AQUATIC WEED POLLUTION

Industry Problem for the '70s

AQUATIC WEED CONTROL

AN INDUSTRY GROWS

By John E. Gallagher
Amchem Products, Inc., Ambler, Pa.

Gallagher: We now realize the necessity of a total environment concept."

GOING BACK beyond the introduction of 2,4-D to compare the early arsenal of water weed killers with the herbicides available today, it seems a little shocking to see that we still use sodium arsenite, copper sulfate, and aromatic solvents. This is not because they are perfect herbicides and no new ones have come along, but rather an indication of changes in policy to prevent too-rapid introduction of herbicides into our waters. There is a great deal of research under way — work that reflects the cooperative action of many agencies. Federal, state, and industry workers are quite often directly involved in a single project because the multiple-use concept of water utilization requires multiple responsibility for finding answers.

Recent renewal of USDA-ARS activity in aquatic weed control indicates the expanding need for answers beyond those of early work with irrigation and drainage areas of the United States. The amount of work was increased tremendously in 1957 when the Ft. Lauderdale, Florida, facility was established and research personnel were shifted to other weed problem areas. ARS soon found itself deeply involved in all phases of aquatic weed control.

The U. S. Army Corps of Engineers, responsible for keeping navigable waters open, had long been battling water hyacinth. In 1958 a bill authorizing an extensive aquatic plant control program involving eight states released funds for joint research projects and was responsible for the movement of research people into the field of aquatics. Another agency, Tennessee Valley Authority, suddenly has found itself the major experimenter in Eurasian milfoil control, putting increasing manpower and hours into resolving the ever-expanding problem in the chain of TVA lakes.

U. S. public health and water pollution agencies are becoming involved either directly in monitoring programs or indirectly through grant-in-aid programs such as the work being conducted by Dr. John Lawrence at Auburn University in Alabama. This work is concerned with the relationship of weed growth and water pollution. Perhaps the catalyst in the whole resurgence of interest in aquatic weed work is the developing philosophies of the new Environmental Protection Agency. The concern over what is going into our waters is requiring far more complex tests now than ever before. We in industry have to account for residues in waters as well as in fish. We are now concerned with effects on fish production and the total food chain. We are doing research to investigate possible effects on crops irrigated with treated waters and may concern ourselves with stock watering and human consumption.

Submersed Weed Species

Early aquatic weed control work was primarily with pondweed species in western irrigation canals. The species most frequently subject to test was sago pondweed *(Potamogeton pectinatus)*.

Recently (that is, over the past ten years), aquatic weed research has also been oriented toward other submersed species. The rapid spread of Eurasian milfoil *(Myriophyllum spicatum)* throughout the United States, and the more regional problem of Florida elodea *(Hydrilla verticillata)* has caused a marked increase in the number of projects proposed and carried out.

The problem of Eurasian milfoil has been receiving the greatest amount of attention judging by the scale and number of agencies involved. TVA, U. S. Army Corps of Engineers, USDA, the U. S. Department of Interior, the Florida Game and Fish Commission, as well as many individual states, are working to control Eurasian milfoil.

The rapid spread of milfoil following its normal pattern of unobtrusive introduction, a 3- to 4-year period of establishment, and a sudden crisis situation, has been responsible for several crash programs attempting to stem the tide. Perhaps the most fortunate characteristic of milfoil is its susceptibility to 2,4-D, established early in the USDI research program conducted by Steenis in the late 1950's. Recent efforts have been directed toward developing new application methods

(Continued on page 18)

AQUATIC WEED CONTROL

USING AVAILABLE TOOLS

By Andy L. Price
Asgrow Florida Co., subsidiary of Upjohn, Plant City, Fla.

TREATMENT of submersed aquatics is done by one of the following tools: (1) Research—knowledge is a tool provided by research to guide us toward our goal of proper vegetation management; (2) Biological, (3) Chemical, and (4) Equipment.

Research is the prime factor of our survival. The weed problems and areas are known. As we become better informed citizens and learn to restrict our importations of noxious flora and fauna, research will provide us with the necessary tools to survive and master our environment.

Biological tools presently available range from *Marisa* snails to species of the carp family which feed upon submersed aquatics to the *Agasicles*,n.sp. beetles feeding on alligator weed. The use of biological tools is still largely in the hands of Federal and state research agencies seeking more data prior to full scale introduction.

Wholesale importation and use in the United States by well meaning, but perhaps uniformed civic lake and waterway associations of biological organisms could produce disasterous results. It is urged, therefore, that the public obtain council with their state and Federal agencies prior to purchasing any biological control agents.

In the case of herbicides, we need to overcome the image of the skull and cross-bones of past decades and begin to light a candle rather than continue to curse the darkness.

The term herbicide should be stressed to overcome public misinformation of pollution in our environment.

Today, aquatic herbicides are commercially available in either granular or liquid formulations. Thickening agents are rapidly becoming a useful tool for the applicator to work under more adverse conditions with greater safety. Granular formulations are particularly useful on marginal aquatic problems along shorelines. And in specific cases for whole lakes where the granular fromulation control rate is based upon surface acres rather than a depth factor. The weed species being combated and the locale determine the herbicide to choose.

Liquid formulations offer more rapid weed control and in many cases are less expensive to apply. From an applicators view the liquid form's ability to disperse often enables his to achieve control in inaccessable areas.

Equipment—I use the term equipment rather than mechanical control since the control of noxious weeds is attained only when the plants are contacted by a hyacinth bucket, mower blade, or sprayed by a herbicide. Therefore, in essence anything mechanical is merely a carrier to bring about control.

In the aquatic field, application control equipment is unique, in the sense that there are few, if any firms presently producing tools specifically for aquatic use. To qualify this statement, there are known firms producing drag lines and aquatic harvesting mowers, but almost nonexistant are firms which produce a packaged aquatic herbicide application unit.

The aquatic applicator of necessity must research and develop his own equipment to treat specific weeds in specific locales. Many units now in use represent years of trial and error and a great deal of expense.

The candle has been lit and with the cooperation and coordination of all segments of the industry and the public we can regain usage of our lakes and rivers—our 'Wilderness Lost."

Price: "Methods will be forthcoming to regain usage of our lakes and rivers."

AQUATIC WEED CONTROL

THE STRIP METHOD

By L. E. Bitting, Sr.
Old Plantation Water Control Dist., Plantation, Fla.

Bitting: "The strip method can be utilized in many problem situations."

NOXIOUS SUBMERSED WEEDS in the waterways of Old Plantation Water Control District must be controlled or its drainage facilities, developed at great cost for the express purpose of protecting homes and industry from flooding, will be useless.

In past years when Southern Naiad was our number one problem, and before weed control was begun, water stage differentials of three and one-half feet over a reach of one and three quarters miles at times continued for almost two weeks. In such a situation, modern and adequate drainage pumps were idled for lack of water, while nearby lands were flooded.

Now, Hydrilla, a harder to kill plant having phenomenal regenerative capabilities, poses an even greater threat. A typical marginal infestation of Hydrilla, if left unchecked, will cover a canal from bank to bank and from bottom to top. Small canals in remote areas may reasonably be given a full volume herbicide treatment and good control is obtainable with predictable results. However, large volume waterways in urban areas demand completely different management.

STRIP TREATMENT

Although marginal strip treatment is not a new concept in aquatic weed control, it may be helpful to note some of its advantages and disadvantages for those who contemplate its use for the first time.

This method is economical because only a portion of a given waterway is treated to control concentration, and if treatment is begun before weeds cover the entire submerged area, this may be enough to halt their spread. Damage to aquatic organisms is vastly reduced as compared with full volume treatment, and the normal ecological balance is soon restored.

Some faults of the strip method are: There is occasionally poor or no control due to dilution; adverse effects of the variables in weed control tend to be magnified, thus loss of time and material is more frequent; unharmed plant segments provide material for reinfestation; it is more difficult to plan efficient rates and application procedures because of irregularities in weed stand, depths, flows, cross-sections, etc.

APPLICATION

As an example, the infested margin of a canal was measured and found to average 20 feet in width and 8 feet in depth, thus an imaginary triangle with a cross-section of 80 square feet. Our aim was to treat this section with Acrolein at the rate of 7 p.p.m./v. Treatment was begun on June 25, 1968, with others following periodically and with rates running from 7 to 9 parts per million.

RESULTS

In seven days, plants were defoliated and limp. Twelve days after treatment, algae was gone and the surface clear of Hydrilla. Acceptable control continued for about six months in nearly all treated margins.

FISH KILL

Fish kill was far lighter than expected. An initial pick-up was made the day after treatment with follow-up as needed.

TECHNIQUE

Since Acrolein is very toxic to fish and this canal had a high fish population, a high fish loss was possible. However, as stated previously, loss was low and the method of application was believed to be an important factor. As the sprayboat advanced in shallow, edge waters, fish were constantly observed darting into deep center waters. Acrolein was injected 2-4 feet from the water's edge and allowed to spread through the Hydrilla stand. Evidently, very few fish returned to this chemical cloud, but rather stayed in fresh center waters thus escaping lethal contact.

A relatively long treatment section does not seem to be detrimental as long as only one margin is treated

(Continued on page 18)

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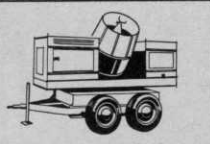

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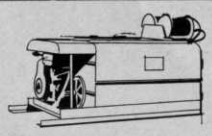

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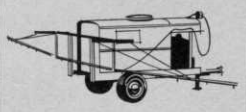
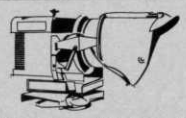


MODEL 1010 TURFKEEPER has flotation tires for golf course use.



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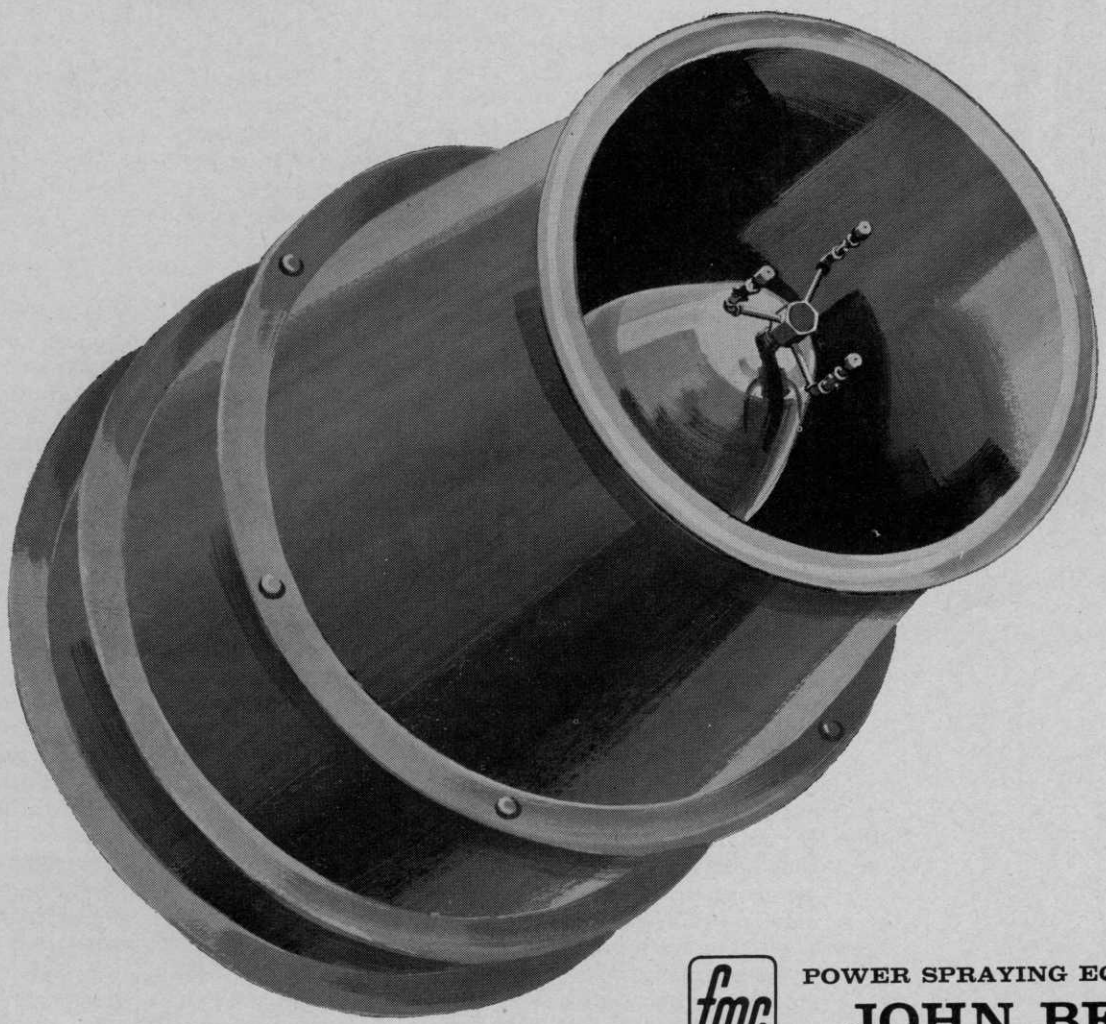

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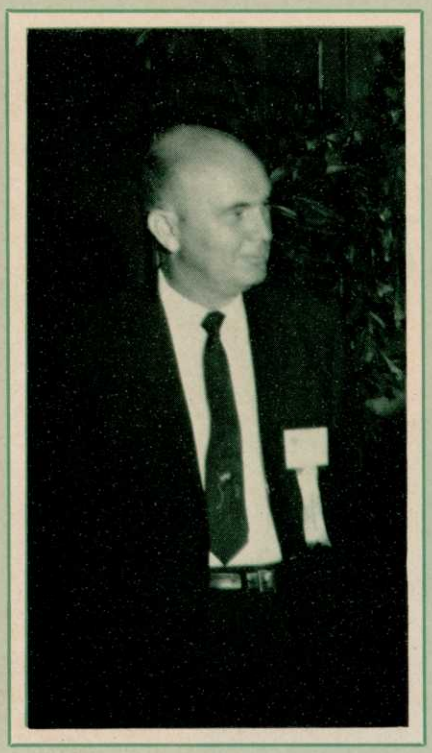
AQUATIC WEED CONTROL

MECHANICS OF SPRAYING

By Frank L. Wilson
Polk County Mosquito Control, Eaton Park, Fla.



Wilson: "Understanding of the major principles increase your percentage of success."

WE APPLY HERBICIDES as a spray because:

—Water is a cheap readily available herbicide carrier.

—Small amounts of herbicide can be diluted in water and spread evenly over the entire area being treated.

—Large areas can be treated rapidly.

It sounds simple, yet many different factors from chemistry and physics are involved in spray application. Each of these factors can be compared to a brick in a wall, it plays a part but it is not the entire wall. Because of this, the following factors have been listed individually.

Spray Formulations

Most chemicals have to be modified in some manner so that they will mix with water. We call these different types of formulation. There are three major ones.

1. Solution—In this category the chemical can be dissolved by or mixed with water. The resulting solution does not separate into water and chemical if allowed to stand. Alter initial mixing agitation is not required. Most herbicides fall in this category.

2. Emulsions — This category of formulation is used to mix oil or oil-like chemicals with water. The better the grade of emulsion, the less agitation it requires to keep it mixed with water. A good emulsion looks like milk.

3. Wettable powders — Formulation of this type contain a pesticide that has been mixed with or sprayed on a "carrier" powder. The entire mixture has been treated with a wetting agent so that it will mix with water. Formulation of this type requires constant agitation.

The purpose of each of these types of formulation is to allow the use of water as a physical carrier so that small amounts of a pesticide can be spread uniformly over a large area. As soon as the spray hits the plant, the water part of the spray starts to evaporate or dry. As this occurs the herbicide comes in contact with the leaf and is deposited. As soon as the chemical is deposited it can begin to act.

Morphological Characteristics

The physical characteristics of a plant influence retention and uptake of an herbicide. Leaf shape, leaf position, type of leaf surface and the density of leaves all play major roles in the problem of getting enough herbicide into a plant to kill it. Collectively, the physical characteristics of a plant act as a group of "obstacles" to successful herbicide application. We must apply our herbicide in a manner to bypass or circumvent these obstacles in order to achieve weed control.

Plant characteristics that influence retention and uptake of herbicides.

- Leaf Shape
  - Broad—generally easier to kill
  - Narrow—generally harder to kill
- Leaf Position
  - Horizontal—holds spray well
  - Upright—spray tends to run off
- Leaf Surface
  - Waxy—spray beads, runs off
  - Hairy—spray held out away from leaf surface
  - Sculptured—sculpturing may channel spray—increases run off
- Leaf Density
  - Heavy—many leaves
  - Light—few leaves

Nozzles

There many techniques and devices that have been developed for shattering a liquid into the small droplets that we call spray. All these devices use some form of energy to break up the liquid and create the tremendously expanded surface of many droplets. The most frequently used type of nozzle in weed control operation is the hydraulic pressure nozzle. For our purposes there are three main types of this nozzle which are identified by the spray patterns they create.

1. Straight stream jet—the spray emerges from a central orifice as a solid stream and breaks up into spray several feet from the nozzle.

2. Hollow Cone—the spray passes through a whirl plate and acquire a high revolution per minute before it passes through the spray disc orifice. Centrifugal force makes the stream form a hollow cone pattern.

Most of our adjustable spray guns such as the spray master, spraymeiser or "orchard" guns can be adjusted to produce either 1 or 2.

3. Flat fan patterns—these are nozzles in which the orifice is milled oblong so that the spray pattern is long and narrow.

a. Tee jet and Vee jet nozzles —these flat fan nozzles are most commonly used on spray booms. They provide very even coverage of a swath. Tee jets are low volume nozzles, Vee jets are high volume nozzles.

b. Off center nozzles (O. C. type) these nozzles provide a wide off-set flat fan spray, under proper conditions they can be used to cover as much as a 30-foot swath.

Surface Tension

Molecules are the sub-microscopic "bricks" of which all things are made. Each molecule exhibits "forces" or "pull" similar to a magnet. Water has surface tension because of its molecular structure which causes each water molecule to have a strong attraction for other water molecules. Molecules on the surface are pulled inward because there are no water molecules on the other side to exert force to pull. This inward force causes water to stay in the smallest possible area, which is a sphere or drop; in other words, surface tension causes water to form a "skin" and makes it form drops.

Spray Droplet Formation

The physicist recognizes several modes of droplet formation, however for our purposes weed control spray droplets are formed by two methods, aerodynamic breakup and instant atomization.

In aerodynamic breakup, the spray issues from the nozzle in a solid jet at high speed. At these high velocities the liquid jet travels straight initially, then due to aerodynamic forces, tends to be stripped apart into "primary" droplets. These droplets are tear shaped. The length of the tail on the primary droplet is proportional to the speed of the droplet at the time of break up. The higher the velocity of the drop the more the tail is elongated. Surface tension acts on this elongated tail causing it to break up into many secondary droplets.

Instant atomization is characterized by the spray issuing from the nozzle in a thin sheet. Due to the resistance format this sheet first develops "ridges" that separate from the sheet as filaments or threads of spray. Surface tension then reduces the threads into droplets.

The lower the spraying pressures, the lower the velocity of the spray. The lower the velocity, the less aerodynamic force present to shatter the spray into droplets. In other words, low pressure results in larger spray droplets.

Viscosity

Viscosity is the resistance a liquid has to flowing. We add thickeners, such as Vistik, to form a spray with syrup-like consistency.

Spray Droplet Size

Spray droplet size is governed by surface tension, viscosity and spray velocity.

Surfactants

Each of us has seen droplets of water on a newly-waxed car. We know that these droplets "stand up" and do not spread over or wet the waxed surface. This phenomena is caused by surface tension. Water can "wet" a substance if its molecules are attracted to the molecules of the substance being sprayed. If these two groups of molecules tend to repel each other then the water forms "beads" such as we see on a waxed car.

In most plants the outer layer of each leaf is made up of wax-like components. Herbicides that are applied as sprays to such plants tend to "bead" or even run off the leaves. In order to overcome this problem we add surfactants to our sprays.

"Surfactant" is a coined word which combines the words "Surface active agent." It is probably easiest to visualize the action of a surfactant as a chemical "public relations" compound. A good surfactant has two positions on its molecule. One of these poles is attractive to wax, the other pole is attractive to water.

When a spreader-sticker type surfactant is added to a spray it remains relatively inactive until the mixed spray is forced from the nozzle and spray droplets are formed. At this point the water-loving end of the surfactant molecules turns inward and the oil or wax-loving end of the molecule orients to the outside of the droplet. Upon impact with the leaf the surfactant forms a "go between" layer linking water to wax.

With surface tension reduced or eliminated the spray spreads on the leaf surface rather than forming a drop. Due to this spreading, greater efficiency is achieved through better coverage. In some cases it is even possible to reduce the amount of herbicide required by the addition of a surfactant.

Coverage

In order to obtain consistent herbicide kills it is necessary to apply sprays so that even coverage is achieved over the entire area. If we can use a boom-type sprayer that can be driven at a known speed while applying a known amount of spray per minute we can apply a very precise amount of herbicide

(Continued on page 49)

Bitting *(from page 14)*
at a time. An interval of at least a week should be allowed between treatments.

EQUIPMENT

The application pipe was a ten foot length of ½ inch thin wall electrical conduit with three inches of the outer end curved down to aid injection and shed trash.

Chemical was educted into the spray system as opposed to a pressure activated system; metering was accomplished by an orifice plate in the eductor line. Various apertures may be used to accommodate the desired output and boat speed. Gasoline may be used to calibrate the equipment.

MISCELLANEOUS OBSERVATIONS

Herbicidal activity of Acrolein was much slower than was normally observed in full volume treatment even though summer temperatures prevailed.

In several instances, small feeder canals were treated on one margin only. Filamentous algae were removed and the margin remained clear for two to three months while the opposite edge supported the usual heavy growth.

The fact that Acrolein requires a relatively short contact time, and degrades rapidly, makes it useful for marginal strip use.

We hope that research will soon bring a compound into practical use that will be non-toxic to fish as well as an effective control agent, but until then, Acrolein and the strip method can be utilized in many problem situations.

Gallagher *(from page 12)*
and formulations. Ease of applying 2,4-D granules was improved by Amchem's Spreader Disc for helicopters and the West Point Products Aeriblower for shoreline boat application. Last year, based on previous test plot work, the dimethyl amine form of 2,4-D was applied large scale during the month of May with considerable success. Steenis (1) has been utilizing fluctuating tidal movement to minimize operational difficulties. In its efforts to control milfoil in 1969 the Engineers utilized both helicopter and boat blower systems for applying granular 2,4-D. In Florida a multiple-agency operation organized a large-scale test program and used everything from an airboat to a helicopter to apply a wide range of herbicides and formulations to control Eurasian milfoil which had become a potential hazard to its resort spring attractions. A number of materials were effective, but all are more expensive than 2,4-D. Although 2,4-D is a partial chemical answer to this particular species, milfoil spreads so fast that no single approach is adequate. The 15 papers presented at a one-day TVA conference on water-milfoil research and control gives an idea of the scope of research activity by personnel involved with the species.

Elser (2), responsible for directing the operational weed control work in Maryland, reports that the decline of tremendous acres of Eurasian watermilfoil in the Chesapeake Bay could be pathological. Two diseases, Lake Venice and Northeast (names for convenience as they have not yet been positively identified and classified) were generally found in the regions of large-scale milfoil decline. Elser reports that Suzanne Bayley of Johns Hopkins University determined that the Northeast disease organism is a filterable agent, possibly a virus. A small controversy exists in the minds of several researchers as to whether the "disease" is in reality a response to high salinity associated with salt water intrusion which occurred over a period of drought years.

The amount of work on other submersed species is generally related to problem size and rate of increase. Florida elodea is rapidly becoming a major weed problem in Florida waters. Blackburn (3) found that acrolein, aromatic solvents, copper sulfate and a diquat-copper sulfate mixture provided temporary control, but the diquat-copper sulfate is the only treatment not highly toxic to fish. Other work on elodea reported over the past few years shows copper sulfate mixtures of copper sulfate and diquat, diquat plus endothall, and blackstrap molasses added to phenoxy compounds controlled this species. Ware (4) reported that 100 lb. of copper sulfate per surface acre provided economical control of elodea. Larger crystals produced better control. Foret (5) used blackstrap molasses as a source of aconitic and itaconic acid and glucose. These materials added to phenoxy compounds increased control of elodea and other submersed species. In the laboratory at Ft. Lauderdale where the nutritional and reproductive studies of Florida elodea simulate field conditions, Weldon (6) found that the WASM formulation of endothall doubled or quadrupled effectiveness in field trials.

(Continued on page 34)

Report From Aquamarine Corporation

THE AQUATIC WEED HARVESTER IN THE PARK SYSTEM

PARK AND RECREATIONAL waters are being endangered by extra nutrients and resulting aquatic weeds. Thus, many over the U.S. have converted to mechanical harvesting. Aquamarine Corporation supplies equipment to fit specific needs of such water areas.

Company records include the New Braunfels, Tex. Municipal Park District. Here flows what Ripley called the shortest river in the world, the Grand Blanco. It runs only 2½ miles.

The Grand Blanco flows out of a fault line escarpment in Landa Park at the rate of 338 cu. ft. per second. The nutrient level has been rising steadily in these waters and, along with it, aquatic vegetation. First, a mechanical cutter was used and the cut weeds left to float. However, a hydro electric plant downstream failed to function with these conditions.

The Park District then purchased an Aquamarine H-650 Harvester, along with a shore conveyor. The harvester works well in the one-foot shallows as well as the five- to six-foot depths. Both river and lake have been cleared.

At the Berkeley (Calif.) Park and Recreation Department, a 68-acre lake, Aquatic Park, has become nationally known for the national water ski competitions. Park use was threatened by heavy encroachments of a weed locally called "duck weed" (Ruppia Maritime). Fresh water input contained excessive nutrients and tidal salt made the water brackish. With no natural enemies, the weed thrived. In August, the weed regularly died off and massive biological oxygen demand increases resulted. Most fish then died, the lake becoming a stinking quagmire. This negated its use until the organic material returned to the bottom or into solution. An Aquamarine H-650 Harvester was purchased along with shore conveyor and mobilizing attachments to haul the equipment back to storage after use. The operation has been highly successful.

In the Los Angeles area, the Big Bear Lake Pest Abatement District found their prime recreational area being completely ravaged by the encroachments of elodea and milfoil. Big Bear Lake is east of Los Angeles at an elevation of 6,500 ft. above the Mojave Desert. It is controlled by an authority that sells water to irrigation users in the valley.

In August, 1970, an Aquamarine Harvester was purchased. It is being used to cut in selected areas of this 2,000-acre lake, at a rate of four tons of weeds every ten minutes. The lake is now open and clear again for a wide range of recreational activities.

Farther south, Lake Cuyamaca, a fifty-acre man-made body of water in the mountains, east of San Diego, was being choked with a strange woody weed that grew in twenty feet of water and extended as much as eighteen inches above the water surface. Twenty-five percent of the lake had already been covered when the Lake Cuyamaca Recreation and Park District took delivery on a new Aquamarine SAWFISH, a cutter that cuts an eight-foot swath at a five-foot depth and pushes the cuttings to shore for recovery. The application has returned the lake to full usefulness.

Eleven hundred-acre Lake Beulah in eastern Wisconsin is another example of the effectiveness of a methodical approach to mechanical harvesting over a longer period. It is also an example of the successful protection of a lake from accelerated eutrophication.

In Wisconsin, certain areas may legally set up their own sanitary districts with some tax levying powers. These districts are self-governing and control their own budgets within certain limits. The tax money accrued can be used for lake improvement and maintenance purposes.

Lake Beulah had 110 acres badly infested and approaching the point where dredging or abandonment was inevitable.

On a contract basis in 1969, Aquamarine equipment — a complete AQUA-TRIO with Harvester, Transport and Shore Conveyor — was hired to harvest the infested area. There were two cuttings in 1969 and one in 1970. The Sanitary District and riparian owners in 1970 then purchased their own AQUA-TRIO.

Because the Aqua-Trio is simple to operate all Beulah harvesting has been done by inexperienced summer employees and proved highly satisfactory.

The growths of lily pads, coontail and pond weeds have been selectively harvested with fish spawning beds preserved and the recreational areas opened. Accelerated eutrophication of the lake has been stopped.

Left to right, Aquamarine' Sawfish which cuts swath 8' wide, 5' deep, H650 Harvester unloading, and harvesting.

Coarse grasses like this barnyard grass defy mowing, says Norm Robie, right, in session with Steve Derrick, Diamond Shamrock.

Challenge for Golf Supe

BATON TWIRLERS AND GOLFERS

By DONALD McGUINESS

IT ISN'T every grounds superintendent who goes about his work surrounded by as many as 300 beautiful girls. But that's the burden which Norm Robie carries at the Smith-Walbridge Camp near Syracuse, Indiana. He is maintenance director and grounds superintendent for the camp. It includes a school for baton twirlers as well as a golf course.

All summer, groups of 300 or so girls arrive at Smith-Walbridge for a week of concentrated instruction and practice in the camp's specialties of baton twirling, "drum majoring" and related activities. During the last three weeks in August, school band marching participants come to the camp for music instruction and marching practice.

Keeping the turf in shape on the practice drill fields at the camp is a tough job in anyone's book, and Robie is constantly striving to keep it looking good and easy to march on. "Those girls will wear this grass down to the bare dirt at the turn points." Robie exclaims. "And we've been eaten up with crabgrass that won't cut neatly. Right after we've mowed it simply pops up, looks unsightly and is difficult to march on."

In 1969, the turf at Smith-Walbridge Camp had become about 60% crabgrass and other annual grasses, and these unsightly pests were rapidly crowding out the bluegrass and fescue which Robie was reseeding regularly. Something more drastic had to be done.

Robie had heard about a pre-emergence herbicide, Dacthal, that really controls crabgrass while being extremely gentle on desirable perennial grasses. In the spring of 1970 he applied Dacthal W-75 wettable powder at 12 lbs. per acre. "We used our new sprayer setup," he says, "and it worked like a charm." The "setup" is a Broyhill sprayer with a 100-gallon tank, fitted onto a Cushman cart, with an 18-foot boom. "With this rig, we can cover an acre before we have to refill," he says.

Robie is "plenty satisfied" with the results he saw as early as June, 1970. "I'd say we got 95% to 98% control of the crabgrass," he exclaims. "What's left looks more like a perennial rye grass or rough fescue." The Dacthal, because it affects the seedling sprout only, hasn't bothered the desirable perennial bluegrass and fescue at all.

The golf course is another part of Robie's job. He is superintendent of the 18-hole Maxwellton Golf Course, which lies just across the road from the camp. Smith-Walbridge recently bought the golf course, and as a result have incorporated a golf instruction program into the camping activities.

"When I took over nine years ago, that golf course was nothing more than a cow pasture," Robie says. "I put it in shape, and we're planning on installing sprinkler irrigation soon." As a result, he wants to start eliminating *Poa annua* and allow perennial bluegrass to cover the course.

Diamond representative Steve Derrick has worked out a plan with Robie that will allow the *Poa* to brown out, and Dacthal to stop the new seedlings from growing and replacing the burnt-out grass. "We should apply 18 to 20 pounds of Dacthal before the middle of August," Derrick says, "and then follow up with 14 lbs. per acre in the spring."

"It might be a brown course in many places this fall," Robie admits, "but if it will mean eliminating the *Poa* without hurting the bluegrass, it might be just what I'm looking for."

Baton twirlers are tough on drill field turf. Challenge is to maintain quality.