EFFECTS OF SELECTED HERBICIDES ON BLUEGILL SUNFISH

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ABSTRACT

The toxicity to bluegill sunfish *(Lepomis macrochirus* Rafinesque) of 15 new or reformulated herbicides is presented. Six phenoxy compounds assayed were within toxicity limits previously reported. The endothal derivatives tested were also within previous limits but did show promise as an aquatic herbicide. Substituted urea compounds checked did not demonstrate any differences from those previously reported. A pelletized formulation of sodium arsenite was very toxic but should be more convenient to apply.

INTRODUCTION

The increased concern by the general public as to the effect of aquatic herbicides on the fish population has necessitated formulation changes of their products by many chemical companies. This desire to cause minimum damage to fish and fish food organisms and still achieve control of noxious aquatic vegetation has placed increased emphasis on fish toxicity data. This study is based on 15 of these newly formulated herbicides.

MATERIALS AND METHODS

The bioassay methods used have been previously discussed by Hughes and Davis (1963). The water quality data, as presented in the foregoing paper, has remained constant.

The following herbicides with trade names or code numbers as applicable were tested: dimethylamine salt of 2,4-dichlorophenoxyacetic acid (2,4-D); long chain tertiary amine salt of 2,4-dichlorophenoxyacetic acid (TD-440); isooctyl ester of 2,4-dichlorophenoxyacetic acid (2,4-D); oleic 1,3 propylene diamine salt of 2,4,5-trichlorophenoxyacetic (2,4,5-T); oleic 1,3 proplyene diamine salt of 2-methyl-4-chlorophenoxyacetic acid (MCPA); triethylamine salt of 2-(2,4,5-trichlorophenoxy) propionic acid (silvex); potassium salt of 2-(2,4,5-trichlorophenoxy) propionic acid and di(N,N dimethylalkylamine) salt of 3,6-endoxohexahydrophthalic acid (Hydrothal plus); an experimental amine salt of 3,6-endoxohexahydrophthalic acid (TD-497); potassium salt of 4-amino-3,5,6-trichloropicolinic acid (tordon); diglycolic acid; dimethyl ester of tetrachloroterephthalic acid (dacthal); N-4 (p-chlorophenoxy)-phenyl-N',N'-dimethylurea (chloroxuron); N-(3-trifluoro-methylphenyl) N^1,N^1-dimethylurea (C-2059); methyl 3,4-dichlorcarbanilate (swep); and sodium arsenite.

RESULTS AND DISCUSSION

The effects of these 15 herbicides on bluegill sunfish, *Lepomis macrochirus* Rafinesque, are presented in Table 1.

The dimethylamine salt of 2,4-D with a TLm of 188 ppm is within the toxicity ranges previously reported (Hughes and Davis, op. cit.). A six pound material previously tested and formulated by the same company was less toxic with a 24 hour TLm of 394 ppm. The formulator explained that this difference was probably due to the additives used.

TD-440 was toxic to fish at very low application rates. On the basis of these findings, this herbicide cannot be recommended for aqua-

tic use in total water application. As a spray on emergent vegetation, it could be applied. Extreme care should be exercised when using this formulation.

The granular formulation of the isooctyl ester of 2,4-D tested was also well within the limits of other formulations discussed by Hughes and Davis (1962). None of these formulations were sufficiently toxic to preclude their use in aquatic environments.

The 2,4,5-T oleic propylene diamine salt is described by the formulator as being a 2 carbon, oi soluable amine. This formulation was a four pound material and less toxic than the two pound material previously reported by Davis and Hughes (1963). The use of this herbicide in an aquatic environment should be permissable under most field conditions. The use of this same salt in a two pound formulation of MCPA was much more toxic. The TLm of 1.5 ppm to the MCPA formuation precludes its use for aquatic vegetation control.

The triethylamine salt of silvex due to its low fish toxicity shows promise as an aquatic herbicide. The formulation tested was less toxic than most of the ester formulations tested (Hughes and Davis, 1963). The formulator reports that it can be readily mixed with other herbicides.

Hydrothal plus is an attempt by the formulator to market an algicide and an effective herbicide both in one product. The product is very effective, but is quite toxic to fish with a TLm of 3.5 ppm. Its use is shallow water should be recommended with extreme caution.

TABLE 1

Median tolerance limit of selected herbicides to bluegill sunfish reported in parts per milion

Herbicide tested	*Acid Equivalent*	
	24 hr. TLm	48 hr. TLm
2,4-D dimethylamine	188	188
TD-440	3.0	2.9
2-4-D isooctyl ester	453	324
2,4,5-T oleic 1,3 propylene diamine	11	10
MCPA oleic 1,3 propylene diamine	1.5	1.5
Silvex triethylamine, liquid	16	16
Silvex triethylamine, granular[1]	20	20
Hydrothal plus	3.5	3.5
TD-497	4.0	3.5
Tordon	43	43
Diglycolic acid	105	105
Dacthal[1]	1000	700
Chloroxuron, wettable powder[1]	25	25
Chloroxuron, granular[1]	60	60
C-2059, wettable powder[1]	55	50
C-2059, granular[1]	90	60
Swep[1]	6.0	6.0
Sodium arsenite, pelletized[1]	0.7	0.5

[1]presented as active ingredient

Endothal and its many derivatives have furnished aquatic biologists with many short-term residue, herbicidally affective, products. TD-497 is another amine formulation. Its toxicity to fish (TLm 4 ppm) renders it suitable for use only where precautions are taken to protect fish.

Tordon is recommended for use on broadleaf weeds and certain woody plants. Its uses in aquatic habitats are yet to be demonstrated.

Experimental plots indicate possible uses on emergent marginal vegetation. The TLm of 43 ppm indicates an adequate safety factor.

Diglycolic acid is reported to be very effective in the control of aquatic vegetation when added to other herbicides (Foret, 1964). The exact herbicidally additive effect is not fully understood. Our bioassays indicate a TLm of 105 ppm. At the present application rate of 25 pounds per acre, no damage to the fish population should be received.

Dacthal has shown some promise as an algicide. Our tests indicate that it should be safe for application in fish ponds. It goes into solution in water rather slowly. It had a 24 hour TLm of 1000 ppm, a 48 hour TLm of 700 ppm and the 96 hour TLm was 200 ppm. Long term acute toxicity tests need to be conducted before extended use is planned.

Chloroxuron and C-2059 are both substututed urea compounds. In both formulations tested, the granular was less toxic during the 48 hour period than the wettable powder. These materials tended to narcotize the fish at much lower rates than the TLm. The C-2059 was apparently less toxic than the chloroxuron.

The use of swep has been recommended in rice fields for grass control. Its toxicity to fish (TLm 6 ppm) indicates that it would be useable for this in most situations.

The granular formulation of sodium arsenite that was tested, proved to be more toxic than other formulations previously used. No added benefits in herbicidal activity are claimed for the material. The granular formulation is more easily applied and therefore has a certain amount of appeal to the applicator. Standard precautions still should be followed with this arsenical.

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