

The safety of food produced in urban agriculture depends on a number of factors, including the history of prior land uses and applications of pesticides or other chemicals on an area. In Perth, Western Australia, attempts to eradicate the Argentine Ant resulted in the widespread treatment of private suburban land with organochlorine insecticides. These pesticides are persistent in the environment and potentially hazardous to human health. They were also used by urban market gardeners and householders.



Chicken run

on contaminated soil?

# Pesticide Soil Contamination

## a Case Study from Perth, Western-Australia

One of the difficulties of the organochlorine pesticides is that they accumulate in fats. Even after the state programme of spraying for Argentine Ants ceased in 1988, unacceptable levels of pesticides were still being found in the eggs of domestic poultry kept in suburban backyards. The legacy of the Argentine Ant campaign and other organochlorine spraying continues even

### Organochlorines accumulate in fats

today, with residue levels in some cases nearing or exceeding the recommended levels. There is no systematic attempt made by any authority to warn people of the possibility of high residue levels in the eggs of backyard poultry, and no subsidised service for the testing of eggs for residues. So, ironically, people in suburban Perth who keep their own poultry in the belief that the eggs produced are 'cleaner' than the commercial alternative, may be getting more than they bargained for.

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### THE ORGANOCHLORINE PESTICIDES

Although safer for humans than the arsenical insecticides commonly in use prior to the Second World War, the organochlorine insecticides which achieved widespread popularity in the 1950s were by no means benign. One of the first organochlorines to be produced and widely distributed was DDT.

In the US, naturalists expressed concern over the potential environmental effects of DDT in 1944, before its general release to the public (Perkins 1980). Scientists were aware of some of the problems of persistence of organochlorines in the soil as early as 1958 (Dingle 1988). However, it was not until after 1962, when Rachel Carson published her research into the health and ecological effects of the new pesticides in *Silent Spring*, that many members of the public seriously began to question the wisdom of using such persistent and potentially dangerous chemicals.

In the 1950s, the organochlorine pesticides were widely regarded as

a cheap, effective and unproblematic means by which to defeat virtually all insect pests, and they were used extensively.

Although it was widely accepted as safe in the 1950s, there is now a lot of debate over whether DDT is a human carcinogen. Currently, it is classified by the World Health Organisation as 'possibly carcinogenic to humans', as well as possibly having toxic effects on human reproduction. The United States Environmental Protection Agency regards it and most other organochlorines as probable human carcinogens<sup>1</sup>. One of the greatest concerns about DDT and other organochlorines - particularly for a species at the top of the food chain - is the fact that they accumulate in fats, including body fats, milk (including breast milk) and eggs. DDT also persists for a long time in the environment. It has a reported half-life of between 2 and 15 years and is fairly immobile in most soils, particularly those containing much organic matter (Extotoxnet 1996).

Dieldrin, Chlordane and Heptachlor are all cyclodiene

insecticides, a type of organochlorine compound. Like DDT, they are very persistent in the environment, and tend to accumulate within food chains. Dieldrin, the most persistent of the cyclodienes, moves extremely slowly in soil and has a reported half-life range of 2-39 years (Gerritse 1988). The cyclodienes are toxic to birds, bees and fish, as well as to humans. Some have been shown to cause cancer in mice and are regarded as probable human carcinogens. They accumulate in human breast milk, and there is little knowledge of their effect on infants (EPAWA 1988).

### THE ARGENTINE ANT ERADICATION CAMPAIGN IN PERTH

The Argentine Ant arrived in Western Australia in 1941, before organochlorine pesticides had achieved widespread usage. The ants became an acute household and garden pest, infesting pantries, dining rooms, even refrigerators, and overran chicken pens, sometimes killing birds. "In severe cases, bed legs were placed on vaseline-smear plates or tins of water with a kerosene film, in order to stop the ants climbing onto the beds. The ants were particularly troublesome in the dry heat of Perth summers, as they invaded houses in their relentless pursuit of moisture". In some Australian states, such as Victoria, control of the pest was carried out by local

authorities on an 'as-needed' basis. In Western Australia, however, the response was legislative.

In 1954 a large-scale spraying campaign began under the *Argentine Ant Act*, with the aim of eradicating the pest within five years (EPAWA 1988). The campaign was based on the use of the organochlorine pesticide Dieldrin, with Chlordane being used in 'sensitive areas' such as around fish ponds and aviaries. The chemicals were sprayed around the perimeter of an infestation, and in grid lines spread three metres apart within the infested area. Later, when Heptachlor replaced Dieldrin and Chlordane, it was applied in grid lines spaced one metre apart, and Chlorpyrifos - a shorter-lived organophosphorus insecticide - was used for 'sensitive areas'. From the commencement of the campaign in 1954 until its suspension in 1988, between 234 and 4,857 hectares were treated every year. Some areas were treated repeatedly. Most of the spraying was carried out in the inner and middle suburbs of Perth, though the campaign also extended to some country towns. Although its spread was controlled, the ant was not eradicated<sup>2</sup>.

The Act gave sweeping powers to 'authorised persons' to enter and inspect properties, and to spray, or require owners to

spray, with prescribed chemicals to kill the ant. In Perth, some residents had doubts about the wisdom of allowing their properties to be sprayed for Argentine ants, and occasionally police gained entry by force where residents had refused to allow ant control personnel onto their properties (Dingle 1988).

Public concern over the use of Heptachlor for Argentine Ant treatment had reached substantial levels in Western Australia by the mid-1980s. DDT, already deregistered

## Residue levels can exceed the limits regarded as safe for health

in the United States in 1972, was deregistered in Australia in 1987 only. In the same year, the cyclodienes were deregistered for agricultural use in Australia, after a well-publicised incident where the United States rejected Australian beef containing high levels of organochlorine residues (especially Dieldrin). However, cyclodienes continued to be used in a suburban context to kill termites and other pests, including Argentine Ants, and it was only in 1995, after a long campaign by community groups that they were deregistered for all uses in Western Australia.

### IMPACTS

The use of organochlorine insecticides in the urban environment (both by market gardeners and by those attempting to eradicate Argentine Ants) had two main impacts on urban agriculture. Firstly, there is evidence pointing to a large decline in the insectivorous bird population in Perth following the commencement of the 1950s spraying programme (EPAWA 1988). This decline is likely to have been responsible for increases in other pest insects normally susceptible to predation by birds, and probably initiated a vicious cycle where more garden insecticides - including organochlorines - were used to counter the increased number of pests. Secondly, organochlorines accumulated in the eggs of fowls and other poultry.

In 1981, it was found that the average level of Dieldrin detected in eggs from fowl-yards sprayed with Aldrin and Dieldrin was greater than 5 mg/kg - fifty times the regulation MRL (Maximum Residue Limit) of 0.1 mg/kg for eggs (Dingle 1988). In Western Australia, a 1989 study of backyard eggs detected organochlorine

### COMMON URBAN SOIL CONTAMINANTS

Due to their widespread use in the past and persistence in the environment, organochlorine insecticides including Chlordane, Aldrin, Dieldrin, Heptachlor epoxide, and DDT and its metabolites, are some of the most prevalent soil contaminants in urban areas. Other potential contaminants which are persistent in the environment include arsenic, mercury, lead, cadmium and PCBs:

- ❖ Arsenical pesticides were commonly used in fruit and vegetable production until they were superseded by organochlorines after the second world war. Arsenic may still be found at elevated levels on some old orchard and garden sites.
- ❖ Mercury was also used in pesticides, but is now more likely to appear as a soil contaminant in areas which have been used for the storage or disposal of certain types of batteries, paints, vapour-discharge lamps and electrical switches. Mercury may also be found in significant amounts in medical and laboratory waste.
- ❖ Lead is commonly found as a soil contaminant in areas which have been used for the production, storage or disposal of lead-acid batteries or lead products such as plates for dampcoursing and flashing, shot and bullets, and fishing sinkers. It can also arrive in the soil via certain types of paints and pigments, solder and pipes, and used motor oil. Lead arsenate was commonly used as a pesticide prior to the second world war, and can contribute to elevated levels of lead in the soil of old market garden sites.
- ❖ Cadmium is found as a contaminant in some types of superphosphate, and with repeated applications it can build up in the soil. It is also commonly found as a metal plating, and in batteries.
- ❖ PCBs, or polychlorinated biphenyls, were used until the mid-1970s in hundreds of commercial and industrial applications including electrical and hydraulic equipment, paints, plastics, rubber products, pigments and dyes, and carbonless copy paper.

Each of these contaminants, and the five main organochlorine pesticides, were found in at least one sample of eggs collected for the 1997 South Australian backyard egg survey (Hardy 1998).



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In Australia, ADIs (Acceptable Daily Intakes) are set by the Therapeutic Goods Administration of the Commonwealth Department of Health and Family Services according to risks of adverse health effects over a lifetime of consumption. For example, the ADI for Dieldrin is 100 ng/kg body weight per day. For a 55kg person, the ADI is 0.0055 mg of Dieldrin per day. If that person eats two 50 g backyard eggs contaminated with Dieldrin at 0.07 mg/kg (below the MRL of 0.1mg/kg), they are getting 0.007 mg of Dieldrin, which is above the ADI for a person of that bodyweight.

levels that were ten times the relevant MRLs in 5% of samples tested (Hardy 1998). In an earlier test of ten egg samples from Perth backyards, seven exceeded the MRL, with one sample containing 80 times the MRL (Dingle 1988). The persistence of organochlorines in soil also means that they continue to accumulate in eggs long after spraying has ceased. In a South Australian study conducted in 1997, 10 years after DDT was deregistered, DDT was detected in 68% of backyard eggs (Hardy, 1998).

Even where residue levels are below the MRL, they can exceed the limits regarded as safe for health, represented by ADIs (Acceptable Daily Intakes). This is possible because the Maximum Residue Limit is based on levels of a residue that would be expected to appear in a food produced according to good agricultural practice. They are not direct health measures.

#### CONCLUSION

After several protests (one big one held in Perth in 1990), organochlorines were finally deregistered for all uses in Western Australia in 1995. However, since the conclusion of the “deregistration campaign”,

awareness of the potential for contamination of backyard eggs by organochlorine pesticides seems to have virtually disappeared. In 1998 and 1999, several of the people interviewed during the course of a study of urban agriculture in Perth and Melbourne indicated that one of the main reasons they grew their own food was because they wanted to be sure it was organic. As one interviewee put it: “you’re pretty sure when you’re growing your own food that it’s going to be clean.” Ironically, many people with backyard poultry did not realise that their eggs could in fact be contaminated with relatively high levels of organochlorine pesticides.

Organochlorine contamination of backyard eggs could affect a substantial number of people: comparable figures are not available for Perth, but a South Australian study in 1996 found that 23.6% of the population consumed eggs from backyard poultry (Langley et al. 1997). Where householders are aware of the potential risks, it is probable that some have been dissuaded from getting their eggs tested for organochlorine residues through lack of knowledge that such a service is available.

One could prohibit all food-production activities where the soil is, or could be, contaminated with organochlorine pesticides. However, a better way to address this issue (and similar problems of contamination) would comprise two steps. The first step involves awareness - making householders aware of the possible risks, through newspaper advertisements or letterbox drops. The second step involves actively helping householders to ensure that the food they produce is safe. This would entail firstly, free or subsidised testing of backyard eggs (or other produce); and secondly, advice and assistance with remediation of any contamination problem.

For example, poultry keepers with contaminated soil could be provided with plans for a deep-litter fowl shed, where birds are kept in an enclosed shelter on a layer of litter over a concrete floor. Presently, some local government authorities in Perth recommend (or require) such sheds for poultry, but as they generally fail to explain why such housing is appropriate, householders often see it as an unjustifiable expense or unreasonable Council requirement, and do not construct it.

Before issues of soil contamination in urban agriculture can be adequately addressed, there needs to be some acknowledgement on the part of state and local authorities that people are producing food in suburban areas, and are possibly doing so at risk to their health through no fault of their own. It should also be recognised that such food production, if carried out safely, can have economic and other benefits, and the response to problems of contamination should therefore look beyond prohibition. It is not being satisfactorily addressed in Perth.

#### NOTES

- 1 Unless stated otherwise, information on the proven or probable harmful effects of organochlorine chemicals is taken from International Chemical Safety Cards (ICSCs). The United States Environment Protection Agency position on organochlorines is derived from their Integrated Risk Information System (IRIS) database, available on-line at <http://www.epa.gov/ngispgm3/iris/>.
- 2 During the campaign, a total of 31,093.4 hectares were sprayed with 35.2 millions of litres of chemicals, at a cost of AU\$ 4,963,230. The figure of 31,093.4 hectares overstates the total area that was sprayed, because areas that received multiple treatments were added to the total each time they were sprayed. As a result of the spraying programme, the extent of Argentine Ant infestation in Western Australia was reduced from around 17,000 ha in the late 1950s (mostly in Perth), to 1,458 ha in 1988, when the programme ceased. By 1991, the extent of infestation had again increased, to more than 3,000 ha.