Acute toxicity of organophosphate pesticides on the juveniles of \textit{Channa marulius} Deraniyagala

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\textbf{ABSTRACT}

Phosphamidon and monocrotophos are two widely used organophosphate pesticides in the paddy fields of Kuttanad, the rice bowl of Kerala. \textit{Channa marulius} is an important food fish inhabiting the intricate canals and polders of Kuttanad. The 48 hr LC50 values for monocrotophos and phosphamidon experimented with the juveniles of the fishes with their fiducial ranges were worked out. Phosphamidon was found to be more toxic (LC50 = 6.18ppm) than monocrotophos (LC50 = 28.52ppm) even though both are organophosphates and neurotoxic in action.

Phosphamidon and monocrotophos are two organophosphate pesticides widely used to control various pests in the paddy fields of Kuttanad, the rice bowl of Kerala. Direct spray of these pesticides into the paddy fields led to the contamination of aquatic ecosystem and causes much stress to the aquatic fauna, especially the edible fishes. This has necessitated to ascertain the dose-response relationship of the pesticide and fishes for better management of the ecosystem. Acute toxicity data generated from the laboratory can be extrapolated for field use. In the present study, \textit{Channa marulius} was used to evaluate the acute toxicity of monocrotophos and phosphamidon through probit method. \textit{Channa marulius} is the largest of all Indian snakeheads, reported to grow to a maximum size of 4 ft. (Day, 1889).

Studies on the effect of different organophosphate pesticides on different species of \textit{Channa} (Dubale and Shaw, 1979, Choudhari et al, 1984, Rao et al, 1985, Sastry and Sharma, 1980) are available. But information on the toxicity of monocrotophos and phosphamidon on \textit{C. marulius} are limited. Hence the present study was undertaken.

Juveniles of \textit{C. marulius} were collected from pollution free ponds in the natural habitat. The size groups of the fishes were 11.5 - 13 cm TL and 12-15g weight. The fishes were acclimatised to the laboratory condition for 10 days prior to the experiment and were fed \textit{ad libitum} once a day on fresh clam meat.

Monocrotophos is a water soluble organophosphate concentrate containing 360g/l monocrotophos (0,0-Dimethylcarbonyl-methyl vinyl phosphate). It is a broad spectrum systemic and contact insecticide-cum-acaricide with long-term residual action. Phosphamidon is a water
soluble organophosphate concentrate containing 850g of phosphamidon (0.0-dimethyl-0-(2-chloro-2-diethyl carbonyl-1-methyl vinyl phosphate) as active ingredient in a kilogram of product (m/m). This is equivalent to 1000g of phosphamidon in a litre of product (w/v). It is a systemic insecticide-cum-acaricide.

After exploratory tests for 48 hours, five concentrations of monocrotophos between 16mg/l (no mortality) and 48mg/l (100% mortality) and phosphamidon between 2mg/l (no mortality) and 9.5mg/l (100% mortality) for *C.marulius* were chosen for the bioassay tests to determine the 50% lethal concentrations (48 hr LC50). Static bioassay with toxicant replenishment in every four hour interval was carried out. The experiments were conducted in triplicate in glass containers with 5 litres of test media and 10 fish each. A control without any contamination of pesticides was also kept. Healthy fishes were taken at random from the stock and starved for 24 hours prior to the experiment. The physicochemical parameters were, oxygen 6.2-7.5ppm, temperature 26 ± 2°C and pH 6.8-7.2. Mortality of the fishes during the 48 hour exposure period was recorded for each of the experiment. The 48 hr LC50 and its 95% fiducial ranges were calculated by linear regression analysis after probit transformation of the mortality and log10 transformation of the test concentrations as described by Finney (1971).

The 48 hr LC50 values and their fiducial limits are given in Table 1 and represented graphically in Fig. 1A & B. The 48 hr LC50 values were 28.52ppm for monocrotophos and 6.18 ppm for phosphamidon.

Behavioural changes in fishes during the 48 hour exposure period were also observed. In both cases the fishes secreted enormous amount of mucus during the first 24 hours of exposure. They tried to jump out of the water during the initial period and were seen coming to surface very frequently for taking in atmospheric air. The colour pattern in *C.marulius* also changed as time progressed. The colour became darker in lower concentrations, but pale in higher concentrations. Eyes of the fishes were seen bulged out when they were dead.

Henderson and Pickering (1958) recorded the LC50 values of malathion for fathead minnow as 25ppm in 24th and 22ppm in 96h. Tarzwell (1958) gave the 96 hour LC50 value for fathead minnows as 12.5ppm. According to Nishiuchi and Hishimoto (1967) the 48 hr LC50 value of malathion for the common carp *Cyprinus carpio* was 4.5ppm. Batia (1971) using *Puntius ticto* determined the 48 hr LC50 value of malathion as 0.01ppm. Ritakumari and Nair (1978) studied the toxicity of two organophosphate pesticides on *Lepidocephalus thermalis*. According to them 24hr LC50 value of malathion was 22.69ppm for large specimens and 12.5 ppm for smaller ones, whereas, 48 hr LC50 values were 20.61 and 7.75ppm respectively. The toxicity of phosphamidon on *L.thermalis* were 53.63 and 44 .25ppm.

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<tr>
<th>Pesticide</th>
<th>LC50</th>
<th>Fiducial Limits</th>
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<tr>
<td></td>
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<td>Lower</td>
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<tr>
<td>Monocrotophos</td>
<td>28.52</td>
<td>21.3675</td>
</tr>
<tr>
<td>Phosphamidon</td>
<td>6.18</td>
<td>5.0321</td>
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in 24 and 48 hours respectively. Sulekha et al. (1999) found the 96 hr LC50 values of monocrotophos for the juveniles of rohu and mrigal to be 46.34ppm and 42.24ppm respectively. Mahapatra and Noble (1991) reported the 48 hr and 96 hr LC50 values as 0.75ppm and 0.482ppm respectively, experimented on Liza parsia with Nuvan (DDVP), an organophosphate. Studies on the effect of different organophosphate pesticides on the allied species of Channa are few. Dubale and Shaw (1979) reported the 96 hr LC50 value of malathion on Channa punctatus to be 2.5mg/l. Choudhari et al. (1984) studied the effect of two organophosphate pesticides on Channa striatus. According to them the 96 hr LC50 values of malathion and phosphamidon are 0.35mg/l and 10.47mg/l respectively. Rao et. al., (1985) reported the 48 hr LC50 value of 0.43ppm of elsan to C.punctatus. Vermaef. al., (1981) while evaluating the toxicity of three pesticides on Ophiocephalus punctatus and Mystus vittatus found that organophosphate is the least toxic pesticide. In the present study the 48 hr LC50 value of monocrotophos to Channa marulius was 28.52ppm and that of phosphamidon was 6.18ppm. It is seen that phosphamidon is more toxic than monocrotophos. Koesoemadinata and Djajadireja (1976) suggested a ranking of toxicity of pesticides for 48 hr LC50. According to them toxicity values < 1ppm = extremely toxic; 1-10ppm = highly toxic; 10-100ppm = moderately toxic and > 100ppm = low toxic. Based on this, phosphamidon is highly toxic and monocrotophos is moderately toxic to the juveniles of Channa marulius. Lethal toxicity studies conducted on the effect of monocrotophos and phosphamidon on different commercially important fishes such as Entroplus maculatus and Anabas testudineus (Anna Mercy et al., 2000) also showed that phosphamidon is more toxic than monocrotophos.

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