soil temperature is below 59° F (Yamaguchi).

Soil Requirements

Watermelons prefer well-drained, sandy loam soils which are slightly acidic or neutral, with a pH in the 6.0 to 7.0 range. Watermelons will also do well on other types of soils as long as adequate water is available and good drainage is provided. Good drainage in the soil is essential to prevent root rots (Nonnecke). Fruit size and quality may be adversely affected by heavy clay soils.

Varieties

Approximately 50 varieties of watermelons are produced commercially in the United States. Although the traditional open-pollinated varieties, such as Crimson Sweet, Jubilee, and Charleston Grey, are still widely grown, growers are increasingly using hybrid varieties (both seeded and seedless), such as Fiesta, Royal Sweet, and King of Hearts. Most varieties fall into one of the following classes: Charleston Grey, Jubilee, Crimson Sweet, Allsweet, Peacock/Klondike, Icebox, Triploid Hybrid "Seedless," and Yellow Meat.

Charleston Greys are long melons weighing 28-35 pounds. The rinds are light grayish-green with dark green veins, and their flesh is bright red. Grown on the East Coast and in the central United States, the main varieties include Charleston Grey, Royal Charleston, Prince Charles, Calhoun Grey, and Charlee.

Jubilees are oblong, and weigh an average of 20-45 pounds. Rind coloring is light green with dark green stripes and their flesh is bright red and firm. Jubilees are popular in the eastern and central United States. The main varieties include Jubilee, Jubilation, Au Jubilant, and Royal Jubilee.

Crimson Sweets are round to oval in shape, with a light green rind that is mottled with dark stripes. Their flesh is red, and they weight an average 16-35 pounds. They are adapted to the East Coast and central United States. The main varieties include Crimson Sweet, Royal Sweet, Au Producer, Mirage, and Huck Finn.

Allsweets are long, red-fleshed melons with a light green rind and dark green mottled stripes. Their average weight ranges from 18-40 pounds. Another watermelon class best grown in the central and eastern United States, primary varieties include Allsweet, Sangria, and Sunsweet.

The Peacock/Klondike class consists of red-fleshed melons having striped, light green rinds with irregular dark green stripes. Peacock-Klondike melons are medium-large and oblong in shape, and weigh 15-25 pounds. Grown mostly in Mexico and on the West Coast, varieties include Peacock, Picnic, Klondike, and Calsweet.

Icebox melons may have dark or light rinds. They are small-to-medium in size and usually weigh 5-15 pounds. The main varieties in this class include Sugar Baby, Mickeylee, Minilee, Petite Sweet, and Yellow Doll.

Triploid Hybrid "Seedless" melons may have red or yellow flesh and are oval to round in shape. Seedless melons are mostly striped and weigh 10-15 pounds. Varieties include Sun World Seedless, King of Hearts, Jack of Hearts, Queen of Hearts, Crimson Trio, Nova, Laurel, and Farmers Wonderful.

Yellow Meat varieties are mostly long with striped or light-colored rinds, and flesh ranging in color from bright orange, to pale yellow, to bright canary yellow, depending on the variety. Weights range from 15-30 pounds. Produced mostly in the southern United States, they are generally grown for local consumption due to their poor shipping quality. The main varieties in this class include Desert King, Tender Sweet, Orangeglo, and Tendergold.

Planting

Watermelon can be either direct-seeded or transplanted. When direct-seeding is used, growers generally overplant and then thin to the desired number of plants per acre after the young plants have become established. This helps insure the desired plant population, although it also makes the use of expensive hybrid seeds very costly.

The high cost of seed has led to increased use of transplants when growing hybrid cultivars. In particular, the seedless varieties are primarily transplanted because of high seed costs and because they tend to be harder to establish by direct seeding than the seeded varieties.

Use of transplants not only reduces seed costs, it also offers the potential for an earlier harvest. That is, growers may use transplants if they are trying to have melons mature early in order to benefit from generally high early-season prices. Transplanted watermelons grown with plastic mulch may mature up to two weeks earlier than direct-seeded melons grown without mulch.

The choice of between-row and within-row spacings of the plants depends on the intensity of management, the soil's productivity, and the desired melon weight. Under dryland farming situations, particularly on sandy soils, 45 to 50 square feet per plant may be required to insure adequate melon size for standard-size cultivars such as Jubilee or Crimson Sweet.

On the other hand, under intensive management (using irrigation and plastic mulch), spacings of 25 to 30 square feet per plant have increased overall yield without significantly reducing melon weight or quality. Ice-box type melons may be planted as close as two feet in the row, with rows five feet apart (University of Georgia).

The usual planting and harvesting dates for watermelons are summarized in Table 6. In many states, planting occurs between March and May. Harvesting generally takes place from early to late summer.

Table 6--Usual planting and harvesting dates for watermelons

State	Planting date	Usual harvest date		
		Begin	Most active	End
Alabama	Mar. 15-May 15	Jun. 10	Jun. 20-Aug. 31	Sep. 30
Arizona	Jan 20.-Mar. 5	May 15	Jun. 1-Jul. 31	Aug. 15
Arkansas	Apr. 10-May 20	Jul. 1	Jul. 15-Aug. 31	Sep. 30
California	See "California" state analysis section.			
Delaware	Apr. 20-May 15	Jul. 15	Jul. 25-Sep. 15	Sep. 30
Florida	Dec. 15-Mar 31	Apr. 10	May 1-Jun. 30	Jul. 15
Georgia	Feb. 15-Apr. 15.	Jun. 15	Jun. 15-Aug. 15	Sep. 15
Indiana	May 10-Jun. 15	Jul. 20	Aug. 1-Sep. 10	Sep. 30
Maryland	Apr. 20-May 15	Jul. 15	Jul. 25-Sep. 15	Sep. 30
Missouri	Apr. 5-May 10	Jul. 5	Jul. 15-Aug. 31	Sep. 5
Mississippi	Mar. 10-May 25	Jun. 20	Jun. 30-Aug. 10	Sep. 10
N. Carolina	Mar. 28-May 6	Jul. 1	Jul. 15-Aug. 20	Sep. 10
Oklahoma	Mar. 15-May 15	Jul. 5	Jul. 15-Aug. 20	Sep. 15
S. Carolina	Mar. 10-May 15	Jun. 20	Jul. 1-Aug. 10	Sep. 30
Texas	Jan. 15-Apr. 30	May 15	Jun. 1-Aug. 15	Sep. 15

Source: USDA, Statistical Reporting Service.

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

Fertilization

Watermelons require moderate amounts of nitrogen (N), phosphorus (P_2O_5) and potassium (K_20). Soil tests are generally used to indicate the availability of nutrients in the soil prior to fertilizer application. Watermelons are a relatively long-season crop, and many nutrients can be leached from the soil, especially from sandy soils, during the growing period. Therefore, split applications of most nutrients are made to reduce leaching losses.

Irrigation

Irrigation is generally necessary for consistently high yields and quality because of the plant's limited root depth and because watermelons are commonly grow on sandy soils with low water-holding capacity.

Water deficits during establishment reduce plant vigor and may delay maturity. In severe situations, plants may die. Water stress in the early vegetative stage may reduce leaf area and decrease yield. The most serious yield reductions result from water stress during flowering and fruit development. Although lack of water at harvest may result in misshapen melons, applying excessive water after stressed melons have reached 10-15 pounds in size may cause them to split or burst.

Most irrigation in the southeast United States is done with sprinklers. Drip irrigation is gaining in popularity, however, because it uses water more efficiently than sprinkler irrigation. Studies in Florida indicate that 40 percent less water is required to drip irrigate than to irrigate with sprinklers (University of Georgia).

In California and Arizona, furrow irrigation is the most common method of irrigation. Some growers use sprinkler irrigation to aid in germination, and then switch to furrow irrigation. Some growers do, however, use drip systems.

Pollination

Flowers develop on watermelon plants at the ratio of about seven to ten male flowers to one female flower. Because insects, usually bees, pollinate the flowers, one to two bee colonies per acre should be placed in the field when male flowers begin to appear. A watermelon plant seldom produces more than 2-3 harvestable melons. Poor or inadequate pollination may reduce fruit set and result in a higher incidence of misshapen melons, thereby reducing yields (University of California Division of Agricultural Sciences; University of Georgia).

Triploid Hybrid "Seedless" Watermelons

Although called seedless, the triploid hybrid watermelon has small, edible remnants of empty ovules (unfertilized seeds) in the flesh.[5] Triploid seed is less vigorous than the normal diploid seed and requires, therefore, more nearly optimal conditions for germination. Seedless varieties need a temperature of roughly 80° F for gemination. Growers frequently use transplants started under greenhouse conditions to insure maximum germination. Because the seedless watermelon is male sterile and requires the presence of a pollen donor, a pollinator variety must be planted with the seedless variety. Usually every third row is planted to a seeded type. The seeded type should have a fruit shape or color distinctly different from that of the seedless variety to avoid confusion at harvest. As with the seeded varieties, bees are required at pollination to produce quality melons.

The seed for the seedless-type watermelon is usually quite expensive, costing around $750-$1000 per pound. Transplanting and the complex pollination process can also be more costly for seedless watermelons than for seeded varieties. However, production of seedless melons is widespread in California and increasing in other areas due to their higher market value when compared with the seeded types.

Harvesting

The length of the growing season varies with the variety grown, the time of year planted, and the type of cultural practice. Long-season varieties transplanted during cool weather may require up to 130 days before harvest. Short-season varieties transplanted after soil temperatures have reached optimum levels, on the other hand, may yield mature melons in as little as 70 days. Using clear plastic mulch to help warm the soil and planting with transplants to reduce the establishment time may reduce the growing season by up to two weeks.

Watermelons are cut from the vine, rather than being pulled or broken off. Harvesting crews typically consist of 2 or 3 cutters, 4 to 6 loaders, 2 stackers, and one truck driver. The cutters select ripe melons and cut and place them along in-field roadways. Loaders pick up and pass the harvested melons to stackers located on a wagon or field truck. The melons are then hauled out of the field to a waiting over-the-road tractor-trailer for bulk loading or to a nearby packingshed for bin- or carton-packing.

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[5] The triploid (3X) watermelon is produced by crossing a diploid (2X) plant with a tetraploid (4X) plant, which is obtained by colchicine (growth hormone) treatment of a diploid (2X) plant. "Ploidy" refers to the degree of duplication of individual chromosomes in the vegetative cells of a plant. Diploid plants, for example, contain two of each chromosome, triploid plants contain three, and tetraploid plants contain four. At pollination, a regular diploid plant is required to fertilize a tetraploid pistillate flower.

Because watermelons in a given field ripen at different times, growers need to harvest several times to achieve maximum yields. The first harvest yields the largest and highest-quality melons. Size and quality generally decline with successive harvests and costs rise because the harvesting crew must glean a larger area to collect a load of melons.

Packing and Shipping Fresh Watermelons

The standard method for handling watermelons has been bulk loading, which involves stacking the melons on a bed of straw on over-the-road tractor-trailers. Increasingly, watermelons are packed in bins (made of corrugated fiberboard and holding around 1,100 pounds) and cartons (holding 3-5 melons). Bins and cartons offer labor savings in unloading because they permit unitized handling. In addition, they result in better quality because the added physical protection offered by the packaging reduces melon bruising and bursting.

Marketing

Growers use a number of different marketing methods to sell watermelons: (1) selling the field, (2) selling wholesale through farmers' markets, (3) retailing through direct marketing outlets, (4) selling direct to truckers or stores, and (5) selling through brokers or shippers.

The field method of sales, whether by the acre or by the pound, requires the grower to locate a buyer who is willing to purchase the entire field. Many growers prefer to sell their entire field because it involves less time and management than other methods of sale. Often, the buyer does the harvesting.

In selling wholesale through a farmers' market, the grower is responsible for harvesting and hauling the melons to the market. This the most common sales method in Georgia. Over half of the annual Georgia volume goes through the state farmers' market at Cordele, Georgia.

Overall, however, retailing through farmers' markets, road-side stands, and pick-your-own operations accounts for a small share of total watermelon volume. With these methods, the grower is responsible for all marketing functions--harvesting, transporting, and selling. Although growers may receive a higher price than for watermelons sold wholesale, large-acreage growers do not retail their melons because of the large time and labor requirements.

Direct sales to truckers or to grocery chains is a practice used throughout the central and southern states. This method requires that growers have contacts and be able to meet the buyers' needs in terms of volume, variety, and timing of maturity.

Sales through brokers or shippers is the most common practice in Florida and California. Because they have contacts in the major markets, brokers and shippers can sell large volumes of melons over an extended period of time.

Their contacts with both producers and buyers allow for matching buyers' needs with producers' supplies.

Costs of Production

Cost of production data indicate the costs incurred by producers at different stages in the growing cycle. The cost of production data for watermelons also illustrate that the value of melons in the field is much less than their value at the first delivery point, a situation which in some circumstances may create the potential for moral hazard.

A large share of total costs for watermelons are variable expenses at the time melons are to be harvested (Table 7). In most areas, harvesting and marketing account for 40-60 percent of total costs.

Production Perils

The major production perils affecting watermelons include excessive rain, which can promote disease growth, excess heat, and in non-irrigated areas, drought.

Excessive Rain

Excessive rain, particularly when accompanied by other critical environmental factors, can affect the watermelon plant at every stage of growth. For example, germination can be reduced if excess rain is accompanied by cool weather at planting time, causing seed rot. Cool, wet weather following emergence of the watermelon plant increases the incidence of damping-off, which also reduces plant survival. Periods of warm, wet weather increase the incidence of foliar diseases such as anthracnose and downy mildew. Excessive rain as watermelons approach maturity can cause white heart (a physiological disorder), lower the melons' sugar content, and result in bursting of the fruit. Flooding, of course, can kill watermelon plants if the roots are submerged in water for a day or more.

Excessive Heat

Excessive heat and direct sunlight increase the likelihood of yield losses due to sunscald or sunburn, which causes yellowing of the rind. Normally, watermelon vines provide a protective canopy that shades the melons from direct sunlight. Any disturbance of this protective canopy, such as drought, harvesting activities, or diseases, increases the chance of sunscald damage.

Excessive Cold

Cold temperatures may reduce seed germination. If accompanied by excessive moisture, cold temperatures may cause severe plant losses due to seed rot and damping-off. Replanting may be necessary in such situations.

Table 7--Watermelons: Variable harvesting costs, selected states

State/Area	Yield	Variable harvest cost	Total cost	Variable harvest percent of total
	Cwt	$/acre	$/acre	Percent
Arizona:				
Central-Maricopa	320	614	1,385	44
South Central-Pima/Pinal	320	824	1,572	52
Western-La Paz/Yuma	340	1,128	1,896	59
California:				
Imperial	260	780	2,012	39
Western Riverside (Seeded)	400	860	1,978	43
Western Riverside (Seedless)	360	774	2,270	34
Florida:				
Southwest	340	1,003	3,279	31
North	325	748	2,111	35
Manatee/Ruskin	320	816	2,161	38
Alachua/Levy	300	690	1,301	53
Georgia 1/	400	700	1,545	45
Missouri	170	264	623	42
South Texas:				
Irrigated	150	450	1,029	44
Dryland	100	300	691	43

1/ Georgia costs are an average of drip and sprinkler irrigation.

Sources: University of Georgia Cooperative Extension Service; Wade, et al.; Takele and Baameur; Smith and Taylor; University of Missouri Cooperative Extension Service; Texas Agricultural Extension Service.

Drought

Drought may reduce watermelon yields by affecting plant growth, limiting the development and size of the melons. In severe situations, plants may die. Drought can also exacerbate losses due to sunscald.

Hail

Hail damages young watermelons by causing scars on the rind. Although the damage is only skin deep, a grower can not sell scarred watermelons because brokers will not handle them if scar-free melons are available.

Insects

The most common insect pests affecting watermelons include root maggots, cutworms, cucumber beetles, aphids, thrips, and melon worms. Some cultural practices reduce the potential for economic injury by certain insects. Planting watermelons when optimum growing conditions insure rapid seedling growth, for example, minimizes the period when plants are vulnerable to injury from seedling insect pests, such as cutworms and root maggots. Spring plantings harvested by early July escape the period when many insect pests pose their greatest economic threat.

Aphids

Aphids are soft-bodied (usually wingless) insects that feed on the undersides of the leaves with their piercing-sucking mouthparts. The leaves of plants curl downward as the aphids suck the plant sap. Heavy populations cause plants to turn yellow and wilt.

Aphids secrete a substance known as "honeydew," which collects on the surface of the lower leaves. Under favorable conditions, honeydew promotes the growth of sooty mold, a fungus that blackens the leaf surface. Sooty mold reduces the plant's ability to photosynthesize, thereby reducing melon quality and/or yield. Aphids also transmit several viruses that can reduce melon quality. Foliar insecticides are effective in aphid control.

Cucumber Beetles

Cucumber beetles feed on the stems and leaves of young watermelon plants and transmit bacterial wilt disease. Bacterial wilt is one of the more damaging diseases of watermelons. Cucumber beetles can be controlled with foliar insecticides.

Cutworms

Cutworms feed on all plant parts, but the most severe damage occurs when they chew on the stems of newly emerged seedlings, severing the young plants from their roots. Maturing melons may also be affected, although damage is usually confined to superficial trails or patches of tan or russet callus tissue on the rind, which diminish the visual appeal of the melon.

Root Maggots

Root maggots tunnel in the seeds, or the roots and stems of seedlings, causing the seed to fail to germinate or the infected seedlings to wilt or die. Because cool, wet conditions and soils rich in organic matter provide the most favorable environment for maggot growth, early spring plantings are most vulnerable to their attack. Maggots can be controlled by plowing litter and weeds deeply into the soil several weeks prior to planting, so there is adequate time for decomposition and the application of recommended soil insecticides.

Spider Mites

Spider mites are very small spiders found on the undersides of the leaves. Mites reproduce very rapidly, completing a life cycle in five days when the temperature is 75° F or above. As a result, they can become very numerous in a short period of time.

Mites feed by sucking sap from the plants, and if present in large numbers, they stress the plant, reducing vigor and eventually yield. Mites reproduce most rapidly during hot, dry weather. Mites can be controlled with miticide sprays.

Rindworm

Rindworm refers to any worm that attacks the rind of the melon, the most common of which are cutworms, corn earworms, loopers, beetworms, and armyworms. When rind damage occurs, it is important to correctly identify the culprit and treat for that specific insect.

Thrips

Thrips are very small, spindle-shaped insects that reach a maximum length of 1/10-inch. Certain thrip species cause early foliage damage, while others are present during the period of heavy fruit set. Thrips damage plants by rasping the leaf surface during feeding. Severe damage usually occurs only during periods of slow growth. Damage is quickly outgrown when the plant is growing rapidly, and usually no treatment is required. If treatment is necessary, thrips can be controlled with foliar insecticide applications.

Nematodes

Root knot nematodes are small, eel-like worms which live in the soil and feed on plant roots, impairing the plants' ability to take up water and nutrients. Moreover, they allow diseases like fusarium wilt to enter the plant. Serious root-knot injury results in stunted, wilted growth, a galled-root system, and reduced yields.

Root knot nematodes remain a major problem in commercial watermelon production because there are no easy-to-use nematicides. Applying fumigants effectively

reduces nematode populations, but the waiting period after application often delays seeding until after optimum planting dates.

Animal Pests

Field mice and rats can destroy watermelon seeds before germination. The fungicide thiram, when used as a seed treatment, is a good repellent against mice and rats. When plants are emerging, deer can cause substantial losses by feeding on the young plants. Later in the season, crows, coyotes, deer, and raccoons can feed on ripe melons and cause yield losses just before harvest.

Many devices, such as aluminum foil strips, shiny can lids hung from poles, and carbide explosive devices, are used with varying degrees of success to keep pests out of melon fields. Losses due to coyotes, deer, and raccoon eating ripe melons usually represent a relatively small part of the crop.

Diseases

Bacterial Fruit Blotch

Bacterial fruit blotch is a relatively new watermelon disease in the United States. It is thought to be a seedborne disease, and its symptoms include brownish scabs and eventual souring of the flesh. These symptoms appear about the time that the melons mature. Yield losses can be substantial in infected fields. The disease is thought to be more serious in humid areas than in drier production areas.

Since the disease appears to be seedborne, some seed companies have withdrawn their seed from the market because of concerns over liability for crop losses. The watermelon industry is working with the seed companies to establish an effective protocol for certifying disease-free seed (Childers). The possibility of not being able to obtain adequate seed during the 1995 season is a present concern among watermelon growers.

Bacterial Wilt

Bacterial wilt causes runners to wilt, and eventually causes the entire plant to die. It is transmitted by cucumber beetles feeding on the young watermelon plant. Prevention consists of controlling cucumber beetles with foliar insecticides.

Anthracnose

Anthracnose, a fungal disease, can infect all above-ground parts of the plant at any stage of growth. Disease symptoms are first noticed as reddish-brown spots on the oldest leaves. Eventually, round, sunken, water-soaked spots appear on the fruit, that turn a dark green to brown color. Infected plants may die, especially following several days of warm, rainy weather.

There are three types of the anthracnose fungus, known as races 1, 2, and 3. Some watermelon varieties show resistance to some races of anthracnose. Race

2 has caused serious damage among watermelons in the Southeast in recent years.

Damping-Off

Damping-off is a seedling disease in which the stems of young plants rot at the ground level and die. Damping-off is most serious in the presence of cool, wet weather, which retards rapid seedling emergence and early plant growth. In some years, the disease can reduce stands by up to 50 percent, while in other years, losses are very rare. Seed treatment and the use of cultural practices that encourage young plant growth are essential in preventing damping-off.

Downy Mildew

Downy mildew, a fungal disease, attacks the leaves of watermelon plants, causing lesions and wilting. Under conditions favoring the spread of downy mildew, an entire field may become infected. Downy mildew is not a problem in every year, but growers must monitor their plantings frequently for signs of the disease. Downy mildew can be controlled with fungicide sprays.

Powdery Mildew

Powdery mildew also affects only the leaves, causing white, powdery mold on the leaf surfaces. Powdery mildew can be controlled with fungicide sprays.

Watermelon Mosaic Virus

Watermelon mosaic virus is an aphid-transmitted disease that causes plant stunting; a bumpy, mottled appearance on the fruit; and reduced yields. Extended high temperatures promote development of this disease.

Fusarium wilt

Fusarium wilt, a soil-borne, fungal disease, is widespread in many fields in all watermelon areas. Infected plants develop wilt symptoms and decline or die. The only practical control is crop rotation and the use of resistant varieties. Wilt-resistant varieties, however, are not completely immune to the fusarium fungus, so it is desirable to use land on which fusarium-susceptible crops have not been grown for a minimum of 8-10 years.

Verticillium Wilt

Verticillium wilt, commonly known as cotton wilt, does not normally kill the entire plant, but it can cause reduced yields. Most watermelon varieties are not resistant to verticillium wilt, so the best control is to plant on soil that has not been infected with the disease.

Physiological Disorders

Blossom-end rot

Blossom-end rot is a physiological disorder caused by a calcium deficiency and/or moisture stress. The incidence of blossom-end rot is limited to isolated melons in the field and tends to occur more readily in oblong melons. Watermelons having blossom-end rot are unmarketable. Prevention includes applying adequate amounts of calcium and maintaining a uniform and sufficient supply of moisture.

Hollow Heart and White Heart

Hollow heart and white heart are physiological disorders that are influenced by genetics, the environment, and several nutritional factors. The incidence of hollow heart and white heart can be lessened by planting less-susceptible varieties, and by producing the crop under near-optimal conditions. Hollow heart and white heart lower watermelon quality and may be severe enough to cause melons to be rejected by potential buyers.

Sunscald or Sunburn

Sunscald (sunburn) damage is caused when the rinds are exposed to intense sunlight. Sunscald lowers quality by making the melons less attractive and may cause them to rot. Buyers usually will not purchase watermelons with sunscald damage. Sunscald can be avoided if the plants develop and maintain a leaf canopy that shades the melons from direct sunlight. Sunscald is more serious among darker-colored varieties, such as Sugar Baby, Peacock, and the Allsweet varieties, than among the lighter-colored ones, including Charleston Greys and Jubilees.

Weeds

If not controlled continuously, weeds can reduce watermelon quality and yields. Weeds compete for sunlight and moisture and create conditions favorable for disease and insect growth.

Weed control consists of hand weeding, mechanical cultivation, and the use of herbicides. Increasingly, growers are using black plastic mulch and herbicides as a weed control method. Plastic mulch controls weeds within the rows, while herbicides are used for weed control between the rows.

State Analyses

Alabama

The Census of Agriculture reported 671 farms in Alabama with 8,023 acres of watermelons in 1992. Only about 11 percent of the acreage was irrigated. Alabama watermelons had a farm value of $4.5 million in 1993.

Most counties in Alabama report some watermelon acreage. Noteworthy acreage is evident in Autauga and Chilton counties in central Alabama, Geneva and Houston in the southeast, Mobile and Baldwin in the southwest, and Jackson, De Kalb, Cullman, and Blount counties in the northeast.

Cultural Practices

Most watermelons in Alabama are direct-seed planted during late March and early April. Growers in south Alabama plant earlier than those in the northern part of the state. Few, if any, growers use plastic mulch (Dangler). Growers usually plant in fields that have not been planted to watermelons for a number of years to reduce insect and disease problems. The most widely grown varieties are Jubilee and Jubilant. Crimson Sweets are also planted in Alabama.

Alabama watermelons are generally harvested from late June through August. About 90 percent of Alabama's watermelon harvest is marketed through broker-shippers (Ware). A small percentage of the crop is direct marketed through pick-your-own operations, farmers' markets, and roadside stands (Dangler).

Yields are relatively low in Alabama. One source estimated the average yield at about 6 tons per acre, compared with a U.S. average of 9.35 tons in 1993 (Dangler).

Production Perils

The most serious production perils for watermelons in Alabama include anthracnose, fusarium wilt, downy mildew, and other diseases (Dangler). Bacterial fruit blotch also was mentioned as a major grower concern.

Drought and excessive rainfall were cited as the main weather-related perils (Walker, Ware). Drought was cited as the main cause for disaster payments to watermelon growers during 1993.

Industry Organizations

The Alabama Watermelon Growers Association was established for the exchange of information among growers and shippers and to promote Alabama watermelon sales. The organization currently has about 20 active members, 15 of whom are growers. The other active members are grower-shippers, financial institutions, and truck brokers (Ware).

The Alabama Watermelon Growers Association does not collect yield data for individual growers. The only source of historical yield data for individual growers is likely to be the growers themselves (Dangler).

Demand for Crop Insurance

There is likely to be substantial interest among Alabama growers in watermelon crop insurance. Growers in recent years appear to have incurred substantial

yield losses. Relatively large disaster assistance payments were made in 1992 and 1993, reaching 48 percent of the value of the crop.

Planted and harvested acreage statistics for the state also suggest that crop losses were relatively high in recent years. Only 64 percent of the planted watermelon acreage was harvested in 1992, and 70 percent was harvested in 1993 (Table 8). For the U.S. as a whole, 85 percent and 87 percent of the planted acreage was harvested in 1992 and 1993, respectively.

Both the Alabama Agricultural Extension Service and the Alabama Watermelon Growers Association indicated that growers would be interested in purchasing crop insurance for watermelons (Dangler, Ware).

Arizona

The Census of Agriculture reported 91 farms with 6,099 acres of watermelons in Arizona in 1992, little changed from the 89 farms and 6,016 acres reported in 1987. All watermelon acreage in the state is irrigated. The farm value of Arizona watermelons was $14.7 million in 1993.

Most of Arizona's watermelons are grown in central Arizona, near Phoenix. Maricopa County and Pinal County have the largest acreages, with Yuma county in western Arizona ranking third in acreage in 1992. The size of watermelon enterprises varies from 5 acres or less to over 500 acres (Duncan). Most farms also plant other crops, such as cotton, wheat, other melons, and vegetables (Oebker).

Cultural Practices

Watermelons are mostly planted from seeds in Arizona, although planting with transplants is becoming more widespread as seedless watermelon acreage increases. Seeded watermelons still account for the largest acreage. The most common seeded varieties are Calsweet, Sangria, and Jubilee. The most common seedless varieties include Trix 313, Firecracker, and Tiffany.

Watermelon seeds in Arizona are planted in February and early March. Transplants are planted mostly in March. Watermelons are harvested from late June through July. If prices are unusually low, producers may only harvest their fields one or two times, instead of the usual three times.

Production Perils

Uncertainty concerning the availability of seed is the greatest production problem at the present time. Some companies have withdrawn their watermelon seed from the market because of liability concerns related to bacterial fruit blotch (Oebker).

Natural disasters are not seen as serious production perils in Arizona. Since all the watermelon acreage is irrigated, drought is considered a minimal risk. Some disaster assistance payments, however, were made for losses due to

Table 8--Watermelons: Planted and Harvested Area, by State, 1977-81 Average, 1992, and 1993

State	1977-81			1992		1993	
	Planted	Harvested	Harvested, % of planted	Planted	Harvested	Harvested, % of planted	Planted Harvested
	Acres	Acres	Percent	-----Acres-----		Percent	-----Acres----- Percent
Alabama	10,000	6,400	64	9,000	6,300	70	
Arizona	6,600	6,600	100	6,500	6,500	100	
Arkansas	3,500	3,500	100	3,400	3,400	100	
California	15,000	15,000	100	17,500	17,500	100	
Delaware	2,200	1,900	86	2,000	2,000	100	
Florida	53,000	45,000	85	42,000	37,000	88	
Georgia	42,000	34,000	81	37,000	30,000	81	
Hawaii	640	640	100	480	480	100	
Indiana	6,500	6,200	95	6,300	6,200	98	
Louisiana	3,000	2,200	73	3,000	2,100	70	
Maryland	3,300	2,700	82	2,900	2,700	93	
Mississippi	9,000	7,200	80	8,000	6,500	81	
Missouri	8,300	7,300	88	6,800	6,300	93	
North Carolina	10,900	10,100	93	9,000	8,200	91	

Oklahoma	89	15,000	11,000	73	13,000	11,000	85
South Carolina	85	14,200	11,500	81	10,500	8,000	76
Texas	91	51,000	44,000	86	47,000	42,000	89
United States	90	254,140	215,240	85	224,380	196,180	87

Note: Abandonment may be caused by not only low yields, but also low prices. However, to be reported as planted, but not harvested, the acreage would not have been picked even once during the season. With economic abandonment, one harvest pass-through would likely occur during the season; later pickings would not be made.

Source: USDA, NASS, *Annual Vegetables*.

drought in 1988. Total disaster payments averaged only 0.2 percent of the crop value during 1992 and 1993.

Verticillium and fusarium wilts are reported as production problems in Arizona. However, other diseases and insects do not appear to be major problems (Duncan).

Industry Organizations

The California-Arizona Watermelon Association represents watermelon producers in Arizona. The association promotes growers' interests in public affairs and other matters.

The Arizona Citrus, Fruit, and Vegetable Standardization Agency inspects all fruits and vegetables shipped by Arizona handlers. The program is funded by grower assessments based on the volume of shipments. The agency also assembles a record of acreage, with both acreage and volume reported in the past for each shipper. Although the agency no longer plans to publish acreage and volume data for each shipper, it still collects these data and indicated they could be released with the shipper's permission for actuarial purposes (Foster).

Demand for Crop Insurance

One grower indicated that he thought there would be substantial demand for watermelon insurance in Arizona (Duncan). One horticulturist, however, did not expect much demand for crop insurance among Arizona watermelon producers (Oebker). He thought growers would generally choose to self-insure because watermelons are often one of several crops produced on a farm. In addition, Arizona growers collected only $70,000 in disaster payments between 1988 and 1993--about 0.2 percent of the crop's value--providing further evidence that they face limited yield risks and, therefore, may not have great interest in buying watermelon insurance. Lastly, Arizona growers normally harvest 100 percent of their planted acreage, indicating that they generally do not have significant crop losses (Table 8).

California

California ranked second in watermelon production in 1993, accounting for one-fifth of U.S. output. The Census of Agriculture reported 327 farms with 16,224 acres of watermelons in California in 1992, all of which were irrigated. The farm value of California's watermelons was $57.8 million in 1993.

The greatest concentration of watermelon acreage is in the San Joaquin valley of central California, including Kern, San Joaquin, Merced, and Stanislaus counties (Appendix table 5). Kern county accounted for 34 percent of California's production. Other major watermelon counties include Imperial (19 percent of state production), San Joaquin (12 percent), Riverside (10 percent), Stanislaus (10 percent), Merced (6 percent), and Sutter (4 percent).

California is the leading state in the production of seedless watermelons. Reportedly, seedless watermelons account for one-quarter to one-half of California's total watermelon production (Hartz, Childers). Although seedless watermelons usually yield less than the seeded types, they sell for a higher price and earn a larger return to the grower. Data for Kern county in 1993 indicate that seeded watermelons returned an average gross value of about $3,100 an acre, while seedless types returned about $4,000 (Browne).

Cultural Practices

The earliest of California's watermelons are grown in the desert valleys of southern California in Imperial and Riverside counties. They are seeded in January, February, and March (Table 9). Plantings are made in March, April and May in the San Joaquin Valley.

To enhance seed germination, early plantings in the desert areas are made on sloped beds that face toward the south to maximize the warming effect of the sun in the seed zone. Asphalt emulsions, sprayed over the row in a 6-8 inch band after planting, may also be used as a means of enhancing the seed zone temperature to promote rapid germination.

The length of the growing period from seeding to first harvest varies from 130 days or more for early plantings to 100 days or less for later plantings. Harvesting extends from May in the desert valleys through October in the San Joaquin and Sacramento valleys (Tables 9 and 10). Melons are usually harvested two or three times during the season at five-day intervals.

Production Perils

Excessive heat, which may contribute to sunscald damage, and extended cold weather at planting time, are the major weather perils in California. Extended periods of cold weather increase the incidence of seed rot and damping-off among watermelon seedlings.

The most common insect pests are aphids, cutworms, and spider mites (University of California Division of Agricultural Sciences). Root knot nematodes are a common problem among watermelons in California and can be a serious production peril in sandy soils (University of California Division of Agricultural Sciences). The most serious watermelon diseases in California include fusarium wilt, verticillium wilt, and watermelon mosaic virus.

Marketing

Almost half of California's watermelon crop is marketed within the state, while much of the remainder is shipped to the Pacific Northwest and the Mountain states, and to western Canadian markets. Part of California's advantage in these markets may be the state's proximity and the associated relatively low transport costs. Watermelons are a bulky commodity and the costs of transportation likely play a key role in determining competitive advantage.

Table 9--Usual planting and harvesting dates for watermelons in California

Region	Season	Planting	Harvesting
Desert valley (Imperial & Riverside counties)	Late Spring	Jan. 1-Mar. 31	Late May-July
San Joaquin Valley	Early Summer	Mar 15-May 15	July-Oct.

Source: *Marketing California and Arizona Melons*.

Table 10--Usual shipping dates for watermelons from California

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Imperial Valley					+	++						
Palo Verde					+	++	+					
San Joaquin & Sacramento Valleys							+	+++	+++	++	*	

* Very low volume
+ Light volume
++ Moderate volume
+++ Heavy volume

Source: *Marketing California and Arizona Melons*.

Watermelon Organizations

The California-Arizona Watermelon Association represents watermelon producers in California. The association's function is to promote growers' interests in public affairs and other matters.

Sources of Yield Data

The County Agricultural Commissioners in California maintain a complete list of current watermelon growers in each county. The California Department of Food and Agriculture requires that growers obtain permits through the County Agricultural Commissioners' offices to apply chemicals to crops. The Agricultural Commissioners maintain acreage records on all those growers who have obtained a permit to spray agricultural chemicals.

Demand for Insurance

Interest in watermelon insurance is likely to be limited among California growers. Drought is not considered a production peril because all of their watermelons are grown on irrigated land. Excessive rainfall is not a peril because the rainy season is between November and April, when few watermelons are grown. Consequently, growers face a relatively limited array of weather-related production risks.

The small amount of disaster payments to California growers for watermelons (0.1 percent of the value of the crop during 1992 and 1993) and the high percent of planted acreage which is harvested (usually 100 percent) provides further evidence of the relative lack of weather-related production perils (Table 8).

An additional reason California growers may not be very interested in buying watermelon insurance is that most are relatively well-diversified among watermelons and other crops. This provides them with a degree of risk management flexibility, and puts them in a relatively good position to self-insure.

Florida

Florida is the leading watermelon-producing state, accounting for 23 percent of U.S. output in 1993. The Census of Agriculture reported 748 farms in Florida in 1992, with 38,770 harvested acres of watermelons, virtually unchanged from the 751 farms and 35,943 acres in 1987. Seventy-three percent of Florida's watermelon acreage was irrigated in 1992. Florida's watermelon crop had a farm value of $67 million in 1993 (USDA, NASS).

Watermelons are grown throughout Florida. Alachua and Suwannee counties in north Florida, and Collier county in southwest Florida, reported the largest acreage in 1993, although 14 counties reported 1,000 or more harvested acres (Florida Agricultural Statistics Service).

Florida's competitive advantage lies in its growers' ability to supply watermelons early in the season, before large volumes from other areas depress market prices. Since planting dates largely determine when watermelons will be ready for harvest, growers try to get their melons planted as soon as possible. Growers are faced, consequently, with a trade-off between planting earlier, risking loss of their young plants to frost, and planting later and risking loss of market value at the end of the season due to low prices.

Growers in central and northern Florida generally have a 2-4 week planting window. If they plant before this window, they risk losing their young plants to frost. If they plant after this window, they risk that their melons will not mature in time to sell them profitably. The planting window in south Florida may extend for 4-6 weeks.

Cultural Practices

Planting for the spring harvest begins in late December in southwest Florida and continues into early February. Growers in central Florida usually plant beginning the first week of February, while growers in northern and western Florida begin planting about March 1. Growers in northern and western Florida need to plant by March 15 for the watermelons to ripen before the 4th of July (Stall).

Most watermelons in Florida are direct-seeded. However, because of the high cost of the newer hybrid seeds, and savings in the quantity of seed required, watermelons are increasingly planted using transplants. Starting the plants in a greenhouse and transplanting also enables growers to obtain more uniform plant stands, particularly of the seedless watermelon varieties, whose seed is harder to germinate under field conditions than for the seeded varieties.

Farmers are increasingly using plastic mulch. Plastic helps control weeds and shortens the growing period, a noted advantage where the timing of harvest has a critical impact on profitability.

In south Florida, watermelons are mostly planted on plastic after a crop of fresh-market tomatoes or peppers have been removed (Swanson). About 70 percent of the crop is produced using this method. This practice enables the grower to recover some of the fertilizer residual and to benefit from the soil fumigation used for the previous crop. The remainder of south Florida's watermelons are grown on recently-cleared pasture, which is reasonably free of watermelon diseases. This latter practice is on the wane, however, because of the declining availability of such land.

Harvesting

A small portion of the fall watermelons produced in south and central Florida are harvested in November or December, depending on weather conditions. Very few watermelons are harvested during January, February, March, and early April.

Harvesting of the spring crop begins in southwest Florida by mid-April. Harvesting extends to central Florida by mid-May, and to north and west Florida by mid-June. The Florida harvest usually ends by the 4th of July because growers are generally not able to find buyers for watermelons after that date. Most brokers and buyers leave Florida after early July because large volumes of first-picking melons are available from Georgia and other southern states by that time. First-picking melons are usually of higher quality than those from subsequent harvests. In addition, trucking costs are usually lower for melons from the more northern areas because there is generally a shorter distance to the final market.

Ideally, Florida growers wish to harvest a field three or four times a season, although one or two pickings is more typical. Low market prices and higher picking costs for later pickings usually limit the number of times a grower harvests his or her watermelons.

Marketing

Selling is usually handled by a broker who operates on a commission. Brokers usually move northward as the watermelon season progresses. One contact cited the example of several brokers located in Columbia County, who began their season by handling watermelons from Arcadia in central Florida, then moved northward with the season to Ocala, to Lake City (where they had their own growing operations), and then on to Georgia and South Carolina as watermelons became available in those areas (Keller).

A number of growers, especially in south Florida, also produce vegetables and have their own handling and marketing businesses. These grower-handlers may do their own selling.

Production Perils

The major production perils in Florida include late spring frosts, excessive rainfall, high winds, extreme drought, and hail. Deer, coyotes, and raccoons may cause minor yield losses, and various insects, diseases, and weeds are production pests which growers must control in order to successfully produce a crop of watermelons.

Cold weather. Frosts or freezing temperatures that kill young plants are the most serious production peril for watermelons in Florida. Although growers like to plant as early as possible in order to enhance their chances of receiving a higher market price, early plantings increase the chances of losing the young plants to frost.

Some growers are using row covers to protect young, early-planted watermelons from frost. Row covers are non-woven, porous blankets placed over the watermelon rows. They raise the temperatures around the young plants by several degrees, protecting them from frost damage.

Excessive wind. High winds, such as those associated with tropical storms or hurricanes, may shred young plants and the vines of more mature plants. Wind also causes damage from blowing sand, which scars the melons and wounds the plants, creating an entry way for diseases. Florida experienced such a storm in March 1992 that destroyed many young plants in northern and western Florida. Growers may replant following such a storm, but run an increased risk of not being able to market their crop because of low prices due to delayed harvest. Damage from excessive wind happens less frequently than losses to frost.

Excessive rain. Excessive rain may cause flooding and death of watermelon plants if the roots are submerged in water for more than 24 hours. Excessive rain is particularly serious if it occurs just as the melons are ready to harvest. Excessive rain at this time, especially if it follows a period of dry weather, can cause the watermelons to burst, resulting in yield losses that range from minor to nearly complete.

Drought. Drought was cited as a serious production peril by all contacts in northern Florida (Stall, Thomas, Keller, Jones). The ASCS county executive director for Columbia County indicated that drought was the most persistent cause of yield losses for which disaster payments were made in his county (Keller).

One contact indicated that growers who do not irrigate are lucky to receive enough natural rainfall to produce a crop (Stall). When rainfall is sufficient, these growers can earn a good profit because their production expenses are lower than those of growers who incur irrigation expenses. If it does not rain, as frequently happens during the spring in north Florida, non-irrigating growers don't make a crop, but "...they recover their expenses from disaster payments." Several contacts indicated that they thought the ready availability of disaster assistance in recent years had encouraged growers to plant more watermelons than they would have without the program.

Hail. Hail was cited as a source of yield losses among watermelons in Florida. The extension agent in Columbia county estimated that serious hail damage may occur to at least one grower's watermelons in his county every second or third year (Thomas). Hail damage, however, tends to be very localized and usually does not cause extensive damage over a wide area. In some cases, hail may be so localized that damage occurs only in part of a field.

Industry Organizations

The Florida Watermelon Association promotes Florida watermelons and is involved in legislative and other matters affecting the interests of the Florida watermelon industry. The association operates on dues and donations from growers and does not have individual production or yield records.

Demand for insurance

One ASCS county executive director indicated that he thought that watermelon growers in his county would be interested in purchasing crop insurance if they

knew that disaster assistance would be more limited in availability (Keller). The secretary-treasurer of the Florida Watermelon Association indicated that he did not recall crop insurance being discussed at any of the association's meetings (Glenn).

Disaster assistance data for Florida suggest that weather-related events can cause substantial yield losses, and that buying crop insurance, therefore, may be of interest to a number of watermelon farmers. Florida growers received $5.6 million in disaster payments during 1992 and 1993, 4.2 percent of the value of production.

Acreage abandonment also may provide evidence of crop loss. Only 85 percent of Florida's planted acreage was harvested in 1992, indicating substantial crop losses in that year (Table 8). For 1993, the harvested-to-planted ratio was 88 percent, while for the 1977-81 period, the ratio was 87 percent.

Substantial differences in the occurrence of yield loss among Florida growers are likely to occur, however, because of the wide range of cultural practices that are followed. Growers producing watermelons without irrigation and those who plant imprudently early are likely to confront relatively high risks of yield loss. Growers who use irrigation, plastic mulch, row covers, and other "state-of-the-art" practices are likely to have much lower yield losses.

Georgia

The Census of Agriculture reported 932 farms with 21,620 acres of watermelons in Georgia in 1992. The Georgia watermelon crop had a farm value of $18.9 million in 1993.

Although watermelons are grown throughout the state, the largest volume of commercial production is located in the south-central and southwestern part of the state. Six counties--Crisp, Turner, Worth, Wilcox, Telfair, and Dooly--accounted for about 51 percent of Georgia's watermelon acreage in 1987 (Census of Agriculture). Other important watermelon-growing areas include Seminole, Decatur, Thomas, and Mitchell counties (Granberry).

Cultural Practices

Georgia growers plant watermelons as soon as possible after the danger of frost has subsided, generally between late March and early April. Growers often produce watermelons in rotation with peanuts, corn, soybeans, small grains, and other vegetables.

Georgia growers are increasingly planting hybrid varieties, such as Fiesta, Royal Sweet, and Sangria. While the seed is more expensive, hybrid varieties tend to provide larger yields, have greater disease resistance, and produce more uniform melons with quality superior to the open-pollinated varieties. Some growers are planting transplants to reduce the high seed costs associated with growing hybrid watermelons.

Direct-seed planting is the predominant method of establishing watermelons in Georgia, but the use of transplants or seedlings is gaining in importance.

Transplant planting in Georgia is usually associated with the use of plastic mulch. Black plastic mulch helps with weed control, conserves moisture and fertilizer, and results in accelerated growth and early maturity. About 7,000 (18 percent) of the 40,000 acres usually planted in Georgia are currently grown with plastic mulch (Granberry).

Production Perils

The major production perils for Georgia watermelons are frost, hail, excessive rain, drought, and disease problems. Watermelons planted extremely early in the season are more likely to face frost injury than melons that are planted later. Early-planted melons are also more likely to suffer from losses due to damping-off than later-planted melons. Damping-off losses are usually associated with extended periods of cold, damp weather. Excessive rain was cited as a major cause of yield loss for which disaster payments had been made (Gurry).

Extremely warm and dry conditions also may cause yield reductions, especially on farms that have no irrigation. Drought was the main reason for disaster payments in 1993 (Gurry, Collier). Hail may reduce yields by tearing up the vines and by cutting or bruising the rind on the fruit, which increases rot problems and deformity (Granberry).

The principal diseases of watermelons in Georgia are anthracnose, fusarium wilt and downy mildew. Root-knot nematodes also were mentioned as a production peril (Granberry).

Industry Organizations

The Georgia Watermelon Association promotes the sale of Georgia watermelons and represents the interests of growers on a wide range of issues. Grower assessments are voluntary, and the association does not collect either production or acreage statistics for individual producers.

Demand For Crop Insurance

There is likely to be substantial interest in watermelon crop insurance among Georgia growers because of the abundant production risks they face. The relatively large disaster payments to Georgia farmers for watermelon losses during 1992 and 1993--at 10.3 percent of the value of the state's watermelon crop--indicate that yield losses have been relatively high for watermelons in recent years. In addition, Georgia growers only harvested about 80 percent of their planted acreage during 1992 and 1993, indicating a potentially significant degree of crop failure in those years (Table 8). The harvested-to-planted ratio was also near 80 percent in the 1977-81 period.

Indiana

The Census of Agriculture reported 278 farms harvesting 5,628 acres of watermelons in Indiana in 1992, compared with 300 farms and 5,343 acres in 1987. A notable increase occurred in the amount of watermelons grown with

irrigation, with irrigated acres nearly doubling between 1987 and 1992. Nearly one-third of Indiana's watermelon acreage was irrigated in 1992. Indiana's watermelons had a farm value of $8 million in 1993.

Watermelon production is concentrated around Indiana's southwest border with Illinois and Kentucky. Knox County had the greatest number of farms (62) growing watermelons and the largest acreage (2,798) in 1992, although Sullivan, Gibson, Davies, and Jackson counties all reported 400 or more harvested acres.

Watermelon enterprises in Indiana range from small (1 to 4 acres) to commercial (40 to several hundred acres) in size (Simon). Central Indiana has most of the larger-size operations. The smaller acreages frequently are grown in combination with other melons, especially in southwest Indiana. Many watermelon farmers also grow other horticultural crops and grains.

Planting dates range from late April to mid-May. Some farmers stagger the timing of planting and the varieties planted to extend the season and to cater to different markets.

Watermelons are mechanically planted using transplants throughout most of the state, except in southern Indiana, where they are planted as seeds. Some growers use black plastic mulch to control weeds, preserve moisture, and hasten growth.

Harvesting occurs from mid-to-late July through early September. July and August are the two largest-harvest months.

Growers in Indiana may sell their watermelons directly to a trucker, through brokers, or through roadside stands, farmers' markets, or to supermarkets. Economic abandonment because of low prices reportedly is not a common occurrence in Indiana (Simon).

Production Perils

The major production perils in Indiana are excessive water, hail, and drought. Insects and disease are considered lesser perils than those that are related directly to the weather. The largest disaster payments received by Indiana watermelon growers were due to the 1988 drought (Simon). In 1993, the major cause of yield loss was excessive rain and flooding (Maynard).

Industry Organizations

The Illiana (Illinois and Indiana) Watermelon Association represents Indiana growers in issues of concern to the watermelon industry.

The Southwest Indiana Melon and Vegetable Growers Association includes Indiana watermelon producers. The association, sponsored by the Agricultural Extension Service, provides educational programs for melon and vegetable growers.

The grower associations do not collect acreage or production data. The state horticulturist was not familiar with any individual yield history information.

Demand for Insurance

Indiana watermelon growers, similar to those in a number of other eastern and central states, likely would be interested in buying crop insurance because they face substantial production risks. Although the amount of irrigated acreage has increased, two-thirds of the watermelons are still grown without irrigation in Indiana, subjecting them to increased risk of losses due to drought. As in other central and eastern U.S. areas, weather is unpredictable and growers can incur large yield losses due to excessive rain and drought.

Disaster payments for watermelons in Indiana averaged 4.4 percent of the value of the crop during 1992 and 1993, somewhat less that the 7.6-percent average for the 16 major watermelon states.

Missouri

The Census of Agriculture reported 327 farms with watermelons in Missouri harvesting 7,124 acres in 1992, compared with 330 farms and 6,765 acres in 1987. Approximately one-third of the acreage was irrigated. Missouri's watermelons had a farm value of nearly $5 million in 1993.

Missouri's watermelon production is concentrated in the southeastern part of the state. Dunklin County had about 81 percent of the state's acreage in 1992. Other counties with large watermelon acreage included Butler, Scott, Mississippi, and Ripley.

Although most farms grow only 10 or 20 acres of watermelons, some range up to several hundred acres. Most farms fall in the 20-to 40-acre category (Baker).

Cultural Practices

For both transplants and seeds, planting begins around April 15, after frost danger has passed. A few producers plant with transplants and use black plastic mulch, hastening the timing of harvest, and enabling them to market watermelons by late June. Farmers who plant with seed, and who do not use plastic mulch, do not have melons for harvest until after the 4th of July. Although seed-planted melons are harvested later and usually receive a lower price, they also involve lower production costs. Some farmers use a mixture of the two methods.

Typically, growers rotate watermelons with crops such as cotton, wheat, and soybeans, that do not host watermelon diseases. Normally, watermelons are not grown in the same field more than once in every three to four years. Cotton and watermelons are often produced on the same farms in Missouri. In Mississippi County, however, where cotton is a less prominent crop, a number of watermelon producers also grow other vegetables.

Center pivot systems are the most commonly used method of irrigation (Baker). Small growers often do not irrigate and do not typically plant watermelons every year. Most of these small growers are cotton farmers who do not have irrigation systems.

Harvesting begins during the last week of June for transplanted watermelons and after July 4th for seed-planted melons. A few farmers plant late in order to have watermelons for sale in the "late market," when prices typically rise above their mid-summer seasonal lows. If watermelon prices dip so low that returns are below harvesting and marketing costs, farmers may harvest less often or abandon the planting.

Watermelons in Missouri are typically marketed through brokers and are often shipped to markets in Indianapolis, Chicago, and St. Louis.

Production Perils

Bacterial fruit blotch and mildews are the principal diseases affecting watermelons in Missouri (Baker). Spider mites, the principal insect pest, thrive in hot, dry conditions and caused low yields for some growers in 1993.

Producer Associations

The Missouri Watermelon Association is a chapter of the National Watermelon Growers Association. The association conducts promotional activities and represents Missouri growers in matters of concern to the industry (Welby). They do not collect production or acreage statistics for individual growers.

Demand for Insurance

One horticulturist did not think Missouri watermelon growers would be very interested in purchasing crop insurance (Baker). He said they were very independent producers, and often planted melons as a side crop for extra cash. He thought they would be unlikely to invest in insurance. Disaster payments for watermelons in Missouri averaged only 2.4 percent of the crop value during 1992 and 1993, compared with a 7.6-percent average for the major watermelon states.

North Carolina

The Census of Agriculture reported 850 farms harvesting 7,726 acres of watermelons in North Carolina in 1992. About 12 percent of the watermelon acreage was irrigated. North Carolina's watermelons had a farm value $6.2 million in 1993. Nearly all of North Carolina's watermelons are grown on the coastal plains in the eastern part of the state.

Cultural Practices

The bulk of North Carolina's watermelons are planted during April. Direct-seed planting is the predominant planting method, although some growers are experimenting with the use of transplants and plastic mulch.

Harvesting in North Carolina usually begins about the middle of July and lasts through August. Reportedly, yields average about 15,000 to 20,000 pounds per acre, but are much higher (about 50,000 pounds) when growers use irrigation (Schultheis). If growers use drip irrigation with plastic mulch, their yields can potentially reach 80,000 pounds per acre (Schultheis). USDA reported average yields of 12,500 and 15,000 pounds for North Carolina in 1992 and 1993, respectively.

Most of North Carolina's watermelons are marketed through broker-shippers. A small amount is sold through local outlets such as farmers' markets, roadside stands, and local supermarkets.

Production Perils

The major production perils in North Carolina are extreme heat and drought. Other perils include excessive rain at harvest-time and hail. Extreme heat and drought were cited as major production perils partly because most North Carolina watermelons are grown without irrigation. Dry conditions can lead to lower yields by reducing the size of the melons. In addition, watermelon plants may fail to develop an adequate protective canopy during hot, dry seasons, and a number of melons may be lost due to sunscald. The North Carolina varieties most susceptible to sunscald are Allsweet, Sangria, and Fiesta.

Extremely hot, dry weather that resulted in sun blisters and yellowing of the melons was reported as the major cause of yield losses for which disaster assistance payments were made in 1993 (Faircloth). North Carolina growers received over $521,000 in disaster payments for watermelon losses in 1993.

Industry Organizations

The North Carolina Watermelon Association promotes consumption of North Carolina watermelons and represents the interests of North Carolina watermelon growers. The association does not collect production or acreage statistics for its members.

Demand for Insurance

There is likely to be substantial interest on the part of North Carolina growers in crop insurance for watermelons because of relatively large yield losses caused by variable weather conditions in recent years. North Carolina growers received disaster assistance payments amounting to 8.7 percent of the value of their watermelon sales during 1992 and 1993, slightly higher than the 7.6-percent average for the industry as a whole.

South Carolina

The Census of Agriculture reported 689 farms in South Carolina, harvesting 14,077 acres of watermelons in 1992. Only 13 percent of the farms in South Carolina irrigated watermelons. However, farms with irrigation tended to be larger than the average, as 17 percent of the watermelon acreage was irrigated

(Census of Agriculture). South Carolina's watermelons had a farm value of $4.2 million in 1993.

Watermelons are grown throughout South Carolina, but most production is located in the south central and southeastern coastal plain. The counties with the largest acreages in 1987 included Barnwell, Allendale, Hampton, Aiken, Bamberg, Orangeburg, Chesterfield, and Colleton.

Cultural Practices

Planting begins about the middle of March in the coastal counties and extends into early May in the northern counties. Most watermelons are direct-seeded. Some growers are using plastic mulch, thereby advancing harvesting dates by 7 to 10 days and improving yields. Yields can be increased by about 25 percent with the use of plastic mulch.

The most widely planted varieties are Charleston Grey and Jubilee. New hybrids, such as Mirage, Royal Sweet, and Royal Jubilee, have been introduced in recent years and generally produce melons with more uniform size and appearance than the Charleston Grey and Jubilee varieties. These hybrids usually mature slightly earlier than the traditional varieties and, under optimal conditions, produce higher yields.

The bulk of South Carolina's watermelon harvest extends from early July through the middle of August. Production in the interior and northern parts of the state matures later than in the lower coastal plain.

Production Perils

Drought, excessive rain, and hail are the major weather-related production perils in South Carolina. Dry weather was cited as a major reason for disaster payments for watermelons in 1993 (Saylor).

The major insect pests are aphids, cucumber beetles, pickleworms, and leaf miners. Race 2 of the anthracnose fungus is the most severe disease problem, with severe losses occurring in years with above-average rainfall during the critical growth and harvest periods. Other common diseases include gummy stem blight, fusarium wilt, watermelon mosaic virus, downy mildew, and damping-off. Nematodes are also a peril.

Industry Organizations

The South Carolina Watermelon Association is the state growers organization which promotes the interests of watermelon growers. The South Carolina Watermelon Board is a state marketing order and assesses growers 1-cent per hundredweight sold for the promotion of South Carolina watermelons. Although the board has a record of the assessments collected from individual growers, acreages are not recorded.

Demand for Insurance

There is likely to be substantial interest among South Carolina growers in insurance for watermelons because yield losses have been a common occurrence in recent years. The relatively large disaster assistance payments made for 1992 and 1993 losses, at 34.2 percent of the value of the South Carolina watermelon crop, suggest that weather-related yield losses have been sizeable. In addition, about 20 percent of the planted acreage in 1992 and 1993 was reported as not harvested, further suggesting that growers may experience substantial crop losses in South Carolina (Table 8). In the 1977-81 period, abandonment was also relatively high, at about 15 percent.

Texas

The Census of Agriculture reported 1,561 farms in Texas, harvesting 61,617 acres of watermelons in 1992. Approximately one-third of the acreage was irrigated. Texas' watermelons had a farm value of nearly $42 million in 1993.

Watermelons are one of the most widely-grown crops in Texas, but many counties report less than 100 harvested acres (Dainello). Hidalgo and Frio counties reported the largest watermelon acreage in 1987, with both counties exceeding 5,000 acres.

Watermelon enterprises range in size from less than half an acre to several hundred acres. Farms in southeast Texas tend to have more of the smaller farms (less than 20 acres). Farms in the Rio Grande Valley and in central Texas tend to have larger watermelon enterprises.

Cultural Practices

Planting generally begins in south Texas during late January and early February and extends through April in east and central Texas. Direct seeding is the most common practice, although some growers are experimenting with more intense production methods using transplants, irrigation, seedless varieties, and plastic mulch.

Most watermelon producers also grow other crops. In eastern Texas, watermelon producers grow other vegetables. In south Texas, growers produce cantaloupes, honeydew, and cucumbers with watermelons, while in central Texas, watermelons are grown in combination with field crops, including cotton, corn, wheat, and peanuts.

Harvesting begins during June and extends through August. Growers generally harvest watermelons three times during the season. Most melons are shipped in bulk containers, although some seedless watermelons are packed in cartons.

Marketing

Frequently, growers sell a whole field of watermelons to a buyer, who arranges for harvesting, marketing, and shipping. In such cases, the buyer may accept part of the production risk for losses occurring at the end of the season.

Near cities, some watermelons are marketed through farmers' markets, roadside stands, and to supermarkets. If prices fall below harvesting and marketing expenses, producers may abandon part, or all, of their watermelons (Dainello).

Production Perils

Most watermelon diseases in Texas can be controlled through the use of approved management practices and by applying fungicides (Dainello). In north central Texas, however, growers have had a problem with vine decline (sudden wilt) which, at the present time, is not well understood and does not have a control. Texas watermelon growers also are very concerned about the potential impact of bacterial fruit blotch disease on their operations. For the 1995 season, the concern centers on the availability of adequate seed. Some seed companies have withdrawn their seed from the market because of liability concerns associated with the seed-transmitted fruit blotch disease.

Other perils include excessive heat and drought, excessive rainfall, and hail. The largest disaster assistance payments made to watermelon producers in Texas were for losses due to drought and excessive heat during 1988 and 1989. Untimely rains at harvest or at planting-time also create production hazards. Large payments were made in 1993 for yield losses due to excessive rain, which drowned plantings in the spring, and drought, which reduced production of the fall crop (Hinojosa). Periods of excessive moisture when the plants are small can increase the number of young watermelon plants lost to damping-off disease. Hail is more serious in south Texas than in other parts of the state (Dainello).

Industry Organizations

The Texas-Oklahoma Watermelon Association disseminates promotional information and represents the interests of watermelon growers in the two states.

Demand for Insurance

There is likely to be a substantial amount of interest among Texas growers in crop insurance for watermelons because of the relatively high risk of yield losses. The large disaster assistance payments for watermelons in Texas between 1988 and 1993, at nearly $42 million, were the largest received by any state, indicating relatively high chances of weather-related yield losses. Disaster payments amounted to 22.4 percent of the crop's value during 1992 and 1993, substantially higher than the 7.6-percent average for the industry as a whole.

Ad Hoc Disaster Assistance for Watermelons

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

Disaster assistance payments for watermelon losses totalled about $95.8 million over the 1988-93 period. Payments for watermelon losses peaked at over $23.5 million in 1993, and were about $21.1 million in 1988. Payments between 1989 and 1992 averaged between $10 and $20 million.

Ad hoc disaster payments for watermelon losses were scattered over a geographically broad area. Forty-five states received payments in at least one of the six years, with twenty-eight states, mainly in the Southeast and Southern Plains, collecting payments in all years.

In an ordering of counties, Brooks County, Texas ranked first in payments for watermelon losses, receiving nearly $4.8 million over the 6-year period. The next three counties in the series include: Hidalgo County, Texas ($3.4 million); Frio County, Texas ($3.0 million); and Duval County, Texas ($3.0 million). Over 1,200 counties received payments in at least one of the 6 years for watermelon losses. Eight of the top-10 counties were located in Texas, one each were in Alabama and South Carolina.

By state, the largest payments were made to Texas growers ($41.8 million) and Florida growers ($12.6 million). Georgia, Alabama, and South Carolina growers each received over $5 million during the six-year period for watermelon losses. Other states that received large payments include Mississippi, Indiana, North Carolina, Louisiana, and Oklahoma.

Ad hoc disaster data can be used to indicate which watermelon-producing areas received large payments relative to their acreage (Table 11). For example, the National Agricultural Statistics Service (NASS) reported an average 43,000 acres produced in Texas in recent years, about 21 percent of the U.S. total. At the same time, ASCS disaster assistance data indicate that Texas accounted for an average 44 percent of U.S. ad hoc disaster payments made for watermelon between 1988 and 1993. Alabama's share of disaster payments, at about 8 percent, also was larger than it's share of U.S. acreage, at 3 percent.

In contrast, Arizona, California, and Florida collected a smaller share of ad hoc payments relative to their acreage. Florida accounted for nearly 20 percent of U.S. watermelon acreage over the 1988-93 period and collected about 13 percent of U.S. ad hoc payments for that crop. California accounted for nearly 8 percent of U.S. watermelon acreage, and only 0.1 percent of ad hoc payments for watermelon.

Table 11--Disaster assistance payments for watermelon, 1988-93

State	Average watermelon harvested acreage, 1992-93	Share of U.S. acreage	Total watermelon disaster payments, 1988-93	Share of U.S. watermelon disaster payments
	Acres	Percent	Thousand Dollars	Percent
Alabama	6,350	3.1	7,961.4	8.3
Arizona	6,550	3.2	70.0	0.1
California	16,250	7.9	136.0	0.1
Florida	41,000	19.9	12,592.3	13.1
Georgia	32,000	15.6	10,663.0	11.1
Indiana	6,200	3.0	2,014.1	2.1
Mississippi	6,850	3.3	2,830.0	3.0
Missouri	6,800	3.3	575.2	0.6
North Carolina	9,150	4.4	1,926.7	2.0
Texas	43,000	20.9	41,792.3	43.6
U.S.	205,710	100.0	95,773.3	100.0

Note: Watermelon harvested area is averaged for the years 1992 and 1993 only. This is because little data exist for watermelons for the 1981-91 period. Disaster assistance data are averaged over the 1988-93 period.

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

Disaster payments for the sixteen NASS watermelon states averaged 7.6 percent of the watermelon crop value over the 1992-93 period (Table 12). Disaster payments as a percent of crop value were highest in Alabama, South Carolina, and Texas, and lowest in Arizona and California. The low payments in Arizona and California likely reflect the relatively limited severity of production perils in these states.

Watermelon Insurance Implementation Issues

Adverse Selection

The cropping history of the field is probably more important for watermelons than for most crops, and is a key adverse selection concern. Watermelons are very susceptible to infestation by fusarium wilt and anthracnose fungi. Watermelons planted in fields in which fusarium- or anthracnose-susceptible crops have been grown in past seasons are more likely to succumb to these diseases during periods of excessive rain and warm weather than fields that are free of these fungi. Some growers are planting over plastic mulch and fumigating to free the soil of insect and disease contamination. These growers, of course, run a reduced risk of loss due to soil-borne, disease related yield losses. With an insurance policy in place, however, some growers may knowingly plant watermelons in a field that has a high probability of infection, resulting in a high expected indemnity relative to the premium payment.

Setting Reference Prices

FCIC provides reference prices (price elections) for insured crops, which become the basis for assigning values to yield losses. Insured growers elect a price guarantee as the basis for indemnity payments.

A reference price for watermelons should represent the in-field value of the crop, because growers would not incur the expenses of harvesting and marketing on that portion of the yield that is lost. Because of the large labor costs associated with harvesting, variable harvesting and marketing expenses account for 30 percent to 60 percent of total production costs. Permitting growers to select a market-value price as the basis for indemnity payments would create situations where indemnity payments would exceed grower net returns had they harvested and marketed the crop. Such situations would provide undue incentive for moral hazard, particularly during periods of low market prices.

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

Market Prices and APH Distortions

Watermelon yields are measured in terms of the quantity of melons harvested and marketed rather than in terms of the quantity produced and potentially

Table 12--Watermelons: Crop value and disaster assistance, selected states, 1992 and 1993

State	Total crop value	Total disaster payments	Disaster payments, percent of crop value
	-----1,000 dollars-----		Percent
Alabama	5,782	2,778	48.0
Arizona	23,367	52	0.2
Arkansas	7,199	487	6.8
California	110,091	91	0.1
Delaware	6,534	61	0.9
Florida	132,750	5,628	4.2
Georgia	38,136	3,913	10.3
Indiana	14,189	618	4.4
Louisiana	3,219	369	11.5
Maryland	7,473	336	4.5
Mississippi	6,021	451	7.5
Missouri	9,211	218	2.4
North Carolina	10,567	921	8.7
Oklahoma	10,544	444	4.2
South Carolina	7,742	2,647	34.2
Texas	71,640	16,062	22.4
16 states	464,465	35,076	7.6

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

available for harvest. In most areas, growers hope to cut (harvest) a field of melons three times before abandoning the planting. During periods of low watermelon prices, however, growers may cut their field only one or two times, and if prices are extremely low, they may even abandon a field completely, prior to any harvesting. Consequently, for a given field of melons, the reported yield is higher if market prices are relatively high when the watermelons mature, than would be the case if market prices were extremely low. Because of this relationship between market price and yields, a grower's actual production history may not necessarily indicate farming ability.

Estimating "Appraised Production"

One approach to estimating appraised production for watermelons (harvestable, but unharvested yield) is to count and weigh marketable watermelons in a sample of plots and expand the plot yields to a per-acre basis. For plantings in which the melons have not yet reached marketable size (immature melons), the yields per plot would be estimated by counting the potentially harvestable fruit in the plots and multiplying by an average or typical weight per melon. Weight per melon would need to account for variety differences and for the number of plants per acre. Watermelon plants in fields with higher plant populations tend to produce smaller melons than plants in fields with lower plant populations.

Insuring Price Risk

Several of our contacts identified low market prices as a considerable risk in watermelon production. A grower may have a perfectly good yield, but may not be able recover his or her cost of production, or may even abandon part or all of the crop, because of low market prices. As a result, watermelon growers may have an interest in an insurance plan for protection against revenue losses due to low market prices.

With a revenue insurance plan, 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.

Market Prices and Moral Hazard

Moral hazard is a potential problem in insuring watermelons as the situation sometimes arises where, because of low market prices, an indemnity payment would be larger than the net return from harvesting and marketing the crop. Moral hazard would arise if the grower could contribute to causing a yield loss by neglecting prudent management practices.

One potential moral hazard concern surrounds the use of irrigation. Drought is a major cause of watermelon yield losses in the central and eastern United States. Farmers who grow watermelons on non-irrigated land are much more likely to suffer yield losses than those with irrigation. Some of our

contacts indicated that growers who did not irrigate were often lucky to produce a crop. With a watermelon policy in place, some growers may prefer to rely on the policy for payment in low-rainfall years, rather than invest in irrigation.

Another potential moral hazard situation concerns the timeliness of planting. Profitability often depends on having watermelons for sale early in the season before prices decline. Planting dates largely determine when watermelons will be ready for harvest. Growers are faced, consequently, with a trade-off between planting earlier and risking losing their young plants to frost, and planting later, and risking losing market value at the end of the season due to low prices. Growers who plant early run a higher probability of losing their plants due to a late spring frost or freeze. Some growers reduce the chances of loss to frost by using row covers. With an insurance policy in place, some growers may rely on a potential crop insurance indemnity, rather than prudently take the necessary precautions for frost protection.

Availability of Individual Yield Data

The National Watermelon Promotion Board collects assessments for promotional activities based in part on the volume of melons sold by individual growers. A limitation to the use of the Watermelon Board's data for estimating yield histories, however, is that it does not include acreage or yield information.

The National Watermelon Association and most of the state associations operate on voluntary contributions and donations and do not collect information on grower production.

The Arizona Citrus, Fruit, and Vegetable Standardization Agency is funded with grower assessments based on the quantity of shipments. The agency also assembles a record of acreage. Although no longer published, both acreage and volume reportedly would be available for estimating individual yield histories (Foster).

The County Agricultural Commissioners in California maintain a complete list of current watermelon growers in each county. They also maintain acreage records on all those growers who have obtained permits to spray agricultural chemicals. They do not, however, have production data with which to estimate individual yield histories.

Demand for Insurance

Our assessment is that watermelon is a good candidate for multiple-peril crop insurance. There is likely to be a substantial amount of interest in purchasing insurance, particularly among growers in the central and eastern U.S. growing areas. Growers in the central and eastern states face a greater array of yield-reducing production perils than growers in Arizona and California. In fact, it is likely that participation in watermelon insurance would be rather low among growers in Arizona and California. The basis for this judgment is, in part, the small amount of disaster assistance paid to

Arizona and California growers in recent years, at 0.2 and 0.1 percent of the value of crop sales.

A comparison of disaster payments for watermelon with those paid for several major field crops provides further evidence that watermelon growers may have substantial interest in buying crop insurance. Disaster assistance paid for watermelon losses averaged 7.6 percent of the value of the crop during 1992 and 1993 (much higher in some states), substantially greater than the 2.4 to 6.6 percent (disaster payments and crop insurance combined) paid for corn, soybeans, and wheat during 1988-1993 (Table 13). Crop insurance participation for these crops ranged from 24 to 41 percent during 1992. Participation in a watermelon insurance policy likely would be in this same range.

FCIC has received numerous requests for watermelon insurance from various locations. Since 1989, requests for insurance have been sent to FCIC from Florida, Indiana, Mississippi, Nebraska, New Jersey, Texas, and Virginia. In total, 63 requests were sent to FCIC from Virginia alone.

Finally, the National Watermelon Association's position is that they would like for watermelons to become a "full partner" in crop insurance in the same manner as the major field crops, such as grains and cotton (Highly).

Other Implementation Issues

There do not appear to be any intractable implementation obstacles in developing a policy for watermelon insurance. The problems encountered in offering watermelon insurance would likely be about the same as those confronted with commodities such as green peppers and fresh tomatoes, for which insurance is currently available. Watermelons, like peppers and fresh tomatoes, are grown as an annual commodity, have a high proportion of costs made up of harvesting and marketing expenses, and have yields subject to current market prices. Because of these similarities, implementation problems for watermelons, such as market-price distortion of yields and moral-hazard problems due to low market prices, are likely to be similar to those encountered with peppers and fresh tomatoes.

Defining "Areas" for the Non-Insured Assistance Program

The Non-insured Assistance program (NAP) of 1994 Crop Insurance Reform covers crops that are not currently insured by FCIC--including watermelons--until the development of an insurance policy. Under NAP, an "area" must incur at least a 35-percent yield loss in order to trigger assistance payments. The definition of "areas" for purposes of calculating "area average yield" may determine whether or not growers with a qualifying yield loss (50 percent or greater of the individual average) are eligible for NAP payments.

In general, defining area average yields along county boundaries should not create great inequities in deciding whether growers qualify for disaster payments. Most of the major disasters, including excessive rain, extreme drought, and extreme cold, would often affect all growers generally more or less the same within a county boundary.

Table 13--Disaster assistance and crop insurance payments and insurance participation, selected crops, 1988-92

Crop	Disaster payments	Crop insurance payments	Total	1992 crop insurance participation
	-------Percent of crop value--------			Percent
Corn	1.7	1.2	2.9	29
Soybeans	1.4	1.0	2.4	24
Wheat	3.3	3.3	6.6	41
Watermelons	7.6	NA	7.6	NA

NA = not applicable.

Note: Watermelon data reflect 1992-93, and include only states for which NASS reports watermelon production. Data for other crops reflect 1988-92, and all states.

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

In the minor watermelon counties, area yields may need to be defined along state lines, or at least at a greater level of aggregation than the county. The reason is that in some counties there are so few growers, and most of the growers have such small acreages, that one large grower's yield may effectively determine the county average. Individual growers, if they had a 50 percent yield loss, would essentially trigger their own NAP payments.

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