Pesticide Classes

Pesticide Safety Technical Note

Number 8

OFFICIAL

Contents

All pesticides contain active ingredients that control pests by interfering with their natural body functions. These functions may be similar in non-target species including humans and therefore may present a hazard to health.

The chemical structure of the active ingredient determines what chemical class that particular pesticide belongs to. The class is not necessarily written on the pesticide label or the Safety Data Sheet (SDS). However, it is useful to understand the properties and modes of action of the most common chemical classes in order to:

- use these pesticides effectively
- appropriately advise clients and,
- minimise potentially adverse health effects.

These chemical classes should not be confused with the authorisations listed on the back of a pest control licence. The licence authorisations depend on the type of pest control work that you are qualified to undertake, not the chemical class of pesticide that you are permitted to apply. A chemical class may also be referred to as a chemical family or chemical group.

Organophosphates

Uses of Organophosphates (OPs)

OPs have traditionally been used due to their effectiveness against a variety of pests. Pests do not appear to develop resistance to this class of pesticides as often as they do to other classes. However, the use of OPs has diminished in favour of pesticides which are more environmentally sound, having shorter persistence and lower toxicity.

Common OP products used in pest control include Agrocn 500 (active ingredient chlorpyrifos) and Insectigas-D (dichlorvos).

Properties of OPs

OPs exist in a variety of forms, such as liquid, mist, bait, powder, paste and dust. In general, OPs are extremely toxic, particularly in the concentrated form. OPs are generally more persistent than other chemical classes currently used. Whilst some OPs start to breakdown within hours of application, others have a much higher persistence and will take longer.

OPs can breakdown chemically under the influence of environmental factors such as sunlight, air, rainfall, and soil moisture, or biologically through plants, animals and microorganisms like bacteria and fungi. The more exposure OPs have to these elements, the faster they will breakdown.

Some labels and SDSs contain information regarding the “half-life” of the pesticide. This refers to the time that it takes for the concentration of the applied pesticide to reduce by half. If a half life of one week is specified, after 7 days the concentration will be half that originally applied, after two weeks it will be a quarter, and so on.

Modes of action of OPs

OPs can be absorbed directly through the skin, the lining of the stomach or respiratory tract, following ingestion or inhalation.

OPs affect the nervous system by attaching to the enzyme acetylcholinesterase. When functioning normally, nerves transmit messages through the production of a chemical called acetyl-choline (ACh). After a message is sent, the enzyme acetylcholinesterase breaks down the ACh to end stimulation of the nerve and return it to its normal state. OPs inhibit this enzyme, causing an accumulation of ACh and overstimulating the nerves. This causes the insect to lose control of their nervous system, resulting in weakness, paralysis and respiratory failure. Because OPs affect acetylcholinesterase, they are known as “anti-cholinesterase compounds”.

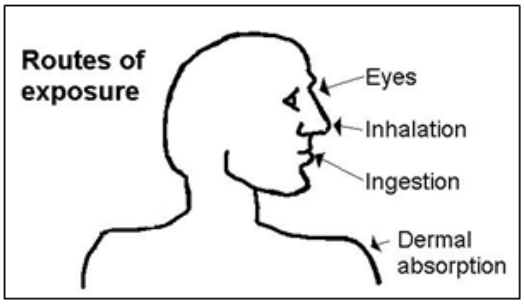

Figure 1 - Routes of exposure

Hazards of OPs

As the human nervous system also relies on acetylcholinesterase, they are also susceptible to OPs. If humans inhale, ingest or absorb enough OP pesticide, they are at risk of experiencing adverse health effects. Acute symptoms such as stomach cramps, sweating, muscle contraction, twitching and weakness may be observed. Chronic poisoning, from long term exposure could result in general feelings of illness, loss of appetite, anaemia, or liver, kidney or nerve damage.

Carbamates

Uses of carbamates

Carbamates are broad spectrum pesticides that are effective against a variety of pests. Commonly used products containing carbamates include Ficam W and Sundew Taserpro 800 WP (active ingredient Bendiocarb).

Properties of carbamates

Carbamates are considered slightly less toxic than OPs because they are rapidly metabolised (processed by the body) and excreted. In addition, they do not persist in the environment for as long as OPs, and usually breakdown within days to weeks. Certain environmental conditions will cause some carbamates to persist for longer.

Carbamates generally have low vapour pressure and low water solubility. This means that they are slow to evaporate and do not dissolve readily in water.

Modes of action of carbamates

Carbamates act mainly as contact and oral poisons as they are absorbed readily through the skin, stomach lining or respiratory tract. They have a similar mode of action to OPs, which is to inhibit the functioning of acetylcholinesterase. This results in nervous system failure with symptoms similar to OP poisoning. In humans, however, they are considered to be reversible inhibitors, which means recovery from over exposure is typically faster than with OPs. As they do not remain in the body like other pesticides can, the risk of chronic poisoning is minimised.

Hazards of carbamates

Carbamates are considered moderately toxic. Acute carbamate poisoning symptoms will usually begin within minutes of exposure and will last a few hours as the body works to metabolise the chemical. Symptoms normally present as stomach cramps and sweating, although if exposure continues symptoms may be similar to OP poisoning with slurring of speech, twitching and jerky movements, difficulty breathing, blurred vision and weakness. Chronic exposure may result in loss of appetite, weakness, weight loss and a general feeling

of sickness. Chronic poisoning is not as common with carbamates as the body is able to metabolise and excrete these pesticides.

Pyrethrins

The flowers of certain Chrysanthemum species, such as daisies, contain a compound known as pyrethrum, which is a natural pest repellent. The active ingredient in pyrethrum is pyrethrin. There are different types of pyrethrins, the most common of which are Pyrethrin I and Pyrethrin II.

Uses of pyrethrins

Pyrethrins are particularly effective against flying pests such as mosquitoes and flies, but can also be used against lice, fleas, silverfish, ants and cockroaches. The most commonly used pyrethrin pesticides are Pestigas Pyrethrins Insecticide, Py Fog, Py Mist, Py Spray and Pymatic.

Properties of pyrethrins

Pyrethrins are thick, sticky, brown plant extracts. They may come in liquid or solid form, and inactivate readily in air. They are generally considered to be insoluble in water, but will dissolve in other chemicals such as alcohol, oil or odourless kerosene.

Pyrethrins are usually mixed with synergists: added chemicals that do not have insecticidal properties on their own, but rather help the pyrethrins to work. For example, piperonyl butoxide is often added to pyrethrin pesticides to increase the toxicity of pyrethrin to pests.

Pyrethrins are not particularly stable in light and air and are therefore not very persistent in the environment.

Modes of Action of pyrethrins

Pyrethrins act on contact, quickly affecting the nervous system to “knockdown” the pest. A few minutes after application the pest cannot move or fly away. Pyrethrin I is highly lethal, whereas Pyrethrin II has excellent “knockdown” properties for a wide range of pests.

Pyrethrins are normally inhaled or ingested by the pest after contact and absorbed through the lining of the stomach or respiratory tract. They affect the nervous system by attaching to a protein found on the surface of nerves called the sodium channel. This channel opens to stimulate the nerve and closes to end the signal when functioning normally. The pyrethrins bind to the sodium channel and prevent it from closing, thus overstimulating the nerve and causing pests to lose control of their nervous system. This is evident in the tremors exhibited by affected pests as they lose co-ordinated movement.

Hazards of pyrethrins

Pyrethrins are much more toxic to pests than mammals. Mammals are able to breakdown pyrethrins into less toxic chemicals, which are then excreted.

However, if exposed to large quantities, humans may show symptoms of poisoning including sneezing, runny nose, sore throat and breathing difficulties. If ingested in large quantities, they can cause nausea and vomiting. Chronic poisoning could result in liver damage.

Synthetic Pyrethroids

Pyrethroids are synthetic versions of the naturally occurring pyrethrins. Pyrethroids exhibit greater stability in the environment and are therefore more persistent. They are also designed to target specific pest species.

Uses of synthetic pyrethroids

More than 1000 synthetic pyrethroids have been produced with greater insecticidal activity than natural pyrethrins. Synthetic pyrethroids are effective on a wide range of pests, however, if used in excess pests may become resistant to the pesticide. The most commonly used synthetic pyrethroids include Biflex Termiticide and Insecticide (active ingredient Bifenthrin), Coopex Insecticidal Dusting Powder (Permethrin) and Cislin Residual Insecticide (Deltamethrin).

Properties of synthetic pyrethroids

Synthetic pyrethroids are insoluble in water, immobile in soil and have a high adsorption ability with particles such as wood and soil. This means that once applied, they will stick to the material and will not tend to transfer.

They are broken down by sunlight and microorganisms such as bacteria. Therefore, synthetic pyrethroids are generally not persistent in the environment, although they are more persistent than pyrethrins.

Pyrethroids were designed to be metabolised quickly in mammals, thus posing a reduced risk of poisoning, whilst remaining toxic to insects.

Modes of action of synthetic pyrethroids

The mode of action of pyrethroids is identical to that of pyrethrins. They affect the sodium channels in nerve cells and cause overstimulation of the nervous system.

Hazards of synthetic pyrethroids

Synthetic pyrethroids are less toxic to mammals than pyrethrins, carbamates and organophosphates, although they do differ significantly in toxicity across the class.

Pyrethroids are not easily dissolved in water but do adhere strongly to substances. There is a risk associated with spray drift affecting foodstuffs, such as vegetable gardens, and being consumed.

Pyrethroids are quite toxic to fish and other aquatic organisms, so care should be taken when using pyrethroids outdoors near waterways or fish ponds, or indoors near fish tanks.

Whilst synthetic pyrethroids do not persist in the body, poisoning can still occur when exposed to high levels. Exposure may result in symptoms such as dizziness, headache, nausea, vomiting and eye irritation. Extremely high single exposure (acute exposure) could lead to fatigue, muscular twitching and unconsciousness. Symptoms of chronic exposure include brain and nervous system disorders and immune system failures.

General precautions for all pesticides

There is a risk associated with the use of any pesticide, regardless of the chemical class. Providing the label and safety data sheet is thoroughly read, the directions followed carefully, and general precautions are taken, the risk to public and environmental health are minimised.

Any pesticide available for use in Australia is registered with the Australian Pesticides and Veterinary Medicines Association. This ensures that products sold are safe and effective when used in accordance with the label directions. It is important to note that some pesticides are registered in certain states of Australia and not others.

As a guide, where possible, the pesticide with the lowest toxicity should be used particularly around high-risk groups such as pregnant women, infants, children and the elderly. If the pesticide has a high persistence,

then consideration should be given to the areas it is applied and possible use of that area by adults, children and animals. The higher the half-life of the chemical, the more persistent it is.

Consideration should also be given to the use of pesticides indoors, as the environmental conditions that normally accelerate pesticide breakdown such as sunlight, rainfall and soil microbes do not exist, meaning the pesticide may remain for longer indoors.

In general, pesticides are most toxic when in concentrated form, so particular care should be taken when handling and mixing undiluted chemicals. Appropriate personal protective equipment should be worn as outlined on the label and SDS to prevent unnecessary exposure.

Advice to clients

Pest control operators (PCOs) have a wealth of knowledge about pests and the pesticides used to treat them. Clients generally have limited experience and may feel uneasy about the use of pesticides in their home. The PCO is their main source of information and advice.

Important information for PCOs to provide clients include:

- the full name of the pesticide to be used and its toxicity rating
- potential health risks associated with its use, how it will be applied and to what areas
- the re-entry period if pesticides are used indoors
- pre- and post-treatment measures that the client can take to minimise exposure.

These pre- and post-treatment safety measures may include:

- ensuring food, clothes, toys, toothbrushes, bedding, towels, vegetable gardens, barbeques, pet bowls and toys, fishponds, clotheslines and cooking utensils are covered or removed from the area to be treated
- relocating pets during treatment and until the pesticide is dry
- vacating the premises while the pesticide is mixed and applied, and until the pesticide is dry (generally four to six hours)
- ensuring that all doors and windows are closed if the pesticide is to be applied outdoors
- ventilating the house, by opening all doors and windows upon return if a chemical smell can be detected
- ensuring that benchtops and kitchen utensils are thoroughly cleaned prior to food preparation if the pesticide has been applied indoors.

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