Slow Release Herbicides

A New View In Aquatic Weed Control

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AQUATIC weed control relies primarily upon the chemical treatment of the water course. Plant mortality depends upon both the amount of herbicide applied and the exposure time. Usually exposure times are small, several days perhaps, and thus the amount of the chemical used must be relatively large. Natural factors, such as reaction of the control agent with the mineral content of the water, solar radiation, dilution by incoming waters and absorption by soil particles and by organic matter detoxifies the control agent. Since a quick kill is essential massive amounts of the herbicide are utilized, and the target plant succumbs through an *acute* intoxication method.

Even the safest of herbicides will affect many non-target members of the biological community; fish certainly and small organisms in the food chain; perhaps birds and mammals as well. If we can reduce the total amount of herbicide needed while achieving the same degree of control, unwanted environmental effects will be lessened. The ecologists are questioning the use of ULV insecticides used at a few ounces or less per acre and we in weed control are applying pounds per acre!

Now what can we do to satisfy our detractors (if that is possible) and perhaps help ourselves economically at the same time?

At the Creative Biology Laboratory we are exploiting three interwoven concepts that promise economy, long term control, and much less environmental contamination. This work, sponsored by the U.S. Army Corps of Engineers, is based upon the slow release of a minute amount of a non-persistent control agent in the growth area (phytozone) of the target; such release to occur over a long period of time. Rather than destroy the pest through *acute* intoxication which re-

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FIGURE 1: Chronic Effect of Herbicides on Eurasian Watermilfoil

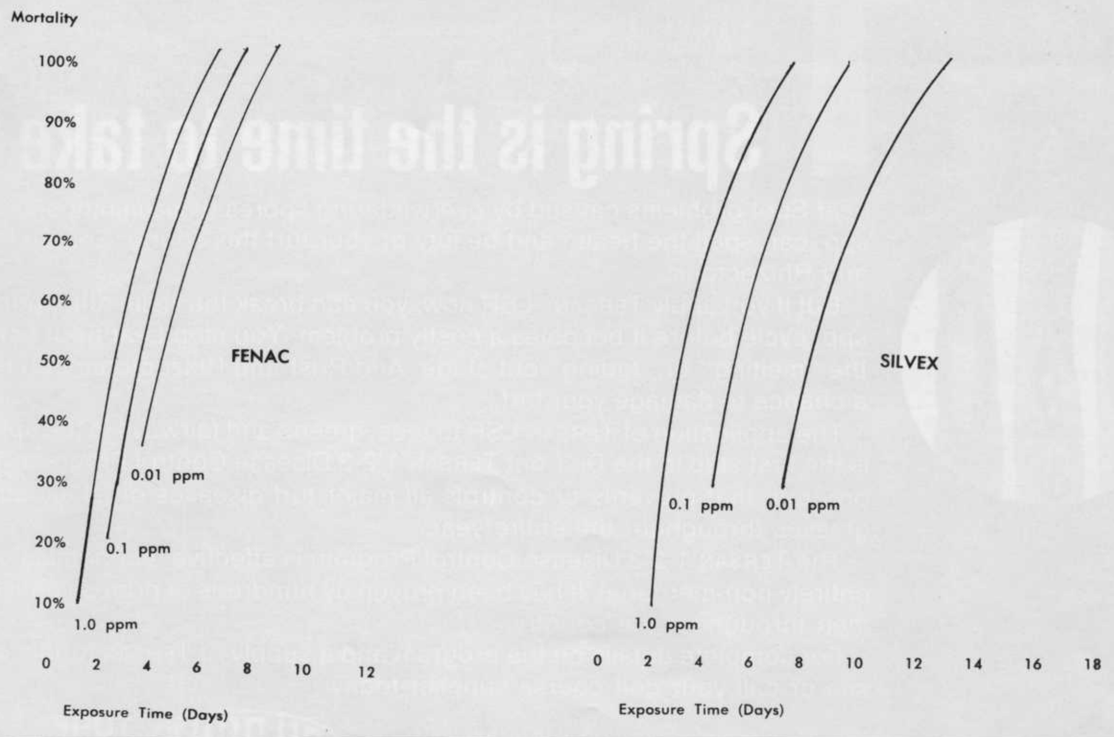


FIGURE 2: Chronic Effect of Herbicides on Southern Naiad

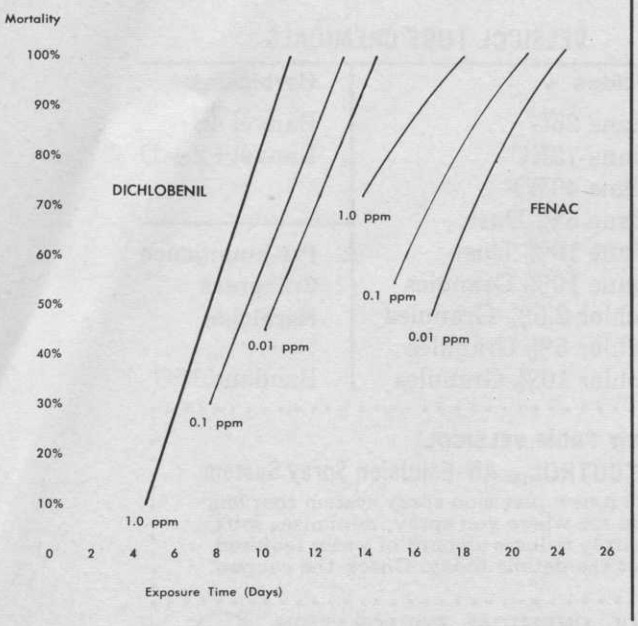
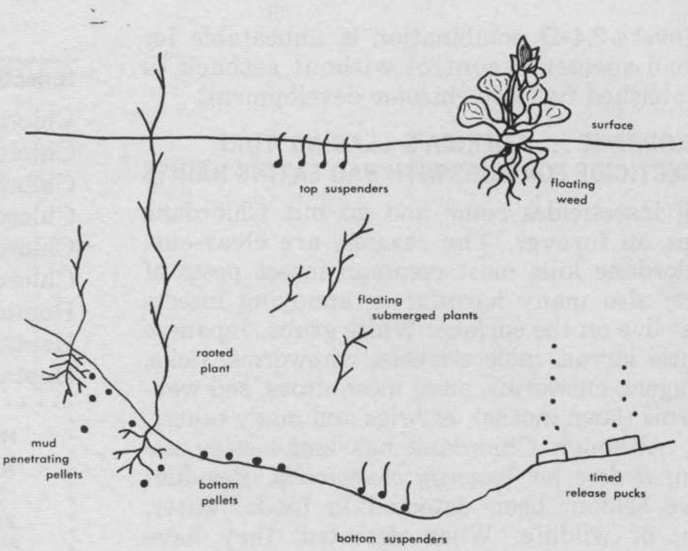


FIGURE 3: Phytozone Treatment Concepts



HERBICIDES *(from page 16)*

quires a great deal of toxicant—and the usual retreatment every few months for adequate control; our intention is to provide just enough chemical to give rise to a *chronic* intoxication effect which is just as deadly to the target through requiring a longer time to kill.

Chronic intoxication requires much less of the control agent than necessary to produce acute effects. As we decrease the amount of agent used, time necessary to kill does not increase accordingly! Figures 1 and 2 illustrate this effect. Present work with herbicides at concentrations as low as 1 part-per-billion in water show that we can destroy Eurasian Watermilfoil if the exposure period is long enough. In fact we intend to extend our studies with this aquatic weed to 100 parts-per-trillion concentrations, 10,000 times lower than in-use concentrations!

Chronic effects have been observed in the following plant-herbicide schemes:

The chronic phenomenon would remain a laboratory curio unless constant ultralow concentrations can be economically used in a field situation. In order to solve this problem we turn to the concept of a "slow release" matrix.

In 1964 it was discovered that anti-fouling agents could be incorporated in certain rubbery materials, and by the use of additives and proper vulcanization, the pesticide would slowly bleed out. Effective release of the agents involved has reached 89 months on test panels and over 5 years on ship hulls, buoys, and other marine objects. This material, under the name Nofoul is marketed by the B. F. Goodrich Company.

By 1966 insecticides, fungicides, and bacteriacides had also been formulated in slow release rubbery materials. However, our big thrust is in the direction of molluscicides, "snail killers" and our organization is a collaborating unit of the World Health Organization (United Nations) responsible for the development of new formulations based on the slow release principle. Field tests in South America and Africa have demonstrated the feasibility of using a slow release molluscicide and destroying snail disease vectors through *chronic* intoxication.

Herbicide	Plant
Butyl ester of 2,4-D	Eurasian Watermilfoil, Water Hyacinth Elodea
Fenac	Eurasian Watermilfoil, Vallisneria, Southern Naiad, Cabomba
Butoxyethanol ester of 2,4-D	Eurasian Watermilfoil, Vallisneria
Silvex	Eurasian Watermilfoil, Water Hyacinth, Alligator Weed
Oleylamine form of 2,4-D	Eurasian Watermilfoil, Water Hyacinth
Diquat	Water Lettuce, Eurasian Watermilfoil
Dichlobenil	Southern Naiad, Elodes
2,4-D Acid	Eurasian Watermilfoil

In 1969, the butoxyethanol ester of 2,4-Dichlorophenoxyacetic acid (2,4-D) was successfully compounded with natural rubber and a slow release mechanism established. Our investigations, confirmed by outside agencies, proved efficacy against the Water Hyacinth and Watermilfoil. Release lifetimes of 18 or more months have been analytically determined. Limited field tests are in progress.

In order to further reduce possible ecological disturbances, advantage was taken of the fact that rubber can be formulated in many shapes. 2,4-D and possibly other herbicides "layer-out" in still or sluggish waters. That is, there is little vertical mixing. Water weeds are confined by nature to certain areas of the water course or phytozones. Slow release materials can be made to stay put in the phytozone of interest, at least in fairly quiet waters, liberating the chemical agent where it will do the most good. Why poison the total water course if the target can only contact and absorb the herbicide in a particular part of that volume? Here are a few exciting solutions to this situation:

Floating pellets released at the

water surface that spread a thin layer of 2,4-D across the surface. Sinking pellets, by density adjustment can be made to penetrate or rest on bottom mud, that release herbicide where rooted plants are the most vulnerable. Suspending strands that hang vertically in the water. What we call "top suspenders" release 2,4-D in the first 6 inches of the water and are extremely effective in small pool tests against Water Hyacinth. In fact they tend to entangle in the roots of this floating plant. Bottom suspenders that release in the six or so inches of water just above the water bottom. All of these forms can be encapsulated in a heavy clay binder that, when dispersed in water, breaks foliage, sinks to the bottom, and degrades, slowly releasing pellets or suspenders. By proper choice of a binder release time is controllable. Figure 3 illustrates these concepts.

Now what does this all mean? If the laboratory results translate to the field we will not only be able to control aquatic weeds at 1/15 to 1/100 present dose levels, but extend between-treatment times to perhaps several years. In other words, we reduce contamination while saving money in labor costs.

A dose of 20 ppm held for 1 day, with retreatment twice a year gives an annual average dose of 164 parts-per-billion per day. We know that control under laboratory conditions is feasible at 10 parts-per-billion per day and probably at 1 ppb/day.

It is our belief that the future will see a great deal of research into slow release pesticides with many resulting commercial products of benefit.

Abbott Laboratories Releases Brochure

A new brochure, "Dipel and the Gypsy Moth," is now available from Abbott Laboratories. Dipel Biological Insecticide recently received Federal registration by the Environmental Protection Agency for the control of Gypsy Moth and certain other caterpillar defoliators of ornamental, shade and forest trees.

The brochure, in question and answer form, provides information on how to use the product under a variety of conditions. Dipel is registered for control of Gypsy Moth, elm spanworm, spring and fall cankerworm, bagworm, fall webworm and Red-Humped caterpillar (California only).

For more details, circle (719) on the reply card.

Insects In Weed Control To Be Studied

Insects to control weeds will be studied in a five-year program to be conducted by Virginia Tech.

Weeds have been estimated to cause more damage to crops than insects and diseases combined. Many insects, however, feed on weeds. Their use as a non-chemical means of weed control will be explored during the study.

According to Robert L. Pienkowski, professor of entomology and director of the project which is funded by the Cooperative State Research Service, USDA, researchers will identify and determine the distribution and abundance of insects attacking important weed species in Virginia.

Among the weed species to be studied are wild garlic, Johnsongrass, curled and musk thistles, crabgrass, morningglory, yellow nutsedge, horse nettle, fall panicum and ragweed.

The research complements work being done by Virginia Tech on control of musk and curled thistle through use of an imported weevil.