Diquat — Prospective Role In Aquatic Weed Control

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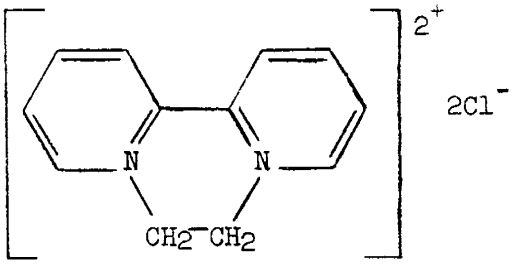
Diquat may be the answer to some of your present aquatic weed problems. Have you taken a look to see where it may help you in your weed control program? After a little background on Diquat as a chemical, we will see where it may fit your problem situations.

Diquat is a quaternary dipyridyl compound which may be described as a potent water-soluble herbicide with a relatively broad spectrum of activity on plants, including floating and submerged aquatic weeds in which we are particularly interested at this meeting.

The structural formula for Diquat will be shown in the first slide. The portion enclosed in the brackets is the Diquat cation,



which is the active portion of the compound.

This may be formulated as various salts, such as diquat dichloride, which is the compound shown, or as diquat dibromide monohydrate, which was distributed earlier as ORTHO Diquat 4 Spray. This product contained 4 pounds of the salt per gallon and had a cation content of 2 pounds per gallon. The newer diquat dichloride formulation contains 2.8 pounds of the salt per gallon, but still has a cation content of 2 pounds per gallon. So you can see there has been no change in the active portion of the formulation.

The way in which Diquat kills plants is interesting. The herbicidal action appears to take place only during periods of photosynthesis, making light a necessary factor in the plant kill. This characteristic has been effectively used to reduce the normal dosage requirement by about one-third. For applications made after dark, or within two hours or less of sunset, less Diquat is needed since there is time during the dark for absorption and translocation of the material within the plant. The following day when light is present and photosynthesis is again started the plant begins to die rapidly. Applied during the daylight hours the systemic action of Diquat appears to be minimized by the very rapid kill.

You will probably now agree that Diquat is a very interesting compound, but if you have aquatic weed problems, you are more interested in knowing what it will do to control the weeds in your canals, ditches, lakes, or ponds and what weed species it will control.

Let us first look at the group classified as floating weeds. Diquat is recommended for control of waterlettuce (Pistia stratiotes), waterhyacinth (Eichhornia crassipes), and waterfern (Salvinia rotundiflora). It is also looking very good for control of duckweed (Spirodela polyrhiza), but the most effective method of application has not been determined. There are also indications of good control of frogbit (Limnobium spp.) and water pennywort (Hydrocotyle spp.). The research work is continuing and the list of weeds controlled by Diquat is growing.

Diquat has several advantages over other herbicides for application to floating weed species.

1) Diquat is not volatile. There is no hazard from vapor drift; therefore, it may be used where the application of such volatile herbicides as 2,4-D would be a hazard to crop plants or residential plantings. When using Diquat, direct spray contact with the plants is necessary for kill.

2) It is less selective than most other materials now in use and is therefore more effective on mixed populations of weeds. Selective control of one species often allows another to take over very rapidly. This reinfestation problem is minimized by Diquat through its broad spectrum of activity.

3) More rapid results can be expected from the use of Diquat. For instance, waterlettuce treated with 1 pound per acre of Diquat cation will be sinking in 7 to 10 Days, while the same weed treated with 16 pounds per acre of 2,4-D takes 8 to 12 Weeks to start sinking.

Now let us see what Diquat can do if submerged weeds are the problem. It is recommended for control of coontail (Ceratophyllum demersum), elodea (Elodea canadensis), pondweed (Potomogeton spp.), and southern naiad (Najas quadalupensis). Good results have also been obtained on bladderwort (Utricularia spp.). Here again, research work is continuing and the list of susceptible submerged plants is growing.

Diquat has a number of advantages over other herbicides for application to submerged aquatic weeds. Let us take a quick look at these advantages.

1) Diquat has a low toxicity to fish. Laboratory tests in Alabama and Illinois generally show the safe levels of Diquat to fish to be 2 to 4 times greater than the maximum dosage needed on susceptible submerged plants. Also, no fish mortality has been reported from field trials in Florida.

2) The mammalian toxicity level is greater than 400 mg. per kilo, or about the same as 2,4-D and 2,45-T. This means no serious handling problem to the applicators in the field.

3) Longer control periods can be expected. Tests have indicated slowed reinfestation and regrowth following Diquat treatments. This may be due to the systemic action of Diquat, resulting in a more complete initial kill than is the case of some chemicals with a more rapid action on submerged weeds.

4) Slower kill of submerged weeds. This may have the advantage of not depleting the oxygen supply as fast as a rapid killing herbicide may do. The speed of kill, however, appears to be associated with the water clarity and light transmission. Darker water slows the action.

5) Diquat is easy to handle and apply. It is water-soluble, which means there is no need for emulsifers and bulky carriers. It is a potent chemical requiring a low relative volume of chemical to treat a given area. Also, no special training is needed to apply Diquat.

Present federal clearances are for use of Diquat in canals, lakes, and ponds with the limitation that treated water is not to be used for human or livestock drinking water and that the water should not be used for spraying or overhead irrigation for 10 days following treatment.

Some federally cleared uses of Diquat, other than aquatic weed control, include:

1) The killing of above ground weed growth around gardens, buildings, walkways, patios, fence lines, parkways, driveways, and other non-crop and non-planted areas.

2) Preharvest desiccation of sorghum, soybeans and alfalfa for harvest of seed crops only, and for desiccation of commercial plantings of castor beans to facilitate harvest.

We feel we have just scratched the surface of the potential herbicide and desiccant uses of this material. As new residue clearances are received we expect to see Diquat come into general use on cotton as a desiccant and defoliation aid. On soybeans, sorghum, sugar cane and other crops we can forsee uses as a desiccant and harvest aid chemical. We also expect to find other uses for Diquat as an agricultural herbicide.

As we have already pointed out, work on all types of aquatic weeds is continuing, and we expect to see many more weed species added to the list of those controlled by Diquat. We are supporting and encouraging more work on treatment techniques, dosage rates, formulations, additives and combinations. We feel that Diquat is going to have a big role in aquatic weed control.

Danger To Crop Plants From Herbicides Used For Aquatic Weed Control

By **James Montelaro**

July 11, 1962

There is a real and constant danger to crop plants, not from the use, but from the misuse of herbicides in aquatic weed

control. This statement is supported by the fact that the number of complaints is quite small when the extensive use of aquatic herbicides is taken into consideration. This is a tribute to the people working in the field of aquatic weeds.

The problem of danger to crop plants is not unique to aquatic weed control. It exists wherever herbicides and other agricultural chemicals are used — including right-of-ways and all farming operations. Anyone using a potentially hazardous chemical, whether he is a government employee or a private operator, is obligated to use that chemical with absolute safety and assurance that no damage is done to neighboring crop plants.

Since there are no well-defined guidelines, this report will cover this subject in a general way. It is based on a survey of Specialists in the fields of agronomy, ornamentals, citrus and vegetable crops. The report will draw on case histories of complaints made by growers and observations noted by experienced and trained personnel of the University and other agencies who were called in to work on the problem.

The subject of damage to crop plants from "wayward chemicals" is highly controversial. No indictment of anyone is intended or even implied in any statements made in this report. The primary object of this report is to point out (1) the dangers involved in using agricultural chemicals (2) how they might be misused and (3) some precautionary measures which might be taken to avoid incidents in the future.

In the past few, if any, cases of injury from aquatic herbicides to agronomic crops or pastures have been reported. There are records of damage to citrus foliage, but the trees recovered without significant reduction in yield or quality. It is in the field of flowers, ornamental plants, both commercial and home gardens, and in vegetable crops where most of the complaints are received. Many of the species in the latter groups are extremely susceptible to injury from the hormone type weed killers.

Where a crop abnormality develops coincidental with aquatic weed spraying, the spray operation automatically becomes prime suspect in the grower's mind. In most cases the abnormality would have developed anyway even if weed spraying operations had not been carried on in the neighborhood. A majority of the times it turns out to be a virus or fungus disease, insect damage, injury from wind, rain, frost etc., a minor element deficiency, toxicity from his own spraying operation or any one of a dozen other disorders.

Danger to crop plants from the use of aquatic herbicides arises from (1) the contamination of water in canals and lakes used for spraying and irrigation of crop plants and (2) drift.

There is considerable doubt, even among specialists in the field of weeds, as to how much, if any, damage is done to crop plants from the use of water from areas sprayed with aquatic herbicides. It all depends upon the actual concentration of the herbicide in the water at the time it is used. There is a definite possibility that highly susceptible crops like tomatoes and pepper might be injured by the use of spray water taken from an area just sprayed with a hormone-type weed killer. This might even be more serious where a grower would irrigate a highly susceptible crop from such a source using an overhead system.

Extremely minute quantities of 2,4-D can cause visible distortions in many crop plants. There are records in Florida where damage to plants resulted from the use of a spray tank which was rinsed with water only after contamination with 2,4-D.

In one instance a grower purchased a small second-hand sprayer for use on a vegetable farm. Unknown to him, the sprayer had been used for application of 2,4-D two years before. Not bothering to thoroughly clean the sprayer, the grower used the sprayer for an application of pesticides to young watermelons. Plants sprayed after a half dozen or more tankfuls had been used, still showed visible symptoms of 2,4-D injury. A sample of the water, taken to our laboratory from the last tankfull, caused severe distortion on cucumber seedlings germinated on filter paper soaked with the contaminated water. Is there any wonder why growers have been suspicious of water from areas sprayed with aquatic herbicides? So dangerous is 2,4-D to the vegetable grower, that he is advised not to attempt to use a sprayer, once contaminated with 2,4-D, ever again on susceptible crops. It is virtually impossible to remove the last traces which are sufficient to effect injury to some crops.

The problem of drift is easier than water contamination to pinpoint. Herbicides may drift into crop areas for days after the spraying operation is completed as a result of volatilization of the chemical. It is the problem caused by drift that most often ends up in the courts. In most cases it is possible for the observer to establish a pattern of drift damage. Generally, the greatest amount of injury or plant distortion occurs in the area of highest concentration — the area nearest the spraying in the direction of the wind. The intensity of injury drops as the distance from the sprayed area increases.

A survey of some of the susceptible native plants adjacent to the sprayed area and the crop in question often serves to confirm observations made in the crop area itself. Tomatoes and peppers are members of the nightshade family — all of which are quite susceptible to 2,4-D injury. There is hardly an area in the state where one or more of the wild nightshades are not growing nearby to cultivated fields. Many other native plants are susceptible to injury and will show the characteristic leaf distortions.

In addition to the danger of actual injury to crop plants from drift of aquatic herbicides, there is the ever-present problem of chemical residues on crops grown for human and animal consumption. It was an herbicide which triggered the cranberry problem of a few years ago. In this case amino triazole was used at harvest time without label approval. A majority of the crop was confiscated with hardship resulting to the entire industry.

If a chemical residue on an edible crop exceeds the tolerance set by the Food and Drug Administration, the crop is subject to seizure and the grower subject to heavy fines. It is entirely possible to create conditions of excessive residues on edible crops from a chemical drifting in from adjoining areas. This has happened a number of times in farming operations in Florida. In one case authorities found twice as much residue of a chemical on a leafy crop than was legally permitted by law. All of the residue resulted from repeated airplane dustings of a crop nearby.

The leafy crop in the previous example was found to contain 15 ppm of the chemical in question. If a chemical is not approved for use or has a zero tolerance for a crop, any detectable amount makes the crop subject to seizure. From this it can be seen that, not only can a crop be injured but that it can, also, be rendered completely useless for purposes of human, and in some cases animal consumption.

There are a number of precautionary measures which should be followed to minimize the damage to crop plants from the use of aquatic herbicides. The more important measures are:

1) Scout the area and determine what crops are being grown and the stage of development of the crops. The nearer a crop is to maturity, the less likely it is to be damaged by herbicides.

2) If at all possible, avoid spraying during the crop season. In almost every area in the state, the period of late June, July and early August finds few, if any, vegetable crops in the field. This is true of commercial cut flower operations but not so for ornamental plantings in the home garden or in nurseries.

3) Spray during early morning, late afternoon or anytime when wind velocities are low.

4) Check wind directions and do not spray when wind is blowing in direction of susceptible crops.

5) As soon as research and label clearance permit replace 2,4-D with the less dangerous, newer aquatic herbicides.

6) Use formulations having the least tendency to drift.

7) Avoid the use of equipment and methods of application which increase the overall danger of drift.

Minor modification in equipment and proper usage of equipment can go a long way toward reducing the hazards to crops from aquatic herbicide application. Dusts have a greater tendency to drift than sprays. Positive shut-off valves are a must to avoid spraying areas where it is not necessary. Regardless of the method of conveyance, the safest spray rig that can be used is one that delivers the material with as large a droplet size as possible consistent with good coverage. This is accomplished best by the use of a low-level boom delivering the spray at low pressure and high gallonage.