The Connecticut Agricultural Experiment Station, New Haven

Pesticide Residues in Produce Sold in Connecticut 1989

BY HARRY M. PYLYPIW JR
AND LESTER HANKIN

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

Bulletin 881

July 1990

SUMMARY

Of the 349 samples of produce tested in 1989, 170 samples (48.7%) contained pesticide residues. Only three of the 349 samples (0.9%) contained residues above allowable tolerances. In the 170 samples there was a total of 27 samples with residues of pesticides for which there is no allowable tolerance on that produce. Sixty-eight of the 349 samples tested were labeled as organically grown and six of those samples (8.8%) contained pesticide residues. For the 1989 produce samples there was a 4% increase in pesticide residues as compared to the produce sampled in 1988.

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. ISSN 0097-0905

Pesticide Residues in Produce Sold in Connecticut 1989

BY HARRY M. PYLYPIW JR AND LESTER HANKIN

Pesticides are registered for use by the Environmental Protection Agency (EPA) on specific crops. When they are applied, the residues that remain in or on the produce must be below allowable tolerances (Code of Federal Regulations, 1989). Analytical testing is used to determine if pesticides are present in the various products and whether the concentrations found are within the EPA tolerances. Tests are performed to assure consumers that produce grown in this state, other states and foreign countries, meets pesticide tolerance levels.

In accordance with the Charter of this Station to report results of analyses, we now present information on pesticide residues in produce sold in Connecticut in 1989 (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 (Pesticide Analytical Manual, 1968, Vol. 1; Luke et al, 1981) or by single residue methods (Conditt et al, 1988, Bushway et al, 1990). The basic principle of the multi-residue method is the analysis for a selected group of pesticides using the combined techniques of extraction and cleanup, followed by compound separation and quantitation by capillary gas chromatography. This was described in more detail by Pylypiw (1989) and Hankin (1988).

Two single residue methods were used this year to test apples for the growth regulator Alar (Conditt et al, 1988) and the fungicide Benomyl (Bushway et al, 1990). Samples analyzed by a single residue method provide only one result for each individual determination. The multi-residue method, however, can provide data for up to 80 different pesticide compounds and pesticide metabolites for each individual determination.

RESULTS AND DISCUSSION

A total of 349 samples representing 63 different varieties and types of produce were tested for pesticide residues (Table 1). We show, in Table 1, concentrations of all residues found. Results of all samples tested are forwarded to the Connecticut Department of Consumer Protection who has the regulatory responsibility.

Pesticide residues were found in 170 samples (48.7%). This is a slight increase as compared to produce examined in 1987 and 1988 (Hankin, 1988, Hankin and Pylypiw, 1989). Only three samples (0.9%) contained residues above EPA tolerance allowances. These were two peach samples that contained an excess of Dursban and one of beet top that contained an excess of Diazinon.

Twenty-seven of the 170 samples with residues contained pesticides for which the tolerance is zero. Included among these 27 samples were the chemicals Bravo and Thiodan on beet and beet top, Diazinon and Kelthane on cabbage, Bravo on spinach, and Malathion on lettuce.

Also in this group of 27 samples were root crops, (beet and carrot) and above ground crops (asparagus, broccoli/cauliflower flourettes, snap-bean, cucumber, kale, lettuce and squash) that contained traces of BHC, DDE, Dieldrin, and Endrin. These materials, no longer in agricultural use, had been used on crops many years ago and have persisted in the soil. The Food and Drug Administration 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, 1986).

Table 2 lists all pesticides that were found on the crops tested, synonyms if available, their use, and their frequency of occurrence. Benomyl was the most frequently detected residue followed by Thiodan, Alar, Kelthane, Dursban, Ronalin, Guthion, DDE, and Bravo. It should be noted that only apple products were tested for

the presence of Alar and Benomyl. In many cases more than one residue was found on the same crop. Sixty-four samples contained two different pesticide residues each, 25 contained three different residues each, seven contained four different residues each and two samples contained five residues each.

Table 3, lists the number and source of the samples. Overall, 73% of the samples were from Connecticut farms and orchards, 23% from other states and 4% from foreign countries. Produce from foreign countries included grape from Chile; carrot from Canada; and eggplant, cucumber and snap-bean from Mexico. Produce grown in other states included orange from California and Florida; potato from Maine, Oregon and Idaho; spinach from New York and Massachusetts; grapefruit from Texas, California, and Florida; and mushroom from Pennsylvania.

A total of 68 samples of produce labeled as organically grown were tested for pesticide residues. Six of the samples (8.8%) contained detectable residues. Three of the samples, asparagus, broccoli/cauliflower flourettes, and kale contained traces of DDE and Endrin, which are considered unavoidable insecticides (Compliance Policy Guides, 1986). The other samples of organically grown produce that contained pesticide residues were one sample of lettuce with the insecticide Malathion, one sample of nectarine with the fungicide Dicloran and the insecticide Thiodan and a sweet potato sample that also contained Dicloran.

We compared the data obtained in our 1989 study to our residue data for 1988. Eight commodities, apple, apple cider, carrot, corn, bell-pepper, green and yellow squash, strawberry, and tomato were selected for comparison. In 1989 there was a significant increase of detectable residues on apple products. These changes included a 15.6% increase on apple and a 67.3% increase in apple cider. This was primarily due to increased testing in the autumn of 1989 on these products.

For example, the fungicide Benomyl was found 62 times (51%) and the growth regulator Alar was found 35 times (29%) in 121 apple products. Before 1989 only limited testing of produce for residues of Benomyl was done. In addition, we did not test for residues of Alar in apple products before 1989.

The manufacturer of Alar, Uniroyal Chemical Co., Inc., withdrew it from sale in early 1989. After this withdrawal, apple growers voluntarily stopped using it. The concentrations of Alar that we found in the 1989 apple crop reflect a carry-over from applications in previous years (Mattina et al., 1990).

Other changes in pesticide residues from 1988 to 1889 included a 1.1% decrease on carrot, a 10.5% decrease on corn, an 8.9% decrease on bell-pepper, a 4.1% increase on green and yellow squash, an 8.8% decrease on strawberry and an 8.2% decrease on tomato.

The Food and Drug Administration (FDA) reported finding 42% of the fruit and vegetable samples they tested in 1988 contained pesticide residues (Food and Drug Administration, 1989). In this study we report finding almost 50% of our samples to contain residues.

The geographical coverage of the samples in the FDA study is significantly different when compared to our study. About 75% of the produce that we tested in our study was grown in Connecticut, whereas the FDA obtains from 0.4% to at most 1.8% of their produce samples from Connecticut (Food and Drug Administration, 1989). In addition, about 58% of the testing by the FDA was produce from foreign countries, while in our study only 4% of the samples were from foreign countries.

In 1988 the FDA noticed a 3% increase in pesticide residues found in produce as compared to 1987 (Food and Drug Administration, 1989). This year, we noted a 4% increase in pesticide residues found in produce since 1988. Most of this increase was due to changes in testing procedures which allows for the detection and determination of more pesticides.

ACKNOWLEDGEMENTS

Samples were collected by John Wadhams of the Connecticut Department of Consumer Protection. Serge Golden, Mary Jane Mattina, Anthony Paiva, and Laura Rousso provided technical assistance.

REFERENCES

Bushway, R.J., Savage, S.A., Ferguson, B.S. (1990) Food Chemistry, 35:51-58.

Code of Federal Regulations (1989) Title 40, U.S. Government Printing Office, Washington, DC, Secs. 180-186.

Conditt, M.K., Baumgardner, J.R., Hellmann, L.M. (1988) J. Assoc. Off. Anal. Chem., 71:735-739.

Compliance Policy Guidelines (1986) Food and Drug Administration, Office of Enforcement, Division of Compliance Policy, Chapter 41, Guide 7141.01, p. 2.

Food and Drug Administration (1989) Food and Drug Administration Pesticide Program-Residues in Foods-1988. J. Assoc. Off. Anal. Chem., 72:133A-152A.

General Statutes of Connecticut (1989) Revised to January 1, 1989, Section 22-81.

Hankin, L. (1988) Pesticide Residues in Produce Sold in Connecticut-1987. Bulletin 863, Conn. Agric. Exper. Sta., New Haven, CT.

Hankin, L., Pylypiw,. H. M. (1989) Pesticide Residues in Produce Sold in Connecticut-1988. Bulletin 873, Conn. Agric. Exper. Sta., New Haven, CT.

Luke, M.A., Froberg, J.E., Doose, G.M., Masumoto, H.T. (1981) J. Assoc. Off. Anal. Chem., 64:1187-1195.

Mattina, M.J.I., Pylypiw, H.M., Paiva, A.A. (1990) Daminozide Residues in Apple Orchards: Concentrations in Fruit, Trees, and Soil. Bull. Environ. Contam. Toxicol., in press.

Pesticide Analytical Manual (1968 and revisions) Vols. 1 and 2, Food and Drug Administration, Washington, DC (Available from: National Technical Information Service, Springfield, VA.)

Pylypiw, H.M., Jr. (1989) Automated Procedure Determines Pesticide Residues Overnight. Frontiers of Plant Science, 42:7-8.

Table 1. Concentrations of pesticide residues in produce sold in Connecticut in 1989. The numbers following the product name is the number of samples tested, the number positive findings for a pesticide residue, the number of organic labeled samples and number positive findings in an organic sample. The number in parenthesis following the pesticide name is the number of times that pesticide was found. Organic products are included in the total for each product.

Produce Pesticide/(number)	Residue range (ppm)	EPA tolerance (ppm)
Apple, Cortland (3 tested, 2 pos.)		
Alar (1)	0.09	20
Benomyl (1)	0.17	7
Guthion (1)	0.39	2
Penncap-M (1)	0.008	1
Thiodan (1)	0.033	2
Apple, Empire (4 tested, 3 pos.)		
Alar (2)	0.04-0.07	20
Benomyl (3)	0.012-0.08	7
Dursban (1)	0.015	1.5
Guthion (1)	0.03	2
Kelthane (1)	0.32	5
Thiodan (1)	0.009	2
Apple, Ida Red (1 tested, 1 pos.)		
Benomyl (1)	0.018	7
Apple, Jonagold (1 tested, 1 pos.)		
Kelthane (1)	0.054	5
Apple, Macoun (6 tested, 5 pos.)		
Benomyl (4)	0.011-0.057	7
Dursban (1)	0.011	1.5
Guthion (3)	0.034-0.10	2
Imidan (1)	0.074	10
Kelthane (3)	0.054-0.39	5
Apple, McIntosh (27 tested, 21 pos.)		
Alar (8)	0.06-0.60	20
Benomyl (8)	0.016-0.16	7
Dursban (5)	0.004-0.054	1.5
Guthion (8)	0.07-0.35	2
Imidan (1)	0.69	10
Kelthane (9)	0.06-0.55	5
Thiodan (6)	0.004-0.035	2
Apple, Milton (1 tested, 0 pos.)		
Apple, Northern Spy (1 tested, 1 pos.)		
Benomyl (1)	0.037	7
Dursban (1)	0.045	1.5
Guthion (1)	0.063	2
Penncap-M (1)	0.009	1

Table 1 (continued)

Produce Pesticide/(number)	Residue range (ppm)	EPA tolerance (ppm)
Apple, Red Delicious (11 tested, 9 pos.)(2 organic, 0 pos.)		
Alar (2)	1.01-1.2	20
Benomyl (7)	0.037-0.14	7
Dursban (3)	0.003-0.055	1.5
Guthion (1)	0.063	2
Imidan (2)	0.025-0.048	10
Kelthane (1)	0.10	5
Penncap-M (1)	0.009	1
Thiodan (2)	0.005-0.013	2
Apple, Rome (2 tested, 2 pos.)		
Alar (1)	0.05	20
Benomyl (2)	0.025-0.05	7
Dursban (1)	0.003	1.5
Apple, Spygold (1 tested, 1 pos.)		
Imidan (1)	0.063	10
Apple, Stayman (1 tested, 1 pos.)		
Dursban (1)	0.092	1.5
Imidan (1)	0.58	10
Apple, Wealthy (1 tested, 0 pos.)		
Apple, Winesap (1 tested, 1 pos.)		
Benomyl (1)	0.26	7
Dursban (1)	0.05	1.5
Imidan (1)	0.015	10
Thiodan (1)	0.029	1.5
Apple, Yellow Delicious (9 tested, 6 pos.)(1 organic, 0 pos.)		
Alar (2)	0.03-1.3	20
Benomyl (5)	0.05-0.5	7
Dursban (3)	0.019-0.10	1.5
Guthion (1)	0.12	2
Imidan (1)	0.18	10
Kelthane (1)	0.15	5
Penncap-M (2)	0.005-0.006	1
Thiodan (3)	0.034-0.13	2
Apricot (1 tested, 0 pos.)(1 organic)		
Apricot-Nectar (1 tested, 0 pos.)(1 organic)		
Asparagus (2 tested, 1 pos.)(1 organic, 1 pos.)		
Endrin (1)	0.176	0
Bean, Green-Snap (4 tested, 3 pos.)(1 organic, 0 pos.)		
Bravo (1)	0.08	5
DDE (1)	0.037	0
Dacthal (1)	0.011	2
Thiodan (1)	0.006	2

Table 1 (continued)

Produce Pesticide/(number)	Residue range (ppm)	EPA tolerance (ppm)
Beet, Root (5 tested, 3 pos.)		
Bravo (2)	0.037-0.60	0
DDE (1)	0.002	0
Diazinon (1)	0.07	0.7
Thiodan (3)	0.037-0.50	0
Beet, Top (2 tested, 1 pos.)		
Bravo (1)	35.0	0
Diazinon (1)	2.8	0
Thiodan (1)	6.25	0.7
Broccoli (3 tested, 0 pos.)(3 organic)		
Blueberry (4 tested, 1 pos.)		
Thiodan (1)	0.005	0.1
Cabbage, Green (3 tested, 1 pos.)		
Diazinon (1)	0.183	0
Kelthane (1)	0.075	0
Cabbage, Red (1 tested, 0 pos.)		
Cantaloupe (1 tested, 0 pos.)(1 organic)		
Carrot (11 tested, 4 pos.)(3 organic, 0 pos.)		
DDE (2)	0.005-0.040	0
DDT (1)	0.04	0
Dicloran (2)	0.23-0.30	10
Celery (1 tested, 0 pos.)(1 organic)		
Cider, Apple (49 tested, 33 pos.)		
Alar (19)	0.01-0.12	20
Benomyl (29)	0.01-0.28	7
Collard (1 tested, 0 pos.)(1 organic)		
Corn (15 tested, 0 pos.)		
Cucumber (7 tested, 5 pos.)(1 organic, 0 pos.)		
Bravo (2)	0.023-0.042	5
DDE (4)	0.003-0.037	0
Thiodan (4)	0.005-0.106	2
Eggplant (1 tested, 0 pos.)(1 organic)		
Grapefruit (7 tested, 0 pos.)(7 organic)		
Grape, Table (10 tested, 0 pos.)(2 organic)		
Juice, Apple (2 tested, 0 pos.)(2 organic)		
Kale (2 tested, 1 pos.)(2 organic, 1 pos.)		
DDE (1)	0.02	0
Lettuce, Green (4 tested, 0 pos.)(4 organic)		

Table 1 (continued)

Produce Pesticide/(number)	Residue range (ppm)	EPA tolerance (ppm)
Lettuce, Hydroponic (1 tested, 1 pos.)		
DDE (1)	0.045	0
TDE (1)	0.056	0
DDT (1)	0.040	0
Lettuce, Red (1 tested, 1 pos.)(1 organic, 1 pos.)		
Malathion (1)	0.4	0
Lettuce, Romaine (1 tested, 0 pos.)(1 organic)		
Lime (1 tested, 0 pos.)(1 organic)		
Mushroom (4 tested, 0 pos.)		
Nectarine (1 tested, 1 pos.)(1 organic, 1 pos.)		
Dicloran (1)	0.11	20
Thiodan (1)	0.009	2
Orange (8 tested, 0 pos.)(8 organic)		
Pea, Pod Removed (2 tested, 0 pos.)		
Peach (6 tested, 5 pos.)(2 organic)		
Dicloran (1)	0.11	20
Dursban (3)	0.014-0.176	0.05
Iprodione (4)	0.134-3.5	20
Pepper, Green-Bell (13 tested, 5 pos.)		
Dacthal (3)	0.007-0.87	2
Diazinon (1)	0.029	0.5
Thiodan (3)	0.012-0.29	2
Potato, Russet (6 tested, 0 pos.)(6 organic)		
Potato, Sweet (4 tested, 1 pos.)(4 organic, 1 pos.)		
Dicloran (1)	0.67	10
Plum (1 tested, 0 pos.)(1 organic)		
Radish (4 tested, 0 pos.)		
Raisin (1 tested, 0 pos.)(1 organic)		
Raspberry (1 tested, 1 pos.)		
Ronalin (1)	0.21	10
Spinach (2 tested, 2 pos.)		
Bravo (1)	0.064	0
Thiodan (2)	0.154-0.227	2
Sprout, Alfalfa (2 tested, 0 pos.)(2 organic)		
Sprout, Radish (1 tested, 0 pos.)(1 organic)		
Squash, Green (11 tested, 8 pos.)		
Bravo (2)	0.01-0.20	5
DDE (4)	0.002-0.024	0
Diazinon (1)	0.083	0.5
Thiodan (6)	0.016-0.13	2

Table 1 (continued)

Produce Pesticide/(number)	Residue range (ppm)	EPA tolerance (ppm)
Squash, Patty Pan (1 tested, 0 pos.)		
Squash, Yellow (10 tested, 7 pos.)		
BHC (1)	0.01	0
Bravo (2)	0.052-0.054	5
DDE (4)	0.002-0.036	0
Dieldrin (2)	0.002-0.018	0
Thiodan (3)	0.017-0.146	2
Strawberry (42 tested, 26 pos.)		
Dursban (3)	0.01-0.13	0.5
Kelthane (5)	0.025-1.15	5
Ronalin (19)	0.004-1.08	10
Thiodan (15)	0.009-0.17	2
Swiss Chard (1 tested, 0 pos.)(1 organic)		
Tomato (14 tested, 4 pos.)(1 organic)		
Bravo (4)	0.010-0.17	5
Dacthal (2)	0.006-0.035	1
Diazinon (1)	0.038	0.75
Thiodan (3)	0.034-0.121	2
Vegetables, Mixed (3 tested, 1 pos.)(2 organic, 1 pos.)		
Broccoli/Cauliflower flourettes		
DDE (1)	0.02	0
DDT (1)	0.04	0
Carrot/Turnip pieces		
Carrots, Cabbage, Celery, and Onion		

Table 2. Pesticides found, agricultural use, total findings and frequency of occurrence.

Common name	Synonym	Use (a)	Total no. of findings (b)	Percent occurrence
Alar (c)	Daminozide	G	35	10.0
Benomyl (c)	Benlate	F	62	17.8
BHC (d)	Benzenehexachloride	I	1	0.3
Bravo	Chlorthalonil	F	13	3.7
Dacthal	DCPA	H	6	1.7
DDE (and DDT) (d)		I	19	5.4
Diazinon		I, N	6	1.7
Dicloran	DCNA	F	5	1.4
Dieldrin (d)		I	2	0.6
Dursban	Chlorpyrifos	I	23	6.6
Endrin (d)		I	1	0.3
Guthion	Azinophos-methyl	I	16	4.6
Imidan	Phosmet	I	8	2.3
Iprodione	Rovral	F	4	1.2
Kelthane	Dicofol	A	25	7.2
Malathion		I	1	0.3
Penncap-M	Methyl Parathion	I	5	1.4
Ronalin	Vinclozolin	F	20	5.7
Thiodan	Endosulfan	I, A	53	15.2

(a) From Farm Chemical Handbook (1989), 75th edition. Meister Publishing Co., Willoughby, OH 44094 A= Acaricide, F= Fungicide, G= Growth Regulator, H= Herbicide, I= Insecticide, N= Nematocide

(b) Based on 349 items.

(c) Reflects overall incidence, however, only apple products were selected for Alar and Benomyl analysis.

(d) No longer in agricultural use.

Table 3. Source of produce tested.

Produce	Connecticut	U.S.	Foreign	Total
Apple, all varieties	67	3	0	70
Apricot	0	1	0	1
Apricot-Nectar	0	1	0	1
Asparagus	0	2	0	2
Bean, Green-Snap	3	0	1	4
Beet, Root	5	0	0	5
Beet, Top	2	0	0	2
Broccoli	0	3	0	3
Blueberry	4	0	0	4
Cabbage, Green	3	0	0	3
Cabbage, Red	1	0	0	1
Cantaloupe	0	1	0	1
Carrot	1	9	1	11
Celery	0	0	1	1
Cider, Apple	49	0	0	49
Collard	0	1	0	1
Corn	15	0	0	15
Cucumber	6	0	1	7
Eggplant	0	0	1	1
Grapefruit	0	7	0	7
Grape, Table	0	2	8	10
Juice, Apple	0	2	0	2
Kale	0	2	0	2
Lettuce, Green	0	4	0	4
Lettuce, Hydroponic	0	1	0	1
Lettuce, Red	0	1	0	1
Lettuce, Romaine	0	1	0	1
Lime	0	1	0	1
Mushroom	1	3	0	4
Nectarine	0	1	0	1
Orange	0	8	0	8
Pea, Pod Removed	2	0	0	2
Peach	5	1	0	6
Pepper, Green-Bell	13	0	0	13
Potato, Russet	0	6	0	6
Potato, Sweet	0	4	0	4
Plum	0	1	0	1
Radish	0	4	0	4
Raisin	0	1	0	1
Raspberry	1	0	0	1
Spinach	0	2	0	2
Sprout, Alfalfa	0	2	0	2
Sprout, Radish	0	1	0	1
Squash, Patty Pan	1	0	0	1
Squash, Green	11	0	0	11
Squash, Yellow	10	0	0	10
Strawberry	42	0	0	42
Swiss Chard	0	1	0	1
Tomato	13	1	0	14
Vegetables, Mixed	0	1	2	3
Totals	255	79	15	349