



**AQUATIC VEGETATION MODULE**

BASIC KNOWLEDGE  
REQUIREMENTS FOR  
PESTICIDE EDUCATION  
IN CANADA

**MODULE – VÉGÉTATION AQUATIQUE**

CONNAISSANCES  
FONDAMENTALES REQUISES  
POUR LA FORMATION  
SUR LES PESTICIDES  
AU CANADA

CAPCO



Health  
Canada

Santé  
Canada

# **AQUATIC VEGETATION MODULE**

**BASIC KNOWLEDGE REQUIREMENTS**

**FOR**

**PESTICIDE EDUCATION IN CANADA**

**AUSSI DISPONIBLE EN FRANÇAIS**

**Prepared by the National Task Force on Pesticide Education,  
Training and Certification**

**If you would like additional information  
on the Standard for Pesticide Education,  
Training and Certification or to be on our  
mailing list, please write to:**

**Health Canada  
Standard for Pesticide Education,  
Training and Certification  
Publications  
Ottawa, Ontario  
K1A 0K9**

**This publication may be reproduced without permission provided  
that the source is fully acknowledged and no changes are made.**

**Catalogue Number: H50-4/5-1995E  
ISBN: 0-662-22810-3**

## **CONTRIBUTORS TO THE AQUATIC VEGETATION MODULE**

**The aquatic vegetation module was written and its co-ordination and completion was overseen by K. Stapleton, New Brunswick Department of the Environment.**

**Review and editing of drafts of the complete text, or parts of the text, by the following people is gratefully acknowledged:**

**Members of the National Task Force on Pesticide Education, Training and Certification**

**R. Burland, Alberta Environment**

**K. Jamieson, Scientific Editor, Forest Pest Management Institute  
Natural Resources Canada**

**K. McCully, New Brunswick Department of Agriculture**

**P. Pilley, PGP Pest Management Consultants, Lindsay, Ontario**

**S. Shiels, Saskatchewan Institute of Applied Science and Technology  
Saskatchewan**

**The dedication and commitment of Lois Lemieux, Health Canada, for word processing is gratefully acknowledged.**

# **BASIC KNOWLEDGE REQUIREMENTS FOR PESTICIDE EDUCATION IN CANADA AQUATIC VEGETATION MODULE**

The Aquatic Vegetation category includes the ground application of herbicides for the control of aquatic weeds in standing or running water or in areas left exposed during periods of low water. This category includes applications in lakes, rivers, irrigation canals, ditches and dugouts.

The knowledge requirements described in this module are additional to the knowledge requirements detailed in the Applicator Core, common to all certification categories. This module adds details to sections of the Core, where it is necessary to include Aquatic Vegetation specific information. An outline of the knowledge requirement for the Aquatic Vegetation module is presented on the following page. This outline shows which sections of the Core have been expanded in this module.

The knowledge requirements provided here are the information a trainer would use to provide training to an applicator on the responsible use of pesticides. It is targeted to the trainer for teaching purposes and is not intended as an applicator manual.

In addition to the Applicator Core, modules of knowledge requirements have been developed for the following 10 pesticide applicator categories:

- Aerial**
- Agriculture**
- Aquatic Vegetation**
- Forestry**
- Fumigation**
- Greenhouse**
- Industrial Vegetation**
- Landscape**
- Mosquito and Biting Flies**
- Structural**

# AQUATIC VEGETATION MODULE

## CONTENTS

<b>GENERAL INFORMATION (refer to the applicator core)</b>	
<b>REGULATIONS (refer to the applicator core plus this module)</b> . . . . .	<b>1</b>
<b>LABELLING (refer to the applicator core)</b>	
<b>HUMAN HEALTH (refer to the applicator core)</b>	
<b>PESTICIDE SAFETY (refer to the applicator core plus this module)</b>	
<b>Application - Safety Procedures</b> . . . . .	<b>2</b>
<b>ENVIRONMENT (refer to the applicator core plus this module)</b>	
<b>Aquatic Impact</b> . . . . .	<b>3</b>
<b>PEST MANAGEMENT (refer to the applicator core plus this module)</b>	
<b>Weeds</b> . . . . .	<b>4</b>
<b>Weeds - Control Options</b> . . . . .	<b>9</b>
<b>APPLICATION TECHNOLOGY (refer to the applicator core plus this module)</b>	
<b>Equipment Selection</b> . . . . .	<b>16</b>
<b>Techniques</b> . . . . .	<b>18</b>
<b>EMERGENCY RESPONSE (refer to the applicator core)</b>	
<b>PROFESSIONALISM (refer to the applicator core)</b>	

**Category: AQUATIC VEGETATION**

**Concept: REGULATIONS**

**General Objective: To understand pesticide regulations in Canada and pesticide regulations pertaining to aquatic use.**

**COURSE OUTLINE**

**INSTRUCTIONAL OBJECTIVES**

**LEARNING OUTCOMES**

**Herbicides used in an aquatic environment must have aquatic use registration.**

**Understand that herbicides must be registered specifically for aquatic use.**

**Identify that herbicides must be specifically registered for aquatic use.**

**Herbicides used in an aquatic environment must be specifically registered for the target pest or pests.**

**Understand that a herbicide registered for aquatic use must also be registered for the specific pest to be controlled.**

**Identify that aquatic use herbicides must be registered for the specific pest to be controlled.**

**Pesticides used in the control of organisms in drinking water processing systems are regulated by Health Canada and are not dealt with under the Pest Control Products Act.**

**Know that provincial regulations may be more restrictive than federal regulations.**

**Describe provincial regulations for aquatic herbicide use.**

**Provincial regulations may be more restrictive than federal regulations for aquatic herbicide use. Consult provincial regulatory agencies prior to conducting aquatic applications.**

**Category: AQUATIC VEGETATION**

**Concept: SAFETY - APPLICATION - SAFETY PROCEDURES**

**General Objective: To know how to apply herbicides safely.**

**COURSE OUTLINE**

**Ensure proper protective gloves are worn if applying herbicides by hand. Ensure that all other items of personal protective equipment are used or readily available.**

**Follow safe boating procedures during the application of the herbicide if applying herbicides using a boat.**

**Ensure that the weight of the application equipment and of the applicator(s) does not exceed the capacity of the boat.**

**Use caution around power motors.**

**Examine the area prior to treatment. Be aware of any hazards such as rocks, submerged logs, etc.**

**Ensure application equipment is functioning properly at all times during application.**

**INSTRUCTIONAL OBJECTIVES**

**Know when protective gloves and other personal protective equipment should be worn.**

**Understand that safe boating procedures must be observed.**

**Know that proposed treatment areas should be examined for hazards.**

**Understand that application equipment must be in good working order.**

**LEARNING OUTCOMES**

**Identify when protective gloves and other personal protective equipment should be worn.**

**List and describe the safe boating procedures to be followed.**



**Category: AQUATIC VEGETATION**

**Concept: ENVIRONMENTAL IMPACT - AQUATIC IMPACT**

**General Objective: To know how to minimize aquatic impact.**

**COURSE OUTLINE**

**Aquatic weed control procedures may involve direct application of herbicides to water. Care must be taken to minimize potential non-target impact. Non-chemical weed control procedures may also impact to a degree on non-targets.**

**Impacts can include:**

- fish kills due to depletion of oxygen or from loss of habitats;
- contamination of adjacent nontarget waterbodies from drift;
- loss of streamside vegetation canopy, which protects against temperature extremes, erosion, and contains insects and plants important to the stream ecosystem.

**Practice methods to minimize impact on the environment, human health and safety. Ways to minimize environmental impact include:**

- ensure correct identification of the target pest;
- use registered herbicides only;
- read and abide by the herbicide label;
- abide by all federal/provincial regulations;
- consider timing of the application in relation to the activity of the target and non-target species;
- consider area to be treated;
- consider weather conditions;
- choose suitable equipment;
- follow correct application techniques.

**INSTRUCTIONAL OBJECTIVES**

**Understand that aquatic applications require special attention to minimizing potential non-target impact.**

**Know the methods used to minimize environmental impact.**

**LEARNING OUTCOMES**

**List potential non-target impacts.**

**List the methods an applicator can use to minimize environmental impact.**

**Category: AQUATIC VEGETATION**

**Concept: PEST MANAGEMENT - WEEDS**

**General Objective: To understand pest management principles required to carry out safe and effective weed control.**

**COURSE OUTLINE**

**INSTRUCTIONAL OBJECTIVES**

**LEARNING OUTCOMES**

**Weeds**

**A weed is a plant growing where it is not wanted.**

**Know what a weed is.**

**Define weed.**

**An aquatic plant is a plant that can spend its entire life cycle submerged or partially submerged in water.**

**Know what an aquatic plant is.**

**Define aquatic plant.**

**Aquatic plants are pests when their growth is excessive and limits other desirable aquatic plants, or their presence has a negative effect on water quality and/or use.**

**Know when aquatic plants are pests.**

**List the ways in which aquatic plants are considered pests.**

**Life Cycle of Weeds**

**Weeds are usually classified according to how long they live.**

**Know how weeds are classified according to how long a weed lives.**

**Identify that weeds can be classified according to how long they live.**

**Annual weeds complete their life cycle within one year. Most annuals produce many seeds to ensure their survival. Annuals can be divided into two groups: summer annuals which germinate in the spring, and winter annuals which germinate in the fall and overwinter in the seedling stage.**

**Know the life cycles of summer and winter annuals.**

**Describe the life cycle of summer and winter annuals.**

**Biennial weeds live more than one year but less than two years (they complete their life cycle within two years). They grow from seed which usually germinates in the spring. The first year they store food, usually in short fleshy roots. Usually the foliage is only a rosette (short clump) of basal leaves. Next season the plant uses the stored food and grows vigorously. It produces seed in the summer and fall and then dies.**

**Know the life cycle of biennial weeds.**

**Describe the life cycle of biennial weeds.**

**Perennial weeds are plants that live for more than two years. Often no seed is produced the first year; thereafter seeds can occur every year for the life of the plant. Many perennial weeds spread by seed. Many also spread by other plant parts such as creeping stems, stolons, creeping roots, rhizomes (a root-like underground stem), underground bulbs or a broken piece of root. This type of spreading is termed vegetative. There are shallow-rooted and deep-rooted perennials.**

**Know the life cycle of perennial weeds.**

**Describe the life cycle of perennial weeds.**

**Know how perennial weeds can spread.**

**Describe how perennial weeds spread.**

**Category: AQUATIC VEGETATION**

**Concept: PEST MANAGEMENT - WEEDS**

**General Objective: To understand pest management principles required to carry out safe and effective weed control.**

**COURSE OUTLINE**

**INSTRUCTIONAL OBJECTIVES**

**LEARNING OUTCOMES**

**Most aquatic plants are classified as perennials.**

**Know that most aquatic plants are perennials.**

**Identify that most aquatic weeds are perennials.**

**Aquatic plants are an important and necessary component in an aquatic ecosystem.**

**Understand that aquatic plants are a necessary and important component in an aquatic ecosystem.**

**Identify that aquatic plants are important and necessary in an aquatic ecosystem.**

**Some advantages of having aquatic plants present in a body of water include:**

**Know the advantages of the presence of aquatic plants in an aquatic environment.**

**List the advantages of having aquatic plants present.**

- consumption of carbon dioxide;
- oxygenation of the water;
- providing a food source for fish, waterfowl, birds and mammals;
- creating shade;
- cooling the water;
- clarifying of the water;
- providing shelter and breeding sites;
- creating stability and preventing erosion.

**Aquatic plants can be a detriment when in abundance.**

**Know that in abundance, aquatic plants can be a detriment.**

**Identify when aquatic plants can be a detriment.**

**Some disadvantages of an excess of aquatic plants are:**

**Know the disadvantages associated with an excess of aquatic plant growth.**

**List the disadvantages associated with an excess of aquatic plant growth.**

- decreased fish reproduction and/or stunted growth;
- depletion of dissolved oxygen due to plant decay;
- stagnation, which can prevent reaeration;
  
- decreased water recreational activities;
- favourable environments for mosquito reproduction;
- reduced water flow and plugged ditches.

**Removal of all aquatic plants would be detrimental to the aquatic environment. Complete loss of vegetation could lead to:**

**Understand that removal of all aquatic plants could be detrimental to the aquatic environment.**

**Explain why it is important to have some aquatic vegetation present.**

- fish kill;
- subsidence of river banks (soil erosion);
- loss of fish habitat;
- increased water temperature.

**It is important to weigh the advantages of aquatic plants against the disadvantages and treat only what is necessary.**

**Understand that before conducting an aquatic control program, you must weigh the advantages against the disadvantages of the presence of aquatic plants.**

**Identify that it is important to weigh the advantages against the disadvantages of the presence of aquatic plants before conducting a control program.**

Category: AQUATIC VEGETATION

Concept: PEST MANAGEMENT - WEEDS

General Objective: To understand pest management principles required to carry out safe and effective weed control.

COURSE OUTLINE

INSTRUCTIONAL OBJECTIVES

LEARNING OUTCOMES

Weed Identification Characteristics

Aquatic plants must be correctly identified if control methods are to be carried out.

Understand that identification of aquatic weeds is important if a control program is to be conducted.

Identify that proper identification of aquatic plants is important before considering a control program.

Control methods used depend on the growth habits of the weeds.

Know that weed growth habits affect the control method to be used.

Identify that weed growth habits affect the control method to be used.

The following growth characteristics will aid in the identification of aquatic vegetation:

Know growth characteristics that aid in the identification of aquatic vegetation.

List the growth characteristics that aid in the identification of aquatic vegetation.

- growth habit;
- flowering habit;
- leaf shape and surface;
- arrangement of leaves on the stem;
- branching arrangement;
- woody vs. herbaceous stems.

Types of Aquatic Plants

Aquatic plants are divided into two main groups. The two groups or divisions of aquatic plants are:

Know the groups into which aquatic plants are divided.

List the main groups of aquatic plants.

- algae;
- vascular plants or aquatic macrophytes.

Algae

Algae are further subdivided into three categories:

Know the categories of algae.

List the categories of algae.

- phytoplankton;
- filamentous;
- macroscopic.

Phytoplankton are microscopic floating plants that form "blooms". The blooms colour the water green, brown or reddish-brown, depending on the type of algae present.

Describe phytoplanktonic algae.

Filamentous algae are floating mats or strings attached to rocks, water bottom or other surfaces.

Describe filamentous algae.

**Category: AQUATIC VEGETATION**

**Concept: PEST MANAGEMENT - WEEDS**

**General Objective: To understand pest management principles required to carry out safe and effective weed control.**

**COURSE OUTLINE**

Macroscopic algae are attached to the bottom. They are similar in appearance to vascular plants (or aquatic macrophytes) but have no real roots, flowers or leaves.

**Vascular Plants**

Vascular plants (aquatic macrophytes) are similar to land plants in that they have stems, leaves, flowers and roots. These plants are subdivided into three categories. The three categories are:

- emergent;
- floating (free-floating and floating-leaved);
- submergent.

An emergent plant is a plant that grows mostly above the water surface. These plants are not dependent on water for support.

Floating-leaved plants are plants that have leaves floating on the surface and are rooted to the bottom. Floating-leaved plants require water for support of the plant or its leaves.

Free-floating plants occur on the surface or within the water column and are not attached to anything.

A submergent plant is a plant that grows below the water surface. Most are rooted at the bottom. These plants are usually not rigid. If the plant produces flowers, the flowers may grow above the water surface.

**Environmental Factors**

**INSTRUCTIONAL OBJECTIVES**

Understand that vascular plants (aquatic macrophytes) are similar to land plants.

Know the categories into which vascular plants (aquatic macrophytes) are divided.

**LEARNING OUTCOMES**

Describe macroscopic algae.

List the similarities between land plants and vascular plants (aquatic macrophytes).

List the categories of vascular plants (aquatic macrophytes).

Describe emergent plants.

Describe floating-leaved plants.

Describe free-floating plants.

Describe submergent plants.

**Category: AQUATIC VEGETATION**

**Concept: PEST MANAGEMENT - WEEDS**

**General Objective: To understand pest management principles required to carry out safe and effective weed control.**

**COURSE OUTLINE**

**INSTRUCTIONAL OBJECTIVES**

**LEARNING OUTCOMES**

There are a number of factors that influence the types of vegetation that will grow within an aquatic habitat. These factors include:

- water hardness;
- length of frost-free season;
- depth of water (light intensity);
- bottom type;
- water temperature;
- nutrient concentration;
- water flow (static or flowing).

Know that there are a number of factors which influence the type of vegetation growth in an aquatic habitat.

List the factors which influence the type of vegetation growth in an aquatic habitat.

**Growth Factors**

The important factors necessary for plant growth are:

- water;
- light;
- nutrients;
- temperature.

Know the necessary plant growth factors.

List the growth factors.

Water, light and nutrients can be altered. Changing the water temperature is usually not feasible.

Understand that some growth factors can be changed.

Identify which of the growth factors can be changed.

**Category: AQUATIC VEGETATION**

**Concept: PEST MANAGEMENT - WEEDS - CONTROL OPTIONS**

**General Objective: To understand pest management principles required to carry out safe and effective weed control.**

**COURSE OUTLINE**

**INSTRUCTIONAL OBJECTIVES**

**LEARNING OUTCOMES**

**Weed Management Methods**

**Weed management methods include:**

- **prevention (sanitation);**
- **environmental manipulation (cultural);**
- **biological;**
- **mechanical;**
- **chemical.**

**Know the weed management methods.**

**List 5 weed management methods.**

**Prevention**

**Prevention consists of measures undertaken prior to the establishment of undesirable aquatic plants. Preventative measures can also be undertaken after a control program has been implemented.**

**Understand preventative methods of weed control.**

**Identify that prevention should be the first option in weed control.**

**Preventative methods should be the first method of control.**

**Know the methods of prevention.**

**List 4 methods of preventing undesirable aquatic plants.**

**Methods of prevention can include:**

- **stabilizing shorelines to prevent soil erosion;**
- **cleaning boats to prevent weed fragments from being carried to or from other water bodies;**
- **surveillance for and removal of small pioneer weed infestations;**
- **design and construction techniques.**

**Environmental Manipulation (Cultural)**

**Environmental manipulation involves changing the aquatic environment to make it unsuitable for undesirable plant growth.**

**Understand environmental manipulation as a method of weed control.**

**List the methods of environmental manipulation.**

**Methods of environmental manipulation can include:**

- **water level manipulation;**
- **shading;**
- **nutrient removal or limitation;**
- **dredging;**
- **fertilization.**

Category: AQUATIC VEGETATION

Concept: PEST MANAGEMENT - WEEDS - CONTROL OPTIONS

General Objective: To understand pest management principles required to carry out safe and effective weed control.

COURSE OUTLINE

INSTRUCTIONAL OBJECTIVES

LEARNING OUTCOMES

Provincial regulations must be met prior to carrying out any of these manipulations.

Know that provincial regulations must be met.

Identify that provincial regulations must be met.

Water Level Manipulation

If water levels can be lowered enough to expose and dry (desiccate) or freeze the bottom sediments where plants may root, initial weed growth the next spring will be stopped and further growth inhibited. This method works best if carried out in the late fall or early winter. It is also feasible in the early spring. Once the bottom is exposed, weed debris and rootstocks should be removed. This process is known as drawdown.

Know the process of drawdown and how it affects aquatic plant growth.

Describe the process of drawdown and state how performing this process is beneficial in preventing weed growth.

Raising the water levels in May or June cuts off the light to the growing tips of the weeds that are close to the bottom. This is practical in the spring and early summer, the critical growth period for many aquatic plants.

Know what effect raising the water level has on aquatic plant growth.

Describe how raising the water level affects aquatic plant growth. Identify when it is practical and effective to raise water levels.

Deepening the water body where aquatic plants are found can lessen the chance of regrowth in that area. Sediment in which the weeds root can be removed. This method of prevention is effective over a long period of time, but is very costly.

Know how deepening the water body affects aquatic plant growth.

Describe how deepening the water body lessens the chance for aquatic growth.

Light can be affected through the use of shading techniques or by increasing water levels.

Know that light can be altered either by the depth of the water in which aquatic plants are found or through shading.

List the ways light levels can be altered.

Shading

Shading is effective if applied during the early spring and summer months when the weeds are growing. Shading is most effective if used to control weeds in small areas such as swimming or docking areas.

Know when and where the use of shading to reduce aquatic plant growth is most effective.

Explain when and where shading is most effective in reducing aquatic plant growth.



**Category: AQUATIC VEGETATION**

**Concept: PEST MANAGEMENT - WEEDS - CONTROL OPTIONS**

**General Objective: To understand pest management principles required to carry out safe and effective weed control.**

**COURSE OUTLINE**

Shading can be produced by using floating platforms or by covering the water bottom. Black plastic sheeting on a floating platform is effective. The cover can be held in place with rocks or a layer of sand. It is advisable not to cover a whole area as some plants should be allowed to grow. Shading can also be achieved with the use of a dye.

**Nutrient Removal**

Removal of nutrient sources or preventing nutrient input into an area can help reduce or prevent aquatic growth.

Nutrient sources such as unwanted trees and shrubs or dead tree limbs can be removed from water to eliminate the growth of aquatic plants. Small settling basins upstream from a lake's inlet function by removing sediment and coloured substances from incoming water. These materials may contain nutrients.

**Dredging**

Dredging involves the removal of plants and nutrient-laden sediments. Water levels are increased during dredging. Disadvantages of dredging include:

- where to deposit the dredgings;
- high costs;
- destruction of fish habitat and rearing beds.

**Fertilization**

**INSTRUCTIONAL OBJECTIVES**

Know how shading can be achieved.

Know that removal or prevention of nutrient sources can aid in reducing aquatic plant growth.

Know how the removal or prevention of nutrient sources can be achieved.

Know the advantages and disadvantages of dredging as a control method.

**LEARNING OUTCOMES**

List the ways to achieve shading.

Describe the use of black plastic sheeting.

Identify that removal or prevention of nutrient sources can aid in reducing aquatic plant growth.

Describe how nutrient sources can be removed or prevented.

Describe the advantages and disadvantages of dredging.

Category: AQUATIC VEGETATION

Concept: PEST MANAGEMENT - WEEDS - CONTROL OPTIONS

General Objective: To understand pest management principles required to carry out safe and effective weed control.

**COURSE OUTLINE**

Water can be fertilized to produce planktonic algal blooms which produce shade. Rooted vegetation is affected by the shade. Disadvantages of fertilization include:

- it can lead to greater problems such as the addition of more troublesome plants;
- blooms can cause problems with the water use and appearance.

**Biological Control**

Biological control is dependent upon the use of plant grazers. Examples of these grazers include:

- insects;
- snails;
- fish;
- mammals.

**Mechanical Control**

Mechanical control techniques include:

- hand pulling or cutting;
- harvesting;
- root removal.

Hand pulling or cutting is feasible for small, localized areas.

Harvesting of aquatic plants is a common form of mechanical control.

All plant fragments must be removed when harvesting to reduce the chance of regrowth. Underwater harvesting is effective if carried out on a regular basis. The cut stems must be removed as many aquatic plants spread vegetatively.

**INSTRUCTIONAL OBJECTIVES**

Understand how fertilizers can help control aquatic plants.

Know the disadvantages of using a fertilizer.

Understand biological control as it relates to aquatic weed control.

Know the methods of mechanical control.

Know that all plant fragments must be removed when harvesting.

**LEARNING OUTCOMES**

Describe how the addition of a fertilizer to the water can help in reducing aquatic plant growth.

List the disadvantages to using a fertilizer for aquatic weed control.

Describe the use of plant grazers for biological control of aquatic weeds.

List the grazers of aquatic weeds.

List and describe the methods of mechanical control.

Identify that all plant fragments must be removed during harvesting to reduce the chance of regrowth.

Category: AQUATIC VEGETATION

Concept: PEST MANAGEMENT - WEEDS - CONTROL OPTIONS

General Objective: To understand pest management principles required to carry out safe and effective weed control.

COURSE OUTLINE

INSTRUCTIONAL OBJECTIVES

LEARNING OUTCOMES

Mechanical harvesting has several advantages:

- all types of aquatic vegetation may be removed;
- the technique can be carried out under any conditions;
- there are no restrictions on the use of the water during or following treatment.

Disadvantages to harvesting include:

- requires expensive equipment;
- high maintenance costs;
- limited mobility;
- several cuttings required;
- cutting bars can disturb spawning areas;
- disposal of waste cuttings;
- increases vegetative propagative materials.

Root removal is more effective than harvesting. This method is more labour intensive and is best accomplished when the water level is low.

Chemical Control

Chemical control of aquatic plants involves the use of herbicides.

Always ensure the chosen herbicide is registered for aquatic use.

Provincial regulations must be observed before using chemical control.

The advantages of controlling aquatic plants with herbicides include:

- quickly affect the plants;
- effective;
- sometimes inexpensive.

Know the advantages as well as disadvantages associated with harvesting.

Know about root removal.

Know that aquatic weeds are chemically controlled using herbicides.

Know that the herbicide must be registered for use in an aquatic environment.

Know that provincial regulations must be met before conducting an aquatic chemical application.

Know the advantages of using herbicides.

List the advantages and disadvantages associated with harvesting.

Identify when root removal is best accomplished.

Identify that herbicides are used for aquatic weed chemical control.

Identify which herbicides can be used in an aquatic environment.

Identify the provincial regulations which must be met prior to applying a chemical to a body of water.

List advantages to using herbicides.

Category: AQUATIC VEGETATION

Concept: PEST MANAGEMENT - WEEDS - CONTROL OPTIONS

General Objective: To understand pest management principles required to carry out safe and effective weed control.

COURSE OUTLINE

INSTRUCTIONAL OBJECTIVES

LEARNING OUTCOMES

The disadvantages of herbicide use include:

- safety precautions must be observed for transporting, storing, handling, applying and disposing of the herbicide;
- algal "blooms" are often stimulated by weed kills;
- danger of overkill, which can lead to oxygen deficiency for fish and other organisms;
- restricted use period after application;
- little control once the herbicide dissipates in the water;
- danger of affecting non-target organisms;
- danger of affecting potable water sources.

Know disadvantages associated with using herbicides.

List disadvantages of using herbicides.

Before carrying out a herbicide application, there are several things an applicator must do. These activities include:

- determine the severity of the infestation;
- identify the target plant and choose the appropriate herbicide to use;
- ensure that the chosen herbicide is registered for use in the type of water body where control is required;
- ensure timing is correct with regards to the target pest;
  
- ensure all necessary requirements are met with federal/provincial regulatory agencies;
- follow label directions;
- ensure application equipment is calibrated and working correctly;
- ensure adequate protective clothing is used and/or readily available;
- know proper procedures for storage and disposal;
- evaluate risks to non-target organisms;
- ensure that potable water supplies will not be contaminated.

Know what an applicator must do before conducting a herbicide application.

List the actions on applicator must take before carrying out a herbicide application.

Use a combination of weed management methods. Plan your control program by considering the pest, the environment, non-targets and human safety.

Realize that control programs involve a combination of weed methods and these programs must be well planned.

Identify that a combination of weed management methods must be used.  
List the factors that must be considered for safe and effective weed control.

Factors Affecting Herbicide Effectiveness

**Category: AQUATIC VEGETATION**

**Concept: PEST MANAGEMENT - WEEDS - CONTROL OPTIONS**

**General Objective: To understand pest management principles required to carry out safe and effective weed control.**

**COURSE OUTLINE**

**INSTRUCTIONAL OBJECTIVES**

**LEARNING OUTCOMES**

There are many factors that affect herbicide effectiveness. Some are:  
- weed species to be treated;  
- growth habit of the weed species;  
- timing;  
- age of the weed.

Know the factors which affect herbicide effectiveness.

List the factors which affect herbicide effectiveness.

**Age of the Weed**

Herbicides are often more effective on young rapidly growing annual weeds. Systemic herbicides spread faster

Know how the age of the weed affects herbicide effectiveness.

Describe how the age of the weed affects the herbicide effectiveness.

in rapidly-growing younger weeds than in older plants. Herbicides are less likely to kill plants that are in full flower or producing seed.

Perennial weeds often become more resistant to herbicides as they grow older, but may become more susceptible again in the bud or early flowering stage. This is because their roots or spreading rhizomes must be killed and at this stage the herbicide will move with the food supply being stored there.

Describe how perennial weeds may become more difficult to control with herbicides as the plants get older.

**Category: AQUATIC VEGETATION**

**Concept: APPLICATION TECHNOLOGY - EQUIPMENT SELECTION**

**General Objective: To know how to select the correct type of application equipment.**

**COURSE OUTLINE**

**INSTRUCTIONAL OBJECTIVES**

**LEARNING OUTCOMES**

The type of equipment chosen to apply a herbicide in an aquatic environment depends upon:

- herbicide formulation;
- characteristics of the treatment area (size, location);
- problem to be treated (pest).

The equipment chosen must meet certain requirements. This equipment must allow for uniform distribution and minimization of labour.

Two types of herbicide formulations commonly used are:

- liquid;
- granular.

Different types of equipment exist for applying the different types of formulations.

**Liquid Herbicide Application Equipment**

The type of equipment chosen varies with the size and location of the area to be treated.

For small areas with direct access to the treatment area use a sprinkling can or pour directly from the herbicide container.

For localized areas along shorelines, hand pumps or boat bailers are means of achieving application. A boat bailer can be attached to a motor with a hose running into a spray tank. The pump creates suction which draws the herbicide into the prop wash and distribution occurs.

Backpack sprayers are effective for remote or inaccessible treatment areas. For larger areas, motorized tank sprayers, wheel-mounted units (hand or tractor pulled) or skid-mounted units (mounted on boats or tractors) are used.

Know that the type of equipment used is dependent upon several factors.

Know that the chosen equipment must meet certain requirements.

Know the types of herbicide formulations which are commonly used in an aquatic environment.

Know that the type of equipment chosen for liquid application varies with the size and location of the area to be treated.

List the factors associated with the choice of aquatic application equipment.

List the requirements the application equipment must meet.

List the commonly used herbicide formulations.

List and describe the types of liquid application equipment liquid.

**Category: AQUATIC VEGETATION**

**Concept: APPLICATION TECHNOLOGY - EQUIPMENT SELECTION**

**General Objective: To know how to select the correct type of application equipment.**

**COURSE OUTLINE**

**INSTRUCTIONAL OBJECTIVES**

**LEARNING OUTCOMES**

**Booms fitted with weighted hoses can be used for injecting herbicides below the water surface. By replacing the hoses with nozzles, the boom can be utilized for surface treatments.**

**Specialized equipment has been designed specifically for aquatic application. Manufacturers should be contacted for specific details.**

**Metering pumps are used in the treatment of recirculating water or flow-through water systems.**

**Pressurized injection systems are devices used in such areas as irrigation canals or ditches.**

**Granular Application Equipment**

**Both physical and mechanical application methods are available for use with granular materials.**

**Physical Application**

**Physical application consists of applying the granular formulation by hand or using a scoop to areas requiring control. These two methods are effective methods for broadcasting granular formulations over localized areas. Ensure proper protective gloves are worn if applying herbicides by hand.**

**Mechanical Application**

**For small areas where control is required, hand operated fertilizer spreaders are effective in applying granules.**

**For larger areas, motorized backpack sprayers or rotary sprayers are effective.**

**Know that aquatic application equipment has a specialized design.**

**Know the methods used for granular applications.**

**List specialized application equipment used to apply herbicides to water.**

**List the methods used for granular applications and describe each.**

**Category: AQUATIC VEGETATION**

**Concept: APPLICATION TECHNOLOGY - TECHNIQUES**

**General Objective: To understand application techniques for aquatic pest control.**

**COURSE OUTLINE**

**INSTRUCTIONAL OBJECTIVES**

**LEARNING OUTCOMES**

**Correct application techniques are important to ensure that the chosen herbicide will be effectively applied and will control the aquatic pest.**

**Know that correct application techniques are important.**

**Identify why correct application techniques are important.**

**Timing of treatment is dependent on several factors:**

- herbicide to be used;
- target pest;
- non-target species.

**Know that the timing of treatment is dependent on several factors.**

**List the factors which the timing of treatment is dependent on.**

**Commonly used application techniques for aquatic pest control are:**

- total water column treatment;
- bottom treatment;
- foliar treatment above water;
- surface water treatment.

**Know the commonly used application techniques for aquatic pest control.**

**List the common application techniques.**

**In the total water column treatment technique, the entire volume of water to be treated must be calculated. The chemical is added in sufficient quantity to reach either a certain dilution or ppm concentration. The herbicide is generally metered or injected into the water using trailing booms or a boat bailer. The total water column technique is an older technique - the current trend is towards treatment of a portion of the water body.**

**Understand the total water column technique.**

**Describe the total water column technique.**



**Category: AQUATIC VEGETATION**

**Concept: APPLICATION TECHNOLOGY - TECHNIQUES**

**General Objective: To understand application techniques for aquatic pest control.**

**COURSE OUTLINE**

**For treatment of surface pests, the surface area is to be calculated as opposed to the entire volume of water.**

**Bottom Treatment**

**Using the bottom treatment technique, only a certain depth from the bottom is treated. This is useful as the upper water is left untreated and therefore fish are not affected. The bottom treatment technique is also practical for deep bodies of water. This technique is recommended for lakes or static waters with firm, sandy bottoms. This technique also requires the use of less chemicals. Generally, this technique is conducted using a boom fitted with nozzles. The length of the hoses and the speed the boat is travelling play a role in determining the depth at which the herbicide is applied.**

**With this treatment, care must be taken to ensure that the bottom is not stirred up.**

**Foliar Treatment**

**This technique involves the use of a solution to thoroughly wet the foliage. Foliar treatment is used for emergent plants.**

**Surface Water Treatment**

**Surface water treatment is a technique used on water bodies not accessible by boat and that therefore must be sprayed from shore.**

**Use appropriate techniques in consultation with provincial agencies to treat the aquatic pest.**

**For all application techniques, to ensure uniform coverage, apply half of the total herbicide in several passes in the treatment area. With the remaining herbicide, repeat the process at right angles to the first treatment.**

**INSTRUCTIONAL OBJECTIVES**

**Understand the bottom treatment technique.**

**Know the foliar application technique.**

**Know the surface water technique.**

**LEARNING OUTCOMES**

**Describe the bottom treatment technique.**

**List the important factors to observe with this technique.**

**Describe the foliar application technique.**

**Describe the surface water technique.**

**Category: AQUATIC VEGETATION**

**Concept: APPLICATION TECHNOLOGY - TECHNIQUES**

**General Objective: To understand application techniques for aquatic pest control.**

**COURSE OUTLINE**

**To minimize impact on fish due to oxygen depletion from decaying vegetation, herbicide treatments should be split. Conduct one treatment one day and finish the treatment 10 days to 2 weeks later.**

**INSTRUCTIONAL OBJECTIVES**

**LEARNING OUTCOMES**