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COMMUNICATION

Effect of Thiobencarb Formulations on Freshwater Shrimp, *Macrobrachium lanchesteri* (De Man)

ABSTRAK

Kajian dijalankan di makmal untuk membandingkan kesan formulasi lepasan terkawal thiobenkarb kob jagung (TA1 dan TA2) dan alginat (TAL 70192) dengan formulasi granul biasapada udang air tawar, Macrobrachium lanchesteri *(De Man). Kematian udang yang dirawat dengan formulasi biasa 24 jam selepas rawatan adalah lebih tinggi ($P \leq 0.05$), dan kematian ini didapati meningkat sehingga 93.3% selepas 120 jam. Formulasi lepasan terkawal TA1, TA2 dan TAL 70192 masing-masing menyebabkan kematian 19.2, 5.8 dan 8.5% pada 120 jam selepas rawatan. Perbezaan ini disebabkan oleh lepasan thiobencarb yang perlahan melalui formulasi lepasan terkawal.*

ABSTRACT

The effect of corn-cob controlled-release formulations (CRF) of thiobencarb (TA1 and TA2) and alginate CRF (TAL 70192) to the freshwater shrimp, Macrobrachium lanchesteri *(De Man), in comparison to a conventional granular formulation was studied in the laboratory. Mortality of the shrimps 24 h after exposure to the conventional formulation was significantly higher ($P \leq 0.05$), and increased to 93.3% after 120 h. The CRF of TA1, TA2 and TAL 70192 caused mortality of 19.2, 5.8 and 8.5%, respectively, 120 h after exposure. This difference is due to the slower release of thiobencarb using CRF.*

INTRODUCTION

Herbicides are commonly used to control weeds in rice fields in Malaysia. These chemicals are used as either pre-emergent or post-emergent herbicides, and are applied as emulsifiable concentrates (EC) or granular formulations. The formulations are designed to release the active ingredient (a.i.) almost immediately after application. This feature often results in significant amounts of the herbicide not being taken up by the weeds and, therefore, remaining in the surrounding environment (Collin *et al.* 1973). The immediate release also increases the concentration of the a.i. in the environment, which can cause deleterious effects on other organisms in the ecosystem.

Recent interest in controlled-release formulation (CRF) herbicides has led to the development of thiobencarb formulations for the control of the weed, *Echinochloa crus-galli*, in rice fields (Omar and Mohamad 1994). CRF is an approach towards safer and more effective use of herbicides. The concept of CRF is to slowly release small amounts of the toxicant over an extended period of time, sufficient to control weeds while being low enough not to cause serious effects on non-target organisms. This study was conducted to evaluate the toxicity of the new CRF of thiobencarb in comparison with the conventional granular formulation on the non-target organism, *Macrobrachium lanchesteri*, a species of freshwater shrimp commonly found in irrigation systems and the rice ecosytem.

MATERIALS AND METHODS

Chemical

Three CRFs of thiobencarb used were corn-cob formulations coded as TA1 (4% thiobencarb) and TA2 (4% thiobencarb) and alginate formulation TAL 70192 (7.56% thiobencarb). These formulations

were obtained from International Atomic Energy Agency (IAEA), Vienna, Austria. The commercial granular formulation, Saturn 5G (5% thiobencarb), was obtained from Agriculture Chemical Malaysia, Butterworth, Malaysia.

Shrimps

The shrimps, *M. lanchesteri*, were collected from the freshwater ponds at Universiti Pertanian Malaysia, Selangor, Malaysia. Their average weight was 27.3 ± 4.7 mg (n = 100) and average length was 3.53 ± 0.28 cm (n = 100). The shrimps were acclimatized for 48 h in the laboratory by being kept in glass tanks half-filled with pond water.

Treatment

The experiment was conducted in glass tanks (45 × 22 × 23 cm), in the laboratory at 27 ± 3°C and 70 ± 20% relative humidity; 5 l of pond water were used in each tank. The water quality was as follows: pH 6.5, BOD 1.5 mg/l, hardness 3.4 mg/l of $CaCO_3$ and conductivity 126 µmhos. The formulations, calculated to give 2.5 mg a.i./l, were added to the water in each tank. Aeration was provided by means of an aerator. Twenty shrimps were released into each tank immediately after application of the herbicide. Six replicates were used for each treatment, including control. Mortality was recorded 24, 48, 72, 96 and 120 h after releasing the shrimps into the tanks. Results were subjected to analysis of variance and means were compared by Duncan's multiple range test using an SAS computer package (SAS Institute Inc, 1982, Cary, North Carolina, USA). Percentage mortality was subjected to arc sin transformation before analysis.

RESULTS AND DISCUSSION

Fig. 1 shows the percentage mortality of *M. lanchesteri* over a period of time following exposure to various thiobencarb formulations. Higher mortality after 24 h was recorded for Saturn 5G, a conventional commercial formulation of thiobencarb, compared with the three CRF. Calculated by probit analysis (Finney 1971), the time taken by the conventional formulation to kill 50% of the exposed shrimps was 30.8 h (lower and upper fudicial limit of 25.7 and 35.3 h, respectively) following treatment. All CRF formulations caused less than 20% mortality of the shrimps after 120 h exposure. This indicates that the immediate release of substantial amounts of thiobencarb from conventional granular formulation causes higher mortality. Earlier studies showed the mortality rate caused by conventional granular formulation of thiobencarb applied at 2.5 kg a.i./ha on $1^1/2$-month-old *Clarias batrachus* and a hybrid of *Oreochromis massambicus*/*O. niloticus* was 100 and 87% respectively, 48 h after treatment (Omar 1989).

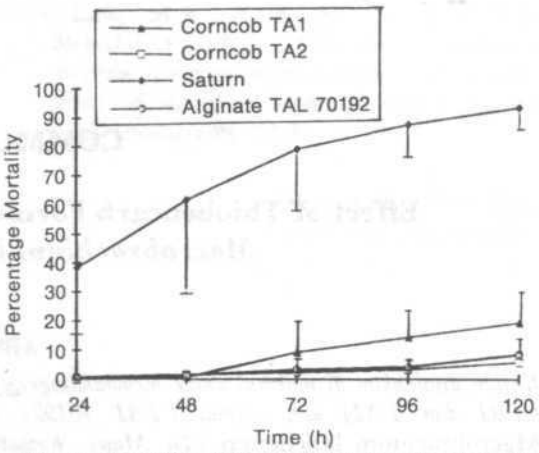

Fig. 1: Mortality of Macrobrachium lanchesteri *over time following exposure to four formulations of thiobencarb (The control showed zero mortality throughout the experiment)*

The significantly lower mortality ($P \leq 0.05$) 120 h after treatment for the CRF of TA1, TA2 and TAL 70192 indicated that these formulations reduced the biological hazard of thiobencarb to *M. lanchesteri*

TABLE 1
Effect of formulations on *Macrobrachium lanchesteri* 120 h after treatment[1]

Formulation	Mortality[2] ± S.D.
TA1	19.2 ± 11.5 a
TA2	5.8 ± 5.8 a
TAL 70192	8.5 ± 4.8 a
Saturn	93.3 ± 8.8 b

[1] No mortality was observed in non-treated control tanks
[2] Means followed by the same letter in the row are not significantly different ($P \leq 0.05$)

(Table 1). The CRF of TA2 was even less hazardous than TA1. This is ascribed to the much slower rate of release of the a.i. from the TA2 formulation, as Soerjani (1991) showed that the release rate at 24 and 48 h measured as percentage radioactivity of C-14 thiobencarb was slower for TA2 than TA1. Thus, TA2 has a less toxic effect due to its slower release and hence lower concentrations in the water.

Studies by Chen *et al.* (1981) on the fate of thiobencarb showed that 23 days after C-14 thiobencarb application, radioactivity corresponded to 2.73 and 0.31% of the initial radioactivity applied in water and biota, respectively. Li and Kang (1979) showed that the herbicide was not detected in paddy water 74 days after application. Although Chen *et al.* (1981) considered thiobencarb non-harmful to the environment because of its low ecological magnification and high biodegradability, the immediate toxicity to non-target organisms should not be ignored. The results of this study indicate that the use of CRF could substantially reduce the immediate hazard to the non-target organism, *M. lanchesteri.*

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