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EFFICACY OF DELTAMETHRIN (BUTOX) IN THE CONTROL OF AQUATIC BEETLES

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ABSTRACT

In the present investigation, the efficacy of deltamethrin (butox) was assessed for the control of aquatic beetles. For this purpose, bioassay studies were conducted in 28 l. of static water holdings using six concentrations (0,300,400,500,600,700 &800 ml/ha m.) of deltamethrin. The LC_{50} values of butox ranged from 268.54 to 381.89, whereas, the 100% beetle toll rate was noticed within 24 hrs when exposed to 500 ml /ha concentration. Further, the second order polynomial regression analysis for deltamethrin concentration *v/s* beetles tool rate showed that a dose of 485 ml/ha m. is most effective for the control of beetles in fish nursery ponds.

Key words: Deltamethrin, aquatic beetle, LC_{50}, butox

INTRODUCTION

Any body of water is invariably explored by a large number of insects, either in their adult or larval stage. The most common are beetles, bugs and dragonfly nymphs. Among beetles are predaceous diving beetle (*Cybister confusus*), water scavenger beetle (*Sternolophus rufipus)* and whirling beetle (*Gyrinus*). Aquatic bugs are highly predatory.Back swimmers (*Anisops bouvieri*) appear in swarms in manured ponds during rainy season and cause heavy damage.Other predatory members of this group are water storpion (*Lacotraphes griseus*), giant water bug (*Belostoma indicum*) and watersick insect (*Ranatra filiformis*).Dragonfly nymphs are highly predatory on carp spawn. Proper preparation of the nursery pond is essential for stocking carp spawn.

Generally, the rate of carp spawn survival during the nursery phase is very low. There are many factors which contribute to this; but the most important factor out of these appears to be the presence of a large number of aquatic insects which prey heavily upon the hatchlings. It has been reported that the soap oil emulsion application controls most of the surface breathing insects, but some subsurface breathers remain unaffected. At the same time, the cost of soap–oil emulsion is much higher (>Rs 5000/ ha). In view this, there is an imperative need of a method which is effective for killing all types of predatory insects at a cost effective rate. Hence, the present investigation has been undertaken to assess the effectiveness of a new synthetic parathyroid "Butox" for the control of predatory insects.

MATERIALS AND METHODS

The present study was carried out with a view to investigating the possible use of deltamethrin (Butox), a synthetic parathyroid for the control of aquatic beetles in nursery ponds. Standard methods of APHA (1989) were followed for conducting bioassay studies and water quality analysis. To work out the optimum dose of deltamethrin (Butox) for the control of aquatic beetles, bioassay studies were conducted using different concentrations of butox (i.e. 0,300,400,500,600,700 and 800 ml per ha meter). A stock solution of Butox was prepared in distilled water by dissolving one ml of insecticide in 100 ml of distilled water. The desired concentrations were obtained by calculating the required quantity of this stock solution and adding the same to the experimental medium. Twenty one glass aquaria of 28 liters capacity were used for the experimentation. Ten specimens of insect species were introduced in each container. Simultaneously control was also run, as customary in all such studies. The above concentrations gave 0 to 100% mortality during the bioassay. The criterion for deciding on mortality was the absence of the movement of the insects when prodded by a glass rod. The L_{C50} values were obtained by graphical interpolation and probit analysis method (Finery, 1964). The optimum dose of butox for controlling of aquatic beetle was calculated through second order polynomial regression between beetle mortality and butox concentration.

RESULTS

The optimum dose of deltamethrin (Butox) for the control of aquatic beetles has been selected on the basis of 100 percent insect mortality in bioassay studies. The results related to insect mortality with varying doses of butox and L_{C50} values are presented in Tables 1&2. Further, the values of water quality parameter are presented in Table 3.

The mortality rates of aquatic beetles in different concentrations of butox are shown in Table 1. It would be seen from this Table that the toll time was less, being 30 percent in 6 hours at the lowest concentration of 300 ml/ ha/meter. By 12 hours and 24 hours of exposure, the death toll was 40 and 70 percent respectively. With 400 ml/ha/ meter dose, the death rate was 50, 70 and 90 percent at the end of 6, 12 and 18 hours of duration respectively. There was progressive increase in mortality with the subsequent increase in butox concentration. In 500 ml/ha/meter dose, the death toll was 60 and 80 percent at 6 and 12 hour duration, respectively. However, in the higher concentrations i.e. 600, 700 and 800 ml/ha, 100 per cent mortality was recorded within 6 hours. For 24, and 6 hours duration, the respective value of LC_{50} were 381.89, and 268.45 ml/ha/meter (Table. 1).

It is evident that the rate of mortality at different exposure times varied slightly. However, in general, the 100 percent rate of insect mortality was achieved within 24 hrs. with 500 ml dose of butox. The lower doses could not result in 100 percent mortality of beetles in desired time. On the other hand, the higher concentrations at more than 500 ml/ha/meter caused 100 percent mortality within 6 to 12 hours of duration. Further, the analysis of mortality data using second order polynomial regression (Table 2) showed that the mortality rate and butox concentration had significant relationship.

The range and mean values of physic–chemical parameters of experimental media are summarized in Table 3. In general, differences in water quality among different bioassay tests were very little. Thus, considering all the tests, water temperature varied between 30.25°C and 33.5°C. The maximum and minimum values of pH were 8.4 and 7.4 respectively .The observed dissolved oxygen levels ranged from 4.8 to 7.6 mg/1, while free CO_2 was altogether absent in all the sets of aquaria. The lowest and the highest values of alkalinity were found in control (142 ml/1).

Table 1. Mean mortality (%) rates of Aquatic Beetles experimented with varying concentrations of Butox.

Exposure time in hrs	Mortality of Aquatic Beetles at Different Concentrations of Butox (ml/ha/meter)							LC_{50}
	Control	300	400	500	600	700	800	
6	0	30	50	60	100	100	100	268.45
12	0	40	70	80	–	–	–	268.45
18	0	60	80	100	–	–	–	315.55
24	0	70	90	–	–	–	–	381.89

Table 2. Regression analysis (second order between butox concentration and beetle mortality rate

Regression Statistics	
Multiple R	0.906448
R Square	0.821648
Adjusted	
R Square	0.785977
Standard Error	124.4635
Observations	7

ANOVA

	df	SS	MS	F	Significance F
Regression	1	356829.9	356829.9	23.03441	0.00488616
Residual	5	77455.83	15491.17		
Total	6	434285.7			
	Coefficients	Standard Error	t Stat	P–value	Lower 95%
Intercept	–50.53	118.493	–0.42644	0.687524	355.1258673
X Variable 1	6.64311	1.384149	4.799418	0.004886	3.085041133

Table 3. Range and mean values of selected water quality parameters

S. No	Parameter	Concentration of deltamethrin (ml/ha m)						
		0	300	400	500	600	700	800
1	Temperature (°C)	30.7–32.0 (31.35)	30.5–32.5 (31.50)	30.5–32.5 (31.50)	31.0–33.5 (32.00)	30.6–32.2 (31.20)	30.4–32.5 (31.40)	30.5–33.4 (31.80)
2	pH	7.80–8.30 (8.00)	7.60–8.20 (7.90)	7.60–8.40 (8.04)	7.50–8.30 (7.90)	7.80–8.40 (8.10)	7.70–8.40 (8.02)	7.60–8.40 (7.90)
3	Dissolved oxygen (mg/l)	4.80–7.60 (5.75)	5.40–7.60 (5.60)	5.00–7.20 (5.60)	4.80–6.80 (5.80)	4.80–7.40 (5.80)	4.90–7.20 (5.70)	5.00–7.00 (5.80)
4	CO_2 (mg/l)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Alkalinity (mg/l)	142.0–156.0 (145.5)	142.0–158.7 (146.5)	142.4–158.4 (146.7)	142.2–157.4 (145.7)	142.5–158.0 (146.1)	142.4–161.2 (146.8)	142.8–159.8 (145.8)

Further, it would be seen from Table 3, that the water used for the bioassay tests was very hard (358–405 ml/1).

DISCUSSION

The discovery of synthetic pesticides revolutionized the concept of insect control, thereby contributing to higher production from fish nurseries and agriculture fields. These pesticides imparted an unusually high toxicity to a wide range of insects and also possessed hitherto unheard persistence properties enabling their residual deposits to remain toxic for long time. This discovery has led to a remarkable proliferation of new organic chemicals for insect control. More recently, quite new groups of chemical insecticides including synthetic pyrethroids allied to natural pyrethrins have been the subject of intense study.

The applicability of different insecticides in the aquatic realm is species dependent, besides, of course, their efficacy again depends on water quality. For example, toxicity or the functional efficiency may increase with increasing temperature (Sparks *et al.*, 1982). The toxicity has also been found to show a negative correlation over one range of temperature and positive correlation over the other (Hinkle *et al.*, 1989).

Helson and Surgeoner (1980) noticed Cypermethrin to be more toxic at lower temperature and more effective against the larvae of *Culex* sp. than on those of *Aedes* sp. Further, technical grade Cypermethrin was found more toxic than an emulsifiable concentrate formulation. Factors known to influence the knock–down effect include penetration (Briggs *et al.*, 1974); metabolic degradation (Sawicki, 1962) and the interaction of the insecticides with the site of the action. Both the central (Burt and Good Child, 1974) and peripheral nervous system (Millers and Adams, 1977) have been suggested as the site of action for knock–down effect of pyrethroids.

Unfortunately there is a paucity of literature on the application of butox in the aquatic systems for the control of aquatic insects. Probably, the need to eradicate the aquatic insect fauna was never felt by entomologists till the emergence of the science of aquaculture. Sajani (1992) compared the efficacy of two synthetic pyrethroids *viz*., Cypermethrin and fenvalterate in the control of aquatic insect and noticed the higher LC_{50} values of Cypermethrin than fenvalerate for aquatic insects Ranatra elongate. Further, a wide diversity of toxicological inputs of pyrethroids on different insects has also been reported by Sajaini (1992). The factor responsible for this diversity could be diverse and probably uninterpretable.

In the field of insect control one particular synthetic insecticide which has been very thoroughly studied is organophosphorus, its outstanding representative being Baytex (fenthian), Durshan and Abate. Sajani (1992) revealed that the application of Abate had no noticeable effect on non–target organisms at any of the applications tested. Extended tests confirmed the great values of the organophosphrous compound Abate for treatments involving water used for drinking purposes. This has an unusually low mammalian toxicity at the application dose of 1 ppm.

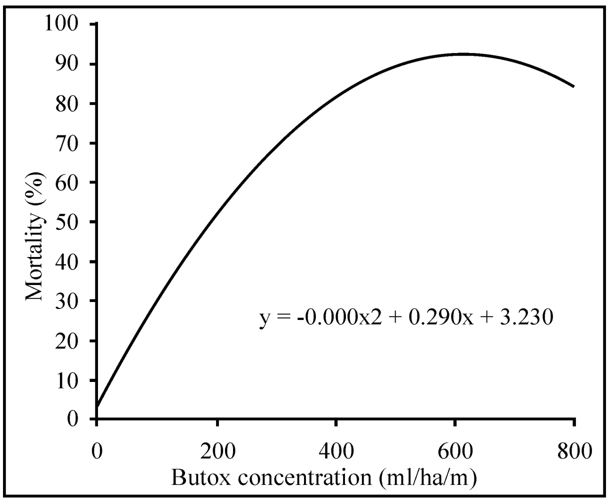

Figure 1. Second order polynomial regression between beetle mortality rate and butox concentration

Pyrethroids have extremely high insecticidal activity at extremely low doses and are biodegradable in nature. Their activity is the most pronounced against Lepidopterous pest and also very effective against beetles and bugs. They are also effective against eggs, larvae and adult stages of insects. butox (Synthetic pyrethroid) is extensively used for the control of ecotoparasites in domestic and farm animals. However, the use of butox for the control of aquatic insects has not been attempted hitherto. The results of the present experiment revealed that the aquatic beetles can be effectively controlled with the use of butox at comparatively low concentration of 500 ml/ha/meter.

The results of the present investigation indicated that the application of butox has no adverse effect on water quality (Table 3) as there was no significant change in water quality over control. However, the application of butox has revealed the significant role of it in the control of aquatic beetles. The different concentrations used for the eradication of beetles had shown a varying degree of insect toll. However, a dose of 500 ml/ha/meter resulted in the complete eradication of aquatic beetles within a period of 24 hours. From the above discussions and results (Tables 1 to 3), it could be concluded that butox may be used as a potential insecticide for controlling predator beetles from fish nurseries. Further, it is worth mentioning here that the cost of butox application for the eradication is much less (i.e. Rs. 600 per ha) than the conventional method of soap + oil emulsion (>Rs 5000). Therefore, the use of butox at 485 ml/ha/meter is recommended for controlling harmful beetles from the nursery ponds.

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