STUDY ON AQUATIC PLANTS AND THEIR CHEMICAL PROPERTIES

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ABSTRACT

Some aquatic plants fulfill many beneficial functions and play a vital role in aquatic environments. Water becomes rich in nutrients aquatic plants can grow vigorously to a point where they become a nuisance or are considered a weed. Aquatic plants serve a variety of uses in a water system, some of which are vital to the overall health of the aquatic environment . Herbicides which diffuse in water quickly can be applied in a concentrated form while others must be diluted and then sprayed evenly over the surface to ensure uniform distribution. In the case of emerged and floating weeds the herbicides are applied as a normal post emergence spray when weeds are in active growth phase

Keywords: *Herbicides, environment, aquatic plants, nutrients aquatic plant weeds.*

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I. INTRODUCTION

A aquatic plants that grow in farm dams, streams and waterways and fortunately most are rarely a problem. However, when water becomes rich in nutrients aquatic plants can grow vigorously to a point where they become a nuisance or are considered a weed. Aquatic plants serve a variety of uses in a water system, some of which are vital to the overall health of the aquatic environment [1]. This information is intended for both property owners and officers of public authorities.

Aquatic plants should only be controlled when they interfere with the use of a particular aquatic environment or when there is a statutory obligation.

An assessment of the plant's ecology and the problem it poses are necessary before taking any action, to ensure that the most cost-effective and environmentally sound control techniques are used. When managing the problem several factors need to be considered. These include the source of the plant, the reason it poses a problem, the use made of the waterway (e.g. dam supplying irrigation or stock water), the management options available, and ongoing costs and benefits.

It may be possible to reduce or eliminate an aquatic weed through well planned management strategies, such as diverting inflow of nutrients. The weed problem may also be seasonal and naturally fluctuate and disappear over time. Often the best option for controlling aquatic plants is to take the necessary actions described in this Prime fact to prevent the problem from occurring in the first place (Figure 1).

Some aquatic plants fulfill many beneficial functions and play a vital role in aquatic environments. Removal of these plants may result in destroying water quality and habitat with no real benefit. Many edge plants play an important role in nutrient buffering, bank stabilization and sediment trapping. Oxygen is the single most important water quality parameter and submerged plants help to oxygenate the water.

Aquatic plants also play an important role in providing habitat for many organisms, particularly birds, amphibians, fish and many insects and other small pond creatures. Floating plants give shade, reduce evaporation rates and keep the water temperature more constant.

In many cases a water body is a diverse and balanced ecosystem and care needs to be taken to keep this balance at an advantage. Excess growth may indicate an imbalance and lead to a deterioration of the ecosystem.

Fig. 1 Water hyacinth (Eichhornia crassipes), a free floating weed

Aquatic plants become a problem when they:

- Blanket the entire water surface, causing oxygen depletion – this may destroy the under-surface ecosystem and kill aquatic species (Figure 2).
- As introduced species, compete with native species and reduce biodiversity.
- Impact on the aquatic habitat of bird species and cause them to relocate.
- Interfere with commercial and recreational activities.
- Cause blockages or impede water intake to pumping equipment – mesh cages may have to be made to house the foot valve away from the weed.
- Contaminate and taint drinking water supplies.
- Cause pungent odors'.
- Accumulate debris.
- Impede the access of stock to water.
- Interfere with flow in irrigation channels.
- Increase transpiration rates.

Invasive and nuisance aquatic plant species are a significant and increasing problem in water bodies throughout the United States. Invasive weeds such as hydrilla, cabomba (fanwort), Eurasian watermilfoil, water lettuce, water hyacinth and watermeal damage fish and wildlife habitats, blocking previously navigable areas, restricting recreation and decreasing property values. Nationwide, costs associated with the chemical and mechanical management of these weeds exceed $150 million per year in public funds, according to a June 2008 article in *Outlooks on Pest Management*.[2]

A. Damages caused by aquatic weeds

Aquatic weeds are those unabated plants which grow and complete their life cycle in water and cause harm to aquatic environment directly and to related eco-environment relatively. Water is one of most important natural resource and in fact basis of all life forms on this planet. Therefore, appropriate management of water from source to its utilization is necessary to sustain the normal function of life. It is one important part of natural resource management. The presence of excessive aquatic vegetation influences the management of water in natural waterways, manmade canals and reservoirs which amounts to millions of kilometers/ square kilometers of such water bodies around the world. The area under small tanks and ponds is equally important due to the establishment of many small irrigation schemes and watershed management projects all over the world. For example, India has 1.9 m ha under water in reservoirs and 1.2 m ha under irrigation canals. The area under village ponds and tanks is nearly 2.2 m ha.

Aquatic weeds often reduce the effectiveness of water bodies for fish production. Aquatic weeds can assimilate large quantities of nutrients from the water reducing their availability for planktonic algae[4]. They may also cause reduction in oxygen levels and present gaseous exchange with water resulting in adverse fish production. Although excessive weed growth may provide protective cover in water for small fish growth it may also interfere with fish harvesting. Dense growth of aquatic weeds may provide ideal habitat for the development of mosquitoes causing malaria, encephality filarasis. These weeds may also serve as vectors for disease causing organisms and can greatly reduce the aesthetic value of water bodies from a recreational point of view.

Aquatic weeds have been found to severely reduce the flow capacity of irrigation canals thereby reducing the availability of water to the farmers field. Aquatic weeds may also damage pumps and turbines in super thermal power stations and hydroelectric power stations influencing electric production and increasing the cost of maintenance of power stations. Many aquatic plants are desirable since they may play temporarily a beneficial role in reducing agricultural, domestic and industrial pollution. Many aquatic weeds may play a useful role of providing continuous supply of phytoplanktons and help fish production.

B. Harmful Effects of Weeds

- Reduces water storage capacity in reservoirs, tanks, ponds.
- Impedes flow and amount of water in canals & drainage systems.
- Reduces fish production.
- Interfere with navigation and aesthetic value.

- Promote habitat for mosquitoes

Aquatic weeds (emergent, floating and submerged) interfere with the static and flow water system. They cause tremendous loss of water from water bodies like lakes and dams through evapo-transpiration. In flowing water system, aquatic weeds impede the flow of water in irrigation canals and drainage channels thereby increasing evaporation damage structures in canals and dams, clog gates, siphons, valves, bridge piers, pump etc. Impediment in flow of water may result in localized floods in neighboring areas. India has the largest canal network in the world where the velocity of flowing water is reduced by about 30 - 40 percent due to the presence of aquatic weeds. Floating and deep rooted submerged weeds interfere with navigation. Water hyacinth and Alligator weed grow profusely and create dense mats which prevent the movement of boats and at times even large ships. Village ponds and tanks get infested with floating and submerged weeds which results in reducing the capacity of the water storage and therefore effecting efficient irrigation. Therefore, considering the losses caused, it is essential to keep aquatic weeds under control in water bodies, flow water systems, ponds and tanks so that these systems can be utilized to best of their efficiency.

Mechanical methods are being practiced at present as use of chemicals is very much restricted due to the difficulty in control on water use for different purposes. Use of bio-agents for weed control is under experimental dissemination and needs further research and refinement in technology for control of aquatic weeds. Within the next two decades bio-agents will be one of the major methods of controlling aquatic weeds, especially the floating ones. Research is also necessary for studying the various factors

influencing the aquatic environment and the resultant vegetation. Researchers are envisaging to establish an integrated approach to aquatic weed control using a mix of mechanical and **biocidal** techniques to control aquatic weeds under specific situations.

C. Classification of aquatic weeds

Aquatic weeds are classified according to various habitats which form their eco-environment and become conducive for their growth, reproduction and dissemination.

1) Emergent weeds

These weeds grow in shallow waters and situations existing near the water bodies where water recedes and rises with the seasons or regular releases from a large water body or reservoir. Most of such situations are of permanent in nature where minimum and maximum water levels are consistent. Such situations includes banks of canals, rivers, periphery of water bodies which are mostly in earthen dams, and partly in masonry dams, drainage ditches

and water ponds near villages. These weeds may be called semi-aquatic but more appropriately referred to as emergent aquatic weeds.

There are situations where vast areas of land- remain inundated with water for long periods of time, and may only dry out in severe drought conditions. Such lands are known as marshes or swampy areas. They support a different type of vegetation which may include plants/weeds that are capable of growing under both flooded and saturated conditions. These may include annuals to large trees.

2) Floating weeds

These are plants which grow and complete their life cycle in water. They vary in size from single cell (algae) and may grow up to large vascular plants. In case of drying of water bodies most of them give their seeds and other vegetative reproductive organs in base ground lands. These weeds are observed in the surface of the large, deep and shallow depths of water bodies; deep continuous flowing canals; continuously flowing rivers large ponds tanks etc. Some of the weeds in this ecosystem freely float and move long distances, while some of them do float on the water surface but anchor down to soil at the bottom of the water body. These weed species make loss of water through evapo-transpiration in addition to impediment caused in flow of water. Therefore, these weeds can be classified in two sub groups viz. a) Free floating and b) Rooted floating weeds.

3) Submerged weeds

Weed species belonging to this group germinate/ sprout, grow and reproduce beneath the water surface. Their roots and, reproductive organs remain in the soil at the bottom of the water body. These weeds damage the maximum, because they are not visible on the surface and impede the flow of water varying upon the degree of their intensity and growth. Most of these weeds are found in shallow and medium deep water bodies and continuous flowing canals and drainage ditches.

The ecosystem provides situations which allows the growth of algae, filamentous algae, higher algae in shallow water situations and under deep water situations, and thus submerged weeds may be further categorized as a) shallow water submerged weeds, and b) deep water submerged weeds.

II. PROPOSED TECHNIQUE

Aquatic weeds can be controlled effectively by use of herbicides. The time and method of herbicide application varies with the type of weed flora and the habitat in which the weeds are to be controlled. Control of aquatic weeds by herbicides is generally easier, quick and usually

cheaper, when compared to mechanical methods. The use of herbicides has the disadvantage of being in water as residue and more especially in areas where there is no control on water use. Not all herbicides can be used for weed control in aquatic environment. A herbicide should have certain specifications for its use in different types of aquatic environments.

- It should have high degree of phytotoxicity to kill weeds fast.
- The chemical should degrade or dissipate from water immediately after the action on weeds.
- Technology should be available for their use in static or flow water systems.
- It should be environmentally safe for humans, fish and other aquatic fauna. Many herbicides are harmless to fish at concentrations required for control of weeds.

The use of herbicides may at times create problems of residues in the aquatic environment. However, many of the herbicides which can be used for aquatic weed control are relatively safe and free from toxins. Often the problem of aquatic weeds is so severe that it necessitates the use of herbicides which outweighs other considerations. There are many aquatic situations where herbicides can be of help in controlling aquatic weeds without coming in contact with water. For example, *Ipomea carnea*, a very common weed around the rim of the water reservoirs can be controlled by use of herbicides (2,4-D and glyphosate) in the month of April-June when water levels are very low and the application areas are several meters away from water. The other areas where herbicides can be effectively used, are where mechanical and other control measures are not very effective or feasible[3].

Most of the new herbicides are low in mammalian toxicity i.e. with reference to humans and other warm blooded animals. Many of the herbicides at recommended levels of application are harmless to fish and other beneficial aquatic fauna. Selective herbicides are also being used in managing weeds in the aquatic environment which will not hurt other flora and fauna which is necessary to maintain the birds and other aquatic species which generally thrive in these situation. Herbicides are applied to emerged (Cattail) and floating (water hyacinth) weeds through foliar application using spraying system in boats or other such carriers. Generally herbicides are applied in patches as spraying the whole weed growth may result in decaying of weeds which in turn may reduced oxygen levels in water thereby killing the fishes and other aquatic animals. In case of submersed weeds, the herbicides are added by adding dilute solutions of herbicides in water through main water system or introducing in patches through sprayers or injections.

Some of the advantages of using herbicides are :

1. Herbicides are economical and fair in action thus save time.

2. The dead weed biomass sinks to the bottom of the water body avoiding loss of nutrients and biomass.
3. Herbicides kill even the roots and other deep rooted reproductive organs which generally can not be removed by mechanical means.
4. One or two applications of herbicides are sufficient while mechanical methods may need to be applied a number of times.

A. Application methodology

Most herbicides are applied as high volume sprays by hand. Tractor and boat mounted sprayers are also used depending upon the location and weed species to be controlled. Boats are used in big reservoirs, tanks, lakes and large ponds where water is still and weeds are to be controlled belong to emerged and floating types. In the case of canals and drainage systems, tractor drawn sprayer can be used for spraying herbicides.

B. Spray applications

Surface area is the main consideration for emergent, floating and marginal weeds in reservoirs, ponds, tanks where water is stagnant. The quantity of herbicide can be determined as

$$\text{Quantity of herbicide (liters/ha)} = \frac{\text{Surface area (m2) x Spray Vol./ha x herbicide concentration.(\%)}}{10{,}000 \times 100}$$

There are number of herbicides which have been found to be effective in controlling aquatic vegetation. Herbicides are being used with restrictions in different countries depending upon the type of aquatic weed flora and control on water use by respective countries. In many situations herbicides are effective and can be preferred tools for managing noxious aquatic weed vegetation. There are specific problems where herbicides are to be used in developing or less developed countries of the world where there is no control on water use. Effect of these herbicides is also to be seen on other aquatic environmental factors which are associated with herbicide use. A single herbicide that controls weeds as well as being safe for all possible uses of the treated water is yet to come. However, there is now a large number of herbicides available keeping in mind the major weed problem, use of water system and the effect of chemicals on aquatic food chain down stream.

C. Dichlobenil

It is a powerful inhibitor of germination and of actively dividing meristems and acts primarily on growing points and root tips. It is therefore used largely as exposed bottom treatment of ponds, tanks, ditches. In reservoirs or other confined water bodies it can also be used in water directly after initial weeding to prevent the re-growth of perennial weeds. In the case of flow

water systems water is to be drained out and herbicide is to be applied on hydrosoil. The water supply may be restored 5 weeks after the treatment of exposed bottoms. Dichlobenil is applied to exposed bottoms at 5 to 10 kg/ha and in standing water 10 to 15 kg/ha. It is effective on *Ceratophyllum demersum; Elodea canadensis; Ranunculus; circinatus; Polygonum amphibium; Hyrophyllum verticillatum; Chara spp., R aquatilis*. Dichlobenil is highly volatile in its liquid form, therefore granules are used in field operations.

Some of the other herbicides suggested include Endothall, Fenac, Silvex, Simazine, Diuron, TCA etc.

Most of them were tested and found effective on aquatic weed vegetation but their toxicological and residue problems did not encourage larger use in aquatic weed management programs. The newer more recently developed herbicides are far more acceptable in terms of efficacy, toxicity, residues and general fate in the environment.

III. CONCLUSIONS

Application methods depend on the chemical properties of the herbicide and its formulation. Herbicides which diffuse in water quickly can be applied in a concentrated form while others must be diluted and then sprayed evenly over the surface to ensure uniform distribution. In the case of emerged and floating weeds the herbicides are applied as a normal post emergence spray when weeds are in active growth phase. In case of submerged weeds, herbicide application before the plants reach full maturity is advised preventing deoxygenation of water through the rapid breakdown of dying plant material resulting in harm to fish and fish populations.

IV. REFERENCES

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