

## **Organochlorine Insecticide Residues in Soils Used for Vegetable and Tropical Fruit Production in the Cudgen-Duranbah Area of New South Wales**

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As part of an environmental study on the occurrence of organochlorine (OC) insecticide residues in the North Coast Region of New South Wales (NSW), McDougall et al. (1987) reported that residues of OC insecticides, including dieldrin, aldrin, heptachlor, and BHC, were present in dairy pasture, sugar cane and banana plantation soils. DDT residues were rarely detected in these soils, yet other data (unpublished) indicate that they are present in fish and birds collected from, and adjacent to some of the major river systems in the North Coast Region. While past DDT use in urban and resort areas may be one source of this environmental contamination (e.g., Miles and Harris 1973), monitoring studies elsewhere have shown that, from an agricultural point-of-view, vegetable and fruit cropping areas tend to have higher DDT residues than land used to produce other crops (e.g., Harris et al. 1977; Wiersma et al. 1972). We wish to report results of a study done to determine levels to which OC insecticides have accumulated in soils on the Cudgen-Duranbah plateau, an important vegetable and tropical fruit production area overlooking the Tweed, one of the major rivers in the NSW North Coast Region.

### **MATERIALS AND METHODS**

Analyses were done at the Biological and Chemical Research Institute and the North Coast Agricultural Institute. Initial studies were done using composite samples of topsoil (0-15 cm) from 20 sites, collected in 1981 as part of an agricultural land suitability study (Anon. 1982), which had been air-dried, placed in air-tight containers, and stored in darkness under cool conditions. Under these conditions, degradation of OC

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insecticide residues in these acid soils from the time of collection was expected to be minimal. However, to insure that this assumption was correct, 9 of the 20 sites which were still accessible were re-sampled in a similar manner in June, 1987. Samples were extracted and analyzed by GLC as described by McDougall et al. (1987). Soil from all locations was examined for heptachlor, heptachlor epoxide, chlordane, aldrin, dieldrin, BHC, p,p'-DDT, p,p'-DDE, and p,p'-TDE. Results are expressed in ppm ( $\mu\text{g/g}$  dry soil). ND = none detected; limit of sensitivity was 0.005 ppm.

## RESULTS AND DISCUSSION

No residues of cyclodiene insecticides or BHC were detected in any of the soil samples.

DDT residues were present in nearly all soil samples (Tables 1, 2). In soils used for vegetable production, t-DDT residues

Table 1. DDT residues (ppm) in soil samples collected from farms used for vegetable production in rotation with field crops and pasture in the Cudgen-Duranbah area, North Coast Region, NSW

Site No.	Year	DDT	DDE	TDE	t-DDT
1	1981	0.14	0.17	0.04	0.35
	1987	0.24	0.34	0.02	0.60
2	1981	0.07	0.07	0.02	0.16
	1987	0.54	0.20	0.30	1.0
3	1981	0.32	0.24	0.09	0.65
	1987	0.12	0.22	0.02	0.36
4	1981	0.13	0.05	0.04	0.22
	1987	ND	ND	ND	ND
5	1981	0.14	0.12	0.05	0.31
	1987	0.11	0.20	0.01	0.32
6	1981	0.15	0.25	0.01	0.41
	1987	ND	0.02	ND	0.02
7	1981	0.02	0.01	ND	0.03
8	1981	ND	0.01	ND	0.01
9	1981	ND	ND	ND	ND
Average 1981 (overall)		0.11	0.10	0.03	0.24
1981 (1-6)		0.16	0.15	0.04	0.35
1987 (1-6)		0.17	0.16	0.06	0.39

at the 9 sites sampled in 1981 averaged 0.24 ppm, with the highest level detected being 0.65 ppm (Table 1). Average residue levels for the 6 sites sampled in both 1981 (0.35 ppm) and 1987 (0.39 ppm) were similar, although examination of individual site data suggests that DDT had been used at sites 1 and 2 between sampling times, whereas residue levels declined substantially at sites 3,4,6, which had no known history of recent DDT use. DDT residues in soils used for tropical fruit production, with average and maximum residue levels of 0.66 and 1.4 ppm, respectively, were higher than those found in vegetable soils (Tables 1, 2). T-DDT residues at the 3 sites re-sampled in 1987 were  $\leq$  levels detected in 1981 (Table 2).

Table 2. DDT residues (ppm) in soil samples collected from farms used for tropical fruit production in the Cudgen-Duranbah area, North Coast Region, NSW

Site No.	Year	DDT	DDE	TDE	t-DDT
1	1981	0.29	0.06	0.06	0.41
	1987	0.10	0.13	0.08	0.31
2	1981	0.39	0.31	0.11	0.81
	1987	0.42	0.38	0.03	0.83
3	1981	0.60	0.58	0.17	1.4
	1987	0.11	0.28	0.02	0.41
4	1981	0.03	0.04	ND	0.07
5	1981	0.70	0.16	0.15	1.0
6	1981	0.29	0.33	0.07	0.69
7	1981	0.24	0.29	0.06	0.59
8	1981	0.36	0.35	0.08	0.79
9	1981	0.22	0.24	0.04	0.50
10	1981	0.02	0.01	ND	0.03
11	1981	0.49	0.37	0.09	0.95
Average	1981 (overall)	0.33	0.25	0.08	0.66
	1981 (1-3)	0.43	0.32	0.11	0.87
	1987 (1-3)	0.21	0.26	0.04	0.52

In general, OC insecticide residue levels in Cudgen-Duranbah soils were substantially lower than those reported in soils used for similar purposes elsewhere, suggesting less intensive past use of OC insecticides than in other countries, or more rapid dissipation under subtropical conditions. For example, while OC residues in Cudgen-Duranbah vegetable soils averaged

0.24 ppm, several other studies have reported total OC residues in vegetable soils in areas of regular insecticide use, 1 to 2 orders of magnitude greater (e.g., Harris et al. 1977; Miles and Harris 1978; Saha and Sumner 1971; Stevens et al. 1970). DDT residues in land used for tropical fruit production were higher than those found in vegetable soils. However, average and maximum residue levels of 0.66 and 1.4 ppm, respectively, also were much lower than levels reported elsewhere, e.g., Harris et al. (1977) reported average total OC residues in orchards >60 ppm from 1964-1974, while others have reported maximum OC residues in orchards >200 ppm (Kuhr et al. 1974; Stevens et al. 1970). Nevertheless, although OC residues in vegetable and tropical fruit growing areas may be relatively low, they can, through erosion of OC insecticide contaminated soil, be one of the sources of the low-level environmental contamination occurring in NSW North Coast river systems.

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