Some Problems With Aquatic Weed Herbicides

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There are many organizations in the world today devoted to the control of noxious vegetation. I find the Hyacinth Control Society particularly interesting, however, because it devotes its energy primarily to the control of aquatic vegetation which happens to be the major field of interest to us at the University of Southwestern Louisiana. While it might be interesting to attend meetings involving problems such as how to remove noxious vegetation from a patch of raspberries or a bed of pansies, these problems are not common with any problem which we are involved in at the University and, therefore, cannot hold our attention as much as the problems involved in the control of weeds in an aquatic environment.

In the United States today there are many weed scientists as compared with the number of such experts 25 years ago. The reason for this is quite obvious; it has only been within these 25 years that the area of organic herbicides has become known and expanded. If we look at any publication, say, the annual report of the Southern section of the Weed Society of America or even at the annual publication of the Weed Society of America itself, we will find a great many publications primarily concerned with the destruction of terrestrial weeds; and in the same publication, we will find very few papers on the chemical destruction of aquatic weeds.

Let us ask why so little attention has been given to aquatic weeds and an enormous amount of research work has been done on terrestrial weeds. I believe that the first reason for the lack of knowledge connected with the destruction of aquatic weeds is an economic one. By way of illustration, it is easy for a farmer to plant certain acreage in corn and use 2,4-D as an herbicide to control the weed growth. Under these conditions he knows how much the 2,4-D costs per acre and what it cost him to apply the chemical. He can also very quickly determine how much hand or mechanical labor has been saved in this process and estimate what the cost of this extra labor would have been. In addition to this, it is easy for him to determine the number of extra bushels of corn obtained per acre and what their monetary value is. Thus, a farmer using simple arithmetic can prove to himself the value of a chemical herbicide. This self-selling operation on the part of the farmer has resulted in annual increase in 2,4-D production from 0 pounds about 1942 to thousands of tons in our present economy.

On the other hand, let us look at the problem of aquatic weeds. In some instances an individual farmer does have a small pond or lake on his property, but usually the use of this lake does not greatly influence the economy of the farmer's personal life. That is to say, he is not raising a crop on this small lake and is only using this small body of water for recreational purposes or otherwise. As a consequence it does not contribute to his livelihood. Therefore, why should he worry about alligatorweed or elodea in his pond?

Most large bodies of water, whether they be for recreational purposes, irrigational purposes, or for water transportation, are owned and controlled by the federal government or a state or in some cases by similar political subdivisions. This immediately places the problem of aquatic weed control within the province of a governmental organization rather than an individual landowner. It is obvious at this point, then, that the general area of aquatic weed control is usually the problem of federal or state governments, and research work should be primarily supported by agencies of these governments.

Again, it is very difficult to determine what the actual benefit of removing weeds from a body of water might be. This has been done by governmental agencies in certain cases, but this involves calculations on such things as hindrance to transportation or added value because of recreational facilities. The factors, then, which an economic feasibility study might be made on aquatic weeds is not as obvious as studies which might be made by some individual farmer or some experiment station.

A great many of the companies have contributed substantially to the research work in connection with the destruction of terrestrial weeds. They, of course, have been prompted to do this because of the vast market in this area. For some 25 years now, we at Southwestern have been working on aquatic weeds. Over this period of years, we have had a number of individuals representing various chemical companies to call upon us and describe either some old product on the market or some new product which the company had recently developed. These products have usually been developed for terrestrial weeds, and most of the individuals who have in the past called upon us have been salesmen; so when one attempted to discuss, say, the chemical properties of the herbicides, the salesmen knew nothing or at best very little. It has only been within the past 5 years that we have had individuals from the various companies call upon us specifically to talk about aquatic weeds and we are thankful that these individuals are becoming more scientifically oriented than the salesman-type. This indicates to me that there is a growing interest on the part of the chemical manufacturer in the aquatic weed problem.

Now that we have pointed out at least two reasons why aquatic herbicides are lagging so far behind the other herbicides, let us turn our attention to other problems connected with the use of aquatic herbicides. The problems of using herbicides on terrestrial weeds are all together different from the problems connected with the use of herbicides on aquatic weeds. For example, to illustrate two cases, let us go back to our corn field which is infested with some weed which is susceptible to 2,4-D. The plants in this field may be sprayed with a solution which may be 1/10 of 1 per cent herbicide, though in cases, of course, by low volume application it is possible to use much higher concentrations than this. The quantity of herbicide, then, per acre can be limited to a matter of a few pounds and at the same time we are insured that the leaf surfaces are picking up all of this, or practically all of this, material and that the objectionable plants are getting a full recommended dose. Furthermore, the herbicide is placed at the point at which it is most desired, that is, directly onto the leaf of the plant and remains in this position so that its activity might extend over a great period of time. On the other hand, let us apply the herbicide to a submersed aquatic weed. Now, if we assume that the aquatic weed is contained in only one foot of water, that is, the given area only has an average depth of one foot, we can readily see how much more herbicide is required to bring the activity level up to a point where the plants will be adversely affected. In other words, if it is necessary to bring a certain concentration of herbicide to bear against a submersed leaf under the conditions just described, a concentration in the water supporting the aquatic weed would have to be roughly 1,3000 times as much as the amount of chemical used on a terrestrial surface spraying. Not only this, but many bodies of water are flowing; thus, the herbicide placed in the water is under a constant threat of being removed from the point of application and, of course, the extra amount required would be increased according to the flow rate in and out of the treated area. Now, I have been talking about submersed aquatics to this point. We can see that there are aquatic weeds which are emergent and which can be affected as readily as terrestrial weeds. One such weed is the water hyacinth, and it is because of the characteristic of the water hyacinth to absorb 2,4-D so rapidly through its leaf surface and distribute it so readily through its vascular system that has made the control of the water hyacinth a relatively simple matter.

On the other hand we have emergent weeds that do not respond as well as does the water hyacinth. All of us here know of one that we are all most intimately acquainted with, and that is alligatorweed. We know that the alligatorweed can receive a foliar application and within a week or so it is apparently destroyed. But after a period of 6 to 8 weeks have passed in the normal growing season, we find that the weed has revived; that is to say, the underwater buds, which are dormant in the nodes and are generally isolated from the vascular system of the plant during the spraying operation, have suddenly come to life and we have as great a coverage of this weed within the 8 week period as we had originally.

Thus, we can expect some aquatic weeds to be controlled easily by terrestrial herbicides, and others will not, of course, respond to any great extent.

Although we have made gigantic strides in the control of vegetation by the use of organic herbicides in the past 20 years, we have, in my opinion, merely scratched the surface. At the present time a great deal of research activity is devoted to the processes of trying out various commercially available organic compounds in varying dosages and in varying time intervals along with the addition of certain additives or combinations of herbicides. While this is well to do in the exploratory stages, we must look forward to a time in which it will be possible to design an herbicide for a specific purpose. Now, it is true that we are some distance from this point in time, perhaps. The major drawbacks at the present time are simply those of insufficient knowledge. We do know that certain herbicides that are effective in one area are not effective in another. Sometimes this is controlled by the environment of the weed itself.

Our major difficulty in finding herbicides for specific purposes are really in the last analysis our lack of knowledge regarding the biochemistry and physiology of the plants involved. Along with this we have insufficient knowledge to see what a given herbicide will do within a given plant because we do not know what metabolites might result from the application from a given herbicide to a given plant. Again, plants vary in their structure.

At the University of Southwestern Louisiana, we definitely demonstrated in 1959 that there was a barrier between the dormant bud in the node of the alligatorweed and the rest of the circulatory system of the plant. Now there are only a certain number of available herbicides. It would appear, therefore, that if we could discover some method of forcing the herbicide into the isolated buds in the node, we would have a method of bringing complete destruction to the plant. We have attempted a number of things to accomplish this. Our first efforts were directed toward the use of slow release glomules which, at least theoretically, give a continuous supply of herbicide; and when the new buds started growing, herbicide would be available to catch them in their early stages of growth. This did not succeed primarily because the quantity of chemical necessary to maintain a sufficient level or concentration of herbicidal activity was economically unsound.

We have made other attempts to suspend oil droplets containing herbicide in the water supporting the growing weed, and, subsequent to this, applied a coagulating agent which would settle through the water and wrap the herbicide about the stems and nodes of the plants and thus position the herbicide for future consumption by the plant. Generally speaking, this method was not successful because the coagulating agent could not, or would not, cover a sufficient amount of the dormant buds to bring about future destruction of the plant.

At the present time we are working in two directions. First, we believe that the acidification of the phenoxy herbicides stimulates them to a greater activity. We are attempting by the use of the hydrogen ion to force the herbicide into the more remote parts of the alligatorweed. This has been partially successful, but considerable work remains to be done in this area.

A second method that we are attempting to follow now is briefly one by which we first treat the plant with a plant growth regulator in order to stimulate the buds in the nodes to sprout and thus open them to the vascular system of the plant. By this method of approach, we hope to find some point at which a majority of the dormant buds in the nodes have been brought to a state of growth and have become inter-connected with the general vascular system of the plant. At this point, at least theoretically, it would be desirable to apply a translocated herbicide such as the phenoxy compounds, because under usual conditions it should enter the newly formed bud and thus destroy a great deal of the dormant potential growth of the alligatorweed.

Other problems occur in aquatic weed control. For example, we have found that certain chemicals are much more rapidly absorbed by the roots of the alligatorweed than by the leaves and that evidently translocation by this method of absorption takes place more completely. Under this condition it would, therefore, be desirable to treat the plants under water and avoid the treatment of emergent leaves. Now, the problem then is just how do you do this. To some extent in Louisiana we can do this during the July-August period when the alligatorweed is in a state of senescence, and approximately 80 per cent of the leaf area has been shed. Of course, we had rather not treat this 20 per cent but, under the conditions available to us in

Louisiana, we have to. One excellent possibility exists in the state of Florida, specifically in those areas that have been worked over by the Argentine flea beetle. Under the conditions that are produced by the Argentine flea beetle, the alligatorweed is, to all intents and purposes, a completely submerged weed since after the beetle has done a good job on the plant, he attacks and destroys any new growth emerging above the water surface very rapidly.

In the meantime our problems seem to multiply rather than to simplify. But, of course, there will be an eventual breakthrough and no doubt at this point, all of us will look at each other and say why didn't we think of this 10 years ago. At the moment, all of us at Southwestern are happy to listen to any of you that hight have suggestions and if they come within the bounds of reason at all, you can be assured that we will try them out.