

Low Management Crops and Areas: Aquatic Weeds (Weed Control in Ponds and Lakes)

Robert J. Richardson, Professor and Extension Specialist, North Carolina State University

The use of pesticides in aquatic environments is quite restricted because these areas provide water for irrigation, recreation, and domestic uses. The recommendations in this section use the herbicide's common name. In the state of Virginia, there are over 100 different trade names for glyphosate and 2,4-D. Only those specifically labeled for aquatics may be used. It is important that chemicals used in these areas be applied strictly in accordance with label directions, as the label is the federal law.

Treatment of aquatic weeds should take place in the spring as the weeds begin active growth. It is important to adhere to this application suggestion, even if an infestation is small. Later in the season, weed density and maturity make control more difficult. Sampling the lake bottom in the late spring or early summer in areas heavily infested the year before should show when the growth begins. The treatment of dense weed growth can result in oxygen depletion during the decomposition of the

dead plants. Severe oxygen depletion can cause a fish kill. Many times it may be necessary to treat only 1/3 to 1/2 of the impoundment at a time.

Recommendations for aquatic applications are based on rate per surface area, rate per acre foot, or parts per million (ppm). An acre foot is 1 acre of water 1 foot deep. For a pond with a gradual slope, acre feet may be determined approximately by multiplying 1/2 the depth at the deepest point, times the surface area. A pond with 1 surface acre and a gradual slope to a 10-foot depth at the deepest point would contain approximately 5 acre feet of water. It is important to get as accurate an estimate as possible. An acre foot of water weighs 2,700,000 pounds, therefore it will require 2.7 pounds of active ingredient to achieve 1 ppm.

There is a quick reference table at the end of this section with water-use restrictions after herbicide application. These restrictions must be followed. Where more than one herbicide is suggested for a specific aquatic weed, please refer to the herbicide information table to find a suitable product.

| Weeds | 2,4-D | bispyribac | carfentrazone | copper compounds | diquat | diquat +copper | endothall | | florpyrauxifen-benzyl | flumioxazin | fluridone | glyphosate | imazamox | imazapyr | peroxide compounds | penoxsulam | triclopyr | triploid grass carp |
|------------------------|-------|------------|---------------|------------------|--------|----------------|-----------|-----------|-----------------------|-------------|-----------|------------|----------|----------|--------------------|------------|-----------|---------------------|
| | | | | | | | Aquathol | Hydrothol | | | | | | | | | | |
| Algae | | | | | | | | | | | | | | | | | | |
| Planktonic | NR | ID | NR | G | P | G | NR | P | NR | ID | NR | NR | NR | NR | G | NR | NR | NR |
| Filamentous | NR | ID | NR | G | E | E | NR | E | NR | G | NR | NR | NR | NR | ID | NR | NR | P |
| Chara / Nitella | NR | ID | ID | G | G | E | NR | G | NR | P | NR | NR | NR | NR | ID | NR | NR | E |
| Floating Plants | | | | | | | | | | | | | | | | | | |
| Azolla (mosquito fern) | NR | G | F | F | E | E | NR | NR | G | ID | E | NR | ID | NR | NR | G | NR | P |
| Duckweed | P | G | G | P | G | G | NR | NR | NR | E | E | NR | NR | NR | NR | G | P | P |
| Frogbit | F | ID | ID | NR | E | E | NR | NR | ID | G | NR | P | E | E | NR | ID | G | P |
| Salvinia, common | NR | G | G | P | E | E | NR | NR | NR | G | E | G | E | ID | NR | ID | NR | P |
| Salvinia, giant | NR | G | G | P | E | E | F | NR | NR | F | E | G | P | G | NR | E | NR | P |
| Waterhyacinth | E | G | G | NR | G | G | NR | NR | E | P | F | G | E | G | NR | E | E | P |
| Watermeal | NR | NR | NR | NR | P | P | NR | NR | NR | G | G | NR | NR | NR | NR | P | NR | P |
| Water lettuce | NR | G | G | NR | G | G | G | G | NR | E | NR | E | G | E | NR | E | NR | P |
| Emerged Plants | | | | | | | | | | | | | | | | | | |
| Alligatorweed | P | G | F | NR | NR | NR | NR | NR | G | F | F | G | G | G | NR | G | G | P |
| American lotus | G | ID | NR | NR | NR | NR | NR | NR | ID | ID | G | E | F | G | NR | ID | G | P |
| Cattail | F | ID | NR | NR | F | F | NR | NR | NR | P | G | E | G-E | E | NR | ID | F | P |
| Creeping waterprimrose | E | ID | F | NR | NR | NR | NR | NR | G | ID | F | E | F | E | NR | G | E | P |
| Floating hearts | P | ID | NR | NR | F | F | E | E | G | ID | F | G | G | G | NR | F | P | P |
| Fragrant waterlily | G | ID | NR | NR | NR | NR | NR | NR | E | ID | G | E | G | E | NR | ID | G | P |
| Grass species | NR | ID | NR | NR | F | F | NR | NR | NR | NR | F | E | F | E | NR | ID | NR | P |
| Parrotfeather | E | G | F | NR | NR | NR | NR | NR | E | F | NR | F | G | E | NR | G | E | NR |

| Table 9.1. Effectiveness of Herbicides and Triploid Grass Carp for Control of Weeds Commonly Found in VA Ponds (continued) | | | | | | | | | | | | | | | | | | |
|--|-------|------------|---------------|------------------|--------|-----------------|-----------|-----------|-----------------------|-------------|-----------|------------|----------|----------|--------------------|------------|-----------|---------------------|
| Weeds | 2,4-D | bispiribac | carfentrazone | copper compounds | diquat | diquat + copper | endothall | | florpyrauxifen-benzyl | flumioxazin | fluridone | glyphosate | imazamox | imazapyr | peroxide compounds | penoxsulam | triclopyr | triploid grass carp |
| | | | | | | | Aquathol | Hydrothol | | | | | | | | | | |
| Emerged Plants (continued) | | | | | | | | | | | | | | | | | | |
| Phragmites (Common reed) | NR | ID | NR | NR | NR | NR | NR | NR | NR | P | NR | G | F-G | E | NR | NR | F | P |
| Pickeralweed | G | ID | NR | NR | NR | NR | NR | NR | E | ID | NR | F | E | E | NR | ID | G | P |
| Rush | NR | ID | NR | NR | NR | NR | NR | NR | NR | ID | NR | G | ID | G | NR | ID | F | P |
| Spatterdock | G | ID | NR | NR | NR | NR | NR | NR | P | ID | G | E | G | E | NR | ID | F | P |
| Smartweeds | F | ID | NR | NR | F | F | NR | NR | G | ID | F | G | G | G | NR | F | G | P |
| Waterpennywort | G | G | NR | NR | F | F | NR | NR | ID | G | G | E | E | E | NR | F | G | P |
| Watershield | E | ID | NR | NR | F | F | NR | NR | G | ID | F | E | G | G | NR | ID | E | P |
| Submersed Plants | | | | | | | | | | | | | | | | | | |
| Bladderwort | P | ID | ID | NR | F | F | P | P | F | ID | E | NR | F-G | NR | NR | ID | P | E |
| Cabomba (fanwort) | NR | ID | ID | NR | F | F | F | F | F | G | F | NR | F | NR | NR | ID | NR | F |
| Coontail | G | ID | ID | NR | E | E | E | E | F | G | E | NR | NR | NR | NR | ID | G | E |
| Egeria (Brazilian elodea) | NR | ID | ID | F | E | E | P | P | F | ID | E | NR | ID | NR | NR | G | NR | E |
| Eurasian watermilfoil | E | G | G | NR | G | G | E | NR | E | G | E | NR | F | NR | NR | G | E | P |
| Hydrilla, monoecious | NR | G | ID | F | G | E | E | E | E | G | E | NR | F | NR | NR | G | NR | E |
| Naiad, brittle | NR | ID | ID | G | E | E | E | E | ID | G | E | NR | ID | NR | NR | F | NR | E |
| Naiad, Southern | NR | ID | ID | G | P | G | P | P | ID | G | G | NR | ID | NR | NR | F | NR | E |
| Parrotfeather | E | G | ID | NR | G | G | E | E | E | G | E | NR | F | NR | NR | G | E | F |
| Pondweed species | NR | G | ID | NR | E | E | E | E | P-F | G | E | NR | G | NR | NR | G | NR | E |
| Proliferating spikerush | NR | ID | ID | NR | NR | NR | NR | NR | F | P | F | NR | F | NR | NR | F | NR | E |
| Variable leaf milfoil | E | ID | G | NR | E | E | E | E | E | E | G | NR | NR | NR | NR | NR | E | P |

Key: NR = Not Recommended; P = Poor; G=Good ; ID = Insufficient Data; F = Fair; E = Excellent

| Table 9.2 - Herbicide Information. IT IS IMPORTANT TO ALWAYS READ AND FOLLOW THE HERBICIDE LABEL. | |
|---|--|
| Herbicide | Remarks |
| 2,4-D | Rate depends on species and depth of water. Water use restrictions vary by formulation and manufacturer. In general, if water is used for irrigating sensitive crops, 2,4-D should not be used. Turfgrasses are generally tolerant to low concentrations of 2,4-D. Also, many 2,4-D formulations are NOT labelled for aquatic use. Read the label before purchasing and/or use. Avoid drift to susceptible plants. |
| Aquashade, many dye products are available. | A blue dye that reduces light penetration in water for up to six weeks may be used to reduce filamentous algae growth in ponds, ornamental ponds or fountains, commercial fish ponds, and lakes. There must be little or no flow out of the pond. Additional applications are made to maintain acceptable shade. Aquashade is not effective when weed growth nears the surface. |
| carfentrazone | Rates vary according to target species. Retreatment of some plants may be required. Methylated seed oil or nonionic surfactant recommended for application on floating plants. Degradation is pH dependent and efficacy will be reduced when water pH > 7.5. |
| copper complex, copper sulfate, other copper products | For optimum control, spray over surface when algae first become visible. Expect temporary control. Repeat treatments are often necessary. Do not use copper sulfate in trout ponds. Hard water requires more copper sulfate than soft water. The copper complex formulation does not precipitate as fast as copper sulfate and usually provides more effective control results. Dilute copper complex with 9 parts of water and spray the surface. Break up the floating mats of filamentous algae before treatment. Water temperature should be about 60°F. Apply on a clear day. Corrosive to spray equipment. Water may be used immediately for swimming, fishing, irrigation, and potable water. Do not use copper complex in water containing trout if the carbonate hardness of the water does not exceed 50 ppm, as it may cause fish kill. Excessive rates may also cause fish kill. When treating chara or nitella, treat only to 1/3 of pond at one time. Allow 7 to 14 days between applications. |

| Herbicide | Remarks |
|----------------------------|---|
| diquat | Apply uniformly over the surface or inject below water surface. For submersed weeds, apply early in season by pouring directly into water in strips 40 ft apart. Later in season, as weeds reach surface, pour in strips 20 ft apart or inject a dilute solution. Avoid stirring the bottom mud. Diquat binds to clay particles and turbid water will reduce efficacy. Retreatment may be necessary if regrowth occurs from underground vegetative parts. Diquat may be fatal if swallowed, inhaled, or absorbed through skin. Copper is sometimes added to improve control with diquat. Be sure to follow the label. When controlling cattail, thoroughly wet the blooms. |
| endothal, dipotassium salt | Granular materials are preferred for spot treatment or treating marginal areas of a pond. Water temperature should be 65°F or above. If areas of heavy vegetation are treated, treat in sections 5 to 7 days apart to prevent fish kill by oxygen depletion during vegetation decay. – follow label for safe handling. Rate will be dependent on most difficult weed to control in the pond. |
| florpyrauxifen-benzyl | May be used for in-water or foliar treatments. Product rates are based on prescription dose units. Allow 14 days or greater between applications. Do not use treated water for irrigation unless specifically allowed by product label. Do not allow contact with sensitive desirable plant species. |
| flumioxazin | Rates vary according to target species and application method. Degradation is pH dependent and efficacy will be reduced when water pH > 7.5. Mix water should have pH < 7.0. A nonionic surfactant is recommended. |
| fluridone | Apply uniformly across the waterbody. Do not apply when there is substantial outflow from the pond. Effects on plant will be gradual from 30 to 90 days for complete response. Use rates will vary by target species and water depth. Generally not effective for small spot treatments. |
| glyphosate | Glyphosate efficacy may be reduced if very hard water containing high concentrations of iron is used to prepare spray solutions. Vegetation must be on or above the surface for treatment to be effective. For floating or emersed weeds, apply to wet foliage above water but do not spray to run off. If applying from a boat, take care not to create waves that may wash the herbicide off floating leaves. Apply in 20.0 gal of water/A as a broadcast spray. Apply to actively growing cattail at the early- to full-bloom stage of growth. Apply when spatterdock, water lily, and water shield are in full bloom. Use only glyphosate formulations labeled for aquatic use. A good surfactant will be required to get spray to wet waxy leaves. |
| imazamox | Rates vary according to species and application method. A surfactant is recommended for immersed and floating plants; see product label for specifics. |
| imazapyr | Rates vary according to target species. Retreatment of some plants may be required. The addition of a nonionic surfactant is recommended. When controlling phragmites, apply to green foliage after complete leaf elongation. Complete coverage is necessary. Do not use within the root zone of desirable plants. |
| triclopyr | Rates vary according to target species. The addition of a nonionic surfactant is recommended. When controlling purple loosestrife, apply to actively growing foliage at flowering. Follow-up spot treatments may be necessary. |

| Aquatic Herbicide | Water Use Restriction (days) | | | | |
|-----------------------|------------------------------|---------|----------|-----------|---------|
| | Irrigation | Fishing | Swimming | Livestock | Potable |
| carfentrazone | 1-14 | 0 | 0 | 0-1 | |
| copper complex | 0 | 0 | 0 | 0 | 0 |
| copper sulfate | 0 ¹ | 0 | 0 | 0 | 0 |
| 2,4-D | ** | ** | ** | ** | ** |
| diquat | 1-5 | 0 | 0 | 1 | 1-3 |
| endothal | | | | | |
| Aquathol K | 0 | 0 | 0 | 0 | ** |
| Aquathol G | 0 | 0 | 0 | 0 | ** |
| Hydrothol 191 | 0 | 0 | 0 | 0 | ** |
| florpyrauxifen-benzyl | *** | 0 | 0 | *** | **** |
| flumioxazin | 0-5 | 0 | 0 | 0 | 0 |
| fluridone | 0-7 | 0 | 0 | 0 | ** |
| glyphosate | 0 | 0 | 0 | 0 | ** |
| imazamox | ** | 0 | 0 | 0 | 0 |
| imazapyr | 120 | 0 | 0 | 0 | ** |
| triclopyr | 120 | 0 | 0 | 0* | ** |

¹0 = no restriction
 * Next growing season for lactating dairy animals. ** Varies, refer to label before use. ***Do not use treated water for irrigation or livestock. Certain irrigation uses may be permitted by label. **** Consult with relevant water authorities prior to application.

| Table 9.4 - Herbicide Trade Names (See specific label for use.) | |
|---|--|
| Common Name | Aquatic Trade Names |
| carfentrazone | Stingray |
| copper ¹ | Komeen, Nautique, Captain, Clearigate, Cutrine Plus, Cutrine Ultra, K-Tea, and many others |
| 2,4-D | various trade names and formulations |
| diquat | Reward, Weedtrine-D, Eliminator, and many others |
| endothall inorganic salts | Aquathol K and Aquathol Super K |
| endothall amine salts | Hydrothol 191 and Hydrothol Granular |
| flumioxazin, common name - florpyrauxifen-benzyl trade name - Procellacor | Clipper |
| fluridone | Sonar, Avast!, and Fluridone |
| glyphosate | various trade names and formulations |
| imazamox | Clearcast |
| imazapyr | Habitat and Imazapyr |
| triclopyr | Renovate 3 and Triclopyr |
| ¹ Copper products may be formulated as copper sulfate pentahydrate, copper complexes, or copper carbonate. | |

■ Biological Control

With biological control, natural enemies are released to feed on aquatic weedy vegetation. Fish have been important in aquatic weed control. Triploid (sterile) grass carp have become the fish of choice for several weeds. Naiad, fanwort, hydrilla, coontail, various pondweeds, bladderwort, elodea, and chara are species usually controlled with the triploid sterile grass carp. Plants that are not preferred by the grass carp and, therefore, are not controlled very well include emergent tough or woody stem species such as cattail, waterlily, and rush. Filamentous algae, watermilfoil, Nitella, and watershield are not controlled very well.

Only triploid (sterile) grass carp may be introduced into Virginia waters for aquatic weed control. A permit must be obtained from the Virginia Department of Game and Inland Fisheries. An application may be obtained by a request via telephone (804) 367-8629 or

through the Web (<http://www.dgif.state.va.us/forms/PERM/PERM-001.pdf>). The application will not be processed without a detailed map(s) of the area. Application must also include the type of weeds and the percent of area covered, size (acres), primary use of the pond, number of fish required, and means for containment of the fish. The application requires a \$10 fee and a few weeks for granting approval. These fish may be stocked in relatively small impoundments where they can be readily contained. After receiving a permit, there are locations approved by the Department of Game and Inland Fisheries to purchase guaranteed triploid sterile grass carp.

Triploid (sterile) grass carp should be about 10 to 12 inches at time of stocking and normal stocking rates are 10 to 15 fish per acre of pond. For larger water bodies, stocking rate should be based on acreage of weedy vegetation.

Low Management Crops and Areas: Weed Control in Right-of-Way and Non-Crop Areas

Shawn D. Askew, Professor, Virginia Tech

The treatments given in this section are not for use in crop land unless otherwise indicated under a given crop section. Note: Most of the chemicals listed perform better when wetting agents are added at 0.25% of the total volume. Use nonionic substances such as Induce, Cide Kick, or other suitable wetting agents. Glyphosate, the active ingredient in the well known product Roundup, is now available under a wide range of product names with varying amounts of active

ingredient per gallon. When using one of these products, consult the label closely for proper mixing and use instructions.

Avoid spraying in close proximity to desirable plants or streams. Do not allow products to contaminate water used for consumption or irrigation. **Dicamba and picloram are very soil mobile and active. They can move down slopes for considerable distances. Do not apply imazapyr where roots of desirable plants extend into the spray zone.**

| Table 9.5 - Brush Control | | |
|--|---|---|
| Problem and Application Technique | Chemical and Application Rate | Remarks |
| Foliage Spray - Brush | | |
| <p>Ground applications often use volumes ranging from 100-500 gpa. Our research has shown good results with volumes as low as 30- 60 gpa if uniform coverage can be obtained. Note: Drift control agents such as Nalcotrol or Polycontrol at labeled rates greatly reduce risk of off Right-of-Way damage.</p> <p>Use controlled size droplets to reduce risk off of the Right-of-Way damage wherever practical.</p> | fosamine (Krenite S) 8.0-12.0 lb/A (2.0-3.0 gal in 50.0-300.0 gal of water) | Apply from mid- June to early fall (prior to leaf coloration) to species listed on label. Susceptible species fail to leaf out the next spring and subsequently die. If rainfall occurs within 24 hours, effectiveness will be reduced. Thorough coverage is imperative for complete control. |
| | fosamine (Krenite S) 2.0 gal + imazapyr (Arsenal) 0.5-1.0 pt in 25.0-50.0 gal water | Apply from mid- June to early fall with a Radiarc or other CD sprayer. For use where certain legumes and other Krenite S resistant species occur. |
| | fosamine (Krenite S) 2.0 gal + glyphosate (Accord XRT) 1.0 gal in 25.0-50.0 gal water | Apply from mid- June to early fall prior to leaf color change. |
| | picloram + 2,4-D (Tordon 101) 1.0 gal/100 gal of water + surfactant 0.25% v/v | Apply uniformly over top of brush as a coarse spray. Use on all species during June and July. |
| | glyphosate (Roundup Pro or Accord XRT) 1.0-2.0 gal/100.0 gal of water | Wet foliage thoroughly after full leaf development. Do not store diluted chemical in metal containers or for more than 12 hours before using. |
| | triclopyr amine (Garlon 3A) 0.5-1.0 gal + 2,4-D amine 2.0 gal/ 100.0 gal water + surfactant 0.25% v/v | Apply 100.0-400.0 gal/A when plants are actively growing. Use higher rates on resistant species or late in growing season applications. |
| | imazapyr (Arsenal) 0.5-1.0 lb ai/A | Apply in 50.0-200.0 gal water/A. |
| | Metsulfuron (Escort) 4.0 oz + Fosamine (Krenite S) 1.0-1.5 gal | Apply in 50.0-100.0 gal water. Insure thorough coverage. |
| | aminocyclopyrachlor+ chlorsulfuron (Perspective) 3.0-11.0 oz/A + 0.25% nonionic surfactant v/v | Use where injury to grasses must be minimal. Apply in 10.0-100.0 gal water/A. May be tank mixed with other products. |
| | aminocyclopyrachlor + metsulfuron methyl (Streamline) 4.75-11.5 oz/A + 0.25% nonionic surfactant v/v | Apply in 10.0-100.0 gal water/A. May be tank mixed with other products. |
| aminocyclopyrachlor + imazapyr + metsulfuron methyl (Viewpoint) 13.0-20.0 oz/A + 0.25% nonionic surfactant v/v | Apply in 10.0-100.0 gal water/A. May be tank mixed with other products. | |

| Table 9.5 - Brush Control (continued) | | |
|--|--|---|
| Problem and Application Technique | Chemical and Application Rate | Remarks |
| Foliage Spray - Brush | | |
| Low-volume application to foliage aerial or ground. Note: Use wetting agents and drift control agents. Follow label recommendations. Use CDA sprayer such as Radiarc for ground sprays to help reduce drift. Thickeners such as Nalcotrol or Polycontrol help prevent drift. | picloram + 2,4-D (Tordon 101) 1.0- 3.0 qt in 20.0-50.0 gal water/A + surfactant 0.25% v/v | Apply during the growing season. |
| | triclopyr 2.0-3.0 gal/A (Garlon 3A, or Garlon 4 Ultra) @ + aminopyralid (Milestone) @ 4.0 oz/A + surfactant 0.25% v/v/A | Apply in 20.0-100.0 gal water. Do not apply Garlon 4 when temperatures are expected to exceed 85°F. For aerial application consult label. |
| | triclopyr (Garlon 3A, Garlon 4, or Garlon 4 Ultra) 0.5-1.0 gal + 1.0-2.0 gal 2,4-D or Tordon 101 (Picloram + 2,4-D) + surfactant 0.25% v/v | Same as above. Do not apply Garlon 4 when daily temperature is expected to exceed 85°F. |
| | imazapyr (Arsenal) 0.5-1.0 lb ai/A | Apply low-volume spray in 10.0-25.0 gal of water/A |
| | glyphosate (Accord XRT) 4.0% + imazapyr (Arsenal) 0.5% + water 95.5% | Apply at 8.0-10.0 gal/A. |
| Dormant Stems, Basal and Stump Treatment | | |
| | triclopyr ester (Garlon 4 Ultra) 20% + basal oil (mineral oil) 80%. Add 1% imazapyr (Stalker) for difficult-to-control species. | Apply anytime except when ground is snow covered. Cover stem up about 18" or over stump and root crown. |

■ General Weed Control - Mixture of Annual Grasses and Broadleaf Weeds

Caution. All use recommendations of herbicides as listed under this category must be regarded as non-selective. Therefore, do not use in crop areas except as shown under **Selective Chemical Weed Control Recommendations**. When treating land that will later be

used to grow crops, observe all label precautions with respect to critical dosages, waiting intervals before cropping, and residue tolerances in the crops. Avoid spray drift onto crops and ornamentals to prevent injury and illegal residues. Do not apply soil sterilants within the root development area of adjoining crops, ornamentals, or other desirable species; also avoid use in areas where there is danger of chemical runoff.

| Table 9.6 - Apply these Herbicides during the Growing Season as a Foliar Spray for General Weed Control | | |
|---|-------------------------------------|---|
| Herbicide | Application Rate ai/acre | Remarks |
| 2,4-D amine + wetting agent (broadleaf weeds only) | 2.0-4.0 qt/A + surfactant 0.25% v/v | Spray to wet all foliage; volume of spray/A will depend on height and density of growth. Apply when weeds are 3-4 inches high. Repeat applications when additional weeds appear. |
| glyphosate (Roundup Pro) (Accord XRT) | 2.0-4.0 qt/A | Apply in 20.0-30.0 gal of water/A. Glyphosate is slow acting and may require 5-10 days before visible results occur. If rainfall occurs within 6 hours, effectiveness may be reduced. Do not use with galvanized spray equipment. Use of mechanical agitation or additional wetting agent will cause excessive foaming. Do not allow spray to drift to contact desirable plants. Glyphosate leaves no soil residue. |
| glyphosate (Roundup Pro) (Accord XRT) + sulfometuron (Oust) + nonionic surfactant | 1.0-2.0 qt + 2.0-4.0 oz of product | Gives season long control. |
| imazapyr (Arsenal) | 0.5-1.0 pt product | Do not use near desired vegetation. |

| Table 9.7 - Specific Perennial Weeds (Except Woody Plants) (See also SOIL STERILIZATION below for general nonselective control, including perennial weeds.) | | |
|--|--|---|
| Weed | Chemical Rate ai/acre | Remarks |
| Bermudagrass (wiregrass) | glyphosate 3.0-4.0 lb ai/A (Roundup or Accord XRT 3.0-4.0 qt) | Best control is obtained when treatment is made at late stages of growth but prior to seed head emergence. See remarks for glyphosate under annual grasses and broadleaf weeds above. Repeat as needed. |
| Canada Thistle | clopyralid (Transline) 1.0-1.25 pt/A + surfactant 0.25% | Best control is obtained when treatment is applied at bloom. |
| | aminocyclopyrachlor + chlorsulfuron (Perspective) @ 5.0-7.0 oz/A | Apply late spring to early summer in 20.0-40.0 gal water/A |
| | aminopyralid (Milestone) 5.0-7.0 oz/A + 0.25% v/v nonionic surfactant | Apply late spring to early summer in 20.0-40.0 gal water/A. |
| Johnsongrass | glyphosate (Roundup Pro or Glypro Plus) 1.0-2.0 qt/A | Best control is obtained when applied in 20.0-25.0 gal water/A during late stages of growth, but prior to seedhead emergence. |
| | fluazifop (Fusilade 2000) 1.0-1.5 qt/A with either 1.0% crop oil concentrate or 0.25% nonionic surfactant. | Apply when johnsongrass is 8-18 inches tall and before boot stage. |
| | glyphosate (Roundup Pro or Accord XRT) 1.0 qt + sulfometuron (Oust) 0.125 oz + 10.0-50.0 gal water/A | Apply at time of seedhead formation. |
| Honeysuckle | 2,4-D 2.0-3.0 qt/100 gal water + 0.25% surfactant v/v | Apply in spring or early summer when plants are in full leaf and actively growing. Thoroughly wet all foliage and stems. Do not allow drift to desirable plants. Dicamba may move down slopes for considerable distances. |
| | glyphosate (Roundup Pro or Accord XRT) 3.0-4.0 qt/100.0 gal water | |
| | 2,4-D 3.0 lb + dicamba 1.5 lb (1.5 gal Banvel 720)/100.0 gal water + 0.25% surfactant v/v | |
| | 2,4-D 2.0 lb + triclopyr 1.0 lb (1.0 gal Crossbow)/ 100 gal water + 0.25% surfactant v/v | |
| Kudzu | 2,4-D + 2, 4-DP + dicamba (Bk-800) 2.0 gal/100.0 gal of water + 0.25% surfactant v/v | Apply at 50.0-100.0 gal solution/A. Dicamba may move down slopes considerable distances. |
| | glyphosate (Roundup Pro or Accord XRT) 4.0 qts/100.0 gal water | Apply when actively growing. |
| | triclopyr 2.0-3.0 lb/A (0.67-1.0 gal Garlon 3A or 0.5-0.75 gal Garlon 4) + 0.25% surfactant v/v | Apply when actively growing. Do not apply Garlon 4 when temperatures are expected to exceed 85° F. |
| | fosamine (Krenite S) 1.5-2.0 gal/100.0 gal water | Apply from mid-summer to early fall. |
| | metsulfuron (Escort) 4.0 oz/100.0 gal water + 0.25% surfactant v/v | Apply when actively growing. |
| | dicamba (Vanquish) 2.0 qt/A in 20-30 gal water. Add 0.25% surfactant v/v. | Apply during late dormant season, March-April. |
| Milkweed (common And dogbane) | dicamba 1.5-2.0 lb (0.38-0.5 gal (Vanquish) + surfactant 0.25% v/v | Apply prior to flowering while plants are actively growing. |
| | dicamba 1.0 lb + 2,4-D 2.0 lb (1.0 gal Banvel 720)/A + surfactant 0.25% v/v | |
| | picloram 0.5 lb + 2,4-D 2.0 lb (1.0 gal Tordon 101)/A + surfactant 0.25% v/v | |
| | 2,4-D 2.0 lb + triclopyr 1.0 lb (1.0 gal Crossbow) + 0.25% surfactant v/v | |
| Mugwort (wild chrysanthemum) | picloram (Tordon) 0.25 lb ai | Do not apply picloram within 100 ft of desirable plants or allow it to contaminate water. Picloram can move down slopes for considerable distances. |
| Mullen | 2,4-D 2.0 lb + surfactant 0.25% v/v | Apply in early summer when in rosette stage. The hairy leaf surface makes this plant difficult to wet; therefore, the use of a surfactant is important. |
| Musk And Curled Thistles | 2,4-D ester 2.0-3.0 lb/50.0-100.0 gal water + surfactant 0.25% v/v | Apply in mid-spring. Midday temperatures should be above 60°F for 2-3 days after application. |
| | dicamba 1.5 lb (0.38 gal Vanquish) + surfactant 0.25% v/v | Observe above-mentioned precautions when using dicamba. |
| | dicamba 1.0 lb + 2,4-D 2.0 lb (1.0 gal Banvel 720) + surfactant 0.25% v/v | |
| | chlorosulfuron (Telar) 0.25-0.5 oz product + surfactant 0.25% v/v | Apply in early spring. Will inhibit grass growth. Not for pastures. Add 0.5% Cide Kick or other wetting agent. |

| Table 9.7 - Specific Perennial Weeds (Except Woody Plants) (continued) (See also SOIL STERILIZATION below for general nonselective control, including perennial weeds.) | | |
|--|--|--|
| Weed | Chemical Rate ai/acre | Remarks |
| Musk And Curled Thistles (continued) | clopyralid (Transline) 1.0-1.25 pts + surfactant 0.25% v/v | Apply from rosette to bud in 25.0-50.0 gal water/A. |
| | aminopyralid (Milestone) 5.0-7.0 oz + 0.25% v/v nonionic surfactant | Apply late spring to early summer in 20.0-40.0 gal water/A. |
| Poison Ivy | fosamine 6.0-8.0 lb (1.5-2.0 gal Krenite S)/100.0 gal water dicamba 1.0 lb + 2,4-D 2.0 lb (1.0 gal Banvel 720)/A + surfactant 0.25% v/v | Apply in late summer before leaf coloration. Thorough coverage is imperative. Apply during periods of active growth. Do not apply within 100 ft of desirable plants or allow dicamba to contaminate water used for irrigation or other domestic purposes. Dicamba may move down slopes for considerable distances. |
| | 2,4-D 2.0-3.0 lb/100.0 gal water + surfactant 0.25% v/v. | |
| | triclopyr 4.0 lb (1.0 gal Garlon 4 Ultra)/100.0 gal of water + surfactant 0.25% v/v | Thoroughly wet all foliage and stems. Density of cover will determine volume of spray/A. Spot treat regrowth as required. Thorough coverage and the use of a surfactant is imperative for good control. |
| | glyphosate 4.0 lb (1.0 gal Roundup Pro or Accord XRT)/100.0 gal water. | |
| Multiflora Rose | 2,4-D 2.0 lb + triclopyr 1.0 lb (Crossbow 1.0 gal)/100.0 gal water + 0.25% surfactant. | Apply when actively growing. |
| | glyphosate 2.0-3.0 lb (0.50-0.75 gal Roundup Pro or Accord XRT)/100.0 gal water | |
| | metsulfuron (Escort) 0.75-1.0 oz product in 50.0 gal water/A + 0.25% surfactant | |
| | triclopyr amine (Garlon 3A) 1.5-3.0 lb (0.5-1.0 gal)/A + 0.25% surfactant | |
| | fosamine 8.0-12.0 lb (2.0-3.0 gal Krenite S)/100.0 gal water. | Apply from mid- summer to early fall prior to leaf color change. Thorough coverage is imperative. |
| Cedar | hexazinone 1.0 lb/10.0 gal water (1.0 lb Velpar 90% SP or 0.5 gal Velpar L) | When preparing the liquid mixture, with Velpar 90% SP, the water should be at room temperature to completely dissolve the powder. Spray 3.0 oz of the solution/2-inch basal diameter on the soil near the base of the stem. For spot control only. Do not treat large areas or every stem in dense stands because erosion may result. Hexazinone may move down slopes for considerable distances. Do not use near desirable plants. |
| | Krenite 3.0 gal/100.0 gal water | Apply after July 15. Wet foliage thoroughly. |
| | 2,4-D 4.0-6.0 lb + dicamba 2.0-3.0 lb (2.0-3.0 gal Banvel 720)/100.0 gal water + 2.0 gal Cide Kick | Wet foliage thoroughly. Dicamba may move down slopes considerable distances. |

■ Soil Sterilization

Soil sterilant chemicals, by definition, render the soil incapable of supporting plant growth for varying periods. The effect may be temporary, as with fumigants, or for an extended period (semi-permanent). In either case, the action is nonselective at rates specified for use as soil sterilants. Therefore, do not apply within the root development area of adjoining crops or desirable species. Do not use in crops or where there is danger of chemical runoff. Note: Since effectiveness varies considerably with the weed species, degree of

infestation, soil and environmental conditions, several herbicidal materials and a range of rates are provided to allow selection of product and dosage based on specific need.

Lower rates (A) apply to annuals, biennials, shallow-rooted perennials, and seedling perennials;

Higher rates (B) apply to established deep-rooted and other hard-to-kill perennials. Read and follow directions on the label for further details.

| Table 9.8 - Chemicals and Recommended Use | | |
|---|--|---|
| Soil sterilants are very potent plant killers and should not be used around the home grounds or near desirable plants; as with all pesticides, consult the label before use. | | |
| Herbicide | Application Rate ai/acre | Remarks |
| borate mixtures with sodium chlorate and/or other chemicals | variable | Follow instructions on the label. Apply as a spray on early growth to first bloom or broadcast as a soil treatment. |
| bromacil | (A) 3.0-6.0 (B) 10.0-25.0 | If dense growth is present, results will be improved if vegetation is removed prior to treatment. Do not apply to frozen ground. |
| chlorate mixtures with borates or other chemicals | variable | Follow instructions on label. Fire hazard usually less than pure sodium chlorate but caution still is necessary. |
| diuron or monuron | (A) 5.0-20.0 (B) 20.0-80.0 | Diuron gives somewhat longer soil sterility. Monuron is more effective on deep-rooted weeds. |
| hexazinone (Velpar) | (A) 1.8-4.5 (B) 5.4-10.8 | Apply in early spring. Do not apply near desirable vegetation. Consult label for specific rates on different soil types. |
| imazapyr (Arsenal) (Topsite) | 0.5-1.0 lb 200-300 lb product/A | Do not apply near trees or other desired vegetation. |
| methyl bromide | 1.0-1.5 lb/100 sq ft | Soil fumigant. Apply in concentrated form under vaporproof cover, when soil is moist, not wet, and in good tilth. Remove cover after 24-48 hours. Warning: methyl bromide is poisonous. |
| prometon (Pramitol) | (A) 10.0-15.0 (B) 20.0-60.0 | Mix in water or oil. Provides quicker contact kill of top growth with oil. Apply to early growth up to first heading. |
| tebuthiuron (Spike) (Sprakil S-5) | (A) 4.0-6.0 (B) 6.0-16.0 40-120 lb product/A | Follow label directions. Do not apply near desirable vegetation. Tebuthiuron can move considerable distance down slopes. |
| diuron + imazapyr (Sahara) | 10-15 lb product/A | Mix in 50-100 gal water. |
| diuron + tebuthiuron (Sprakil 13) (Sprakil 26) | 150-400 lb product/A 150-300 lb product/A | Apply granules uniformly over area to be treated. |
| Bermudagrass Release, Rights-of-Way Only | | |
| glyphosate + sulfometuron | (Roundup Pro) 1.0 qt + (Oust) 1.0 oz + Cide Kick 1.0 qt | Apply in early spring or October for control of cool-season grasses (Ky 31 fescue, etc.) and weeds. |
| Summer Grasses in Bermudagrass, Rights-of-Way Only | | |
| sulfometuron + glyphosate | (Oust) 0.25-0.5 oz + (Roundup Pro) 1.0-2.0 pt + Cide Kick 1.0 qt | Apply in June for control of dallis, broomsedge, johnson, and annual grasses in 50.0 gal of water. |
| Stabilized Shoulders and Guard Rails | | |
| glyphosate + indaziflam | glyphosate (Roundup Pro) @ 1.0-2.0 qts/A + indaziflam (Esplanade) @ 5.0-7.0 oz/A. Add 1.0-3.0 oz/A of sulfometuron methyl (Oust) for difficult-to control species and longer control time. | Apply in 50.0 gal of water in spring. Repeat if necessary. Keep off of desired vegetation. Do not apply more than 2 ft past guard rail or edge of shoulder to prevent erosion of soil. Will not control bermudagrass. |
| glyphosate + surflan | (Roundup Pro) 2.0-4.0 qt + Surflan 4.0 lb | |
| glyphosate + pendimethalin | (Roundup Pro) 2.0-4.0 qt + Pendulum 4.0 lb | |
| Always read the label before applying any pesticide. Use caution when applying herbicides on windy days or when temperature is above 85° F. Many herbicides exhibit soil activity and may cause damage or death to desirable plants if they contact the roots of such plants. This problem is compounded on steep terrain. Always use adequate personal protection clothing or devices as suggested or required by the label. | | |

