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10 June 1967

Mr. L. C. Fuhrmeister
Technical Services Superintendent
Monsanto Chemical Company
Anniston, Alabama

Dear Mr. Fuhrmeister:

In a paper entitled "The toxicity of organic phosphorus and chlorinated hydrocarbon insecticides to fish" (1960. Biological Problems in Water Pollution, 2nd Seminar), Henderson, Pickering, and Tarzwell noted that "A response characteristic of the organic phosphorus compounds, not observed with other chemicals, was the extreme forward position of the pectoral and pelvic fins when the fish were affected".

The "Discussion" section of the report prepared by the Water Improvement Commission includes the following statement: "Loss of equilibrium and reversed pectoral fins displayed by distressed fish observed by the investigators are typical reactions from poisoning by organic phosphorus insecticides".

Parker's report mentions "reversed pectorals" several times, e.g., "In particular, reversed pectoral fins are characteristic of poisoning by organic phosphorus compounds and not of other insecticides". In another place he states that "At this time, practically all the distressed fish observed displayed reversed pectorals, loss of equilibrium, and were in a tetanic state".

In our own lab, we have tested fish on more than 25 insecticides and have not noted a greater tendency for reversed pectorals in phosphates than in other compounds such as Toxaphene. Also, I noted that a large number of the dead and dying fish observed at the Eureka Bridge on May 25 had reversed pectorals. ?

We have recently completed a series of tests in which fish were killed by many different methods. These tests show that loss of equilibrium, a tetanic state, and reversed pectorals are in no way specific symptoms of phosphate poisoning. In fact these symptoms occur almost any time a fish dies as a result of stringent external agents or stimuli.

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Green sunfish (Lepomis cyanellus) were collected near State College, Mississippi for use in tests. The fish ranged between 1" and 3" in standard length. No more than two fish were tested in a liter of test solution. Toxicants tested included several commercial insecticides and various household chemicals which are possible pollutants in streams. Most tests were of an acute nature although certain tests produced kills over a period of several days.

Commercial insecticides tested were as follows: Toxaphene, DDT, Parathion, Roterone, and Malathion. The insecticides (both chlorinated hydrocarbon compounds and organophosphates) were prepared at several concentrations, the lowest levels being near the 36-hr TL_m value for susceptible populations of green sunfish, the highest levels being uncalculated excesses.

LD_{50}

Domestic chemicals were used in an undiluted state or were diluted to such a point as to produce slow death of the test fish.

The fins of test fish were observed after death and scored (+) if the fins were held at right angles to the body or at an angle greater than 90°; (-) if less than 90°.

Commercial Insecticides:

Toxaphene, 150 ppb	(+)
Toxaphene, 300 ppb	(+)
Toxaphene, excess	(-)
DDT, 50 ppb	(+)
DDT, 100 ppb	(+)
DDT, excess	(-)
Parathion, 50 ppb	(+)
Parathion, 100 ppb	(+)
Malathion, 2000 ppb	(+)
Malathion, excess	(+)
Rotenone, excess	(-)

Domestic Chemicals:

High sudsing, household detergent, low conc.	(+)
High sudsing, household detergent, high conc.	(+)
Low sudsing, household detergent, low conc.	(+)
Low sudsing, household detergent, high conc.	(-)
Household bleach (Purex), low conc.	(+)
Household bleach (Purex), high conc.	(+)
Hand soap (Dial), high conc.	(+)
Hand soap (Dial), low conc.	(-)

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Ammonia, high conc.	(+)
Ammonia, low conc.	(+)
"Sani-sol", high conc.	(+)
"Sani-sol", low conc.	(+)
Table salt, high conc.	(-)
Table salt, low conc.	(+)
"Coca-Cola", undiluted	(-)
Water extract of cigarette tobacco, high conc.	(+)
Water extract of cigarette tobacco, low conc.	(+)
Urine, undiluted	(+)
Gasoline, emulsion	(+)
Gasoline, surface film	(+)
Gasoline, absolute	(+)
Motor oil, surface film	no kill
Acetone, absolute	(+)
Acetone, 1:1 in water	(+)
"Dequest", 10% solution	(-)
"HB-40", in water	no kill
"HB-40" in acetone and water	(+)
Formaldehyde	(-)
Ethanol, 95%	(+)

Physical Test: Various tests were performed to determine effects of several physical factors upon pectoral positions.

Fish were taken from laboratory tanks (ca. 70°F) and transferred to water at temperatures of 32°F or to water at 100°F.

High temp. shock (100°F)	(+)
Low temp. shock (32°F)	(-)

A similar test was run in which the temperature of water containing test fish was gradually raised or lowered to temperatures described in the previous test, i.e., 32°F or 100°F.

High temp.	(+)
Low Temp.	(+)

A number of fish were killed by electrical shock. The pectoral fins of such fish assumed "reversed" positions.

In most tests, loss of equilibrium and tetanus preceded death. None of the compounds caused reversed pelvics.

Sincerely yours,

Denzel E. Ferguson
Professor of Zoology

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