

**Pesticides are substances that are designed to kill or discourage pests – such as insects, rodents, fungi, weeds, parasites and bacteria which threaten the food supply or public health and safety. However, being mostly designed to kill, pesticides can sometimes have harmful effects on humans, livestock and the natural environment, especially if they enter the food chain or drinking water supply.**

Pesticides take a range of forms – they can be synthetic or naturally occurring chemicals, disinfectants or anti-microbial substances and even living organisms designed to biologically control the target pest.

While there is much discussion about the risks of pesticides, they have all been developed with one aim in view – making life safer and healthier for people. For example there has been extensive use of pesticides to control the spread of diseases such as malaria or West Nile virus, which are carried by insects. Food preservatives are a form of pesticide intended to prevent death or sickness resulting from toxic organisms which grow in unpreserved food. Herbicides have been developed to combat weeds which compete with food crops for soil space, water, light and nutrients. Rodenticides or rat poisons have been developed to counter the rats and mice which eat a large part of the world's grain supply.

Pesticides are often thought of as a 20th century innovation but have in fact been used for more than 4500 years, since early farmers in Sumeria used natural deposits of sulphur to discourage insects, while lead, copper, arsenic, mercury and other metal-based pesticides have been used by gardeners, fruitgrowers and medical practitioners for almost 500 years. Persistent organochlorine chemicals – now mostly banned – were developed following WWII because they combined low toxicity with great persistence to provide long-lasting protection from the pest.

## Downsides

However the same features which make them attractive for controlling pests also make many pesticides risky for people or non-target species in the environment. The persistent chemicals, in particular, tended to concentrate up the food chain so that 'top predators' like hawks, predatory fish and people accumulate a greater burden of them by eating other species – and this has led to their use being banned in most countries. Also it has been calculated that up to 95% of a pesticide sprayed reaches non-target species in the environment or else soil, water and the food supply, as well as the pest they are aimed at<sup>1</sup>.

Unregulated pesticides are estimated by the World Health Organisation to poison about three million farm workers a year, of whom 18,000 die. There are also concerns about the health of consumers exposed to pesticides, and the United Nations Codex Alimentarius as well as many national governments have established maximum residue limits (MRLs) to prevent this – however these address only the maximum permitted level of individual chemicals and not the combined effect on individual health of consuming a 'cocktail' of different substances. To reduce the amounts of pesticide residues in food, consumers can wash, peel, and cook their food, trim fat from meat

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and eat a variety of foods to avoid repeat exposure to a pesticide used on a specific crop. Consumers can also buy organically grown food, though even this may on occasion have traces of pesticides.

Human health effects from consuming pesticides may include various forms of cancer, nerve disorders, birth defects and allergies or food sensitivities.

Recent trends in pesticide development have focused on the design of synthetic chemicals which target a particular biological pathway within a particular pest or category of pest, making them much safer for non-target species including humans.

## Regulation

Pesticide use in Australia is stringently regulated by State Environment Protection Authorities, food authorities and by the Australian Pesticides and Veterinary Medicines Authority (APVMA) which is charged with evaluating the safety and performance of all such chemicals sold, registering and de-registering them<sup>ii</sup>. Manufacturers and many users must be licensed and use is strictly controlled, with extensive labelling requirements. APVMA provides extensive advice to the public about pesticides and their safe use.

## Pathways

Pesticides can reach people through several pathways:

- in fresh food that has not been washed or cleaned
- in water which has been discharged by places using pesticides
- in soil, where some pesticides may persist for years and be taken up by plants, so entering the food chain
- in air, where pesticides sprays drift over inhabited areas or in homes and buildings where old pest treatments turn into vapours and can be inhaled.

## Remediation

Synthetic pesticides are generally of two kinds – organic (made from molecules combining carbon, hydrogen and oxygen) and inorganic (usually metals and their salts). Both kinds can be successfully cleaned up using a range of strategies – and successful clean-up depends on a good analysis of the source of the pollution and the tailoring of the right mix of technologies to deal with the actual contaminants present. In any cases the natural action of soil and water microbes, sunlight and oxygen will break down the chemicals into harmless constituents like CO<sub>2</sub> and water, often within days or hours.

Where this does not occur a wide range of methods are available. These include:

- the application of specially tailored groups of microbes
- the stimulation of natural soil or water microbes
- the use of soil improvers which break down or lock up the toxic compounds
- the treatment of contaminated air with sunlight or UV
- the design of special filters for water or groundwater, and
- the use of chemical or physical methods to degrade the pesticide to a harmless state.

## CRC CARE's role

CRC CARE is pursuing a wide range of scientific projects aimed at risk assessment and the clean-up of soil and water contaminated by pesticide residues and making the food chain, drinking water and environment safer.

<sup>i</sup> Miller GT (2004), *Sustaining the Earth*, 6th edition. Thompson Learning, Inc. Pacific Grove, California.

<sup>ii</sup> <http://www.apvma.gov.au/index.asp>

CRC CARE is a partnership of organisations providing research, technologies and knowledge in assessing, preventing and remediating contamination of soil, water and air.

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