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Enzymes tackle another pesticide residue problem

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In a trial last year in the cotton growing area around Narrabri, a team of scientists from CSIRO Entomology, CSIRO Molecular Science and Orica Australia Pty Ltd successfully reduced the amount of pesticide residue in 80,000 litres of irrigation tailwaters by 90 per cent in 10 minutes. They achieved this spectacular result using an enzyme they had developed to break down organophosphate insecticide residues into non-toxic products.

This enzyme was isolated from a naturally occurring soil bacterium that feeds on the pesticide and breaks it down. Once the enzyme had been identified it was mass produced in a laboratory and then trialled in the field.

Now they have conducted another successful trial, this time on insecticide contaminated water generated by the washdown of insecticide spraying equipment. Disposing of this rinsate must be done in ways which minimise the risk to the environment and farm workers.

Two commonly used methods are diverting the rinsate to evaporation ponds and disposal by licensed contractors. Both of these are costly and time consuming.

In evaporation ponds, the rinsate residues are slowly broken down by sunlight and microbes. This can take a considerable time. For example, for organophosphates (OPs), a 50 per cent reduction in residues can take between several days and several weeks (under certain conditions microbes can speed up the degradation). Scientists have been looking for ways to speed up the breakdown.

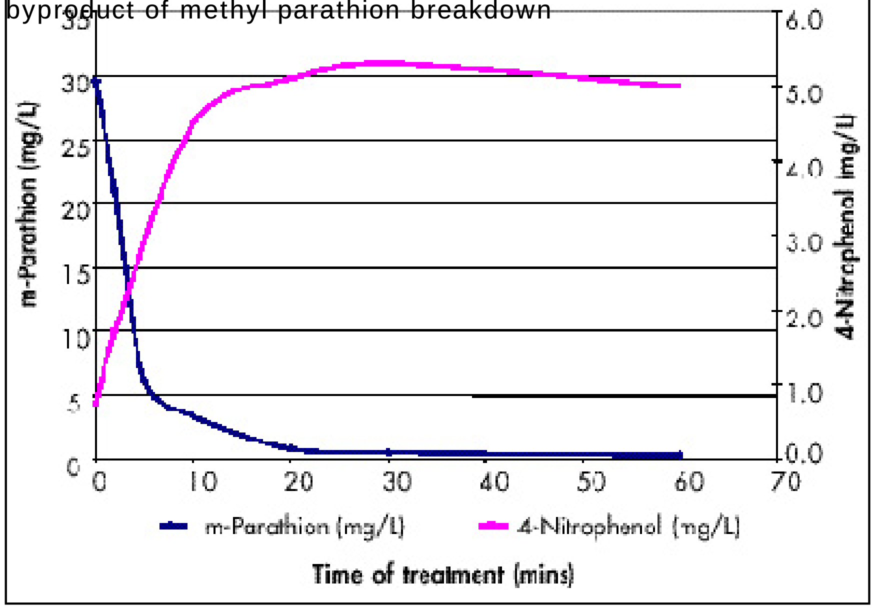
Speeding up breakdown

Trials of an organophosphate degrading enzyme were conducted at a research orchard of the Victorian Department of Natural Resources and Environment, Tatura. Almost complete degradation of methyl parathion in rinsate was achieved in a matter of minutes.

During the trial, the container used to hold the dilute methyl parathion during spraying was rinsed thoroughly with water and the rinsate was then treated with the enzyme preparation. The treated solution was sampled throughout the treatment period so as to evaluate the level of pesticide reduction (Figure 1). A second rinse

A ground rig is used to apply a dilute solution of methyl parathion to a pear orchard at the Victorian Department of Natural Resources and Environment, Tatura. Rinsing of the storage tank after pesticide applications leads to the generation of pesticide-contaminated rinsate.

FIGURE 1: Enzymatic treatment of the rinsate produced from equipment washdown: the rapid decrease in the concentration of methyl parathion is accompanied by an increase in concentration of 4-nitrophenol, a relatively innocuous and readily biodegradable byproduct of methyl parathion breakdown



and treatment was also done.

Before treatment, methyl parathion residues in the first rinsate were as high as 30 ppm. Enzyme treatment reduced this by 89 per cent after 10 minutes and 99 per cent after one hour.

Methyl parathion residues in the second rinsate were much lower than in the first but treatment with the enzyme still gave an 86 per cent reduction in the first 10 minutes with an overall reduction of 89 per cent in 30 minutes. During the trial it was also demonstrated that polyurethane pads specially formulated to contain the enzyme could be used to effectively remove and degrade pesticide residues from the surface of spray equipment. The team hopes to follow up these promising results.

As part of best management practice, used pesticide containers are triple rinsed to remove residues, and stored for collection at a later date. Enzyme technology offers the opportunity to reduce residue levels on the interior surfaces of the containers.

These methods of bioremediating pesticide residues in rinsate and on equipment are simple, require minimal effort from users, and no capital outlay is needed. Other pleasing aspects are that the process is rapid and only small amounts of enzyme are required.

This should encourage adoption of the product by growers seeking to improve environmental management of pesticides. The technology will also provide benefits for the environment by reducing the possibility of soil contamination and reducing the risk of exposing workers to pesticide residues.

Other applications of enzyme technology are also being investigated. One application with considerable potential is the treatment of used sheep dip liquor, which contains the organophosphate diazinon. Laboratory studies have provided proof of concept and planning for a field trial is in progress.

A second application concerns the treatment of permethrin containing effluent from wool dyeing operations. Laboratory studies aimed at establishing proof of concept are underway. Enzymes also have the potential to help in decontamination of polluted soils where they could be used in solutions applied directly to damp soil.

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