STAFF REPORT

1979 PESTICIDE USE ON FLORIDA VEGETABLES, A PRELIMINARY REPORT

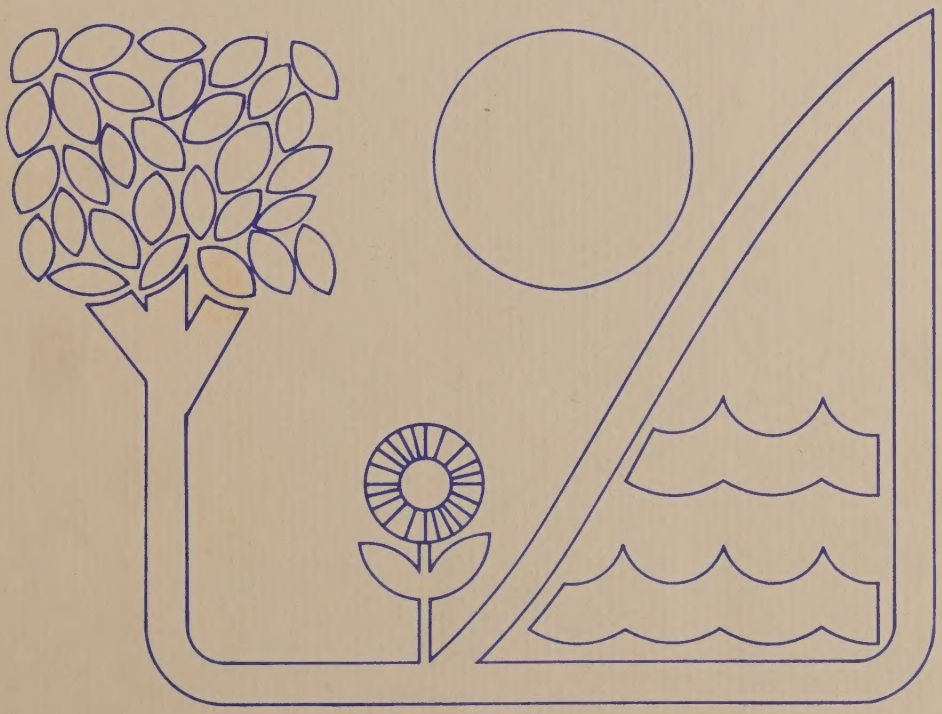
by

Walter L. Ferguson
and
Iris E. McCalla

July 1981

ERS Staff Report No. AGESS810708

NRE Economics and Statistics Service
United States Department of Agriculture



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ABSTRACT

According to the 1979 Vegetable Pesticide Survey, nearly 4.6 million pounds of pesticides were used to control weeds, insects, diseases, and nematodes on six vegetable crops in Florida. The six vegetable crops included cabbage, celery, lettuce, sweet corn, tomatoes, and watermelon. About 4.6 million acre-treatments were made ranging from 2.2 million for tomatoes to 148,800 for cabbage.

Key Words: Pesticides, herbicides, fungicides, insecticides, nematicides, tank-mixes, acres treated, application rates.

This paper was prepared for limited distribution to the research community outside the U.S. Department of Agriculture. The data in this report are preliminary, and consequently subject to change. The data have not been subjected to statistical reliability testing, but will be tested prior to finalization and publication. The final tabulation of the data will provide information for six regions which will include data for 18 States. The final tabulations are scheduled for publication in late 1981. The data are being released at this time to allow the agricultural community an opportunity to comment on the data. If you have any comments, please send them by September 1, 1981 to:

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Use of company names or products in this report is for identification only and does not imply endorsement by the U.S. Department of Agriculture.

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Introduction

In this report, patterns of pesticide use in Florida in 1979 are discussed for cabbage, celery, lettuce, sweet corn, tomatoes, and watermelon. Survey data were collected on quantities of pesticides used, acres treated, acre-treatments, number of applications, seasonal rates, and rates per acre-treatment. This report provides information useful to policymakers, researchers, extension specialists, and industry personnel. Because vegetables are highly susceptible to weeds, insects, diseases, and other pest damage, there is a continuing need

for information on pesticides used in vegetable production. Regulations on the use of pesticides and review of registrations by the Environmental Protection Agency create the need for accurate, detailed information for economic studies of pesticide use.

A major factor affecting the quantity of pesticides used is the number of acres planted. For five of the six crops, 1979 acreage was slightly below the 1978-80 average (Table 1). A minor difference of less than one percent is indicated for the six crop total, 191,700 acres in 1979 versus 197,000 for the 3-year average. Thus, 1979 could be described as a typical year for acreage of vegetables planted. However, the number of planted acres is only one of several factors affecting pesticide usage. Weather conditions, pest infestations, and pest resistance to pesticides affect pesticide rates and the number of applications per season.

Planted acreage of the six crops surveyed in 1979 ranged from nearly 60,000 acres of sweet corn to about 12,000 acres of celery. Five of the six crops are planted for harvest during the winter, spring, and fall seasons. Watermelons are harvested only in the spring. All six crops are sold mainly in the fresh market. Small amounts of cabbage and tomatoes are grown for the processing market. As pests affect not only yield but also quality, the appearance of the product has a considerable impact on market price. Thus, for these fresh market crops, pesticides are especially important.

Table 1. Vegetables: Acres planted by season of harvest, Florida, 1979-80. a/

Crop b/	Acres planted for harvest in:												3 year average
	Winter			Spring			Fall			Total			
	1978	1979	1980	1978	1979	1980	1978	1979	1980	1978	1979	1980	
	1,000												
Cabbage	9.3	10.5	11.1	6.5	5.8	6.3	2.0	1.2	1.8	17.8	17.5	19.2	18.2
Celery	4.4	5.2	5.0	5.0	4.7	5.9	2.4	1.8	1.8	11.8	11.7	12.7	12.1
Lettuce	5.1	6.5	7.4	3.8	4.6	5.0	3.0	3.0	3.4	11.9	14.1	15.8	13.9
Sweet corn	11.2	11.4	11.0	36.8	33.2	32.6	13.8	13.6	14.3	61.8	58.2	57.9	59.3
Tomatoes	12.9	12.4	15.0	17.0	15.9	16.0	13.0	11.9	12.6	42.9	40.2	43.6	42.2
Watermelon	--	--	--	59.0	50.0	45.0	--	--	--	59.0	50.0	45.0	51.3
6 Vegetables	42.9	46.0	49.5	128.1	114.2	110.8	34.2	31.5	33.9	205.2	191.7	194.2	197.0

a/ Vegetables, 1980 Annual Summary, U.S. Dept. Agr., Vg 1-2 (80) Dec. 1980.

b/ In Florida, these crops are grown mainly for the fresh market. The above totals do not include the the minimal acreages of cabbage and tomatoes grown for the processing market.

Methodology

As part of a national survey of pesticide use on vegetables, about 400 Florida vegetable growers were personally interviewed by the Economics and Statistics Service to collect data on specific pesticides used, acres treated, methods of application, and target pests controlled in 1979.

A systematic random sample design was used to select growers. Data were expanded for individual farms in the survey to reflect all farms by multiplying the sample data by the inverse of the sample ratio for the state. The pesticide use data were then adjusted by the ratio of the number of acres of each crop grown in the state to the number of expanded sample acres for each crop grown.

Interpreting the Data

Pesticides are grouped into the following categories: (1) herbicides (used to kill plants or inhibit their growth), (2) insecticides (used to kill or inhibit insects), (3) fungicides (used to control diseases by killing or inhibiting fungi), and (4) nematicides (used to kill or inhibit nematodes and other organisms in the soil). Bactericides (used to control bacterial diseases) are grouped with fungicides while multi-purpose soil fumigants are included in nematicides.

The term acres treated is used to identify acres receiving one or more application of a specific pesticide. Acres treated are not additive because two or more different specific ingredients may have been used on the same acre. As these acres are not mutually exclusive, summing them could result in double counting. For this reason, the sums of acres treated are not shown in Tables 4 through 9.

Acre-treatments are the number of acres treated one time by a specific pesticide. The number of applications per season was derived by dividing the acre-treatments by the acres treated for each specific pesticide material.

Single application and annual rates are estimated for specific active ingredients. Annual rates include the average rate for all seasons (winter, spring, and fall). The single application rate is derived by dividing the total active ingredients of a specific pesticide by the number of acre-treatments; the annual rate is derived by dividing the total active ingredients by the number of acres treated.

Acres treated and acre-treatments for Bacillus Thuringiensis, a bacteria, are included in the insecticide category. The rates and quantities applied are not reported since application rates are expressed in terms of spores per gram rather than in pounds of active ingredient.

The rate per application and number of applications for specific pesticides may vary considerably from published guidelines for a number of reasons. For example, published rates are generally broadcast rates whereas a number of the rates reported in the survey were band or in-furrow rates which are one-fourth to one-third that of the broadcast rates. Also, young vegetable plants require considerably lower dosage rates of insecticides and fungicides than do older plants. For insect control, vegetables grown on sandy soils generally require lower rates of soil insecticides than the same vegetables grown on organic soils.

Weather plays an important role in the use of fungicides as low moisture years generally require lower rates and fewer applications than high moisture years. Some varieties of vegetables have greater resistance to specific diseases and are less attractive to insects than other varieties, requiring

lower rates and fewer applications. Also, resistance of pests to pesticides plays an important role in determining rates and number of applications. Rates are lower generally when two or more pesticides with the same spectrum of control are applied in tank-mix applications than when those respective pesticides are applied as single ingredients.

Results

In 1979, Florida growers planted about 192,000 acres of cabbage, celery, lettuce, sweet corn, tomatoes, and watermelon for the fresh market. The growers applied 4.6 million pounds of active ingredients (a.i.) to the six vegetable crops. They applied 85 percent of the total quantity to sweet corn and tomatoes (Table 2). These two crops also accounted for 80 percent of the 4.6 million total acre-treatments. Of the total quantity of pesticides applied, about 650,000 pounds were applied as tank-mix applications while the remainder were applied as single ingredient applications.

Fungicides applied as single ingredients accounted for 1.9 million of the total 4.6 million pounds of all pesticides applied, about 40 percent. Of the 1.9 million pounds of fungicides applied as single ingredients, about 55 percent were used on tomatoes. Insecticides and fungicides each accounted for about 2.0 million acre-treatments applied as single ingredients, followed by herbicides at 131,000 and nematicides at 12,300. Most nematicides are applied to the sandy soils used for growing tomatoes. Generally, nematicides are not used for celery and lettuce as these crops are grown on muck soils. Nematodes are controlled on these soils by flooding the soil, allowing it to dry, and flooding again.

Table 2. Pesticide usage: acre-treatments and quantity applied to 6 vegetables, Florida, 1979. a/

Pesticide Category	Cabbage	Celery	Lettuce	Sweet Corn	Tomatoes	Watermelon	Total
	1,000						
Single applications							
Herbicides							
Acre-treatments	10.9	15.4	25.1	37.8	41.0	0.7	130.9
Pounds a.i.	22.6	30.8	61.9	66.0	31.2	.5	213.0
Insecticides							
Acre-treatments	83.1	168.1	108.5	871.6	885.1	47.2	2,163.6
Pounds a.i.	36.4	50.4	33.0	416.1	352.0	30.4	918.3
Fungicides							
Acre-treatments	40.8	268.0	41.4	401.9	1,156.0	71.2	1,979.3
Pounds a.i.	30.7	246.8	44.1	428.4	1,042.6	91.0	1,883.6
Nematicides							
Acre-treatments	3.2	--	--	--	8.9	--	12.1
Pounds a.i.	6.5	--	--	--	886.5	--	893.0
Tank-mix applications							
All pesticides							
Acre-treatments	10.8	2.1	0.7	226.1	87.0	2.3	329.0
Pounds a.i.	10.2	17.1	.6	343.7	274.1	2.0	647.7
Single and tank-mix applications							
All pesticides b/							
Acre-treatments	148.8	453.6	175.7	1,537.4	2,178.0	121.4	4,614.9
Pounds a.i.	106.4	345.1	139.6	1,254.1	2,586.4	123.9	4,555.5

-- = none reported in survey sample.

a/ 1979 Vegetable Pesticide Survey, Natural Resource Economics Division, ESS, USDA.

b/ Totals may differ slightly from Tables 4 through 9 due to rounding.

The rate per acre-treatment of all pesticides ranged from 0.7 pounds (a.i.) per acre for cabbage to 1.2 pounds for tomatoes (Table 3). The rate for herbicides ranged from 1.8 to 2.5 pounds (a.i.) for cabbage, celery, lettuce, and sweet corn; and about 0.7 pounds for tomatoes and watermelons. For the five crops, the rate for insecticides ranged from 0.3 to 0.5 pounds (a.i.) per acre-treatment and for fungicides the rate was in the neighborhood of 1.0 pound.

Nematicides were applied at a rate of 100 pounds (a.i.) per acre on tomatoes and about 2.0 pounds per acre on cabbage. The nematicides applied at the higher rate to tomatoes consisted mostly of fumigants such as chloropicrin plus methyl bromide. These fumigants are applied at a 6-inch depth and covered immediately with plastic sheeting. In addition to nematodes, these fumigants control a complex of soilborne diseases, certain insects, and in some cases, weed seeds. Fenamiphos, a nonfumigant nematicide, was applied on cabbage in a band application at a rate of 2 pounds (a.i.) per acre. Nonfumigants have a narrower spectrum of control, some control soil-born insects in addition to nematodes, others only nematodes.

Cabbage

In Florida, cabbage is planted monthly from August through April. Approximately 17,500 acres were harvested during the winter, spring, and fall seasons of 1979. About 106,000 pounds (a.i.) of all pesticides were applied in nearly 150,000 acre-treatments (Table 4).

Weeds affecting cabbage include annual grasses and broadleaf weeds. DCPA and nitrofen were the major herbicides used accounting for 75 percent of the nearly 23,000 pounds of herbicides used. Other herbicides included CDEC and trifluralin.

Major insect problems on cabbage include aphids, diamondback moth larvae, cabbage loopers, mole crickets, and cutworms. Methomyl and methamidophos accounted

Table 3. Pounds (a.i.) of pesticides applied per acre-treatment, single and tank-mix applications, Florida, 1979. a/

Pesticide category	Cabbage	Celery	Lettuce	Sweet corn	Tomatoes	Water-melon
	Pounds a.i.					
Single applications						
Herbicides	2.08	2.01	2.46	1.75	0.76	0.65
Insecticides	.44	.30	.31	.48	.40	.14
Fungicides	.75	.92	1.07	1.07	.90	1.28
Nematicides	2.04	--	--	--	99.53	--
Tank-mixes						
All categories	1.15	8.00	.82	1.52	3.15	.85
Single and tank-mix applications	.72	.76	.80	.82	1.19	1.02

-- = None reported in survey sample.

a/ 1979 Vegetable Pesticide Survey, Natural Resource Economics Division, ESS, USDA.

Table 4. Cabbage: acres treated, acre-treatments, rates and quantity used, single ingredient and tank-mix applications, Florida, 1979. a/

Pesticide	Acres treated	Acre-treatments	Number of applications	Pounds active ingredient: Per application	Pounds active ingredient: Annual average	Pounds active ingredient: Total
Herbicides						
CDEC	2,260	2,335	1.0	1.95	2.01	4,547
DCPA	2,488	2,488	1.0	3.90	3.90	9,697
Nitrofen	3,660	4,646	1.3	1.57	1.99	7,271
Trifluralin	119	119	1.0	.33	.33	40
Other b/	--	1,291	--	.84	--	1,090
Single applications b/	--	10,879	--	2.08	--	22,645
Insecticides						
Bacillus thuringiensis c/	4,206	14,735	3.5	--	--	--
Diazinon	1,200	1,200	1.0	.59	.59	703
Methomyl	9,043	40,099	4.4	.42	1.88	16,966
Methamidophos	8,278	23,405	2.8	.70	1.98	16,418
Parathion	780	2,628	3.4	.56	1.87	1,459
Other b/	--	1,016	--	1.15	--	824
Single applications b/	--	83,083	--	.44	--	36,370
Fungicides						
Chlorothalonil	3,476	15,734	4.5	.43	1.95	6,765
Mancozeb	672	3,162	4.7	1.20	6.06	3,780
Maneb	3,733	17,855	4.8	1.00	4.77	17,820
Metiram	624	2,016	3.2	.21	.63	423
Other b/	--	1,760	--	.71	--	1,257
Single applications b/	--	40,849	--	.75	--	30,747
Nematicides						
Fenamiphos	3,184	3,184	1.0	2.04	2.04	6,486
Tank-mixes						
Bacillus thuringiensis + methomyl c/	1,248	4,609	3.7	-- .53	-- 1.97	-- 2,463
Methomyl + fungicides	1,200	3,784	1.9	.39 + 1.30	.75 + 2.48	653 + 2,167
Other b/	--	2,405	--	.41	--	4,892
Tank-mix applications	--	10,798	--	1.15	--	10,175
All applications b/	--	148,793	--	.72	--	106,423

a/ 1979 Vegetable Pesticide Survey, Natural Resource Economics Division, ESS, USDA.
b/ Acres treated data not reported because two or more materials may have been used on the same acre resulting in double counting.
c/ Quantity data not reported because Bacillus thuringiensis is expressed in terms of number of spores per gram rather than in pounds active ingredient.

for about 90 percent of 36,000 pounds (a.i.) of insecticides applied as single ingredients. The surveyed growers indicated methomyl also was used in tank-mixes with Bacillus thuringiensis and various fungicides. Other insecticides used included diazinon and parathion.

Cabbage diseases include damp-off, downy mildew, Alternaria leaf spot, Rhizoctonia rot, and sclerotinia rot. Maneb and chlorothalonil accounted for about 80 percent of the active ingredients of fungicides applied as single ingredients and 80 percent of the acre-treatments.

For nematode control, about 6,500 pounds of fenamiphos were used in 3,200 acre-treatments.

Celery

An estimated 11,700 acres of celery were planted for harvest during the 1979 winter, spring, and fall seasons. About 345,000 pounds (a.i.) of all pesticides were used for nearly 454,000 acre-treatments (Table 5).

CDEC was the major herbicide reported, accounting for nearly 80 percent of the active ingredients used as single applications. CDEC was also reported used in tank-mixes with CDAA.

Insect control is important because they are vectors for viral diseases affecting celery. Two examples include cucumber mosaic virus and celery mosaic virus, both transmitted by aphids during feeding. Oxamyl accounted for 50 percent of the active ingredients used to control insects on celery. Oxamyl and permethrin accounted for about 75 percent of the acre-treatments of insecticides. Permethrin was applied an average of eight times per season at a per acre rate of 0.11 pounds (a.i.) per application as compared with 16 applications and a 0.48 pound rate for oxamyl.

Table 5. Celery: acres treated, acre-treatments, rates and quantity used, single and tank mix applications, Florida, 1979. a/

Pesticide	Acres treated	Acre-treatments	Number of application	Pounds active ingredient: Per application	Pounds active ingredient: Annual average	Pounds active ingredient: Total
Herbicides						
CDAA	2,790	2,790	1.0	1.35	1.35	3,780
CDEC	7,845	7,845	1.0	3.10	3.10	24,285
Prometryne	1,170	2,340	2.0	.16	.32	374
Nitrofen	2,400	2,400	1.0	1.00	1.00	2,400
Single applications b/	--	15,375	--	2.01	--	30,839
Insecticides						
Bacillus thuringiensis c/	3,300	15,000	4.5	--	--	--
Methomyl	1,170	11,700	10.0	.81	8.10	9,477
Naled	2,025	16,200	8.0	.46	3.69	7,472
Oxamyl	3,195	52,200	16.3	.48	7.89	25,207
Permethrin	9,258	72,976	7.9	.11	.89	8,203
Single applications b/	--	168,076	--	.30	--	50,359
Fungicides						
Benomyl	2,400	7,200	3.0	.25	.75	1,800
Chlorothalonil	7,953	91,537	11.5	.64	7.41	58,935
Copper hydroxide	4,158	66,097	15.9	1.60	25.40	105,626
Mancozeb	1,800	9,630	5.4	.78	5.76	10,368
Maneb	6,153	75,972	12.3	.74	9.17	56,415
Sulfur	1,170	17,550	15.0	1.08	11.70	13,689
Single applications b/	--	267,986	--	.92	--	246,833
Tank-mixes						
CDAA + CDEC	2,133	2,133	1.0	4.00 + 4.00	4.00 + 4.00	8,532 + 8,532
All applications b/	--	453,570	--	.76	--	345,095

a/ 1979 Vegetable Pesticide Survey, Natural Resource Economics Division, ESS, USDA.
b/ Acres treated data not reported because two or more materials may have been used on the same acre resulting in double counting.
c/ Quantity data not reported because Bacillus thuringiensis is expressed in terms of number of spores per gram rather than in pounds active ingredient.

Copper hydroxide accounted for about 45 percent of the active ingredients of fungicides reported for celery with chlorothalonil and maneb each accounting for about 25 percent. The annual number of applications ranged from 16 for copper hydroxide to 3 for benomyl.

Lettuce

An estimated 14,000 acres of lettuce were planted for harvest during the 1979 winter, spring and fall seasons. Approximately 140,000 pounds (a.i.) of pesticides were applied using about 176,000 acre-treatments (Table 6).

CDEC and paraquat were the only herbicides reported by the surveyed growers. The two herbicides comprised about 25,000 acre-treatments. Paraquat was used at an average per acre rate of 0.4 pounds (a.i.) per application versus 3.7 pounds (a.i.) for CDEC. With paraquat, a nonselective herbicide, the plants must be shielded to avoid injury to the crop.

Insects affecting lettuce include aphids, caterpillars, cucumber beetles, cutworms, mole crickets, wireworms and leaf miners. Permethrin was used for nearly 54,000 acre-treatments or about 50 percent of the 108,000 acre-treatments for all insecticides. Methomyl was an important insecticide also, accounting for about 6,600 acres treated and nearly 18,000 acre-treatments.

Some of the major diseases affecting lettuce include Alternaria leaf spot, downy mildew, and drop disease. Mancozeb was the primary fungicide used accounting for about 60 percent of the acre-treatments and about 80 percent of the active ingredients.

Table 6. Lettuce: acres treated, acre-treatment, rates and quantity used, single and tank-mix applications, Florida, 1979. a/

Pesticides	Acres treated	Acre-treatments	Number of applications	Pounds active ingredient: Per application	Pounds active ingredient: Annual average	Pounds active ingredient: Total
Herbicides						
CDEC	9,562	15,706	1.6	3.69	6.05	57,880
Paraquat	7,576	9,385	1.2	.43	.53	4,015
Single applications b/	--	25,091	--	2.46	--	61,895
Insecticides						
Bacillus thuringiensis c/	2,562	13,830	5.4	--	--	--
Dimethoate	1,530	8,507	5.6	.40	2.23	3,410
Methomyl	6,635	17,656	2.7	.28	.74	4,877
Permethrin	4,881	53,587	11.0	.09	.98	4,773
Phosdrin	1,069	4,132	3.9	.48	1.85	1,980
Toxaphene	3,806	9,512	2.5	1.83	4.56	17,362
Other b/	696	1,254	1.8	.80	--	557
Single applications b/	--	108,478	--	.31	--	32,959
Fungicides						
Copper hydroxide	675	4,050	6.0	.83	4.98	3,362
Mancozeb	5,024	25,818	5.1	1.39	7.14	35,854
Maneb	990	11,341	11.4	.40	4.60	4,554
Other b/	54	185	3.4	1.87	--	346
Single applications b/	--	41,394	--	1.07	--	44,116
Tank-mixes						
Methyl parathion + parathion	321	724	2.3	.27+ .55	.62+ 1.24	199+ 398
All applications b/	--	175,687	--	.80	--	139,567

a/ 1979 Vegetable Pesticide Survey, Natural Resource Economics Division, ESS, USDA.

b/ Acres treated data not reported because two or more materials may have been used on the same acre resulting in double counting.

c/ Quantity data not reported because Bacillus thuringiensis is expressed in terms of number of spores per gram rather than in pounds active ingredient.

Sweet Corn

Approximately 58,000 acres of sweet corn were planted for harvest during the 1979 winter, spring and fall seasons. For these crops, an estimated 1.3 million pounds (a.i.) of pesticides were used for 1.5 million acre-treatments (Table 7).

Atrazine accounted for about 65 percent of the 38,000 acre-treatments of herbicides applied singularly. About 14,000 acre-treatments were also reported for atrazine as a tank-mix application with butylate. Additional herbicides reported included alachlor and 2,4-D.

Insects attacking sweet corn include corn borer, rootworms, wireworms, and cutworms. Methomyl and toxaphene comprised 90 percent of the active ingredients of insecticides reported as single applications. Methomyl accounted for about 75 percent of the acre-treatments with an annual average of 14 applications reported for 1979.

Sweet corn diseases controlled by fungicides include leaf blights and leaf rusts. Maneb and mancozeb constituted nearly all of the fungicides reported as single applications.

Tomatoes

In 1979, approximately 40,000 acres of tomatoes were planted for harvest during the winter, spring and fall seasons. For these crops, about 2.6 million pounds of active ingredients were used for 2.2 million acre-treatments (Table 8). About 87,000 acre-treatments were applied as tank-mixes using 274,000 pounds of active ingredients.

Table 7. Sweet Corn: acres-treated, rates and quantity used, single and tank-mix applications, Florida, 1979. a/

Pesticide	Acres treated	Acre-treatment	Number of application	Pounds active ingredient: Per application	Pounds active ingredient: Annual average	Pounds active ingredient: Total
Herbicides						
Alachlor	4,081	4,081	1.0	1.25	1.25	5,115
Atrazine	23,701	24,626	1.0	1.54	1.60	37,926
Butylate	4,555	4,555	1.0	2.71	2.71	12,366
2,4-D	3,337	3,337	1.0	.36	.36	1,190
Other b/	1,180	1,180	1.0	8.00 c/	--	9,440
Single applications b/	--	37,779	--	1.75	--	66,037
Insecticides						
Disulfoton	241	241	1.0	2.25	2.25	542
Fonofos	12,837	12,837	1.0	1.50	1.50	19,256
Methomyl	46,112	660,359	14.3	.29	4.11	189,437
Parathion	8,148	41,765	5.1	1.20	2.65	21,623
Toxaphene	19,780	152,952	7.7	1.03	9.30	183,888
Other b/	1,829	2,426	1.3	.54	--	1,305
Single applications b/	--	871,580	--	.48	--	416,051
Fungicides						
Mancozeb	18,524	227,994	12.3	1.11	13.71	253,972
Maneb	24,226	172,452	7.1	1.00	7.15	173,109
Other b/	363	1,455	4.0	.88	--	1,284
Single applications b/	--	401,901	--	1.07	--	428,365
Tank-mixes						
Atrazine + butylate	14,004	14,004	1.0 1.0	1.85 + 4.35	1.85 + 4.35	25,910 + 60,914
Methomyl + fungicides	1,023	8,182	8.0	.29 + 1.10	2.24 + 8.82	2,295 + 9,019
Methyl parathion + parathion	22,706	203,892	9.0	.40 + .80	3.60 + 7.21	81,838 + 163,681
Tank-mix applications	--	226,078	--	1.52	--	343,657
All applications b/	--	1,537,338	--	.82	--	1,254,110

a/ 1979 Vegetable Pesticide survey, Natural Resource Economics Division, ESS, USDA.
b/ Acres treated data not reported because two or more materials may have been used on the same acre resulting in double counting.
c/ Other category is comprised mainly of dalapon which has a label limit of 11.0 pounds of active ingredients per acre.

Table 8. Tomatoes: acres treated, acre-treatments, rates and quantity used, single and tank-mix application, Florida, 1979.

Pesticide	Acres treated	Acre-treatments	Number of applications	Pounds of active ingredient: Per application	Pounds of active ingredient: Annual average	Pounds of active ingredient: Total
Herbicides						
Diphenamid	2,926	2,926	1.0	2.92	2.92	8,552
Metribuzin	7,177	8,719	1.2	.39	.48	3,432
Paraquat	19,000	28,592	1.5	.62	.94	17,832
Other b/	--	763	--	1.92	--	1,431
Single applications b/	--	41,000	--	.76	--	31,247
Insecticides						
Bacillus thuringiensis c/	19,166	173,840	9.1	--	--	--
Diazinon	2,552	12,553	4.9	.75	3.69	9,415
Dimethoate	4,345	80,422	18.5	.28	5.15	22,372
Endosulfan	4,148	33,240	8.0	.61	4.85	20,128
Fonofos	1,356	1,356	1.0	1.20	1.20	1,626
Methomyl	29,722	312,505	10.5	.45	4.79	151,317
Methamidophos	27,301	121,863	4.5	.92	4.09	111,745
Monocrotophos	2,451	15,407	6.3	.89	5.62	13,770
Oxamyl	5,209	39,136	7.5	.38	2.85	14,865
Permethrin	16,047	90,355	5.6	.06	.34	5,391
Other b/	--	4,426	--	.33	--	1,349
Single applications b/	--	885,103	--	.40	--	351,978
Fungicides						
Benomyl	8,769	25,917	3.0	.35	1.03	9,071
Captafol	1,017	1,757	1.9	1.48	2.55	2,595
Captan	4,100	10,970	2.7	.71	1.90	7,793
Chlorothalonil	14,878	170,245	11.4	.85	9.76	145,187
Copper compounds	30,726	376,096	12.2	.84	10.27	315,539
Mancozeb	16,586	303,290	18.3	1.07	19.54	324,050
Maneb	13,796	179,781	13.0	1.28	16.69	130,310
Metiram	3,022	27,562	9.1	1.18	10.78	32,576
Streptomycin	2,517	13,575	5.4	.07	.40	1,016
Zineb	1,688	33,754	20.0	1.50	30.00	50,632
Other b/	--	13,089	--	1.82	--	23,879
Single applications b/	--	1,156,036	--	.90	--	1,042,648

-continued

Table 8. Tomatoes: acres treated, acre-treatments, rates and quantity used, single and tank-mix application, Florida, 1979.

Pesticide	Acres treated	Acre-treatments	Number of applications	Pounds of active ingredient: Per application	Pounds of active ingredient: Annual average	Pounds of active ingredient: Total
Nematicides						
Ethylene dibromide	1,645	1,645	1.0	6.29	6.29	10,338
Chloropicrin + methyl bromide	6,998	7,262	1.0	62.21 + 58.45	64.55 + 60.65	451,751 + 424,432
Single applications	--	8,907	--	99.53	--	886,521
Tank-mixes						
Bacillus thuringiensis + methomyl c/	342	2,019	5.9	-- + .34	-- 2.02	-- + 689
Parathion + toxaphene	1,542	12,336	8.0	.70 + 2.90	.54 2.28	864 + 35,774
Copper compounds + other fungicides	2,787	20,480	7.3	--	--	103,755
Other	--	52,209	--	2.55	--	133,051
Tank-mix applications b/	--	87,044	--	3.15	--	274,133
All applications b/	--	2,178,090	--	1.19	--	2,586,527

a/ 1979 Vegetable Pesticide Survey, Natural Resource Economics Division, ESS, USDA.

b/ Acres treated data not reported because two or more materials may have been used on the same acre resulting in double counting.

c/ Quantity data not reported because Bacillus thuringiensis is expressed in terms of number of spores per gram rather than in pounds active ingredient.

Paraquat accounted for 70 percent of the 41,000 acre-treatments of herbicides. As with other vegetables, the crop must be protected by a shield when paraquat is used. Other herbicides used included diphenamid and metribuzin.

Insects attacking tomatoes include aphids, armyworms, fruitworms, pinworms, hornworms, loopers, leaf miners, stinkbugs, cucumber beetles, cutworms, wireworms, and crickets. In 1979, Bacillus thuringiensis, methomyl, and methamidophos accounted for 70 percent of the acre-treatments. The number of applications per acre ranged from 18.5 using dimethoate to 1 using fonofos.

Tomatoes are affected by a considerable number of diseases including late and early blights; Fusarium, verticillium and bacterial wilts; various fruit rots; and viral diseases. Approximately 1 million pounds (a.i.) of fungicides were used for 1.2 million acre-treatments in 1979. Maneb, mancozeb, chlorothalonil and copper compounds comprised nearly 90 percent of the acre-treatments applied as single applications. The average annual number of applications ranged up to 18 for mancozeb and 20 for zineb.

The nematicides, ethylene dibromide and chloropicrin + methyl bromide, were used for a total of nearly 9,000 acre-treatments.

Watermelon

In Florida, the watermelon crop is harvested during the spring season, with about 50,000 acres harvested in 1979. Approximately 124,000 pounds (a.i.) of pesticides were used for about 122,000 acre-treatments (Table 9).

Paraquat was the only herbicide reported by surveyed growers. There were about 700 acre-treatments using nearly 500 pounds of active ingredient.

Table 9. Watermelon: acres treated, acre-treatments, rates and quantity used, single and tank-mix applications, Florida, 1979. a/

Pesticide	Acres treated	Acre-treatments	Number of applications	Pounds active ingredient: Per application	Pounds active ingredient: Annual average	Pounds active ingredient: Total
Herbicides						
Paraquat	715	715	1.0	.65	.65	468
Insecticides						
Bacillus thuringiensis c/	1,106	6,429	5.8	--	--	--
Dimethoate	2,435	10,991	4.5	.37	1.67	4,063
Endosulfan	946	2,963	3.1	.83	2.59	2,451
Methomyl	4,375	20,077	4.6	.79	3.67	16,062
Parathion	850	3,350	3.9	.33	1.31	1,117
Other	1,798	3,431	1.9	1.14	--	3,895
Single applications b/	--	47,241	--	.64	--	30,405
Fungicides						
Benomyl	2,877	7,227	2.5	.35	.89	2,560
Captafol	1,154	2,872	2.5	1.30	3.28	3,720
Chlorothalonil	2,952	7,032	2.4	.69	1.64	4,832
Mancozeb	2,574	10,068	3.9	1.67	6.53	16,812
Maneb	6,385	37,981	5.9	1.41	8.41	53,672
Other	1,137	6,033	5.5	1.56	--	9,435
Single applications b/	--	71,213	--	1.28	--	91,031
Tank-mixes						
Benomyl + maneb	409	1,143	2.8	.37 + .61	1.03 + 1.71	421 + 698
Copper sulfate + dimethoate + maneb	733	1,195	1.6	.16 + .25 + .32	1.44 + 2.25 + 2.88	191 + 299 + 383
Tank-mix applications	--	2,338	--	.85	--	1,992
All applications b/	--	121,507	--	1.02	--	123,896

a/ 1979 Vegetable Pesticide Survey, Natural Resource Economics Division, ESS, USDA.
b/ Acres treated data not reported because two or more materials may have been used on the same acre resulting in double counting.
c/ Quantity data not reported because Bacillus thuringiensis is expressed in terms of number of spores per gram rather than in pounds active ingredient.

Pickleworms, cutworms, wireworms, mites, leafminers, aphids, cucumber beetles, rindworms, darkling beetles, and leafhoppers are some of the insects that attack watermelon in Florida. Methomyl and dimethoate comprised about 65 percent of the acre-treatments of insecticides.

Anthracnose, downy mildew, gummy stem blight, and leafspots are some of the major disease affecting watermelons. Maneb and mancozeb accounted for nearly 70 percent of the acre-treatments used as single ingredient applications.

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