Depredation of Tilapia Fry by Dragonfly Nymphs and a Means for Control[1]

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ABSTRACT

Dragonfly nymphs readily prey on *Tilapia nilotica* fry. In plastic pools (10 m^2, 0.8 m deep) stocked with equal numbers of dragonfly nymphs and tilapia fry, survival of fry was 51% higher in pools treated with methyl parathion[3], than in untreated pools. Applying 0.25 p/m active ingredient of methyl parathion 3 days before stocking fry killed all dragonfly nymphs with no apparent direct effects on fry survival or growth.

INTRODUCTION

Widely variable survival rates between small rearing units (tanks and pools) stocked with tilapia swim-up fry led us to suspect depredation by aquatic insects. Laboratory and field studies documented depredation of striped bass *Morone saxatilis* fry by phantom midge larvae, *Chaoborus* sp. (7). However, direct evidence of depredation of larger fry, such as tilapia, by aquatic insects is only suspected. Undoubtedly, prey size is related to predator size, and only larger aquatic insects, such as water scorpions (Nepidae), giant water bugs (Belostomatidae) and dragonfly nymphs (Odonata), are likely predators of tilapia fry. These predators, especially dragonfly nymphs, may become abundant when time between filling and stocking is extended (4). Three months after filling a 10 m^2 pool, we harvested more than 400 dragonfly nymphs.

Draining and re-filling a few days before stocking is an effective means of controlling aquatic insects. However, inadequate quantities of water for rapid re-filling and the loss of nutrients and plankton communities important to initial growth of fry make alternate management techniques desirable.

Organophosphate insecticides have been used in fish culture ponds as parasiticides (3, 8), to regulate zooplankton composition and succession (5, 6, 8) and to control predatory aquatic insects (1). Bonn et al. (1) recommended applying 0.25 p/m methyl parathion at least 2 days before stocking striped bass fry in ponds to control aquatic insects. Our study was designed to determine the impact of tilapia fry depredation by

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[3] The authors and the University of Puerto Rico do not endorse the use of this product. Methyl parathion is extremely toxic and must be handled with great care by strictly following all recommendations on the label. Check laws concerning its use with local authorities.

dragonfly nymphs while evaluating the use of methyl parathion as a control.

MATERIALS AND METHODS

The study was conducted at the Aquaculture Field Station, Department of Marine Sciences, University of Puerto Rico, Mayagüez Campus, in conjunction with the Puerto Rico Agricultural Experimental Station. On July 4, 1984, six 10 m^2, 0.8 m deep plastic pools were drained, cleaned and filled with water pumped from adjacent pools and passed through a 0.73 mm mesh filter. Three days later, each of the three pools was stocked with 55 dragonfly nymphs of a size nearing metamorphosis. Nymphs were *Pantala flavescens* (Fabricius) (length 47 to 50 mm) and *Anax junius* (Drusy) (length 68 to 80 mm) stocked at a 1:4 ratio, respectively. Four hours after stocking the naiads, methyl paration (0,0-dimethyl-0-p-nitrophenylphosphothioate) was applied to these pools at 0.25 p/m active ingredient (the time between stocking dragonfly nymphs and applying insecticide was kept short because preliminary work showed 40% of similarly sized dragonfly larvae metamorphosed to adults after only 3 days). Four days later, the three other pools were stocked with dragonfly nymphs at the same rates as above. No methyl parathion was applied to these pools. A few hours later, all six pools were stocked with 150, 10 mm-long, 13- to 16-day-old *Tilapia nilotica* swim-up fry. This day was designated day 0 of the experiment.

Fry were fed a 37% protein, sinking meal at a rate of 1 g/m^2 from day 1 to 12, and 1.5 g/m^2/day from day 13 to 19. The fish were subsampled on day 19 and subsequently fed at 6% body weight daily, assuming a food conversion ratio of 1.3. The food was divided equally among two daily applications, except for days 1 to 3, when the food was presented in four applications.

Dissolved oxygen (DO) and temperature were taken daily at 0700 hours. Heat of dilution chemical oxygen demand (COD) (2) was taken on days −4, −1, 2, 3, 5, 9, 13, 20, 26, 33, 40 and 48. All pools were drained on day 48, and individual weights and total lengths of all fish recorded. Sample means were compared by Student's t-test ($P = 0.05$).

RESULTS AND DISCUSSION

No live dragonfly nymphs were observed in any pool treated with methyl parathion 1 day after its application. Fry survival was significantly higher ($P < 0.05$) in pools treated with methyl parathion (92%, SD = 8.4) than in non-treated pools (41%, SD = 8.4). No 96-hr LC_{50} has been reported for tilapia fry, but toxic levels for other warmwater fishes are above 5 p/m methyl parathion (9). The 0.25 p/m concentration used in this experiment was sublethal to fry stocked 4 days later.

At harvest, the average weight per fish was 16 (SD = 2.4) and 25 g (SD = 1.9), and average total length was 87 (SD = 5.3) and 105 mm (SD = 2.9) in treated and non-treated pools, respectively. Individual fish weight and total length at harvest decreased as the number of fish harvested per pool increased ($r = -0.99$ and -0.99, respectively, $P < 0.05$, $df = 4$). Food conversion was 0.47 (SD = 0.026) and 0.65 (SD = 0.108) in treated and non-treated pools, respectively.

Water quality was similar between treatments, and did not influence fry survival. Early morning DO levels never dropped below 2 mg/L except on day 26 in one treated pool when dawn DO was 0.6 mg/L. To restore oxygen, we replaced half of the water with oxygen-rich water. No dead fish were observed following this episode. Average early morning water temperature was 27.6 C. Before day 3, COD was lower ($P < 0.05$) in treated than nontreated pools. After day 3, there was no difference ($P > 0.05$) in COD between treatments on any sample day, with treatment means increasing gradually over time.

High survival of fry, quick establishment of plankton blooms, and rapid fish growth in treated pools suggest that methyl parathion degraded rapidly. However, further research is needed to determine effects on plankton communities, degradation rates, and accumulation of residues in culture organisms, before it can be recommended for use with food fish.

Dragonfly nymphs are efficient predators upon tilapia fry reared in small units. Application of 0.25 p/m methyl parathion followed by a 3-day degradation period was effective in eliminating nymphs and increasing fry survival. Since draining was unnecessary prior to stocking fry, nutrients were not lost and affected plankton communities re-developed rapidly.

RESUMEN

La supervivencia de alevines recién nacidos puede ser baja debido a la depredación por parte de artrópodos carnívoros. Las ninfas de anisópteros parecen ser responsables de esta depredación y pueden causar pérdidas severas de alevines. Insecticidas organofosfatados, en bajas concentraciones, podrían ser útiles para eliminar insectos acuáticos, pero se degradan rápidamente en sistemas acuáticos. Este estudio contempló el efecto de la aplicación, antes de la siembra, de metil-parathion sobre la supervivencia de alevines de tilapia, en aguas que contenían ninfas de los anisópteros *Pantala flavescens* F. y *Anax junius* (Drusy). A cada uno de los seis tanques plásticos (10 m^2) se le añadió 55 ninfas de los anisópteros. Cuatro días antes de sembrarlos con alevines de tilapia se aplicó metil-parathion en concentración de 0.25 p/m a tres de los tanques. Los otros tres tanques se utilizaron como controles. A cada tanque se le añadieron

150 alevines recién desovados. Los peces en cada tanque se alimentaron dos veces al día hasta saciarlos. La adición de 0.25 p/m de metil-parathion fue eficaz para eliminar las ninfas de los anisópteros. La supervivencia de los peces fue 51% mayor en los tanques tratados con metil-parathion. La misma tampoco fue afectada por el grado de concentración del oxígeno disuelto en las madrugadas.

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