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Pesticide Residues
in Produce Sold
in Connecticut 1988

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SUMMARY

Of the 310 samples of produce tested in 1988, 138 or 44.5% contained pesticide residues. Only two of the 310 samples (0.6%) contained residues above allowable tolerances. In the 138 samples we found a total of 67 residues of a pesticide for which there is no allowable tolerance on that specific crop. The concentrations of 42 of these findings were above trace concentrations.

Pesticide Residues in Produce Sold in Connecticut—1988

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The citizens of Connecticut, like those in other States, are interested in what pesticides are used on agricultural crops and if any residues remain after harvest. Pesticides registered for use on specific crops may be legally used so long as applications are no closer to harvest than the time specified on the label. Testing determines if pesticide residues are present in various crops and within the limits established by the Environmental Protection Agency (EPA) (Code of Federal Regulations, 1988).

Each year for over 25 years, The Connecticut Agricultural Experiment Station in cooperation with the Department of Consumer Protection has tested produce grown within this State, in other States, and in foreign countries, and sold in Connecticut. We now present information on pesticide residues in produce sold in Connecticut in 1988. This Bulletin is published in accordance with the charter of this Station to report results of Analyses (General Statutes, 1989).

METHODS

Samples were collected at farms, roadside stands, and food stores by an inspector of the Connecticut Department of Consumer Protection and delivered to the laboratory within 24 hours of collection.

Products were tested for pesticide residues by official and recommended methods known as multi-residue methods (Guide to Chemicals, 1982; McMahon, 1978; Official Methods of Analysis, 1984; Pesticide Analyt. Manual; Luke et al 1981). The basic principle of each method is the analysis for a selected group of pesticides using the combined techniques of extraction and column chromatography cleanup, followed by compound separation and quantitation by gas chromatography. These methods allowed for the identification of over 60 residues (Hankin, 1988). Sample preparation was described in more detail by Hankin (1988).

RESULTS AND DISCUSSION

A total of 310 samples of 58 different varieties and types of produce were tested for pesticide residues (Table 1). Although we show in Table 1 concentrations of all residues found, levels below 0.01 ppm for chlorinated compounds and 0.02 ppm for phosphated compounds are considered by the Food and Drug Administration (FDA) to be trace quantities and are reported by them as trace quantities (Pesticide Analytical Manual).

Pesticide residues were found in 138 samples (44.5%). This is about the same percentage as found in produce examined in 1987 (Hankin, 1988). Only two samples (0.6%) contained residues above EPA tolerance allowances. One sample of strawberry contained an excess of Kelthane (Dicofol) and one sample of tomato contained an excess of Bravo (Chlorothalonil). Sixty-seven of the 138 samples with residues contained pesticides for which the tolerance is zero. Included among these 67 samples were the chemicals Mesurol (a bird repellent) on blueberry, Bravo (a fungicide) on eggplant and pepper, and Endrin (an insecticide) and HCB (a seed protectant) on squash.

Also in this group of 67 samples were root crops (beet, carrot) and above ground crops (beet green, cucumber, spinach, squash, strawberry) that contained traces of DDT, Chlordane, or Dieldrin. These materials, no longer in use, had been used on crops many years ago and have persisted in the soil. The Food and Drug Administration (FDA) recognizes their persistence and states "Food and feed crops may contain a pesticide residue from sources of contamination that cannot be avoided by good agricultural or manufacturing practices, such as contamination by a pesticide that persists in the environment" (Compliance Policy Guides).

Table 2 lists all the pesticides found on crops tested, synonyms if available, their use, and the number of times detected. Thiodan was the most frequently detected residue

followed by Dieldrin, Captan, Guthion, Kelthane, DDT, and Ronalin. In some cases more than one residue was found on the same crop. Twenty-nine samples contained two different pesticide residues each, 21 contained three different residues each, and two samples contained four residues each.

Table 3 lists the number and source of the samples. Overall, 79% of the samples were from Connecticut farms and orchards, 16.5% from other states, and 4.5% from foreign countries. Produce grown in foreign countries, sold in Connecticut and tested, included Brussels sprouts from Mexico, carrots from Canada, grapes from Chile, and pineapple from Costa Rica and Honduras. Produce grown in other states, sold in Connecticut and tested included asparagus, carrots, and lettuce from California, beet greens, spinach, cole slaw, and radishes from New York, carrots from Massachusetts, cereal (wheat and oats) from Texas and Tennessee, cucumbers from South Carolina, pineapple from Hawaii, radishes from Florida, and spinach from Pennsylvania.

Tests for pesticide residues performed by the California Department of Food and Agriculture (California, 1987) showed only 18.7% of California's produce with detectable residues. Frank et al. (1987) reported finding 42% of samples tested in Canada with pesticide residues. The NRDC (Mott, 1984) reports finding 44% of domestic and foreign produce containing residues. The FDA (Residues in Foods, 1987) reported only 37% of the produce sampled contained detectable residues.

Residue data obtained in our 1988 study were compared to data obtained in 1987. Six crops, apple, cider, corn, squash, strawberry, and tomato were selected for comparison. Specifically, in 1988 there was an 11% increase in detectable residues on corn samples. Other changes included a 5% increase in pesticides on apple, a 7% decrease on squash, a 3% decrease on strawberry, and no changes for cider and tomato. A statistical analysis (t test) showed no significant difference between 1987 and 1988 results.

We compared data obtained from the 77 crops grown in Connecticut with 25 of the same crops grown in other States. Of the 77 grown in Connecticut, 53% contained pesticide residues. For the 25 from other States, 32% contained pesticide residues. Connecticut-grown crops with a greater percentage of residues included squash 65%, pepper 53%, cucumber 50%, and blueberry 38%. From other States, the crops with the largest percentage of residues included carrots 60%, followed by spinach and squash with 50% each, and lettuce 33%.

Overall, 43% of the crops grown in a foreign country contained pesticide residues, compared to 44.5% of all crops tested. We did not find any unusual residues on crops grown in foreign countries when compared to those found in crops grown in Connecticut or other States.

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Table 1. Concentrations of pesticide residues in produce sold in Connecticut in 1988. The number of samples tested and the number positive for a pesticide residue follows the product name. The number in parenthesis following the pesticide name is the number of times that pesticide was found.

Produce Pesticide/(number)	Residue range (ppm)	EPA tolerance (ppm)
Apple, Baldwin (1 tested, 1 pos.) Kelthane (1)	0.016	5
Apples, Cortland (3 tested, 3 pos.) Chlorpyrifos(1)	0.036	1.5
Guthion (1)	0.021	2
Kelthane (2)	0.090-0.300	5
Thiodan (1)	0.043	2
Apple, Golden delicious (2 tested, 1 pos.) Guthion (1)	0.173	2
Thiodan (1)	0.005	2
Apple, Green (1 tested, 0 pos.)		
Apple, Empire (1 tested, 1 pos.) Guthion (1)	0.173	2
Apple, Ida Red (2 tested, 2 pos.) Guthion (1)	0.645	2
Thiodan (1)	0.005	2
Apple, McIntosh (19 tested, 13 pos.) Chlorpyrifos (2)	0.005-0.018	1.5
Guthion (6)	0.014-0.059	2
Imidan (1)	0.007	10
Kelthane (5)	0.020-0.560	2
Thiodan (4)	0.011-0.012	2
Apple, Macoun (7 tested, 3 pos.) Chlorpyrifos (1)	0.014	1.5
Guthion (2)	0.029-0.035	2
Kelthane (1)	0.260	5
Thiodan(1)	0.015	2
Apple, Melrose (1 tested, 1 pos.) Guthion (1)	0.023	2
Thiodan (1)	0.11	2
Apple, Northern Spy (4 tested, 1 pos.) Chlorpyrifos (1)	0.001	1.5
Guthion (1)	0.023	2
Apple, Red Delicious (6 tested, 4 pos.) Diazinon (1)	0.52	2
Guthion (2)	0.213-0.52	2
Imidan (1)	0.040	10
Thiodan (1)	0.012	2

Table 1. Concentrations of pesticide residues in produce in 1988 (Continued).

Produce Pesticide/(number)	Residue range (ppm)	EPA tolerance (ppm)
Apple, Rome (2 tested, 0 pos.)		
Apple, Spartan (2 tested, 2 pos.)		
Guthion (1)	0.084	2
Kelthane (2)	0.30-0.45	5
Apple, Winesap (1 tested, 0 pos.)		
Asparagus (3 tested, 0 pos.)		
Banana Chips (1 tested, 0 pos.)		
Barley (1 tested, 1 pos.)		
Dieldrin (1)	0.01	0
Malathion (1)	0.01	8
Thiodan (1)	0.011	0.1
Bean, Green (5 tested, 0 pos.)		
Beet (4 tested, 3 pos.)		
DDE (1)	0.013	0
DDT (2)	0.011-0.071	0
Dieldrin (2)	0.001-0.004	0
Thiodan (3)	0.012-0.018	0.1
Beet Greens (2 tested, 1 pos.)		
DDE (1)	0.02	0
Dieldrin (1)	0.01	0
Blueberry (10 tested, 4 pos.)		
Captan (1)	0.05	25
Mesurol (4)	0.15-2.9	0
Broccoli (1 tested, 1 pos.)		
Dacthal (1)	0.01	1
Brussel Sprouts (2 tested, 0 pos.)		
Cabbage (2 tested, 0 pos.)		
Cabbage, Shredded (1 tested, 0 pos.)		
Carrot (8 tested, 3 pos.)		
DDE (2)	0.03-0.05	0
DDT (1)	0.025	0
Cereal, Cracked Wheat & Rolled Oats (2 tested, 0 pos.)		
Cider (20 tested, 0 pos.)		
Cole Slaw (4 tested, 0 pos.)		
Collard (1 tested, 0 pos.)		
Corn (19 tested, 2 pos.)		
Thiodan (2)	0.014-0.14	0.2

Table 1. Concentrations of pesticide residues in produce in 1988 (Continued).

Produce Pesticide/(number)	Residue range (ppm)	EPA tolerance (ppm)
Cucumber (10 tested, 5 pos.)		
Captan (1)	0.05	5
Chlordane (1)	0.012	0
Dieldrin (4)	0.003-0.014	0
Thiodan (3)	0.018-0.04	0.1
Cucumber, Pickling (1 tested, 0 pos.)		
Eggplant (2 tested, 2 pos.)		
Bravo (1)	0.63	0
Thiodan (1)	0.13	2
Granola (1 tested, 0 pos.)		
Grape, Green (3 tested, 2 pos.)		
Captan (2)	0.15-0.40	50
Grape, Red (2 tested, 1 pos.)		
Captan (1)	0.15	50
Grapefruit (6 tested, 6 pos.)		
Chlorpyrifos (3)	0.015-0.085	10
Ethion (5)	0.012-0.53	2
Diazinon (1)	0.006	0.7
Malathion (2)	0.004-0.084	8
Juice, Apple (1 tested, 0 pos.)		
Kale (1 tested, 0 pos.)		
Lettuce (8 tested, 2 pos.)		
Dacthal (2)	0.005-0.01	2
Millet, Puffed (1 tested, 0 pos.)		
Peach (1 tested, 0 pos.)		
Pepper, Green (18 tested, 9 pos.)		
Bravo (3)	0.020-0.14	0
Dacthal (1)	0.003	1
Thiodan (6)	0.005-0.179	2
Pepper, Red (1 tested, 0 pos.)		
Pineapple (5 tested, 0 pos.)		
Pineapple, Dried (1 tested, 0 pos.)		
Plum (1 tested, 0 pos.)		
Radish (2 tested, 0 pos.)		
Salad Mix (1 tested, 0 pos.)		
Spinach (5 tested, 3 pos.)		
Captan (1)	1.5	100
Chlordane (1)	0.04	0
DDE (2)	0.01-0.02	0

Table 1. Concentrations of pesticide residues in produce in 1988 (Continued).

Produce	Residue	EPA
Pesticide/(number)	range (ppm)	tolerance (ppm)
Strawberry (41 tested, 29 pos.)		
Captan (13)	0.05-0.50	25
Dacthal (5)	0.005-0.10	2
Dieldrin (1)	0.004	0
Kelthane (5)	0.005-9.5	5
Ronalin (14)	0.005-1.0	10
Thiodan (11)	0.01-0.35	2
Squash, Green (12 tested, 8 pos.)		
Chlordane (3)	0.025-0.156	0
DDT (4)	0.007-0.028	0
Dieldrin (7)	0.001-0.008	0
HCB (2)	0.005-0.01	0
Thiodan (5)	0.005-0.091	2
Squash, Patty Pan (1 tested, 1 pos.)		
Dieldrin (1)	0.017	0
Thiodan (1)	0.024	2
Squash, Yellow (26 tested, 16 pos.)		
Chlordane (5)	0.05-0.08	0
DDT (3)	0.02-0.025	0
Dacthal (2)	0.02	1
Dieldrin (8)	0.001-0.086	0
Endrin (1)	0.015	0
HCB (3)	0.002-0.02	0
Thiodan (8)	0.002-0.09	2
Swiss Chard (1 tested, 0 pos.)		
Tomato (19 tested, 7 pos.)		
Bravo (5)	0.051-6.0	5
Lindane (1)	0.004	3
Thiodan (4)	0.009-0.28	2
Triticale, Organic (1 tested, 0 pos.)		

Table 2. Pesticides found in produce, their use and times detected.

Common name	Synonym	Use ^a	Times detected
Captan		F	19
Chlordane*		I	10
Chlorothalonil	Bravo	F	9
Chlorpyrifos	Dursban	I	8
DDT (and DDE)*		I	16
Dacthal		H	11
Diazinon		I, N	2
Dieldrin*		I	25
Ethion		I, A	5
Endrin*		I	1
Guthion	Azinophos-methyl	I	17
HCB	Hexachlorbenzene	S	5
Imidan	Phosmet	I	2
Kelthane	Dicofol	A	17
Lindane	BHC (gamma isomer)	I	1
Malathion		I	3
Mesurof	Methiocarb	I, A, R	4
Ronalin	Vinclozolin	F	14
Thiodan	Endosulfan	I, A	53

^a From Farm Chemical Handbook '89, 75th edition. Meister Publishing Co., Willoughby, OH 44094

A= Acaricide, F= Fungicide, H= Herbicide, I= Insecticide, N= Nematocide, R= Bird repellent, S= Seed protectant

* No longer in agricultural use

Table 3. Source of produce tested.

Produce	Conn.	U.S.	Foreign	Total
Apple	52	0	0	52
Asparagus	0	3	0	3
Banana Chips	0	1	0	1
Barley	0	1	0	1
Bean, Green	5	0	0	5
Beet	4	0	0	4
Beet Green	0	2	0	2
Blueberry	8	2	0	10
Broccoli	1	0	0	1
Brussels Sprout	0	0	2	2
Cabbage	2	0	0	2
Cabbage, Shredded	0	1	0	1
Carrot	0	5	3	8
Cereal	0	2	0	2
Cider	20	0	0	20
Cole Slaw	2	2	0	4
Collard	1	0	0	1
Corn	19	0	0	19
Cucumber	10	1	0	11
Eggplant	2	0	0	2
Granola	0	1	0	1
Grape	0	0	5	5
Grapefruit	0	6	0	6
Juice, Apple	1	0	0	1
Kale	0	1	0	1
Lettuce	2	6	0	8
Millet, Puffed	0	1	0	1
Peach	1	0	0	1
Pepper	17	2	0	19
Pineapple	0	1	4	5
Pineapple, Dried	0	1	0	1
Plum	0	1	0	1
Radish	0	2	0	2
Salad Mix	0	1	0	1
Spinach	1	4	0	5
Strawberry	41	0	0	41
Squash	37	2	0	39
Swiss Chard	0	1	0	1
Tomato	19	0	0	19
Triticale	0	1	0	1
Total	245	51	14	310
% of total	79.0	16.5	4.5	



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