The Connecticut Agricultural Experiment Station, New Haven

Pesticide Residues in Produce Sold in Connecticut 1993

BY HARRY M. PYLYPIW JR., TERRI MISENTI, AND MARY JANE INCORVIA MATTINA

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A cooperative study by The Connecticut Agricultural Experiment Station and the Food Division of the Connecticut Department of Consumer Protection

SUMMARY

Of the 441 samples of produce tested in 1993, 126 samples (28.6%) contained pesticide residues. Three of these samples were above EPA tolerance and seven samples contained pesticide residues for which there is no EPA tolerance. Thirty-one samples labeled as "organically grown" were tested and one of these samples contained a pesticide residue. The findings from 1993, as in earlier years, indicate that pesticide residues on produce sold in Connecticut are generally well below EPA tolerances.

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Pesticides are used on agricultural crops to control plant pests such as fungi, insects, and weeds. Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which was enacted by Congress in 1947, the Environmental Protection Agency (EPA) registers pesticides for use in the United States and sets tolerances for the amounts that remain on the produce after harvest (Code of Federal Regulations, 1992).

The Connecticut Agricultural Experiment Station, in cooperation with the Connecticut Department of Consumer Protection, collects and tests fruits and vegetables sold in Connecticut to determine if residues are within EPA tolerances. These tests assure consumers that produce grown in this state, other states, and foreign countries meet EPA pesticide tolerance levels.

This report presents the results of our 1993 market basket study on pesticide residues on produce sold in Connecticut.

METHODS

Samples were collected at farms, roadside stands, and food stores by an inspector from the Connecticut Department of Consumer Protection and delivered to the laboratory for pesticide residue testing.

All commodities were tested for pesticides using a multiresidue method developed in our laboratories (Pylypiw, 1993). The method begins with extraction and cleanup of the sample, followed by compound separation and quantitation by capillary gas chromatography. The method we use to test our samples has a general sensitivity limit of 0.002 parts-per-million (ppm) in the fruit or vegetable matrix.

Currently, we standardize on 25 to 30 of the most commonly used pesticides in Connecticut. Pesticides to be analyzed by the screening method must meet the following criteria: 1) they must be volatile to permit detection by gas chromatography and 2) they must be recoverable to greater than 80% by the extraction solvents. Although we standardize on 25-30 compounds, our method can detect over 60 pesticide residues and their metabolites. Of the 17 most frequently found pesticides in the Food and Drug Administration (FDA) Total Diet Study from 1986 to 1991 (Food and Drug Administration, 1993), we can recover and quantitate 14 (82%) by our procedure.

The laboratory procedure is part of an ongoing research effort. As part of this work, analyses for previously nontargeted pesticides are being examined. The incorporation of mass spectrometry to identify the presence of pesticide residues is now a significant part of this study.

RESULTS AND DISCUSSION

In 1993 a total of 441 samples representing 56 different varieties and types of produce were tested. Pesticide residues were found in 126 samples (28.6%). In addition, 13 resamples were obtained to confirm the presence of violative pesticide residues found in the initial testing. Results of all tests are forwarded to the Connecticut Department of Consumer Protection (DCP) which has the regulatory responsibility for enforcement of pesticide tolerances. The sample commodities and concentration ranges of all residues found are given in Table 1.

Ten of the 126 samples contained residues outside EPA guidelines. Three samples of apples from the same grower contained a residue of permethrin above the EPA tolerance of 0.05 ppm. Resamples were obtained and upon investigation by a DCP inspector, it was determined that the residue was a result of a mis-application of the pesticide in the orchard. Seven samples contained trace amounts of pesticides for which no EPA tolerance exists for that commodity. One sample of blueberries obtained from a farm in Connecticut contained a residue of the insecticide dicofol. Resampling and investigation revealed that the residue was a result of spray drift from an application of the pesticide to an adjacent apple orchard. Four other samples contained residues of the fungicide chlorthalonil. These samples were turnip greens from Georgia, bell-peppers from Florida and Connecticut and lettuce from Connecticut. The source of the chlorthalonil contamination from Florida and Georgia could not be ascertained. However, the residues in the samples from Connecticut were found to be due to spray drift.

Two samples of blueberries from farms in New Jersey contained traces of chlorthalonil. Although chlorthalonil is not registered for use on this crop, an exemption was given to New Jersey growers by EPA under the provisions of section 18 of FIFRA to control anthracnose on blueberries

(Pavlis, G.C., 1992). Thus, a residue of chlorthalonil on blueberries from New Jersey was permitted. Testing of blueberries grown in other states, including Connecticut, showed no traces of chlorthalonil residue. In summary, 10 samples out of the 441 tested, or 2.3% overall, contained violative residues.

Twelve samples, one each of beets and beet tops, three of cucumbers, and seven samples of squash, contained either a trace of DDE (a soil metabolite of DDT), chlordane, or dieldrin (see Table 1). The agricultural use of these organohalogen pesticides in the United States has been banned since 1972; however, they have persisted in the environment (Pylypiw et al, 1991). Even though there is no EPA tolerance for these pesticides, the FDA recognizes their persistence in the environment and has set action levels (allowable amounts) for these compounds in produce (Compliance Policy Guides, 1986). No sample that contained these pesticides was above the FDA action levels.

Thirty-one of the 441 samples were labeled as "organically grown." When tested, one of the 31 samples, a sample of spinach, contained a detectable residue of endosulfan (see Table 1). The residue was within the EPA tolerance for endosulfan on spinach. However, Connecticut Organic Law states that any produce labeled as "Organically Grown" can not contain any detectable pesticide residues (State of Connecticut, General Statutes).

Table 2 lists all pesticides that were found in the commodities tested, synonyms, if available, their use, and their frequency of occurrence in the 1993 analyses. As in past years, endosulfan was the most frequently detected residue in all commodities tested. Other pesticides that occurred significantly in the study were dicofol, captan, chlorpyrifos, chlorthalonil, and permethrin. In a few cases more than one residue was found on the same crop. This usually occurred on fruits, especially strawberries, apples, and peaches.

Overall, 54.2% of the 441 samples were from Connecticut farms and orchards, 36.1% from other states and 9.7% from foreign countries. Typical Connecticut-grown produce is apples, strawberries, blueberries, tomatoes, and squash. Commodities from foreign countries include grapes, nectarines, and peaches from Chile, tomatoes and eggplant from Mexico and cantaloupe from Honduras. Produce grown in other states include blueberries from New Jersey, citrus fruits and strawberries from California and Florida, beets from Texas, and apples from New York and Washington.

We compared our 1993 data to our 1992 study and to data from the FDA 1992 Residue Monitoring Program (Food and Drug Administration, 1993). The FDA reported that approximately 37% of the fruit and vegetable samples they tested contained allowable pesticide residues and approximately 2.6% contained violative residues. For 1992, we reported that 35% of the fruit and vegetable samples we tested contained a residue (Pylypiw and Mattina, 1993). For 1993 we found 26.3% of the fruits and vegetables tested contained allowable residues and 2.3% of the samples contained violative residues. Our data from 1993 are consistent with results from previous years.

A detailed summary of our findings from 1988 to 1993 is shown in Table 3. Prior to 1993 the total number of samples listed in Table 3 included resamples. Starting in 1993, resamples were separated from this total because resamples are obtained for residue confirmation only. Figure 1 summarizes the results of our market basket study in 1993.

As in earlier years, our findings continue to show that the residues of pesticides found in fruits and vegetables sold in Connecticut are generally well within the safety limits established by EPA.

ACKNOWLEDGMENTS

Samples were collected by Ellen Sloan, an inspector from the Food Division of the Department of Consumer Protection.

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Table 1. Summary of pesticides found in fruits and vegetables sold in Connecticut.

Commodity / Pesticide	Samples with residues	No. of times detected	Residue range (ppm)	EPA tolerance (ppm)
Apples (62 samples)	30			
Captan		12	0.01-0.20	25
Chlorpyrifos		8	0.005-0.05	1.5
Dicofol		11	0.15-1.4	5
Phosmet		1	0.15	10
Methyl Parathion		1	0.02	1
Endosulfan		10	0.015-0.2	2
Permethrin		3	0.11-0.25 (a)	0.05
Apple Cider (59 samples)	0			
Apple Juice (8 samples)	0			
Asparagus (2 samples)	0			
Bananas (2 samples)	0			
Beans-Snap (13 samples)	1			
Chlorthalonil		1	0.07	5
Endosulfan		1	0.04	2
Bean Sprouts (2 samples)	0			
Beans, Shell (1 sample)	0			
Beets (4 samples)	1			
DDE		1	0.006	0
Beet-Tops (2 samples)	1			
DDE		1	0.009	0
Blueberries (19 samples)	10			
Chlorthalonil		2	0.06-1.03 (b)	0
Captan		2	0.1-2.0	25
Phosmet		1	0.12	10
Dicofol		1	0.32 (b)	0
Malathion		1	1.0	8
Endosulfan		4	0.01-0.02	0.1
Broccoli (3 samples)	0			
Broccoli Rabe (1 sample)	1			
DCPA		1	0.274	5
Brussels Sprouts (2 samples)	0			
Cabbage (7 samples)	1			
Endosulfan		1	0.06	2

Table 1. Summary of pesticides found in fruits and vegetables sold in Connecticut (continued).

Commodity / Pesticide	Samples with residues	No. of times detected	Residue range (ppm)	EPA tolerance (ppm)
Cantaloupe (6 samples)	0			
Carrots (5 samples)	0			
Cauliflower (1 sample)	0			
Celery (1 sample)	0			
Cherries (1 sample)	0			
Cherry Juice (1 sample)	0			
Corn (16 samples)	0			
Cucumbers (11 samples)	5			
Chlorthalonil		1	0.2	5
Chlordane		2	0.03-0.07	0
DDE		1	0.01	0
Endosulfan		3	0.025-0.1	2
Eggplant (5 samples)	1			
Endosulfan		1	0.035	2
Grapefruit (4 samples)	0			
Grape Juice (1 sample)	0			
Grapes, Table (2 samples)	1			
Chlorpyrifos		1	0.033	0.5
Iprodione		1	0.17	60
Vinclozolin		1	0.15	6
Kale (2 samples)	1			
DCPA		1	0.035	5
Kiwifruit (1 sample)	1			
Vinclozolin		1	0.07	10
Lettuce (13 samples)	1			
Chlorthalonil		1	0.07 (b)	0
Limes (1 sample)	0			
Mangoes (1 sample)	0			
Mushrooms (1 sample)	0			

Table 1. Summary of pesticides found in fruits and vegetables sold in Connecticut (continued).

Commodity / Pesticide	Samples with residues	No. of times detected	Residue range (ppm)	EPA tolerance (ppm)
Nectarines (5 samples)	3			
Dicloran		1	0.19	20
Iprodione		3	0.025-0.15	20
Onions (1 sample)	0			
Oranges (6 samples)	0			
Orange Juice (9 samples)	0			
Parsnips (1 sample)	0			
Peaches (11 samples)	6			
Captan		1	0.5	50
Chlorpyrifos		3	0.003-0.045	0.05
Phosmet		2	0.1-0.5	10
Iprodione		3	0.1-0.2	20
Dicofol		1	0.6	10
Endosulfan		3	0.01-0.02	2
Pears (6 samples)	3			
Phosmet		1	0.22	10
Permethrin		1	0.2	3
Endosulfan		2	0.01-0.33	2
Peas (1 sample)	0			
Peppers, Bell (19 samples)	8			
Chlorthalonil		2	0.1 (b)	0
Diazinon		2	0.15-0.65	1
Chlorpyrifos		1	0.08	1
Ethion		1	0.025	1
Dicofol		1	0.22	5
Permethrin		3	0.04-0.2	1
Vinclozolin		1	0.02	3
Endosulfan		4	0.01-0.1	2
Peppers, Hot (3 samples)	1			
Chlorpyrifos		1	0.15	1
Pineapple (2 samples)	0			
Plums (3 tested)	2			
Dicloran		1	0.02	15
Iprodione		2	0.08-1.0	20
Potatoes (8 tested)	2			
Chlorpropham		2	0.25-7.5	50

Table 1. Summary of pesticides found in fruits and vegetables sold in Connecticut (continued).

Commodity / Pesticide	Samples with residues	No. of times detected	Residue range (ppm)	EPA tolerance (ppm)
Potatoes, Sweet (4 samples)	2			
Dicloran		2	0.2-0.4	10
Chlorpyrifos		1	0.03	0.1
Raspberries (4 samples)	1			
Captan		1	0.1	25
Malathion		1	0.4	8
Spinach (8 samples)	3			
Permethrin		2	1.2-4.1	20
Endosulfan		1	0.01	2
Squash, Summer (16 samples)	8			
Chlorthalonil		4	0.02-0.04	5
Chlordane		1	0.08	0
DDE		5	0.006-0.023	0
Dieldrin		1	0.03	0
Endosulfan		5	0.02-0.08	2
Squash, Winter (4 samples)	1			
Chlorthalonil		1	0.035	5
Endosulfan		1	0.06	2
Strawberries (36 samples)	21			
Captan		3	0.4-10	25
DCPA		3	0.018-0.09	2
Chlorpyrifos		1	0.005	0.5
Iprodione		2	1.0	15
Dicofol		2	0.5-0.75	5
Vinclozolin		8	0.01-0.6	10
Endosulfan		10	0.01-0.1	2
Swiss Chard (1 sample)	0			
Tangerines (1 sample)	0			
Tomatoes (30 samples)	8			
Chlorthalonil		3	0.01-0.1	5
Diazinon		1	0.023	0.5
Chlorpyrifos		1	0.012	0.5
Endosulfan		7	0.005-0.03	2
Turnip Greens (2 samples)	2			
Chlorthalonil		1	20 (b)	0
DCPA		1	0.143	5

(a)=Residue over EPA limit. (b)=Residue not allowed on this commodity

Table 2. Pesticides detected in 1993 produce, agricultural use, total number of detections and percent of samples containing the pesticide.

Common Name	Other Name	Use [a]	Total No. of Detections	Percent Occurrence [b]
Captan		F	19	4.3
Chlordane		I	3	0.7
Chlorpropham	CIPC	H,P	2	0.5
Chlorpyrifos	Dursban	I	17	3.9
Chlorthalonil	Bravo	F	16	3.6
DCPA	Dacthal	H	6	1.4
DDE	Metabolite of DDT	I	8	1.8
Diazinon		I,N	3	0.7
Dicloran	Botran	F	4	0.9
Dicofol	Kelthane	A	16	3.6
Dieldrin		I	1	0.2
Endosulfan	Thiodan	I,A	53	12.0
Ethion		I,A	1	0.2
Iprodione	Rovral	F	11	2.5
Malathion		I	2	0.5
Methyl Parathion	Penncap-M	I	1	0.2
Permethrin	Pounce	I	9	2.0
Phosmet	Imidan	I	5	1.1
Vinclozolin	Ronilan	F	11	2.5

(a) From Farm Chemical Handbook (1992), 78th edition. Meister Publishing Co., Willoughby, OH 44094; A= Acaricide, F= Fungicide, H= Herbicide, I= Insecticide,N= Nematocide, P= Plant Growth Regulator.

(b) Based on 441 samples.

Table 3. Six year summary of samples tested.

Year[a]	Samples	Samples Within Tolerances [a]	Samples Over Tolerances [b]	Samples with No Tolerances [b]
1988	310	138	2	5
1989	349	170	3	2
1990	436	265	0	1
1991	285	96	0	1
1992	282	99	1	4
1993	441 [b]	126 [b]	3	7
Total	2103	894	9	20

(a) Includes resamples.

(b) Represents original samples only, does not include resamples.

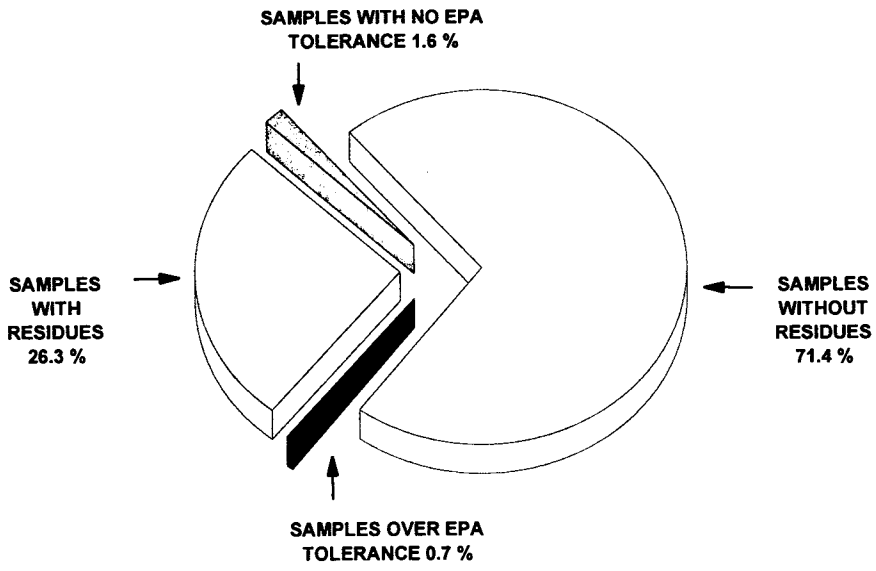

Figure 1. Summary of 1993 Results.

The Connecticut Agricultural Experiment Station, founded in 1875, is the first experiment station in America. It is chartered by the General Assembly to make scientific inquiries and experiments regarding plants and their pests, insects, soil and water, and to perform analyses for State agencies. The laboratories of the Station are in New Haven and Windsor; its Lockwood Farm is in Hamden. Single copies of bulletins are available free upon request to Publications; Box 1106; New Haven, Connecticut 06504.

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