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Acute Toxicity of Thiram in *Gammarus pulex:* Effect of a One-Hour Contamination and Degradation of an Aqueous Suspension

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Thiram is intensively used in agriculture as a fungicide. Through its uses, the aquatic ecosystems can be contaminated by this product. Its acute toxicity to *Lymnaea* and *Gammarus* (BLUZAT et al. 1982 a, b), to *Cloeon* larvae (SEUGE et BLUZAT 1982), and to *Dugesia, Asellus,* and *Xenopus* larvae (SEUGE et BLUZAT 1982) has been studied.

The present study investigates (1) the effects of a high level but brief exposure (one hour) on the survival of a freshwater invertebrate, and (2) the toxicity of an aqueous thiram suspension as a function of time. Experiments were conducted with the crustacean *Gammarus pulex* due to its sensitivity and its importance in the freshwater food-chain.

MATERIALS AND METHODS

Product. The commercial powder (Pomarsol, Bayer) tested was 80 % pure. Test results are presented in terms of the active ingredient of the formulation (water suspension). Five nominal concentrations were prepared just prior to use : 1, 2, 5, 10, and 50 ppm (1 ppm = 1 mg L^{-1} = 0.0046 mM L^{-1}).

Animal. The crustaceans (*Gammarus pulex*, Peracarides, Amphipods) were collected in a brook in Ile de France and were aquarium-acclimated about three weeks before the tests.

One Hour Exposure. Ten day experiments were conducted in small aquaria with 30 animals in one liter of water. The animals were immersed in the different concentrations for one hour ; then the animals were rinsed and transferred to freshwater, (20°C, pH = 7.5, total hardness : 230 ppm $CaCO_3$) ; air was bubbled gently ; the animals were fed ad libitum with dead poplar leaves (*populus*) under long photophase (L : D 16 : 8).

All the animals were removed and examined daily for mortality and the water changed.

The experiments and the controls were repeated three times.

Toxicity of a suspension (0.7 ppm) as a function of time. The general methods were similar to those of an acute-toxicity test

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Table 1. Cumulative mortality between 24 and 96 hours after an intoxication by thiram aqueous suspensions (0.7 ppm) prepared 1 hour (Day 0), 48 hours (Day + 2) and 96 hours (Days + 4) before the beginning of the test, c. l. : confidence limits, t : values of Student test ($p \leq 0.05$).

Series	Number of animals	% cumulative mortality 24 h c.l.	48 h c.l.	72 h c.l.	96 h c.l.
Day 0	130	5.4 $^{2.26}_{11.1}$	27.7 $\pm$ 7.8	60.8 $\pm$ 8.6	84.6 $\pm$ 6.3
		$t = 1.6$	$t = 0.28$	$t = 0.89$	$t = 1.72$
Day + 2	130	10.8 $^{5.84}_{18.1}$	29.3 $\pm$ 8	66.1 $\pm$ 8.3	91.5 $\pm$ 5
Day + 4	190	0.5 $^{0}_{2.93}$	8.4 $^{4.74}_{13.74}$	21 $\pm$ 5.9	50 $\pm$ 7.2

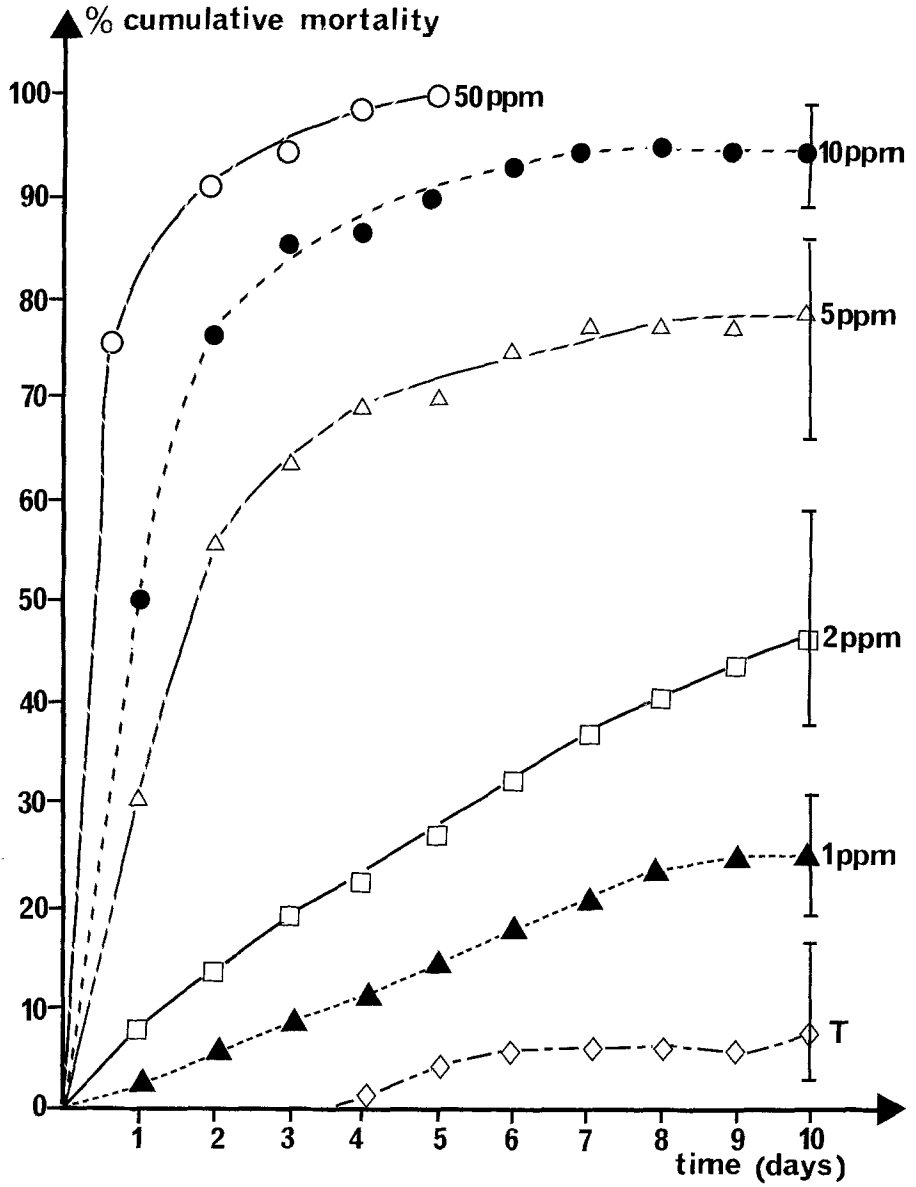

Figure 1. Cumulative mortality related to time according to the contamination level (exposure : 1 hour) : 1, 2, 5, 10 and 50 ppm; 95 % confidance intervals of the last percentage are indicated.

(BLUZAT et al. 1982 a, b) : the animals (10 in a jar, 800 cm^3 of aqueous suspension) were not fed during the four days of the test. The aqueous suspension of thiram (0.7 ppm) was prepared at Day 0 time ; the animals were added either immediately (Day 0), or after 48 h (Day + 2) or 96 h (Day + 4).

RESULTS

The results are expressed as cumulative mortality related to time (Figure 1). According to intoxication level the mortality, after ten days, is in the range of 25 % (1 ppm) to 95 % (10 ppm). Concentration of 50 ppm resulted in total mortality within five days.

A possible loss of toxicity with aging of the aqueous thiram suspension is considered in the Table 1 : the decrease, evaluated by the rate of mortality, appears to be negligible when the suspension was prepared 48 h before the experiment but it was obvious for an older suspension (96 h).

DISCUSSION

It was clearly demonstrated that survival time is concentration dependent : after 10 days the mortality was 25 % (1 ppm), 48 % (2 ppm), 79 % (5 ppm) and 95 % (10 ppm) but only 7.5 % in controls.

In comparison with the LC 50 values, a 1 ppm exposure of only one hour (0.07 x LC 50 - 24 h) can lead to a significant mortality within 10 days ; in the same manner, 10 ppm (3.6 x LC 50 - 24 h) induced the death of almost all the animals.

For the two lower concentrations (1 and 2 ppm) the animal mortality was in a linear relationship with time (Figure 1). On the other hand for the 3 higher concentrations mortality was very high within the first three days (Figure 1). These data show that a very exposure to as low as 1 ppm intoxication is nowious for *Gammarus pulex* ; higher concentrations can destroy a local population within a few day after an accidental contamination because 3,000 ppm concentration is recommended by the directions for use, that is to say 60 to 300 times the danger level.

It is obvious that this fungicide can be a real threat for slow flowing brooks.

The data of the acute-toxicity test (Table 1) show that the toxicity of a thiram suspension did not decrease significantly within 48 h. On the other hand, these data show a decrease in toxicity of 71 % (48 h) and 45 % (96 h) when the animals were put in a suspension 96 h old.

The aged suspension was then less toxic but there was some repellent degradation product because the behavior of the crustaceans was abnormal : the animals tried to escape from the experi-

mental jar. A degradation of thiram suspension was observed elsewhere by means of *Cloeon* larvae (SEUGE et BLUZAT 1982) ; this insecta-test leads it to be thought that the degradation in thiram suspension occured some hours after preparation.

In conclusion it appears that, even if a thiram aqueous suspension is rapidly degraded, this fungicide remains noxious for freswater crustaceans.

REFERENCES

BLUZAT R., O. JONOT and J. SEUGE : Cahiers INSERM, in press, (1982 a).

BLUZAT R., O. JONOT and J. SEUGE : Environ. Pollut. in press, (1982 b).

SEUGE J. and R. BLUZAT : Hydrobiologia, in press, (1982).

SEUGE J., D. MARCHAL-SEGAULT and R. BLUZAT : Environ. Pollut. in press, (1982).

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