Acute Toxicities of Selected Herbicides to Fingerling Channel Catfish, *Ictalurus punctatus*

Fred M. McCorkle, Janice E. Chambers, and James D. Yarbrough

Department of Zoology
Mississippi State University
Mississippi State, MS 39762

INTRODUCTION

The production of channel catfish (Ictalurus punctatus), an important industry in Mississippi and Arkansas, occurs in ponds on old agricultural land and in proximity to cotton and soybean farms. Little information is available on the toxicity to channel catfish of herbicides which might be used on these crops. Channel catfish have a good tolerance of metribuzin, propanil and MSMA (CHAMBERS and FABACHER, 1974; ANDERSON et al., 1975) while black bass (Micropterus dolomieu) have a good tolerance of MSMA (ANDERSON et al., 1975). Toxicity levels for propanil, molinate, DNBP, 2,4-D butyl ester and trifluralin to mosquitofish (Gambusia affinis) and for dinitramine to a variety of coldwater and warmwater fishes have been found in the low ppm range (FABACHER and CHAMBERS, 1974; CHAIYARACH et al., 1975; OLSON et al., 1975). To determine the potential hazard of herbicides commonly used around commercial catfish ponds, this study was undertaken to a) scan the toxicity of 18 common herbicides to one-year-old channel catfish fingerlings at concentrations of 1 and 10 ppm at 48 hrs and b) determine the 96-hr LC_{50} values for those that were toxic in the scan.

MATERIALS AND METHODS

One-year-old channel catfish fingerlings averaging 14 g in weight and 12 cm in length were used in this study. Static bioassays were conducted in 76 liter all-glass aquaria with 5 fish per aquarium at a temperature of 20-21°C. Nonchlorinated well water with a pH of 8.2 was used. Water quality parameters included: alkalinity ($CaCO_3$), 80 ppm; total solids of the filtered sample, 133 ppm; total soap hardness ($CaCo_3$), 22 ppm; total acidity (CO_2), 0 ppm; and iron, 0.1 ppm.

The following herbicides were tested: alanap, bensulide, chloramben, 2,4-D acid, 2,4-D dimethyl amine salt, dalapon, diuron, DNBP, DSMA, EPTC, fluometuron, metribuzin, monuron, MSMA, nitralin, propanil, 2,4,5,-T and trifluralin. The herbicide mixture Dyanap® was also tested. As a point of comparison, the highly toxic insecticide endrin was tested. Toxicity scans were repeated at 1 and 10 ppm and were run for 48 hours.

Bulletin of Environmental Contamination & Toxicology,
Vol. 18, No. 3 © 1977 by Springer-Verlag New York Inc.

Concentrations were based on active ingredients of the herbicide and no solvents were used. If more than 10% death occurred at either concentration, then 96-hr LC_{50} values were calculated for the herbicide using a log-probit analysis.

RESULTS

For the majority of the herbicides tested, there was less than 10% mortality in 48 hr at 10 ppm: alanap, chloramben, 2,4-D acid, 2,4-D dimethyl amine salt, dalapon, diuron, DSMA, EPTC, fluometuron, metribuzin, monuron, MSMA, nitralin, and 2,4,5-T. The 96-hr LC_{50}'s for the four herbicides that were toxic at 1 and 10 ppm are shown in Table 1. These four, in increasing order of toxicity, are propanil, trifluralin, bensulide, and DNBP. The toxicity of Dyanap®, a mixture of DNBP and alanap, was lower than that of DNBP. The 96-hr LC_{50} for the very toxic insecticide endrin was considerably lower than that for all the herbicides tested.

TABLE 1

96-hr LC_{50} Values and 95% Confidence Limits (ppb) for Selected Herbicides and Endrin to Channel Catfish Fingerlings.

Propanil	3796	(3475 - 4194)
Trifluralin	417	(380 - 447)
Bensulide	379	(327 - 402)
DNBP	118	(103 - 135)
Endrin	0.8	(0.5 - 1.2)

DISCUSSION

The majority of the herbicides studied were not toxic to channel catfish fingerlings at 10 ppm. Since the probability of herbicide concentrations in excess of 10 ppm occurring in the production ponds is low, these fourteen herbicides could probably be used around ponds without causing any acute effects to catfish.

No consistent patterns of toxicity were found among the chemical classes of herbicides tested. The four herbicides which were toxic in this study belong to different chemical classes. Propanil is used in weed control in rice production; trifluralin, bensulide and DNBP are used in cotton and soybean farming, so all four are potential contaminants of catfish ponds. The toxicities observed here bear little similarity to corresponding mammalian

toxicities, nor do they correspond closely to toxicity levels reported for other fish species.

Propanil, which was toxic to all fish at 10 ppm in 48 hrs, had a 96-hr LC_{50} value of 3.8 ppm. CHAMBERS and FABACHER (1974) reported mortality in channel catfish of less than 20% at 20 ppm in 24 hours. The difference in toxicity could be related to the age and size difference of fish used in the two studies. Trifluralin with a 96-hr LC_{50} value of 417 ppb, was 5 times more toxic to channel catfish than to mosquitofish (FABACHER and CHAMBERS, 1974) and 7 times less toxic than to bluegills (PARKA and WORTH, 1965). There were no reports in the literature of bensulide toxicity levels to fish. DNBP was the most toxic herbicide studied here with a 96-hr LC_{50} of 118 ppb. The herbicide Dyanap®, a mixture of DNBP and the non-toxic alanap, was 2.4 times less toxic than DNBP, so DNBP is probably not synergized or antagonized by alanap in the mixture. DNBP is 7 times more toxic to channel catfish than to mosquitofish (FABACHER and CHAMBERS, 1974).

As a point of comparison, the insecticide, endrin was found to have an LC_{50} value of 0.8 ppb to channel catfish fingerlings which is similar to the EC_{50} of 1.0 ppb reported for channel catfish by COPE (1966). When the acute toxicities of propanil, trifluralin, bensulide and DNBP are compared to that of endrin, these four herbicides do not appear extremely toxic. Nevertheless, they do represent a potential hazard to catfish in production. On the other hand, alanap, chloramben, 2,4-D acid, 2,4-D dimethyl amine salt, dalapon, diuron, DSMA, EPTC, fluometuron, metribuzin, monuron, MSMA, nitralin and 2,4,5-T appear safe for controlled use near catfish ponds.

SUMMARY

A scan of the acute toxicities of eighteen common herbicides to one-year-old channel catfish (Ictalurus punctatus) was conducted. Herbicides causing less than 10% mortality in 48 hr at 10 ppm were: alanap, chloramben, 2,4-D acid, 2,4-D dimethyl amine salt, dalapon, diuron, DSMA, EPTC, fluometuron, metribuzin, monuron, MSMA, nitralin and 2,4,5-T. The 96-hr LC_{50} values in ppb for four herbicides found toxic were: propanil, 3796; trifluralin, 417; bensulide, 379; and DNBP, 118. The toxicity of Dyanap®, a mixture of DNBP and alanap, was lower than that of DNBP; there was no apparent synergism between DNBP and alanap in the mixture.

ACKNOWLEDGEMENT

Appreciation is extended to Mr. Bobby Thompson and Mr. Skinner Anderson of Anderson-Thompson Fish Farms of Thornton, Mississippi, for the catfish fingerlings used in this study.

REFERENCES

ANDERSON, A.C., A.A. ABDELGHANI, P.M. SMITH, J.W. MASON and A.J. ENGLANDE, JR.: Bull. Environ. Contam. Toxicol. 14, 330 (1975).

CHAIYARACH, S., V. RATANANUM and R.C. HARREL: Bull. Environ. Contam. Toxicol. 14, 281(1975).

CHAMBERS, H. and D.L. FABACHER: MAFES Res. Highlights. 37, 1 (1974).

COPE, O.B.: J. Appl. Ecol. 3, 33(1966).

FABACHER, D.L. and H. CHAMBERS: Environ. Letters. 7, 15(1974).

OLSON, L.E., J.L. ALLEN and W.L. MAUCK: J. Agric. Food Chem. 23, 437(1975).

PARKA, J.S. and H.M. WORTH: Proc. So. Weed Conf. 18, 469(1965).