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Toxicity of Selected Organophosphorus Insecticides to the Backswimmer, *Notonecta* sp.

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Abstract - DDVP, Phyphanon (malathion) and Sumithion (fenitrothion) were compared with Dipterex (trichlorfon) in effectiveness and cost as aquatic insecticides in laboratory aquaria. The 24-hour LC_{100}s for the test organism, the backswimmer (*Notonecta* sp.), ranged from 0.05 ppm Sumithion to 1.0 ppm Dipterex. The least-cost insecticide was Sumithion, $1.33 to treat a 0.1-ha pond 1 m deep at double the effective concentration. Dipterex cost was highest, $22.00/0.1-ha pond at double the effective concentration. Carp fry exposed to Sumithion at 0.1 ppm did not suffer lethal or apparent sublethal effects.

In the successful nurture of fry to fingerlings, predators including insects must be controlled. Current recommendations for control of aquatic insects are application of diesel oil or kerosene to the surface of the pond or Dipterex or other nonpersistent organophosphorus insecticides to the pond prior to stocking (Prasad 1981; Jhingran and Pullin 1985). The latter management technique removes all insect predators, whereas surface films control air-breathing insects and not those with gills such as larvae of beetles and odonates. In Bangladesh, Dipterex has been recently imported and distributed, but whether equally effective organophosphorus insecticides were available at less cost was not known. This study was conducted to compare locally available organophosphorus insecticides with Dipterex to determine least-cost treatments for the control of the backswimmer, *Notonecta* sp., perhaps the most abundant of pond predators of fry.

The study was conducted in ten drainable, 175-l stainless steel and glass aquaria housed in the Freshwater Aquaculture Research Station (FARS), Mymensingh, Bangladesh. Bioassay methodology followed Johnson and Finley (1980).

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The test organism was the backswimmer, *Notonecta* sp. Sufficient numbers were easily obtained by sweep net from FARS pond. Prior to each test they were acclimated in well water (hardness, 160 ppm; pH, 7.3-7.7) for one day in the test aquaria. Three organophosphorus insecticides - DDVP, Phyphanon (malathion) and Sumithion (fenitrothion) - and Dipterex (trichlorfon) were obtained locally and were commercial formulations. To determine the 24-hour LC_{100} of the compounds, three test concentrations with three replicates each and one control were made and stocked with 20 backswimmers each. Tanks were unaerated and maintained at ambient temperatures of approximately 32°C. After applying the test concentration, mortality was recorded at 24 hours. Test concentrations were increased arithmetically until the 24-hour LC_{100} was obtained.

After the 24-hour LC_{100} values were determined, the toxicity to carp fry of the least-cost compound was tested. Tanks were prepared at double the 24-hour LC_{100} level and each day fry of carp were introduced and mortality noted until no mortality occurred. Observations were continued for several days. Field testing of double the effective concentration was performed in a 0.1-ha earthen pond at FARS. The double concentration was chosen to provide a margin of safety in the elimination of backswimmers. This level was also effective against one of the largest insect predators, the water scorpion.

Mortalities of backswimmers at the tested levels of the four chemicals and treatment costs using double the 24-hour LC_{100} levels for a 0.1-ha pond of an average depth of 1 m are presented in Tables 1 and 2, respectively. Sumithion was effective at the lowest concentration, 0.05 ppm, and at the least cost, $1.33. Dipterex was the most expensive, $22.00, and required the highest concentration, 1.0 ppm. Dipterex has been suggested at a rate of 3.0 ppm for aquatic insect control (Jhingran and Pullin 1985). This rate would seem to provide a substantial margin of safety in elimination of all pond insect predators, based on our results with backswimmers. In pond tests Sumithion at 0.1 ppm appeared effective in removing insect predators.

Sumithion was formulated to be relatively selective in toxicity, with low toxicity to fish. Hatchlings of carp suffered no apparent effects at 0.1 ppm in our laboratory tests.

In Bangladesh, treatment for predacious insects, from unpublished data in a survey of fry buyers at the FARS hatchery in

Table 1. Toxicity of various concentrations of organophosphorus insecticides to the backswimmer, *Notonecta* sp.

Chemicals and test concentrations (ppm)	Average 24-hour mortality (%)
DDVP - 2,2-Dichlorovinyl dimethyl phosphate	
0.05	3.33 ± 5.77
0.10	53.50 ± 21.60
0.20	71.11 ± 20.01
0.30	100.00 ± 0.00
Phyphanon - 0,0-Dimethyl S - (1,2-Dicarbethoxyethyl) phosphorodithioate	
0.10	60.00 ± 20.00
0.20	56.67 ± 11.55
0.30	96.67 ± 5.77
0.40	100.00 ± 0.00
Sumithion - 0,0-Dimethyl - 0 - (3-Methyl-4-nitrophenyl) phosphorodithioate	
0.01	0.00 ± 0.00
0.05	100.00 ± 0.00
Dipterex - 0,0-Dimethyl 1-hydroxy-2-trichloromethyl phosphate	
0.80	83.33 ± 11.55
1.00	100.00 ± 0.00

Table 2. Treatment levels and costs for eradication of backswimmers in a 0.1-ha pond of 1 m average depth.

Insecticide	Concentration (ppm)	Treatment Cost ($)
Dipterex	2.00	22.00
DDVP	0.60	6.80
Phyphanon	0.80	4.00
Sumithion	0.10	1.33

1986 (Rahman et al. 1987), was performed by only 22% of the fingerling producers and consisted of diesel (36%), kerosene and oil (36%) and Dipterex (28%). The level of Dipterex used was inadequate, approximately 1/3 the concentration found in this experiment to be effective against backswimmers. The low, average fingerling production of 30% of stocked fry (calculated from this survey) may in part be accounted for by the low levels of predator control, which in turn may be due to ignorance and cost.

Insecticides versus surface-film treatments should be compared for cost-effectiveness in fingerling production. As Jhingran and Pullin (1985) pointed out, the effects of organophosphorus insecticides on the environment must be determined.

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