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# Toxicity of a New Pyrethroid Insecticide, WL85871, to Rainbow Trout

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Under field conditions no direct effects on fish have been observed following the commercial use of pyrethroid insecticides (Smies et al 1980 and Crossland et al 1982) even though they are known to be highly toxic to these animals in laboratory tests (Mauk et al 1976 and Stephenson 1982). Moreover, the direct overspray of ponds with pyrethroids has resulted in no significant fish mortalities (Mulla et al 1981 and Crossland 1982). Unfortunately however, only limited information is available (Shires 1983) on the dose related effects of these compounds on fish in the field.

The study described here was undertaken in an attempt to determine the effects of different dose rates of the new pyrethroid insecticide, WL85871, (FASTAC[1], a mixture of the (1R cis)S and (1S cis)R isomers of cypermethrin) on rainbow trout maintained under field conditions.

## MATERIALS AND METHODS

The trial was carried out using ten open-ended stainless steel enclosures (1 $m^2$ x 1.2 m high) placed in a mature experimental pond (10 m long x 6 m wide x 1 m deep) located in farmland near Headcorn, Kent, UK. Ten previously acclimated rainbow trout (2 to 5 g) (Salmo gairdneri Richardson) were introduced into each enclosure three days before treatment. Different volumes of a diluted emulsion concentrate formulation (100 g ai $litre^{-1}$ EC) of WL85871 were applied with a small hand-held single nozzle sprayer onto the water surface of seven different enclosures to give a logarithmic series of dose rates ranging from 5 to 500 g ai $ha^{-1}$. The three remaining enclosures were left untreated to serve as controls.

Dissolved oxygen, pH, conductivity, temperature, suspended solids and chlorophyll a were measured at frequent intervals during the study; both within the enclosures and in the open pond. In addition, the concentration of WL85871 in sub-surface water was estimated at intervals in control enclosures and those treated at 5, 50 and 500 g ai $ha^{-1}$. Further water samples were also collected from these enclosures 24 hours after treatment to estimate the amount of WL85871

[1]FASTAC is a Shell registered trade mark.

associated with suspended solids and dissolved in the aqueous phase. All residue samples were removed to the laboratory, where they were extracted with hexane and analysed for WL85871 residues using gas chromatography with electron detection. At the end of the study (96 hours after treatment) the number of live and dead fish in each enclosure was counted and the living fish were carefully observed for possible behavioural abnormalities.

Further details of the test system and procedures used are given in a report of a similar study carried out by Shires (1983).

## RESULTS AND DISCUSSION

Water quality parameters in all enclosures remained at suitable levels to support unstressed fish life throughout the trial period (Table 1). Only very minor differences occurred in water quality within the enclosures or in the open pond and no dose-related trends were observed with any of the measured parameters.

Table 1 - Ranges of water quality parameters in the enclosures during the trial

| | Minimum | Maximum |
|---|---|---|
| Dissolved oxygen (mg litre$^{-1}$) | 12.4 | 20.0 |
| pH | 7.7 | 8.9 |
| Conductivity (µmhos) | 555 | 690 |
| Temperature (°C) | 8.0 | 11.5 |
| Suspended solids (mg litre$^{-1}$) | 12.0 | 24.0 |
| Chlorophyll *a* (µg litre$^{-1}$) | 26.1 | 88.3 |

The concentration of WL85871 in water samples attained peak levels at about 4 to 24 hours after application and thereafter remained fairly stable until the end of the study period (Table 2). Between 40 to 80% of the nominal applied dose was accounted for by the concentrations detected in water at 24 hours post-treatment. Analysis of water samples after the removal of suspended solids indicated that only 50% of the WL85871 residues was present in the aqueous phase, the rest being associated with the particulate material.

No fish deaths occurred in the untreated control enclosures or in those treated with WL85871 at or below 50 g ai ha$^{-1}$ (Table 3). However, all fish were killed in enclosures treated at or above 100 g ai ha$^{-1}$. With the exception of a few fish in the WL85871 50 g ai ha$^{-1}$-treated enclosure, all of the live fish removed at the end of the study appeared to be unaffected by the insecticide application.

Table 2 - Concentrations (µg litre$^{-1}$) of WL85871 in water samples

| Applied dose rate (g ai ha$^{-1}$) | Time after treatment in hours | | | | |
|---|---|---|---|---|---|
| | 4 | 24 | 48 | 72 | 96 |
| 5 | 0.4 | 0.4 | 0.3 | 0.2 | 0.2 |
| 50 | 2.0 | 2.0 | 1.5 | 1.9 | 2.0 |
| 500 | 13 | 32 | 20 | 30 | - |

Table 3 - Percentage mortality of rainbow trout 96 hours after the application of WL85871

| Applied dose rate (g ai ha$^{-1}$) | % Mortality |
|---|---|
| 0 (control) | 0 |
| 5 | 0 |
| 10 | 0 |
| 20 | 0 |
| 50 | 0 |
| 100 | 100 |
| 200 | 100 |
| 500 | 100 |

This study has again (Shires 1983) demonstrated the value of small pond enclosures in determining the dose related effects of a pesticide on fish in the field. The role such tests can play in a logical step-wise testing programme for evaluating the effects of a pesticide on fish has already been described by Stephenson (1983).

The results obtained suggest that a WL85871 concentration of about 2 to 5 µg litre$^{-1}$ was toxic to the rainbow trout. This estimate is in close agreement with the 96 hour $LC_{50}$ value obtained for WL85871 and rainbow trout (i.e. 2.8 µg litre$^{-1}$) under carefully controlled laboratory conditions (Stephenson and Shires 1983). In terms of nominal application rate, the no-effect level for WL85871 lies between 50 and 100 g ai ha$^{-1}$. Since these dose rates are many times higher than those used for most crop protection purposes, the normal agricultural use of WL85871 will be unlikely to result in fish deaths, even if water bodies are directly oversprayed. Moreover, the test system described here probably represents the maximum hazard. Unlike a natural pond system, there were fewer adsorptive surfaces such as macrophytes, little water movement and higher than normal rate of spray deposition.

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