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Aquatic Weeds in Fish Culture: Prevention and Control Practices

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ABSTRACT

Concept of Aquatic Weeds in Fish Culture: Weeds are unwanted plants that grow where they are not wanted. Aquatic weeds are plants that grow in the pond where they are not wanted. These weeds, even though are not wanted in the pond by the farmer because of their effect mainly, some of them are essential parts of natural systems and form the basis of water body's health and productivity. The habitat for aquatic weeds involve various proportions of water and soil, including intermittently wet ditches, ditches which always hold standing water, streams, stock ponds, farm ponds, lakes, ornamental ponds, and intermediate habitats.

Keywords: aquatic weeds, aquatic herbicides, management practices, sprayable formulations, principles of chemical method.

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Identification of Aquatic Weeds

Aquatic weeds can be identified into two botanical groups; algae and flowering plants. Algae are usually very simple in structure with no apparent leaves or stems but some, for example, *Chara*, can resemble flowering plants. For effective weed management, especially chemical method, it is essential that you distinguish between algae and flowering plants.

Algae: Algae are very simple, usually small plants that grow in or near water and do not have ordinary leaves or roots. Microscopic algae form scums and/or color the water green or yellow-green depending on the environment and type of algae. They, sometimes, cause red, black, or oily streaks in the water called "blooms." Filamentous algae, also known as moss, form floating, mat-like growths which usually begin around the edges and bottom of ponds in the early spring. Moss is probably the most common in lakes and ponds in the Midwest. Often, repeated chemical treatments during the summer season are necessary for effective control. *Chara* or stonewort usually grows in very hard water and is often calcified and brittle. The plant has roots and leaves that are arranged along the stem in whorls. It grows completely underwater and has a musky smell. *Chara* can be difficult to control once it is established in a pond and has a heavy coating of Calcium Carbonate. Use contact herbicides when the plants are still young and not heavily calcified. Although this plant resembles some flowering plants, it is an alga.

Flowering Aquatic Plants: These are very complex, usually big plants that grow in or near water and have ordinary leaves or roots. They can be grouped into broad categories according to where they are found in a body of water. They are submerged and floating flowering plants.

a. **Submersed Weeds:** These are flowering plants that are rooted in the bottom sediments and grow up through the water. Flowers or flowering spikes occasionally

emerge above the water surface. The main criteria for identification are leaf arrangement and leaf shape.

- b. **Floating Weeds:** These flowering plants freely float on water. Some of them such as duckweed and water meal are seed-bearing plants which float free on the water's surface. They never become rooted in the soil, and are propagated by both sexual and asexual methods. They can completely cover the surface of a pond. Both are extremely small.
- c. **Rooted Floating Plants:** These are flowering floating plants but are rooted in water. Examples include waterlily, spatterdock, and water lotus. Spatterdock is usually the weediest of the three and completely fills in shallow areas less than 3' or 4' inches deep. Spatterdock is a massive, difficult to kill underground rhizome from which new plants sprout. It differs from waterlily in having heart-shaped leaves that come above the surface of the water and a yellow flower. Waterlily has round leaves.

Classification of Aquatic Weeds

Aquatic weeds are classified based on various habitats which form their eco-environment and become conducive for their growth, reproduction and dissemination. They are classified into three, namely; emergent, floating and submerged weeds.

- a. **Emergent Aquatic Weeds:** These weeds grow in shallow waters and situations existing near the waters where water recedes and rises with the seasons or regular releases from a large waters or reservoir. Most of these weeds are permanent in nature where minimum and maximum water levels are consistent. Such situations that favour emergent weeds includes banks of canals, rivers, periphery of waters which are mostly in earthen dams, and partly in masonry dams, drainage ditches and village water ponds. These weeds are sometimes referred to as semi-

aquatic but more appropriately as emergent aquatic weeds. Some examples of the emergent weeds are Cattail narrowleaved, Cattail common, Cattail, Common reed, Watergrass, Umbrella plant, Besharam, Pickrel weed among others.

- b. **Floating Aquatic Weeds:** These are plants which grow and complete their life cycle completely in water. Floating weeds vary in size from single cell (algae) and may grow up to large vascular plants. In case of drying waters, most of them give their seeds and other vegetative reproductive organs in base ground lands as a surviving strategy. These classes of weeds are observed in the surface of the large, deep and shallow depths of waters; deep continuous flowing canals; continuously flowing rivers large ponds tanks. In this ecosystem, some of the weeds 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 waters. The weed species make loss of water through evapotranspiration in addition to obstruction caused in flow of water. Therefore, this class of weeds can be further classified into free floating and rooted floating weeds. Examples of free floating aquatic weeds include Water hyacinth, Water fern, Water lettuce, Duck weed, Water smart weed and Water velvet while that of rooted floating weeds include Arrowhead, Nilkalmi, Lotus, White water lily, Yellow waterlily and Horned pond weed.
- c. **Submerged Weeds:** The species of weed belonging to this class germinate, grow and reproduce beneath the water surface. The roots and, reproductive organs of the weeds remain in the soil at the bottom of the water body. These weeds cause heavy damage in the pond because they are not visible on the surface and impede the flow of water according to the degree of their intensity and growth. Most of these types of weeds are found in shallow and medium deep

waters and continuous flowing canals and drainage ditches. The ecosystem provides environment which allow the growth of algae, filamentous algae, and higher algae in shallow water and under deep water situations. As a result, submerged weeds may be further classified into shallow water submerged weeds and deep water submerged weeds. Examples of shallow water submerged weeds are Blue green algae, Cotton mat type algae, Wet wool type algae, Slimy green algae, Musk grass and Stone wort while those of deep water submerged weeds include Naiad, Eel weed and Curly leaf pond weed.

Effects of Aquatic Weeds

In wild waters, weeds may be of economic values but in the artificial pond, the disadvantages outweigh the advantages. This implies that there are positive and negative effects of aquatic weeds in fish ponds. Aquatic plants may be advantageous but excessive growth of any aquatic plant may be extremely disadvantageous.

Positive Effects of Aquatic Weeds

The ways in which aquatic weeds could be beneficial to fish production include the following.

1. Some aquatic weeds serve as source of feed to fish as they feed on them in water.
2. During the daylight hours, aquatic weeds produce and introduce dissolved oxygen into the pond through the process of photosynthesis.
3. Moderate population and growth of water weeds can provide good cover for fish preventing predator from sighting them in the pond.
4. Aquatic weeds compost can be used for fertilizing the fish pond in aquaculture. Nutrients lock up in weed and become available for primary product and increasing fish food organisms by applying the compost. Compost of water hyacinth are reported to increase the yield of tilapia.

5. They provide spawning and nesting habitat for fish and waterfowl in most natural waters.
6. It helps in water quality management. For instance, aquatic plants such as water hyacinth and Chinese water green can trap excessive nutrients and detoxify chemicals in the water. They help in purification of water from pollution in the pond.
7. Aquatic wildflowers such as the water lily provide floral beauty to garden ponds, hence could be sold by the farmer to enhance income.
8. They help in bio-energy aquaculture system. The aquatic weeds are harvested and used with animal waste for biogas production in integrated farming systems.
4. Water weeds could interfere or restrict swimming, boating, fishing, and other water sports in wild waters.
5. Some water weeds possess and impart unpleasant taste (musty flavor) that is capable of polluting the water. For example, certain species of algae give water bad tastes and odors that are offensive to the fish in the water.
6. Also, decaying water weeds emits offensive odors like rotten egg smell which discomforts fish and causes stress for fish in water.
7. Some of the weeds like algae can discolor pond waters on excess, hence, affect the vision of fish for their preys and predators in the water.

Negative Effects of Aquatic Weeds

These are the ways in which aquatic weeds adversely influence fish production. The effects include the following.

1. Excessive population and dense growth of aquatic weeds such as over 25% of the surface area can cause depletion in the night time oxygen in the pond. This is because green plants produce oxygen in sunlight through the process of photosynthesis, but they consume oxygen at night due to translocation.
2. Also, excessive population and dense growth of water weeds can provide too much cover in the water that may lead to stunted small-sized fish population.
3. Decaying water weeds can deplete the oxygen supply in the water to a very high extent that may instantly suffocate fish to death. This is because during decay of water weeds, the bacteria which break down the plant material make use of oxygen in their own respiration. For instance, fish kills in summer are frequently caused by die-offs of algae blooms and those in winter occur when snow accumulates on ice cover.
8. The dense growth of water weeds over 25% of the surface seriously interferes with pond recreation and threatens aquatic life.
9. Dense population of water weeds may block the entrance of sunlight, thus preventing photosynthesis by any living plants or algae in the water.
10. Aquatic weeds produce quiet water areas or covers that become ideal for mosquito breeding in the pond.
11. Water weeds obstruct water flow in drainage ditches, irrigation canals, and culverts, causing water to back up in most natural ponds.
12. The presence of some water weeds detracts from the aesthetic appeal of a body of water.
13. Where herbicides are used in controlling water weeds, the side effects could lead to death of fish after some times.
14. Densely populated water weeds increases water turbidity and causes stress for fish as they spend more energy for locomotion

Disadvantages of Aquatic Herbicides

Aquatic herbicides are disadvantageous in the following ways.

1. Some aquatic herbicides are toxic to aquatic life and even to other animals on direct and indirect consumption such as consumption of a poisonous fish.
2. Some of them lead to the death of fish depending on the concentration of the herbicide in water.
3. They are expensive to use and adds to the cost of fish production.
4. There are always restrictions to the use of water that contain herbicides.
5. It is always necessary for retreatment of water with herbicides which means that the effect is temporal.
6. Herbicide causes adverse shift in the taste of water in the pond.
7. They are source of odor to many water ponds.
3. Construct fish pond to prevent water runoff from entering the pond indiscriminately. For instance, lining canals helps to alleviate water weed problems, because they find it difficult to thrive in such canal.
4. Regularly observe and remove any water weed before it spreads in the pond.
5. Avoid the entrance of fish predators that are capable of introducing weed seeds into the pond.
6. Encourage maintenance of a good sod and grass cover around the pond so that runoff and erosion could be prevented to avoid introducing weed or weed seeds into the pond. Ensure that grass clippings are not intentionally or accidentally added to the pond.
7. Keep livestock away from having access to a pond except under conditions of extreme heat. But where the water is used for livestock, fence the pond and provide water for the animals from a stock tank below and outside the fence. Avoid overgrazing of livestock around the pond for they may serve as agents of seed dispersion.

Management practices of Aquatic Weeds

Evidence has shown that one method of aquatic weed management is not always effective for all types of water weeds. The advice of experts for effective management of aquatic weeds requires an integrated approach that incorporates cultural, mechanical, biological, and chemical methods as appropriate. Management involves prevention and controlling of aquatic weeds in the fish ponds.

Ways of Preventing Aquatic Weed

It is easier and less costly to prevent weed problems in the pond than to control them once they have developed. Therefore, aquatic weeds may be prevented in the following ways.

1. Designed fish pond with measures to avoid the incidence of water weeds in the pond. For example, shallow water at the margins provides an ideal habitat for immersed weeds like cattails. The pond should be designed for it to slope steeply so that very little water can always remain in the pond.
2. Carefully site the pond where there is reduced population of aquatic weeds.
8. Adopt strip cropping and contour farming round the pond to prevent water runoff and erosion into the pond.
9. Minimize feeding fish and ducks in the pond to avoid accumulation of unused feed that serves as fertilizers.
10. Prevent animal waste and fertilizer runoff from entering the pond to boost the growth of water weeds in the pond.
11. Always dredge and deepen the pond to remove aquatic weed seeds and make the pond uncondusive for weeds to thrive.
12. Install pond bottom liners such as a layer of mineral soils (sand, gravel, clay) or both of these materials during construction is an effective way that hinders the growth of water weeds in the pond.
13. Limit the amount of sunlight available to aquatic habitat by floating black plastic sheeting on the water surface or by using dark-colored dyes is also been effective in

preventing or controlling waterweeds. As a means of controlling water weeds, it is used for sport treatment in the pond.

14. The government can stop or regulate importation of such plants in to the country through legislative or policy procedures. The government can also place embargo on the disposal of such plants into waters in the country.

Methods of Controlling Aquatic Weed

Aquatic weeds can be controlled in three ways. They are as follows.

1. **Complete Eradication:** This is where the weed is completely eliminate or exterminated from the pond. This is usually done if the weed is a serious threat to light penetration for photosynthesis in the water. For example, water hyacinth requires complete eradication.
2. **Controlled Growth:** In this case, the growth of weeds is regulated so that it becomes useful rather than threat to the pond. This is done when it is necessary for fish propagation, because some fishes lay their eggs on reedy areas such as carps.
3. **Occasional Control:** This involves trimming of few plants that emerge around the edges of the ponds so that they do not extend to the pond to constitute threat to the pond.

In any case, aquatic weeds may be controlled through the following methods.

1. **Manual Method:** This is where the farmer removes weeds from the pond by physically uprooting or cutting them from the pond. Examples of this method include cutting and raking, hand-pulling the weeds or dredging the pond but where the infestation is so severe, these methods are impractical or uneconomical. This method is common in artificial ponds but may be difficult in natural and large pond that may be deeper than the height of the farmer. Manual method consists of three essential steps namely; cutting or uprooting the weeds, collecting the cut or uprooted weeds, and removing

the weeds (debris) from the pond. This method can be accomplished with simple hand tools and physical labour or with the help of cutting machines. Whole uprooting of weed is generally better than cutting because some plants are capable of reproducing from their cuttings. Also complete removal of all cut or uprooted weeds is advisable because cut plants left in the water will decay and release nutrients that stimulate future weed growths. Decomposing plants left in the pond use oxygen and can suffocate fish to death. Total uprooting or harvesting of water weeds provide immediate relief from nuisance plant growths and does not endanger fish life in any way.

2. **Cultural Method:** This involves manipulating the environment to make conditions less suitable for the growth of aquatic weed. Such manipulations include fertilization, dyes, draw downs and the use of benthic barriers. Manipulate the water levels in the pond to exposes weeds to harsh conditions including freezing, desiccation (drying out), strong wind action and bottom sediment compaction.
3. **Mechanical Method:** This method makes use of machine to remove weeds by seining, charming or backhoe from the pond. It is the most common and expensive method of pond weed management. This method may be necessary where immediate control is required or in a circumstance where other methods could be used. Mechanical method has the advantage of totally removal of all the vegetation in the pond. Motor-driven underwater weed cutters such as mowers are available and can be used for the control of such plants as waterlilies and watermilfoil. The disadvantages of this method are that it fragments weeds which can spread and reproduce from the cut pieces. The disposal of the harvested weeds could also be a problem. Besides, mechanical control is

usually slower and more expensive than use of herbicides. Underwater weed cutting must be done continuously during the summer and usually represents a long term financial investment in fish production.

4. **Biological Method:** This entails introducing animals and plants that eat or compete with waterweeds in the pond. Herbivorous animals, that is, those that eat plants, include a wide variety of insects, snails, crayfish, tadpoles, turtles, fish, ducks, geese, and swans which can be stocked in ponds to consume aquatic weeds in the pond. However, only herbivorous fish have proven both effective and relatively easy to obtain and manage for aquatic weed control. Farmers should ensure that the organism to be used in this method will not create predation on the fish at the end of the weed control. Animals such as grass carp, cattle can be used to graze on herbivorous fish species like carp and tilapia in natural waters but note that there is a law prohibiting the introduction of these fish to the ponds, lakes, and streams of many countries in the world.
5. **Chemical Method:** This is the use of approved aquatic herbicides to control weeds in the pond. The method makes use of the ability of certain chemicals to kill weeds in water. There are chemicals that can kill any vegetation they come in contact, while some are selective in the killing ability. Selective herbicides target specific weeds while allowing other plants that may be useful to the fish to grow. It is advisable that fish farmers use selective herbicides in controlling weeds in their pond to reduce much harm in the pond. In any case, the first step in chemical method is to accurately identify the problem weed, and then followed by sourcing for matching herbicide from the market. Fish farmers should note that various chemicals have different product formulations and strength, by law, only aquatic labeled herbicides may be used

in aquatic weed management. The examples of common aquatic plant herbicides include Chelated Copper Compounds, Fluridone (Sonar), 2,4-D, Glyphosate (Rodeo, Pondmaster), Diquat and Endothal (Aquathol, Hydrothol). These aquatic herbicides are generally available in sprayable or granular formulations.

Sprayable Formulations (SF)

These herbicides are usually mixed with water and applied so that they disperse evenly. These include:

- a. **Water Soluble Powder (WSP):** The powder is dissolved to form true solutions in water.
- b. **Wettable Powder (WP):** Wettable powders form suspensions when added in water. The particles do not dissolve.
- c. **Emulsifiable Concentrates (EC):** Emulsifiable concentrates form milky white "oil-in-water" emulsions. They form layers on surface of water in the pond.

Granular Formulations (GF): These are small clay-based pellets that carry the active ingredient on or in the product. They are usually distributed manually or by some sort of slinger-spreader and sink to the bottom. The slow-release granules or pellets release the pesticide active ingredient over an extended period of time. Sprays are applied as water surface treatments, especially in shallow waters. The herbicide is then dispersed through the process of diffusion, thermal currents, and wave action. The effectiveness of the herbicide depends upon good dispersion of the chemical in the water. Granules herbicides are used primarily to control algae or submersed weeds. The granules sink to the bottom and work about the same manner as bottom soil treatments. The rate of application for granules is given as amount per unit of surface area or as a concentration in part per million (ppm). The best method of application is by even broadcasting over the surface of water in the pond. Granular formulations are advantageous in the following ways.

- a. The treatment lasts long as the constituent of the herbicide is gradually released in the pond bottom.
- b. The effect of the treatment is confined to the bottom of the pond where submersed weeds are found.
- c. The rate at which the constituent is released helps to reduce toxicity of the herbicide to the fish.
- d. It makes it possible to use herbicides of low concentrations to achieve good result.

Principles of Chemical Method of Weed Control

The use of chemicals in controlling aquatic weeds in fish pond is guided by the following principles.

1. The identity of the weeds in the pond should be known. This can be made easy with the help of extension agents or teachers of agriculture in the country of the farmer.
2. The information of the permission or restrictions on use of water treated with herbicides should be obtained to determine the appropriateness of its usage.
3. Check for the amount of chemical to apply per acre-foot. Calculate the amount or dosage of chemical to apply in the pond per acre-foot. Check the dosage on the container as recommended by the manufacturer. The acre-foot is calculated by multiplying the surface area by the average depth. For instance, a pond with a surface acreage of 1/2 acre and an average depth of 4 feet contains (4 feet x 1/2 acre) 2 acre-feet. The label on the container of the herbicide can then be read and calculated using the dimension of pond to determine the dosage.
4. Determine the appropriate time to apply the herbicide in the pond. It is always better early spring, actively growing, cool water and slow decay. For example, late spring is usually the best time to apply aquatic herbicides. This is because the plants are young and actively growing and most susceptible to herbicides. The pond should

not be chemically treated when the vegetation is extensive and thick; it will lead to waste of herbicides and seriously deplete the water of its oxygen that may result in a fish kill. The time to apply herbicide depends on the cycle of the farmer's production and rainy or dry season in one's country.

5. Apply herbicide when the temperature of the water is warm other than too cold. Research has shown that aquatic weeds are not affected by herbicides when the water is too cold. The herbicide should be applied as soon as the farmer observes that the plants are up and actively growing, and the water temperature is right.
6. The rate of application of aquatic herbicide depends on a number of factors such as the extent of area to be treated, water depth, water temperature (stratification), water exchange (flow) rates, weed density, weed species, weather conditions, water clarity and suspended particles.
7. A fish pond should be retreated regularly to keep the water plant from regenerating. More than one treatment may be needed for adequate control of aquatic weed in the pond. Retreatment is usually required in succeeding years depending on the fertility of the pond and intensity and viability of the water weeds. Plants can regenerate each spring from seeds, spores, and underground rhizomes.
8. The use of herbicide treated water should be restricted from drinking, livestock watering, swimming, fish production, irrigation, and other uses until safe level of the herbicide is reached. Most herbicides are short-lived like 10 days or less, but others persist for 30-90 days before the expiry of their effects in water.

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