AQUACULTURE

DEET TOXICITY TO CHANNEL CATFISH SAC FRY

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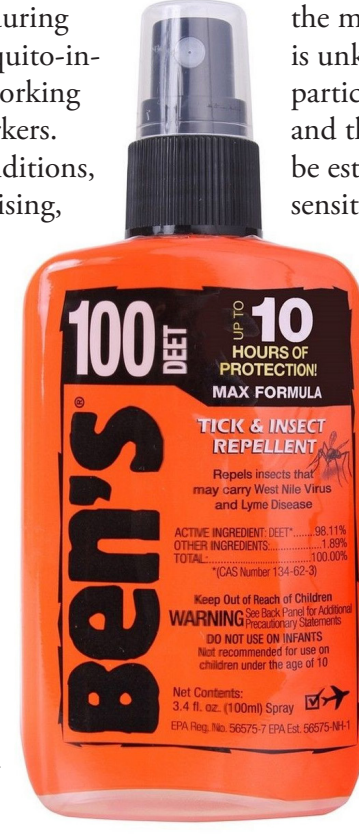
MOSQUITOES CAN BE A BIG NUISANCE IN CATFISH HATCHERIES IN THE SPRING. FORTUNATELY, DEET APPEARS TO HAVE A LOW TOXICITY TO CATFISH FRY AND SHOULD BE SAFE TO USE AROUND THE HATCHERY.

Larval and juvenile channel catfish are produced in numerous private hatcheries throughout the southeastern United States. The combination of open facilities, moisture, and warm weather during the catfish spawning season causes mosquito-infestation problems. Mosquitoes make working in the hatchery unpleasant for farm workers. Besides causing unpleasant working conditions, mosquito bites can cause blistering, bruising, or inflammatory reactions, and mosquitoes are vectors for viruses that can be transmitted to humans, including West Nile Virus.

The most common solution to mosquito problems in catfish hatcheries is widespread use of mosquito repellents applied to exposed skin and clothing. DEET (N,N-diethyl-m-toluamide) is the active ingredient in most personal insect repellents.

DEET was developed in the 1940's by the U.S. Department of Agriculture for the U. S. Army for protection against biting insects and control of disease transmission. In the U.S., DEET is contained in 225 registered products with over 1.8 million kg used annually.



Oddly, the toxicity of DEET to channel catfish—the most widely cultured fish in the United States—is unknown. Further, the early life stages of fish are particularly sensitive to environmental pollutants and the toxicity of this widely used chemical should be established to ensure it is safe to use around the sensitive sac-fry developmental stage present in hatcheries.

Researchers at the NWAC conducted toxicity tests of DEET to catfish fry (2-3 d post-hatch). Test solutions were made by dissolving the appropriate amount of DEET (Ben's 100 Max Formula, Tender Corporation, Littleton, New Hampshire, 98.11% DEET) in well water. The 24-h LC10 and LC50 values (the concentration of DEET lethal to 10 or 50% of the test fish in 24 hours, respectively) were determined.

In addition to the toxicity testing, a trial was conducted to determine the amount of active ingredient dispensed from two different applicators: a pump sprayer (Ben's 100 Max Formula, 1.25 fl. oz., Tender Corpora-

tion, Littleton, New Hampshire, 98.11% DEET) and an aerosol can (Ben's 30% DEET Wilderness Formula, 6 fl. oz. aerosol, Tender Corporation, Littleton, New Hampshire, 30% DEET). For the pump sprayer, one pump (from a full bottle) was sprayed onto a pre-weighed paper towel in a plastic weigh boat, and the amount dispensed was weighed. Five replicate trials were conducted to determine the mean and standard error active ingredient dispensed. For the aerosol can (from a full can), the product was dispensed into a pre-weighed paper towel in a plastic weigh boat for 5 sec, and the amount dispensed was weighed. Five replicate trials were conducted to determine the mean and standard error active ingredient dispensed.

LC test	LC value (95% CI)
24-h LC_{10}	274 (246.9 – 293.2)
24-h LC_{50}	345 (327.0 – 365.9)

Acute toxicity, expressed as lethal concentration (24-h LC10 and LC50 values and 95% confidence interval), of DEET to 2- to 3-d-old channel catfish sac fry. All results are given in ppm active ingredient.

The 24-h LC10 was 274 ppm, and the 24-h LC50 was 345 ppm. When discussing chemical toxicity to aquatic organisms, it is convention to categorize chemicals from super toxic (96-h LC50 <0.01 ppm) to practically non-toxic (96-h LC50 >100 ppm). Although this test was 24-h and not 96-h, the concentration required to kill 50% of the organisms was well above the 100 ppm threshold to be considered practically non-toxic.

The pump sprayer (98.11% active ingredient) dispensed 113.3 +/- 0.57 mg (mean +/- SEM) active ingredient per pump. This would require 2.4 pumps directly into the hatchery trough for every liter of water to achieve the 24-h LC_{10}. The aerosol can (30% active ingredient) dispensed 526.8 +/- 6.71 mg (mean +/- SEM) active ingredient per second. Although the aerosol can was only 30% DEET, it dispensed large amounts of product compared to the pump bottle. Nonetheless, to reach 24-h LC_{10} concentrations, it would require spraying the aerosol can directly into the hatchery trough for 0.5 sec for each liter of water. Typical hatchery troughs hold 380-450 L of water, which would require spraying directly into the trough for 190-225 seconds, not accounting for exchange rate from fresh water flowing through the tanks.

In hatcheries where air movement by fans is not sufficient to control mosquitoes, using insect repellent products containing DEET as an active ingredient should be safe. However, this study only determined acute toxicity of a single exposure; repeated exposures may increase mortalities. As with the use of any chemicals, follow label directions and take care to avoid drift into hatchery troughs. As a general precaution, one should not spray the parts of the hands and arms that will be submersed in hatchery trough water; but because DEET falls into the practically non-toxic category, there should be no problem spraying the repellent around worker's head, body and legs.