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Laboratory Evaluation of the Relative Effectiveness of Plant and Animal Source Oils for Control of Notonectidae in Fish Ponds

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Abstract.—Predation on small finfish fry and juvenile crustaceans by air-breathing insects such as Notonectidae can be a significant problem. Effective and widely used control methods employ petroleum products to create a thin surface film that prevents insect respiration, but these products pose an environmental concern. This study was conducted to evaluate potentially safer plant- and animal-based oils as effective methods of insect control. Based on their physical properties when added to water, menhaden fish oil (MO) and corn oil (CO) were selected as the most promising candidates. These oils were then compared with two previously recommended petroleum product mixes (a 2:1 motor oil : diesel fuel mix [PC-I] and a 1:20 motor oil : diesel fuel mix [PC-II]). The two oils and two oil mixes were evaluated at two application rates (1.48 mL/m^2 and 4.45 mL/m^2) with three replicates of each treatment. These were tested in 8-L glass aquaria filled with 6 L of reservoir water with a water-surface area of 0.107 m^2. Thirty minutes prior to treatment, each aquarium was stocked with five adult Notonectidae. After 2 h, all oil treatments at the high application rate had total mortality. At the low application rate, the PC-II and MO treatments produced complete insect mortality while the PC-I and CO treatments resulted in 87% mortality in 2 h. These trials indicate that menhaden fish oil is a potential alternative to petroleum products for the control of predaceous, air-breathing insects at similar application rates. At higher application rates, corn oil may also be an effective control agent.

Predation by aquatic, air-breathing insects is a major concern in nursery ponds (Gonzalez and Leal 1995). Historically, the standard method used for insect eradication has been the surface application of petroleum-based products to create a thin film on the water surface, thereby preventing respiration by air-breathing insects. However, recent environmental concerns over the use of petroleum-based treatments have generated an interest in the development of environmentally safe and effective alternatives such as plant- or animal-based oil products.

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Standard treatments have included some combination of motor oil and diesel fuel with a wide range of application rates. Piper et al. (1982) recommended a 1:20 ratio of motor oil to diesel fuel at a rate of 19–37 L/ha for finfish fry ponds. Tucker and Robinson (1990) recommended a similar 1:20 ratio of motor oil to diesel fuel at a higher rate of 28–47 L/ha for ponds with fry of channel catfish *Ictalurus punctatus*. D'Abramo et al. (1995) recommended a 2:1 ratio of motor oil to diesel fuel at a rate of 9–19 L/ha prior to stocking juvenile freshwater giant Malaysian prawns *Macrobrachium rosenbergii*. Cottonseed oil in combination with diesel fuel at a 1:4 ratio has also been used (Bryan and Allen 1969). The objective of this study was to evaluate potentially safer treatments with different plant and animal source oils.

Initial trials tested corn oil, peanut oil, canola oil, menhaden fish oil, and cod liver oil at previously recommended rates for petroleum oils. Oils which spread uniformly and remained intact (forming a thin, contiguous film) were considered most promising. Peanut, canola, and cod liver oil clumped in water and were not tested further. Corn oil (CO) and menhaden fish oil (MO) were selected for further evaluation and compared for their effectiveness in controlling the air-breathing insect predator Notonectidae with two currently recommended petroleum-based mixes at two application rates. *Notonecta* spp. (Order Hemiptera, Family Notonectidae) were chosen as the test animal since they have been reported to be the most destructive air-breathing insect predators in nursery ponds (Gonzalez and Leal 1995).

Standard petroleum product mixes included a 2:1 motor oil : diesel fuel mixture (PC-I) and a 1:20 motor oil : diesel fuel mixture (PC-II). The oil treatments (CO, MO, PC-I, and PC-II) were evaluated at low (1.48 mL/m^2 or 14.8 L/ha) and high (4.45 mL/m^2 or 44.5 L/ha) application rates.

Twenty-seven round, glass aquaria (total capacity, 8 L) were filled with 6 L of reservoir water giving a surface area of 0.107 m^2. Adult *Notonecta*

TABLE 1.—Survival (%) of Notonectidae after 2 h when treated at two surface concentrations of 1.48 mL/m^2 and 4.45 mL/m^2 of 2:1 motor oil : diesel fuel mixture (PC-I), 1:20 motor oil : diesel fuel mixture (PC-II), menhaden fish oil (MO), and corn oil (CO). A control (C) received no oil treatment.

	Treatment concentration	
Treatment	1.48 mL/m^2	4.45 mL/m^2
PC-I	87	100
PC-II	100	100
MO	100	100
CO	87	100
C	0	0

spp. were captured from ponds using an 800- × 900-μm-filter fabric kick net (Wildlife Supply Company, Saginaw, Michigan) and stocked at five per aquarium in three replicates per treatment, plus three control aquaria. They were allowed to acclimate for 30 min prior to oil application (using a 1-mL syringe). Treatments were staggered at 3-min intervals to allow observations to be made at exact times (2 h) posttreatment. Insects that sank to the bottom of the aquaria or no longer attempted to extend their breathing apparatus through the surface film were considered dead.

All four oil treatments at the high application rate killed test animals within 2 h. The low application rate for PC-II and menhaden fish oil resulted in 100% mortality by 2 h posttreatment (Table 1). The low application rate corn oil treatment did not kill all *Notonecta* spp. (2 of 15 survived) but produced the same results as the PC-I petroleum treatment at the lower dose rate (D'Abramo et al. 1995).

Menhaden fish oil can be used instead of petroleum products as a control agent, and corn oil may be effective at a higher application rate. The cost of menhaden fish oil is approximately $0.80/L (Omega Protein, Hammond, Louisiana), which is comparable to the petroleum-based products.

Menhaden fish oil is commercially extracted from *Brevoortia* spp. and is commercially used in aquaculture diets as a lipid source. Menhaden fish oil is environmentally safe and ingestion by the culture animals should cause no adverse effects. These results, however, should be verified in production-scale ponds.

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