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A Long Range Look At

AQUATIC PLANT MANAGEMENT

By WILLIAM N. RUSHING*

THE MAGNITUDE and nature of the problem of troublesome aquatic plants in the United States is extensively documented and generally well known. There is no need to repeat this information; if no problem existed we would have no real reason to be here.

This presentation is a summation of my personal views and it is not to be construed as the official stand of the Waterways Experiment Station of the Corps of Engineers.

My purpose is to suggest that the problem is so large and so complex that there is no single solution to it, and that instead of a panacea, we need an arsenal. It has seemed to me that many of the people concerned with aquatic plant management, both research and operational types, have been guilty of tunnel vision; they have selected a small part of the puzzle, declared it to be *the* essential part, and worked on it without regard to its relation to the big picture. To be sure, it is essential that scientific specialization continues. But I believe it to be equally true that someone must attend to the whole mosaic, so that the tessera of special products may be fitted together. In effect, I am proposing the development of an integrated system for managing aquatic plants.

I prefer to think in terms of "aquatic plant management" rather than "aquatic weed control." It has become obvious that "the problem" is concerned with *managing* a complex system and not just *controlling* one facet of it. The term "management" is also more compatible with the thinking behind the new name for this Society. What we must have is a logical, but possibly rather complex, methodology by which the entire aquatic ecosystem is managed for the benefit of nature and a highly complex and changing society. The system will almost surely be multifaceted, consisting of an entire arsenal of techniques and hardware, any combination of which can be called upon for attacking a given problem.

The Situation

In past years when aquatic plants were just beginning to be problems in the nation's waterways, people responsible for their control thought in terms of total eradication. It has taken some years and considerable frustration to realize that any aquatic plant that is successful enough to become a national problem is here to stay. Why is this so? Because they almost all have very large ecological amplitudes, i.e. they flourish in a wide variety of situations. The water hyacinth, for example, grows in the tropics, subtropics, and temperate zones. It grows along exposed lake banks, under cypress trees, in shallow ditches, in large open reservoirs, in narrow canals and broad streams, in small shallow depressions with very little water, and, indeed, in wet soil where there is no standing water. It grows in coastal lagoons with saline water, in open sewers, and in pristine brooks, and on and on *ad infinitum.* I have even seen them grow in distilled water for a surprising length of time.

There are at least two major implications here. One is that the plants are now an integral part of

(continued)

**The author, botanist with the United States Army Engineer Waterways Experiment Station, Vicksburg, Miss., presented this article at the Hyacinth Control Society convention, July, 1974.*

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We build equipment the way we do because you wouldn't settle for less.

the aquatic ecosystem and play an essential role in it. The fact that the plants now play an essential role in the biosystems suggests that in many places, we would not *want* to eradicate them, even if we could. Indeed, whether a plant is "good" or "bad" is entirely a matter of who is doing the defining. One land owner may like water hyacinths around his boat dock and another may not — in one case they are good and the other bad. Introduction of the human factor complicates the situation drastically. Each individual and group tends to see the aquatic plants in terms of its own viewpoint. The result is that landowners, environmental groups, fishermen, water skiers, the EPA, and so on, express the problem and the acceptable solution in different ways.

The second implication is that methods to control growth and proliferation must enable us to reach effectively into every nook and cranny of the aquatic world; into broad lakes, swift streams, drainage ditches, navigation canals, cypress swamps, reed marshes, and so on. Further, we must be able to reach into these places and kill or suppress the target plant, but *only* the target plant. A technique that kills water hyacinths in a drainage canal, but that also kills the soybeans in the fields alongside, is clearly unacceptable.

The situation, then, is a complex of factors about aquatic plants and about the nature of the problems they pose to society. From this, it is clear that an aquatic plant management capability must be one that can be applied with precision and selectivity. Each situation will dictate how precise and how selective each operation must be.

The Problem

The situation discussed above demonstrates that an effective aquatic plant management system must meet three general requirements.

First, the control method must be fitted to the situation. At first glance this often seems to be easy, but in practice, many subtleties intrude. For example, Blue Lake, Mississippi, is choked with alligatorweed, so let us introduce the Agasicles beetle to suppress the plants. But it turns out that there is a difficulty. The lake is surrounded by cotton fields, and the insecticides used to suppress the bollworm and bollweevil also eliminate the Agasicles. The cotton farmers are not going to lose their crop to save a few funny bugs on alligatorweed in a lake they mostly wish wasn't there to begin with. So let us spray the alligatorweed with a herbicide — but let's make sure that it doesn't drift over into the cotton fields — a practical impossibility. What is left? Perhaps a slow-release herbicide in the water. Perhaps mechanical harvesting. Perhaps a fungus that is immune to insecticides, but is specific to alligatorweed. Perhaps some combination of these.

In parts of Louisiana water hyacinths grow among the cypress trees, choke narrow and tortuous bayous, and cover the nearby open lakes in huge masses. Let us assume that the situation is such that herbicides may be safely sprayed on them. A rig mounted on an airboat is effective in open lakes and bayous, but how do we get the herbicide to the plants amid the closely spaced trees? Clearly another kind of operational platform is required. The point is that the control method must fit the geographical, ecological, and social situation, and it is utterly unrealistic to assume that one weapon will deal with all possible eventualities.

The second general requirement is that the control methods must be economical. To be sure, there is obviously a direct relation between the criticality of the problem and the amount of money that may be spent to eliminate the problem. Nevertheless, the lower the cost, the happier we all will be. Thus, a technically effective method may be ineffective in practice because no one is willing to foot the bill.

The scientific community is often guilty of forgetting the sordid fact that somebody has to pay for each operation. But we all sometimes forget that economics is not based on the same considerations in all places. Thus it is that a candidate control method may be tried in one situation and rejected because it is too costly. The method is then all too often automatically removed from consideration for other situations. And that may be a mistake. In the next county is a lake used for recreation; the people concerned with it might well be willing to pay a high price for a control method that would keep the water free without deleterious or undesirable side effects. But the method used in, for example, Lake Loiza, Puerto Rico, is rejected because it is "too expensive." We have thrown the baby out with the bath water.

The point is the cost is relative. Thus, it may be concluded that our arsenal of weapons can include systems that range widely in cost of operation.

The third general requirement is that control methods must be timely. A method, however effective at killing aquatic plants, that cannot be cranked up until after a boat in Jacksonville harbor has been swept from its mooring by a flood of water hyacinths is not really acceptable.

The argument here is that an effective and economical aquatic plant management system must incorporate procedures for applying the various plant-killing or plant-growth suppression methods at the optimum time and place. All too often the plant control agencies do not learn of the existence of a problem until a telephone call from a frantic citizen apprises them that the bridge to his house is about to be swept away by legions of water hyacinths. At this point in time, the population explosion has already occurred, so the control agency is faced with the prospect of dealing with the worst possible situation.

The nagging fact is that those legions were once upon a time only a handful of juvenile plants. If they could have been attacked at that time, the population explosion would not have occurred, and the crisis would never have arisen. And all of this might have been achieved by a couple of hours of effort and a few grams of herbicide, or a few gallons of fuel to run a mechanical harvester, or whatever. The difficulty is that there is no effective method of finding potential centers of population explosions or of monitoring the growth of populations. The result is that our control agencies are forced to await the onslaughts of the mature armies, instead of strangling the babies in their cradles. The latter would clearly be cheaper.

The point is that we need an effective intelligence service, so that our available arsenal of control methods can be deployed with maximum effort.

(continued on page 36)

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Alva Burkhalter Updates

The White Amur Controversy

RESEARCHERS are making a concerted effort to find biological control organisms for noxious aquatic plants. The three primary control groups being studied are insects, diseases, and fish. Perhaps the most controversial group of biological control agents is the fish, of which the white amur has received the most criticism.

The white amur is a member of the family Cyprinidae — the minnow or carp family — and is indigenous to the great rivers forming the boundary between northern China and southern Russia. Once it grows to three or more centimeters, the amur is almost exclusively a herbivore and offers promise for controlling aquatic higher plants. Investigated as a potential biological control agent for submerged aquatic weeds, the fish has an outstanding history.

The amur was first introduced in the U.S. in 1963 at the Bureau of Sport Fishery and Wildlife's Fish Farmer Experiment Station at Stuttgart, Ark. Research was initiated at the station and at Auburn University in Alabama. In the late 1960's, the Arkansas Game and Fish Commission started using the white amur in an operational aquatic weed control program. This action initiated the controversy that exists today. There was an immediate uproar from the other states who banned the amur from introduction until more was known about its environmental impact in the U.S. The white amur is now being studied intensively in a number of these states, many of which feel it has a tremendous future in aquatic plant control.

In preparing this manuscript, my initial step was to phone other state representatives actively involved in white amur research. I asked two general questions: What were their past and present programs with the fish? What future investigations were planned? I will take each state contacted and briefly summarize the responses.

ARKANSAS — Since much of the controversy started with the Arkansas Game and Fish Commission's endorsement of the white amur, I feel it would be appropriate to start with the State of Arkansas. Bill Bailey, fisheries biologist with the Commission, has been engaged in work with the white amur since shortly after its arrival. He studied the fish in closed systems until the late 1960's, then Arkansas began releasing amur into public waters. The fish has since become the primary means of aquatic plant control. In addition, Arkansas also has investigated artificial propagation of the amur, its effect on selected native sport fish and its commercial and sporting potential.

The author, Dr. Alva P. Burkhalter, is coordinator, Aquatic Plant Research and Control, Florida's Department of Natural Resources, and immediate past president of the Hyacinth Control Society, Inc.

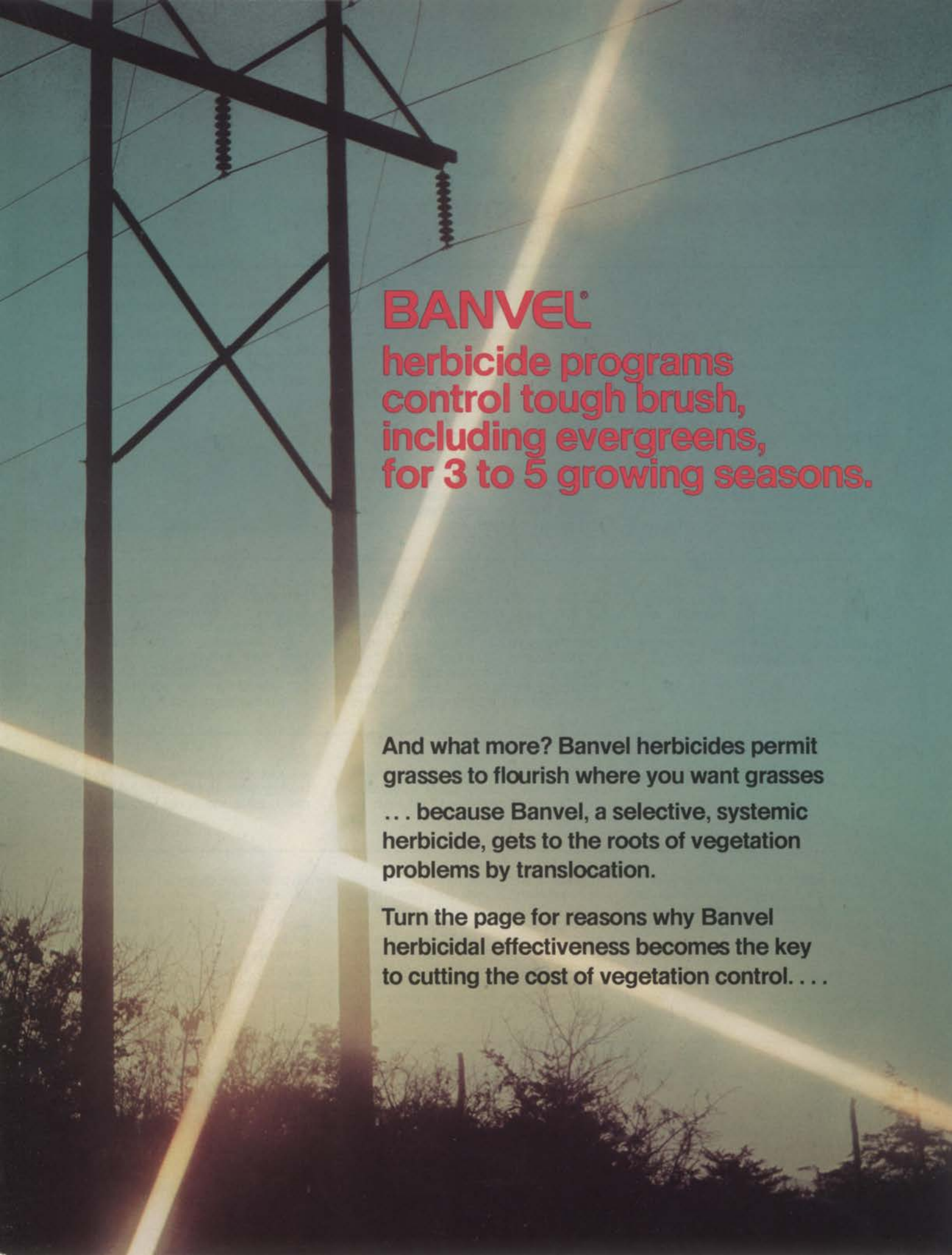
Virtually all public lakes with submerged weed problems in Arkansas have been stocked with this biocontrol agent. This has involved more than 100 public lakes, totaling more than 50,000 surface acres and 380,000 white amur. The exact number of private ponds and lakes that have been stocked is unknown.

The initial controversy arose from the fact that many of the stocked lakes are in the Mississippi River watershed which comprises a drainage area equivalent to almost three-quarters of the U.S.The white amur currently is distributed from the lower Mississippi in Louisiana to the Missouri River into Nebraska, including the Ohio, Tennessee, and numerous other rivers connecting with Mississippi drainage. This strongly suggests presence of the amur in the waters of three-quarters of the U.S.

To date, no one has confirmed natural reproduction. All fish captured thus far can be traced to known age groups accidentally escaped from Arkansas. Most captured fish have weighed several pounds and no fingerlings or fry have been recorded. One paradox of this situation is that many states are still arguing over releasing this fish into their waters. Since the amur now has access to the vast area between the Appalachian and Rocky Mountains via the Mississippi River, it seems this argument makes as much sense as "hip boots on a boar hog." For at least three-quarters of the U.S., this argument is ludicrous.

I asked Bailey if the Arkansas Game and Fish Commission felt it had made the correct decision in releasing the white amur. I received an unequivocal "YES" to that question. They have attained good weed control, recorded no adverse effects on sport fisheries and feel they will continue to have one of the finest waterfowl-hunting states in the country. Even though fish have escaped into the Mississippi River, Arkansas feels that there is no imminent danger. If the amur reproduces naturally in the Mississippi watershed, Arkansas feels it will be controlled by its own demand of a highly selective spawning site or by natural predation.

Bailey made an interesting statement in one of his reports: "The stocking of white amur in weed control concentrations has produced definite long-range, detrimental effects on one species — the white amur itself." In other words, white amur used at proper rates appear only to be detrimental to themselves since they tend to lose weight even to the point of starvation when



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Why and how Banvel® industrial herbicide formulations in your vegetation control program make excellent economic sense....

Q. We've sprayed picloram for two or three cycles and got rid of many brush species, but the tough brush gets bigger and tougher. Our problem is to control a mixture of oak, ash, hickory, poplar, sassafras, cedar . . . well, you name it. What formulation do you suggest in a long-term selective brush control program along our transmission line right-of-way?

A. Basal applications of Banvel®-510, one pound dicamba and two pounds 2,4,5-T per gallon, has proved effective and economical for the control of both hardwood and evergreen species, including root-suckering trees such as sassafras, chokecherry, aspen, sumac, and locust.

As with picloram, Banvel-510 herbicide is applied by hydraulic spray, using a mix of two gallons of Banvel-510 in 98 gallons of oil, at the rate of approximately 100 gallons of spray mixture per acre of brush.

Spray the basal parts of the brush and tree trunk from the ground line up to a height of 1-1/2 to 2 feet. Spray until runoff, with special emphasis on covering the root crown.

Treatment may be made at any time during the year.

As a foliage spray with water, use Banvel®-320 or Banvel®-710 at the rate of one gallon in 99 gallons of water and spray the entire plant to runoff.

Q. Our experience indicates that picloram is a long-residual material, and our company is greatly concerned about this. How does Banvel dicamba compare in this regard?

A. The half-life of picloram is in excess of 100 days. The half-life of Banvel dicamba is 25 days. Once Banvel dicamba gets into the plant system, it works over a period of two or three years in disrupting the plant's cellular structure. In the soil, Banvel dicamba that is **not** absorbed by the root system of the plant dissipates quickly. It breaks down into harmless compounds in the process of biodegradation.

Soil moisture, organic matter content and temperature greatly influence Banvel dicamba degradation, but metabolism by soil micro-organisms is the major factor in degradation.

Q. Can we tank mix Banvel dicamba with 2,4-D and 2,4,5-T?

A. You certainly may. Banvel herbicides have Federal label registration for tank-mix combinations with the phenoxies for both water- and oil-soluble formulations. Also by tank-mixing with 2,4-D and 2,4,5-T, you can double the acres you can spray.

Q. Some parts of our right-of-way are cattle-grazed. We find that picloram is not registered for use in grazing land. What about using Banvel herbicide here?

A. Banvel dicamba herbicide has Federal registration for use on pasture grasses. Established tolerance in grass is 40 ppm and in milk, 0.05 ppm. There is no withholding period for meat animals on Banvel dicamba when used alone on treated areas, with this exception: do not graze meat animals on treated areas within 30 days of slaughter. Also, do not graze dairy animals on treated areas within 60 days after application at high application rates; up to 90 days delay is required before harvesting hay.

No tolerances have been established with 2,4-D or 2,4,5-T in or on grass. 2,4-D, 2,4,5-T and picloram are federally registered for use on pasture grasses. However, picloram has EPA registration for use in Texas.

Q. What about Banvel 4-W.S. herbicide toxicity?

A. Banvel® 4-W.S. herbicide was developed and tested during the period when extensive toxicological and residue requirements were necessary to obtain Federal registration. It has met every requirement of the USDA, the FDA and the EPA in this regard, and obtained label clearance for industrial brush control in 1968. Be sure to observe grazing and harvesting restrictions shown on the label.

Although Banvel 4-W.S. is several times more active on brush than the phenoxy compounds, it is approximately five to ten times less toxic than 2,4-D or 2,4,5-T. The LD_{50} in rats for dicamba acid is 2900 mg/kg. 2,4-D is 300-470 mg/kg, and 2,4,5-T is 390-640 mg/kg.

Q. Much of our right-of-way is overgrown with a varied mixture of brush and weeds. What chemical should we use in a foliar spray?

A. If there is a mixture of species—conifers, softwoods, hardwoods, vines—you need a formulation that controls the broadest spectrum. Use Banvel-320, containing one pound dicamba, one pound 2,4-D and one pound 2,4,5-T per gallon. Or use Banvel-710, containing one pound dicamba and two pounds 2,4,5-T per gallon. Banvel dicamba alone controls most species, including softwoods that phenoxies do not control. Moreover, Banvel dicamba permits grasses to flourish.

Q. I have willows taking over my ditch banks. Picloram and 2,4,5-T are not registered for ditch bank use. What chemical can I use to get rid of these trees and a lot of other brush and weeds?

A. Banvel 4-W.S. dicamba gives excellent control of willows and their destructive, water-seeking roots, and is registered for ditch bank brush control. It also destroys broadleaf weeds and extensively rooted vines. Because it is a selective weedkiller, at proper dosages it will not harm grasses, so you can avoid erosion along banks of irrigation or drainage ditches. Banvel dicamba, alone or in combination with 2,4-D, is registered for vegetation control along ditch banks.

Q. Last year we had difficulty getting an adequate supply of Banvel dicamba and phenoxy in premixes, or in any form. What is the supply situation this coming year?

A. Banvel dicamba and phenoxy should be in adequate supply, in spite of demand that has doubled each year for the past three years for use on several crops and on grazing lands throughout the United States. Recently, Velsicol completed a new manufacturing plant that has more than doubled the production of Banvel dicamba.

At present, our supplies of 2,4-D and 2,4,5-T acid are limited. You can, however, profitably stretch the 2,4-D or 2,4,5-T materials you are able to find with the various Banvel dicamba tank mixes.

Q. Can I use Banvel dicamba to sterilize certain areas?

A. Banvel dicamba is not a soil sterilant, and should be used at label dosage rates for brush and broadleaf weed control. Banvel 4-W.S. herbicide is selective, allowing grasses to grow for soil cover and to prevent erosion. If you wish to sterilize the soil, your contract applicator can advise you, or call Velsicol on the Banvel "Hot Line."

Q. How does Banvel 4-W.S. herbicide kill brush? Why is it more effective than the phenoxy compounds?

A. Phenoxy compounds enter the plant through the leaves and bark, while Banvel 4-W.S. herbicide enters the plant through the roots as well as the leaves and bark. It is several times more active biologically than the phenoxy herbicides. Its different mode of action and greater mobility within the plant give a higher degree of brush and vine control with Banvel 4-W.S. dicamba alone or with Banvel dicamba plus phenoxy mixtures than with phenoxies used alone.

Banvel 4-W.S. dicamba not only controls those brush species controlled by 2,4-D and 2,4,5-T, but also controls many species not controlled by phenoxy chemicals, such as evergreen species and suckering hardwood species. There are no other herbicides in commercial use that outperform Banvel 4-W.S. for control of brush and vines.

Because Banvel 4-W.S. dicamba translocates, it gives a more complete kill, even though the entire plant is not sprayed. Other herbicides may merely suppress. Therefore, Banvel 4-W.S. is more effective on the toughest weeds, trees and vines that have the deepest or most extensive root system. Translocation of Banvel 4-W.S. herbicide through the plant system eventually gets to the roots.

Q. I put out Banvel-510 herbicide in September as a basal application, according to your label directions. Brush browned out very well, but in June the next year, some trees started to leaf out. Does this indicate partial failure?

A. It's true that elm and certain other species often leaf out during the first growing season. However, Banvel-510 herbicide usually gives complete kill in the second growing season after the application. Translocation takes time. Chemicals that give immediate, first-year brownout do not necessarily give third-year kill, so that you have to spray more often. Full benefit of Banvel-510 herbicide, its ultimate effect, is in the third year.

Banvel 4-W.S. dicamba by itself, applied to brush, is slow in giving brownout. With some species brownout is never achieved, as leaves curl and fall without turning brown. With the addition of 2,4,5-T brownout is faster, occurring within two to four weeks after application. The addition of Accutrol® adjuvant will increase penetration and absorption of the chemical.

Some species take longer to die than others. For a few, it will be 18 to 24 months from time of application.

In short, this means that you spray on a three- to five-year cycle . . . you seldom have to go in again sooner than three years.

Q. My management has made a decision not to use 2,4,5-T for brush control. Do you have a product I can use that does not contain 2,4,5-T as a basal application to control brush?

A. Yes, for sure. Banvel®-520 herbicide, containing one pound dicamba and two pounds 2,4-D per gallon, controls a broad spectrum of brush. Why don't you give this formulation a good test? But, if you feel that it is not doing the job as expected, call Velsicol on the Banvel "Hot Line" free of charge. On certain species, Banvel-520 herbicide proves effective but works more slowly than Banvel-510 herbicide.

Q. We use some pellets in our vegetation control program for brush and vines. Does Velsicol manufacture a Banvel dicamba pellet?

A. Yes, Velsicol sells Banvel® XP pellets, containing ten percent dicamba in clay. It is applied by hand or mechanical applicator, scattered uniformly on the ground under the tree, within six inches of the trunk. Banvel XP dicamba leaches to the roots where it is taken up and translocated throughout the tree, destroying growth tissue as it goes.

Q. I've been using 2,4,5-T on poplar, sumac, chokecherry, locust, sassafras, aspen, and persimmon with good kill the first year. But right now, about two years after, these areas are thick with root sprouts. Would this happen if I used the right Banvel dicamba plus phenoxy formulation?

A. Not at all likely. Banvel herbicide combined with a phenoxy kills dormant buds and gets absorbed by the roots of these trees as well as through the leaves and bark, to put a sure end to root suckering. As long as you get good coverage around the crown of the plant, you will get good brush control. Banvel-510, containing 2,4,5-T, is recommended, unless you have an environmental restriction against 2,4,5-T. If so, then you may be able to use Banvel-520, containing 2,4-D. Lower in cost than Banvel-510, Banvel-520 does not control quite as broad a spectrum of brush species, especially maple.

Q. Environmentally, how does Banvel dicamba compare with other brush control chemicals?

A. The table shows a comparison of Banvel dicamba with other brush control chemicals.

ENVIRONMENTAL COMPARISON OF BRUSH AND WEED CONTROL CHEMICALS

	BANVEL	2,4-D	2,4,5-T	TORDON
Chemical Toxicity (acid) oral LD_{50} over 2500 mg/kg	Yes	No	No	Yes
EPA Federal Label Approval on Pasture and Rangeland	Yes	Yes	Yes	*
Waiting Period Between Treatment and Grazing:**				
Beef Cattle	No	No	No	*
Dairy Cattle	Yes	Yes	Yes	No
Federal Residue Tolerances Established on:				
Pasture Grass	Yes	No	No	*
Crops	Yes	No	No	No
Milk	Yes	No	No	No
Soil Persistence Half-Life	25 days	4 days	20 days	100+ days
Ditch Bank Application (registered label)	Yes	Yes	No	No
Controls Both Hardwood and Softwood Species	Yes	No	No	Yes

*EPA registration for use in Texas.
**Read all labels for limitations on harvesting hay and slaughter restrictions.

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the submerged weeds are eliminated.

There are several large commercial fish farms in Arkansas currently producing and selling white amur for weed control. The fish farmers are advertising in magazines such as *Progressive Farmer, The Commercial Fish Farmer,* and many others. Their advertisements get wide distribution as do their commercial sales. There is no federal legislation that prohibits these dealers from selling fish to persons in any other state — only legislation within the various states it may enter. Therefore, the only way a state can stop the entry of the fish is to confiscate it upon entry.

Many of the small cyprinid minnows commonly sold as bait closely resemble the white amur. Unless examined by a well-trained person, the amurs would likely pass as just another shipment of bait minnows. Therefore, legally or illegally, the fish is already in nearly every state — particularly those which encourage farm pond practices.

Be it blessing or curse, Arkansas' stocking and sale of the white amur has forced many states to backtrack and initiate research programs. Regardless of their position on the fish, most states now have it in their natural waters.

ALABAMA — Since Auburn University obtained amur concurrently with Arkansas, they probably have conducted as much scientific investigation as anyone, particularly towards farm pond use. Many fishery scientists at Auburn have been working on white amur studies for eight years. They have studied its artificial propagation, dietary preference, feeding habits, effects on water quality and effects on native sport fishes.

Most of Auburn's fisheries personnel feel there is tremendous potential for the use of white amur as a control tool in farm ponds. They have found the amur, if properly used, will provide good aquatic plant control with no adverse effect on the sport fisheries.

Probably the most damaging scientific evidence against the use of the amur was reported by Dr. John Lawrence, fisheries scientist at Auburn. When stocked at excessive rates in fertilized ponds void of vegetation or lightly vegetated, amur may interfere with bluegill recruitment. Lawrence feels that this does not damage the potential use of the fish in farm ponds, but rather the fish should not be used at random stocking rates.

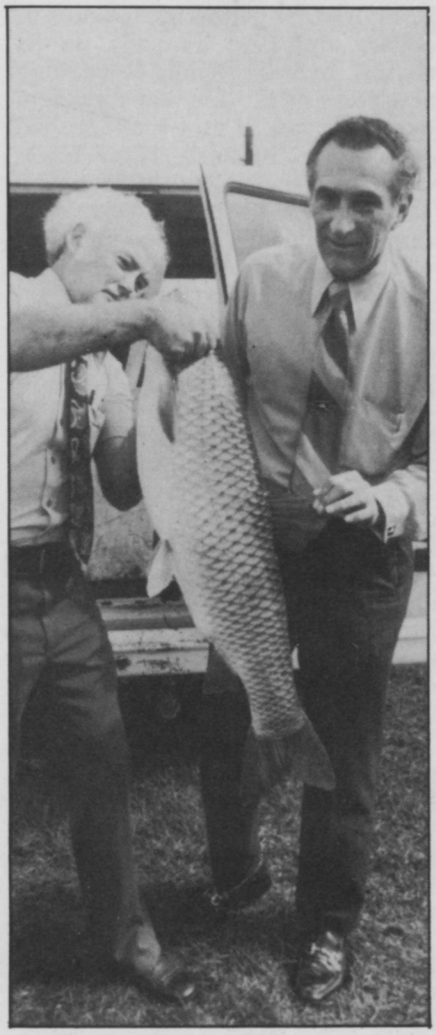
A very precarious situation exists in Alabama. Although Alabama's Game and Fish Commission officially has taken no action for or against the fish, it nevertheless is being sold commercially within the state and probably is being used in farm ponds as extensively as in Arkansas. In fact, the fish is being sold in many bait shops and some commercial dealers even advertise in farm and ranch magazines.

FLORIDA — Since Florida has the most severe aquatic plant problem in the U.S., much of the present day controversy over the white amur is centered around this state.

White amur were brought into Florida in the late 1960's. Initial studies with the amur started as a joint effort between the University of Florida and the U.S. Department of Agriculture Laboratory under the direction of Dr. David Sutton and Robert Blackburn. Early work evaluated plant preferences and changes in water quality in aquaria and small plastic pools. Under a permit from the Game and Fresh Water Fish Commission and funding by the Florida Department of Natural Resources, Sutton initiated further studies in 1970.

Currently, the white amur is stocked in approximately 10 to 12 locations in the state. All are closed systems ranging from 5 to 250 acres. Plans are being promulgated to stock additional lakes, some of which will exceed 1,000 acres.

To date, most of the research conducted in Florida supports the ability of the amur as a weed control agent. No past studies have confirmed any undesirable effects on sport fish, water quality or other parameters of the aquatic environment. The crux of the controversy in Florida is not whether the fish does or does not have potential as a weed control agent — the controversy centers around the possibility of the fish naturally reproducing in the river systems of the state in sufficient quantities to pose a threat to fisheries and waterfowl populations. Proponents of the white amur, such as myself and my staff, feel there is little scientific evidence to warrant this extreme fear and caution. Opponents of the fish, primarily the Florida Game and Fresh Water Fish Commission and several environmental groups, feel that all programs should proceed with extreme caution until more information is obtained on the potential reproduction of the fish in Florida's rivers. If the fish is ever given a clean bill of health, Florida, more than any other state in the Union, stands to benefit from its use.



The Honorable William E. Fulford (right), Florida House of Representatives, Orlando District No. 40, examines a white amur. Florida, with the most severe aquatic plant problem in the United States, has the most to gain with the use of the amur as aquatic weed controllers.

Florida has a severe submerged weed problem, particularly with a species of plant commonly called Florida elodea or hydrilla *(Hydrilla verticillata).*

Introduced from the Malaysia-Indonesia area in 1959, it has spread rapidly and now infests over 100,000

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acres of water. Although millions of dollars are spent annually on its control, hydrilla rapidly is invading new areas of Florida and spreading to other states. It now is established in Georgia, Louisiana, Texas, Iowa, Oklahoma and several other states.

Currently, hydrilla is being controlled chemically at an average cost of 150 to 300 dollars per acre. Studies show that this soft-bodied plant can be controlled easily and economically by the white amur; preliminary costs range from 15 to 25 dollars per acre and would constitute a persistent treatment.

Regardless of the controversy, amur are still being moved and sold commercially to people in the state. The Florida Game and Fresh Water Fish Commission at last count documented approximately 32 cases of illegal stocking of white amur. I seriously doubt if this represents even one-tenth of the actual illegal stockings.

Hopefully, answers to many questions will be forthcoming in future years. Studies currently are underway in Florida to determine impact of the amur on sport fish, water quality, benthic organisms, vegetation and other parameters.

LOUISIANA — To update Louisiana's position and work with the white amur, I called Louie Richardson, supervisor of aquatic plant control research for the Louisiana Wildlife and Fisheries Commission.

Louisiana initially took a "hands off" position on the white amur after the initial release by Arkansas. Later, Dr. Dana Sanders at Northwestern Louisiana State University, under permit from the Louisiana Wildlife and Fisheries Commission, began studies on the white amur/common carp hybrid. For all practical purposes, a hybrid would be sterile. If it retained parental characteristics of the white amur, the hybrid could be used without fear of reproduction. The presence of white amur in the natural waters of Louisiana and loss of some desirable parental amur characteristics has prompted Louisiana to discontinue hybrid investigations and concentrate efforts exclusively on the amur.

Some white amur escapes from Arkansas were first recorded in the Louisiana portion of the Mississippi River. Louisiana has confirmed the commercial and sporting catches from the Mississippi and its tributaries of more than 50 white amur ranging from nine to 40 pounds. Although there have been 50 confirmed captures, Richardson suspects this represents only a small portion of what has actually been taken. He additionally informed me that a commercial market is beginning to establish in Louisiana, and the amur is referred to as the shiner buffalo. In fact, local people ask for the shiner buffalo by name at market places.

An environmental impact study is being conducted by university fishery scientists within Louisiana and the Louisiana Wildlife and Fisheries Commission biologists. During the current year, six 30- to 250-acre lakes are to be stocked. Research considerations include the effect of the white amur on aquatic vegetation, water, quality, sport fisheries, benthic organisms and other parameters of the aquatic ecosystem. They also are examining the effects of the white amur on crawfish since the state supports a large crawfish industry.

In summary, Louisiana's policy on white amur research is one of "proceed with caution," but they do feel the fish has potential for use as a biological control tool.

GEORGIA — Georgia began investigations with the white amur several years ago. Dr. Al Fox, Cooperative Fishery Unit, University of Georgia, has investigated the weed control potential of the white amur together with the impact of the white amur on sport fish, water quality, algae production, and benthic organisms. Basically, his results have been encouraging. The amur has exhibited good weed control and has not exhibited detrimental effects on sport fish, even at high stocking rates with sparse vegetation.

I talked with Leon Kirkland, chief of the Fisheries Division, Georgia Department of Natural Resources, who informed me that they currently are conducting a single study on the white amur. Kim Primer, fisheries biologist in Calhoun, Georgia, is investigating the amur in hatchery pond management for control of *Pithophora*, a species of filamentous algae. Primer reported very good *Pithophora* control which enhanced sport fish, primarily striped bass and catfish, recovery. He also noted that the amur can be aggravating to fish recovery because they are very active (particularly when seined) and thrash violently in the net occasionally causing harm to the recovery species. However, Primer felt the better recovery obtained as a result of the weed control made up for this small inconvenience.

Primer said 123 five-pound amur were stocked in a 16-acre *Pithophora*-infested catfish pond open to public fishing. Within a year, the amur had grown from five to 14 pounds, the *Pithophora* was controlled and two white amur were caught by fishermen. He reported that no additional research was planned except for minor investigations in some southern hatcheries.

IOWA — A newcomer into white amur research is the State of Iowa. The person currently conducting investigations is Larry Mitzner, fisheries biologist with the Iowa Conservation Commission. In 1973, the Commission stocked Red Hall Lake, a 73-acre impoundment in southern Iowa, and plan to evaluate the effectiveness of the amur in controlling undesirable aquatic vegetation and its effect on sport fish population. To date, Mitzner has been pleased with the degree of vegetation control obtained and the absence of significant water quality changes. I would evaluate Iowa's attitude as optimistic, but again with a cautious approach towards research.

ILLINOIS — Dr. Bill Lewis, University of Southern Illinois, has been using the amur for weed control for several years in many of the hatchery ponds at the fisheries research center where catfish, bluegill, bass and several other species are reared. Lewis is highly satisfied with the weed control ability of the amur, its palatability, and its compatability with catfish and centrarchids. Additionally, he said white amur have been recovered from the Illinois reaches of the Mississippi River.

NORTH DAKOTA — I had a very interesting conversation with Dale Henager of the North Dakota Game and Fish Commission. In August, 1973, 5,000 three-inch fingerlings were stocked in a 500-acre closed-basin lake which has an excellent population of northern pike. Gut analysis of pike taken from the lake after stocking revealed that many small amur were being consumed by the pike. However, no amur have been recovered in rotenone or pike gut samples taken after the first overwintering which suggests few if any residual amur. According to Henager, northern pike probably are highly predaceous on small white amur and the amur may not be able to tolerate North Dakota winters.

Although the white amur does tolerate winter conditions equivalent to North Dakota in its native range, it does so primarily in large river systems. The North Dakota lake was a non-flowing type and probably has much colder winter temperatures than the Amur River. Henger said the final demise of the amur was probably the severe North Dakota winters, but pike predation also played a significant role.

Additionally, he said that 800 to 900 fry were stocked in a small spring-fed pond. Although this pond contained very few predator species, there were no amur recaptured after one winter. Therefore, no further research is planned in North Dakota since the winters probably

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Toro Chief Optimistic Toward Mower Safety Recommendations

David T. McLaughlin, President of The Toro Company, recently said he was optimistic that the final form of the mandatory mower standards, currently being developed by Consumers Union (CU) for the Consumer Product Safety Commission, (CPSC) would give the public maximum protection without imperiling the future of the power mower industry.

He pointed out that the Consumers Union committee working on this complex problem still has nearly one month before the standards are to be presented to the Consumer Product Safety Commission. "While the industry has done a highly commendable job in developing voluntary standards, there are a few areas where further performance safeguards could lessen accident frequency. It is important, however, to realize that approximately 95 percent of all lawnmower accidents are caused by user carelessness. Standards to protect the consumer must be related on a cost/benefit basis so that the public does not pay excessively for the protection it receives.

"I am certain that members of the general public and of the mower industry will have an ample opportunity to make known their views before the Commission takes final action. I am hopeful that the Commission will look at this rationally and not repeat the mistakes evident today in the automotive industry."

McLaughlin said the impact of the CU standards would undoubtedly be less critical for Toro than for many others in the industry. "We did not wait for the government to mandate safety for Toro customers," he explained. "Toro, over the past quarter of a century, has invested heavily in research for its on-going development of a safer rotary mower. As a result, we have introduced a host of innovative test procedures and safety features, a number of which the CU committee has recommended for adoption."

The chief executive said he hoped both Consumers Union and the CPSC would give full consideration to a Stanford Research Institute study released recently by the Outdoor Power Equipment Institute, the industry association which commistioned it. According to SRI, the latest CU draft standards could force more than one-third of the power mower manufacturers out of business.

Lew Hammer (center), president of the Associated Landscape Contractors of America, was an honored guest at the National Landscape Contractors/Garden Centers of America Clinic recently staged in Louisville. The clinic, open to all landscape professionals, landscape firms and garden center retailers, attempts to give participants a hard-hitting program aimed at top and middle management problems. Pictured with Hammer are Tom Gilmore (right), immediate past president of the National Landscape Association and Don Johnson, current NLA president.

Hyacinth Society To

The Hyacinth Control Society will meet for the last time July 6-9, 1975 before that organization changes their name to Aquatic Plant Management Society. L. V. Guerra, president, said the new name is more descriptive of their work, aims and activities.

The society's 15th annual meeting is planned for the Hilton Palacio Del Rio, San Antonio, Texas.

There is an international flavor to the up-coming meeting with many papers coming from foreign countries and a post-convention trip to Mexico City. A newcomer to the meeting is Dr. Pedro Mercado, representing Mexico's Fish and Wildlife agencies. His topic is "The Control of Aquatic Plants in the Central and Southern Zones of Mexico." Other speakers include John B. Ritch, director, Registration Division of the Environmental Protection Agency, presenting a paper entitled "The Progress in Pesticide Registration for Aquatic Weed Control."

Many papers are being pre-