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CHEMICAL VEGETATION CONTROL MANUAL OR FISH AND WILDLIFE MANAGEMENT PROGRAMS

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FOREWORD

Man depends upon chemical control agents for solving or mitigating many pest problems. Proper use of chemicals to destroy pests and disease organisms that affect man, animals, and plants has an enormous potential for the public good. There must, however, be a recognition that almost any chemical which will kill or control pests is capable of causing harm. Use of a pesticide chemical, therefore, should be first evaluated to decide whether the risk involved is commensurate with the contemplated benefits. The potential problems--including public reaction--arising from pesticide programs must be identified in order that such problems may be avoided or minimized.

The basic policy of the Department of the Interior with respect to use of pesticides has been clearly stated by Secretary Udall:

"It is essential that all pesticides, herbicides and related chemicals be applied in a manner fully consistent with the protection of the entire environment. Any contemplated use of these chemicals must take into account both known and possible environmental effect. The guiding rule for the Department shall be that where there is a reasonable doubt regarding the environmental effects of the use of a given pesticide, herbicide, or other chemical, no use should be made."

The Chemical Vegetation Control Manual was developed primarily as a guideline for Bureau of Sport Fisheries and Wildlife personnel and their cooperators in the translation of the above policy into the practical solution of the Bureau's pest plant control problems.

Any criticism or suggestion you may have that will lead to improvement in a revised edition is solicited.

CHEMICAL VEGETATION CONTROL MANUAL

FOR FISH AND WILDLIFE MANAGEMENT PROGRAMS

This manual has been prepared as a guide for vegetation control operations of the Bureau of Sport Fisheries and Wildlife and for programs approved by the Bureau for Federal reimbursement. It is intended also to provide the management biologist with information about the chemical, physical, and biological properties of some herbicides currently available. We intend to revise the manual from time to time to include additional information from management reports and research. Your comments on contents, organization, and general utility are needed for such revisions.

USE OF HERBICIDES

Herbicides are useful and the preferred method for vegetation control in many circumstances. When it has been determined that chemical control is desirable, selection and use of the herbicide must be in accordance with Bureau policy and the recommendations and restrictions contained on the herbicide label. If the label does not include instructions for a proposed use, such as aquatic vegetation control, the product has not been registered for that purpose and may not be used.

5xcept for copper sulfate no herbicide has been approved for use in potable water or in flowing natural stream

Residue tolerances for fish or shellfish have not been established by the Food and Drug Administration for any herbicide. Consequently, fish and shellfish from treated waters may not be sold for human consumption.

Several chemicals that have been registered for vegetation control are not approved for use on Bureau lands or for use in programs approved by the Bureau for Federal reimbursement. Arsenicals, chlorinated hydrocarbons, dinitro compounds, and amitrole are included in this category. These chemicals are restricted because of undue hazard to public health or to resources other than fish and wildlife. Federal programs or programs supported by Federal funds must have prior approval by the Federal Committee on Pest Control. There are no pesticides exempt from this requirement. Consequently, some herbicides which may be safe insofar as fish and wildlife are concerned are not approved.

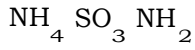
Vegetation control programs that propose use of herbicides that have been suggested in Table 1 will be acceptable to the Federal Committee on Pest Control. The Bureau has established maximum application rates for use of some of these chemicals on Bureau lands. The herbicide information sheets included in this manual list these restrictions. Except for these limitations, application rates should be in accordance with label recommendations.

The plants included in Table 1 can be satisfactorily controlled with the suggested herbicide. Except for a few species, only one herbicide is shown; however, other herbicides also will provide control for many of these plants. This table provides guidance for the management biologist but is not intended to restrict the choice of herbicide. Other properly registered chemicals, known to be effective, may be selected but must be used in accordance with Bureau policy and the recommendations and restrictions contained on the herbicide label.

Vegetation control and all habitat management programs should always be governed by ecological principles. Control programs often receive critical public attention, and our decision to embark upon these programs should be ethical and defensible. The following statement from a paper presented by Dr. Robert A. McCabe at the symposium on "Scientific Aspects of Pest Control" in Washington, D. C., February 1966, expresses well our ethical obligations:

"The guidelines needed to regulate a pest situation are more than a manufacturer's list of scare devices or a chemical company's cookbook for repellent and poison formulations. In addition to all the methodology of control, society must understand control as an ethical or moral issue, and for this mental adjustment there are no lists or cookbooks. Man's ethics **should** include an appreciation of the natural beauty of our environment, an understanding of the role of aesthetic values in man's well-being, a conviction that the integrity of plant and animal communities must be maintained, and a recognition of the material and spiritual needs of other men."

Ammonium Sulfamate



(also Ammate; AMS; Ammonium amido sulfate)

Ammonium sulfamate occurs as crystals and is extremely soluble in water and breaks down rapidly in moist soils. It is available in a crystal form containing 95 percent ammonium sulfamate and as a solution containing 5.3 pounds of 95 percent ammonium sulfamate per gallon. It is nonflammable and nonvolatile.

Ammonium sulfamate is especially effective for control of poison-ivy, poison-oak, and poison-sumac. It also is used for aquatic vegetation control and is effective for stump applications.

Used in accordance with label recommendations, ammonium sulfamate is no hazard to fish or wildlife.

Copper Sulfate

$\text{CuSO}_4 \cdot \text{H}_2\text{O}$ (monohydrate) $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$ (pentahydrate)
(Blue copperas; bluestone; blue vitriol; cupric sulfate)

Copper sulfate is the most common salt of copper and is highly soluble in water. It is the most widely used herbicide for control of algae.

Use of copper sulfate as a herbicide does not constitute a hazard to livestock or terrestrial wildlife. Toxicity of copper sulfate to aquatic organisms varies with the species and with the physical and chemical characteristics of the water, such as its temperature, hardness, turbidity and carbon dioxide content. Killing concentrations for aquatic fauna reported by various investigators vary over a wide range. The highest concentrations of copper sulfate tolerated by fish that have been reported are presented by McKee and Wolf in "Water Quality Criteria" (McKee, J. E. and Wolf, H. W., "Water Quality Criteria." California State Water Quality Control Board, Publication No. 3-A, 1963). These data are as follows:

Trout	0.14 ppm	Perch	0.67 ppm
Carp	0.33 ppm	Largemouth bass	
Suckers	0.33 ppm	and bluegill	0.80 ppm
Catfish	0.40 ppm	Sunfish	1.35 ppm
Pickrel	0.40 ppm	Smallmouth bass	2.00 ppm
Goldfish	0.50 ppm		

Comparison of these tolerances with the following rates of application, that have been recommended by the Department of Agriculture for control of several types of algae in farm ponds, indicates the potential hazard to fish when using copper sulfate. ("The Destruction of Algae in Farm Ponds and Other Bodies of Water" U.S .D.A. Bureau of Plant Industry, Soils and Agricultural Engineering, Bulletin 77 CC. 1954.)

Anabaena	0.09 ppm	Navicula	0.07 ppm
Beggiatoa	5.00 ppm	Oscillatoria	0.1-0.4 ppm
Chara	0.2-5.0 ppm	Scenedesmus	5.0-10.0 ppm
Cladophora	1 .00 ppm	Spirogyra	0.05-0.3 ppm
Cladothrix	0.20 ppm	Ulothrix	0.20 ppm
Conferva	0.40 ppm	Volvox	0.25 ppm

Application of copper sulfate in soft-water hatchery ponds must be undertaken with caution. Toxicity tests have shown that fish can withstand much higher concentrations of copper sulfate in hard water than in soft water. Tests conducted at Marion, Alabama, showed that two-inch bluegills in water having a total hardness of 15 ppm began to die at a concentration of 0.25 ppm and that 100 percent mortality occurred when the concentration of copper sulfate reached 0.8 ppm. In contrast, bluegills in water having a total hardness of 132 ppm and a total alkalinity of 1544 ppm were not killed until a 10.0 ppm level was reached. Seventy ppm was required to obtain 100 percent mortality. The 48-hour LD₅₀ for bluegills in four sources of water supply were as follows:

LD ₅₀	Total Hardness	Total Alkalinity
0.6 ppm	15.0 ppm	18.7 ppm
8.0 ppm	68.0 ppm	166.0 ppm
10.0 ppm	100.0 ppm	245.0 ppm
45.0 ppm	132.0 ppm	1544.0 ppm

Although copper sulfate has been used effectively for controlling algae and other aquatic vegetation for many years, it has the undesirable characteristics of being toxic to desirable organisms and tends to be cumulative. Newer herbicides such as endothall and diquat are proving to be effective for control of some plant species and are far less toxic to fish. As better products become available, copper sulfate will be replaced. Meanwhile, the need to control certain species justifies the hazard involved in using copper sulfate.

Copper sulfate probably is the best herbicide currently available for control of some species of algae, including water-bloom algae. Water-bloom algae, microscopic, free-floating plants which create turbidity in water, are usually desirable in shallow lakes as the turbidity they create tends to shade out undesirable vegetation, thereby maintaining a better habitat for fish. However, these algae may become a problem. Lakes in fertile agricultural areas or lakes in which sewage effluents or other wastes greatly increase natural productivity of the water may develop excessive growths of algae that can create serious hazards to livestock, fish and wildlife. Water-bloom algae sometimes becomes so abundant in farm ponds that fish are killed during the night due to oxygen depletion in the water. Although during the day algae give off oxygen as a by-product of photosynthesis, during the night they remove oxygen from the water. Thus, there are conditions which justify use of copper sulfate, even though it may be hazardous for fish.

PHENOXY COMPOUNDS

The phenoxy compounds include 2,4-D, MCPA, 2,4,5-T and silvex. These herbicides in the acid form are **only** slightly soluble in water and are formulated for commercial use as esters and salts. Esters form milky emulsions with water and also dissolve in light oils. The salts are easily soluble in water and usually are sold in liquid form. The amine salts are the most commonly used. Sodium and ammonium salt formulations are available as water-soluble powders. Some formulations change rapidly into vapor and this volatile quality increases the danger of drift from the treated area. The salts are practically nonvolatile. There are relatively high-volatile esters and relatively low-volatile esters. Both types are **volatile** at high temperatures. Drift can occur with any formulation if the spray is in fine droplets or mist and there is a wind. Phenoxy compounds are noncorrosive and nonflammable.

When used in accordance with recommended procedures, the phenoxy derivatives are not a hazard to livestock or warm-blooded wildlife. Some formulations are relatively toxic to fish and other aquatic organisms. Any phenoxy compound will cause a taste in water which may last for several months and will impart an unpleasant flavor to fish. Because the effectiveness of the control program and the hazard to the aquatic environment varies with the derivative, it is imperative that the user select the proper formulation.

2,4-D

2,4, -Dichlorophenoxyacetic acid; C₈H₆Cl₂O₃

Various forms and formulations of 2,4-D are available. All have the property of killing most broadleaf herbaceous plants without injury to grasses, cereals and other monocotyledonous plants. 2,4-D also is used for control of woody plants. It is sold under many trade names and is available in combination with 2,4,5-T. A nearly complete list of formulations containing 2,4-D is available in "Pesticides Handbook" by D. E. H. Frear (published annually - 1966 edition lists more than 10,000 products). These formulations contain 2,4-D in a form that can be (1) dissolved or suspended in a carrier and distributed in solution by sprayers, or (2) distributed dry by dusters or spreaders.

2,4-D is formulated as water-soluble sodium, ammonium, or amine salts and volatile or low-volatile esters. Sodium salts and esters are available also as dusts. The dimethylamine salt is oil-soluble and has the weed killing properties of an ester and the nonvolatile feature of amine salts. The herbicidal effectiveness and the toxicity to fish and other aquatic organisms are related to the formulation. The acid equivalent of a product usually is given on the label to standardize comparisons.

Low-volatile esters (chemically, an ester with a high molecular weight) include the butoxyethanol, iso-octyl, and propylene glycol butyl ether esters. The methyl, ethyl, propyl, isopropyl, butyl, amyl, and pentyl esters are volatile esters. Low-volatile esters are equally effective, and in some instances are better, than the volatile esters.

2,4-D is a plant hormone that stimulates growth to the extent that the plant destroys itself. It will be absorbed through the leaves and readily translocated in the plant. It also can be absorbed by the roots. The herbicide is most effective on warm sunny days when photosynthesis is active.

Herbicides must be used as registered by the Department of Agriculture and in accordance with directions on the manufacturer's label. Broadcast or spray application of 2,4-D on Bureau of Sport Fisheries and Wildlife lands must not exceed 8 lbs. acid equivalent per acre, per year. Forty pounds acid equivalent per acre, per year is permitted for scattered spot treatments. Topical application to individual plants is unrestricted. Terrestrial vegetation control on Bureau lands with 2,4-D is limited to the following derivatives: dimethylamine salt, butoxyethanol ester, iso-octyl ester, propylene glycol butyl ether ester, potassium salt, and free acid. It is difficult to wash 2,4-D out of spraying equipment and, if possible, equipment used to apply 2,4-D should not also be used in areas where crops or ornamental plants might be damaged.

Many terrestrial species, including the following, are effectively controlled with 2,4-D:

buckbrush	■	Indian hemp		puncturevine
snowberry	■	knawweed	■	purslane
wedgeleaf ceanothus	■	notweed	■	rabbitbrush
chamise	■	silvery lupine		creeping sage

chickweed	little mallow	big sagebrush
cinquefoil	manzanita	sorrell
dock	milkvetch	Chinese sumac
flixweed	nutgrass	tansy
wild garlic	post oak	toyon
gooseweed	white oak	tree -of -heaven
ground-ivy	wild onion	narrowleaf vetch
hawkweed	poison oak	annual wormwood

Use of 2,4-D for aquatic vegetation control must take into consideration effects upon fish and other aquatic organisms. 2,4-D derivatives which are considered hazardous to fish include butyl ester, isopropyl ester, butoxyethanol ester, ethyl ester, diN, N-dimethyl cocamine salt, duomeen 0 salt, propylene glycol butyl ether ester, and 2,4-D acetamide.

Satisfactory control of several aquatic plants usually can be obtained with 2,4-D without harm to fish if the following precautions and application rates are used.

<u>Vegetation</u>	<u>Formulation</u>	<u>Rate of Application</u>
Coontail (<u>Ceratophyllum demersum</u>)	Iso-octyl ester granules	20 lbs. ae/acre in ponds and lakes
	Apply during early stage of vigorous growth.	
Water stargrass (<u>Heteranthera dubia</u>)	Iso-octyl ester, liquid or granule	20 lbs. ae/acre in ponds and lakes
	Apply early in period of vigorous growth.	
Watermilfoil (<u>Myriophyllum</u> spp.)	Iso-octyl ester granules	20 lbs. ae/acre in ponds and lakes
	Apply during period of vigorous growth.	
	Low-volatile esters have been used effectively for control of <u>Myriophyllum spicatum</u> during slack tide in fresh and brackish tidal areas when the temperature exceeds 68° F. Best results have been obtained with the butoxyethanol ester but the iso-octyl ester is less toxic to fish. This treatment is not registered for commercial fishing areas.	
Lotus (<u>Nelumbo pentapetala</u>)	Dimethylamine salt or iso-octyl ester liquid	2-4 lbs. ae/acre
	Apply during flowering period to early fruiting stage.	
Spatterdock (<u>Nuphar luteum</u>)	Iso-octyl ester or dimethylamine or alkanolamine salt (liquid)	6-8 lbs. ae/acre. Repeat 4 to 6 weeks later.
	Iso-octyl ester granules	30 lbs. ae/acre. Repeat 4 to 6 weeks later.
	Apply early in period of vigorous growth.	

*Acid equivalent

<u>Vegetation</u>	Formulation	<u>Rate of Application</u>
Water chestnut (<u>Trapa natans</u>)	Dimethylamine salt- granules or Dimethylamine salt - low pressure spray	10-20 lbs. ae/acre solid stands, pre- flowering stage, in non-tidal waters 4-6 lbs. ae/acre solid stands, pre- flowering stage, in non-tidal waters
Water primrose (<u>Jussiaea</u> <u>uruguayensis</u>)	Iso-octyl ester spray treatment	8 lbs. ae/acre at maximum flowering period
White waterlily (<u>Nymphaea</u> <u>tuberosa</u>)	Iso-octyl ester granules	30 lbs. ae/acre during period of vigorous growth
Arrow-arum (<u>Peltandra</u> <u>virginica</u>)	Iso-octyl ester or dimethylamine or alkanolamine salt spray on foliage	6-7 lbs. ae/acre during flowering period
Needlerush (<u>Juncus</u> <u>roemerianus</u>)	Iso-octyl ester or dimethylamine or alkanolamine salt spray on foliage	30 lbs. ae/acre during flowering and early fruiting period
Hibiscus (<u>Hibiscus moscheutos</u> H. <u>militaris</u> , H. <u>lasiocarpos</u>)	Iso-octyl ester or dimethylamine or alkanolamine salt spray	7 <u>lbs. ae/acre</u> during late flowering and early fruiting period
Groundselbush (<u>Baccharis</u> <u>halimifolia</u>)	Iso-octyl ester or dimethylamine or alkanolamine salt spray on foliage	4 lbs. ae/100 gallons of water. Coastal marshes during early flowering period
Hightide bush (Iva <u>frutescens</u>)	Iso-octyl ester or dimethylamine or alkanolamine salt spray on foliage	4 lbs. ae/100 gallons of water. Coastal marshes during flowering period

Vegetation	Formulation	<u>Rate of Application</u>
Swamp loosestrife (Decodon <u>verticillatus</u>)	Iso-octyl ester or dimethylamine or alkanolamine salt spray on foliage	2 lbs . ae/100 gallons of water. Period of maximum leaf growth through early fruiting period
Willow (<u>Salix</u> spp.)	Iso-octyl ester or dimethylamine or alkanolamine salt spray on foliage	4 lbs. ae/100 gallons of water. During period of maximum foliage

MCPA
2-methyl-4-chlorophenoxyacetic acid
(also MCP; Mephanac; Argoxone; Methoxone)

The sodium and amine salts are the most widely used formulations of MCPA. "Pesticides Handbook," D. E. H. Frear, 1966 edition lists 33 MCPA products. These salts may be used on Bureau lands in accordance with directions on the manufacturer's label but not to exceed 2 pounds per acre in a single application or a total of 2 pounds per acre per year. It is difficult to wash MCPA out of spraying equipment and, if possible, equipment used to apply MCPA should not also be used in areas where crops or ornamental plants might be damaged.

MCPA is more effective than 2,4-D for control of tartary buckwheat, burcucumber, buttercup, coffeebean, honeysuckle, spotted knapweed, and perennial pepperweed.

2,4,5-T

2,4,5-trichlorophenoxyacetic acid

2,4,5-T is sold under many trade names and is available in combination with 2,4-D. "Pesticides Handbook" by D. E. H. Frear (published annually - 1966 edition lists more than 10,000 products) includes a nearly complete list of formulations containing 2,4,5-T.

It is used principally for control of woody vegetation. 2,4,5-T is not recommended for aquatic vegetation control on Bureau of Sport Fisheries and Wildlife lands. It is available in salt and ester formulations but the esters are more effective on woody plants. The low-volatile esters are equally as effective as the volatile. Broadcast or spray application of 2,4,5-T on Bureau of Sport Fisheries and Wildlife lands is limited to the following derivatives: butoxyethanol ester, iso-octyl ester, propylene glycol butyl ether ester (these are low-volatile esters) dimethylamine salt, potassium salt and free acid. Application must not exceed 8 lbs. acid equivalent per acre, per year. Forty pounds acid equivalent per acre, per year is permissible for scattered spot treatments. Topical application to individual plants is unrestricted. It is difficult to wash 2,4,5-T out of spraying equipment and, if possible, equipment used to apply 2,4,5-T should not also be used in areas where crops or ornamental plants might be damaged.

2,4,5-T and 2,4-D are combined in a formulation called "Brush Killer." One-third to one-half 2,4,5-T to two-thirds to one-half 2,4-D (low-volatile esters) is the usual ratio. This combination is useful for control of mixed populations, as some woody species are tolerant to 2,4,5-T but susceptible to 2,4-D and vice versa. "Brush Killer" may be used on Bureau lands in accordance with the 2,4,5-T restrictions.

Many woody plants, including the following, are effectively controlled with 2,4,5-T:

alder	common guava	coastal sagebrush
aspen	hackberry	salmonberry
Allegheny barberry	lilac	sassafras
birch	black locust	Scotch broom
blackberry	lotebush	snowbrush
boxelder	magnolia	spicebush
wooly buckthorn	mountain misery	spiraea
buttonball bush	post oak	Chinese sumac
varnishleaf ceanothus	shinnery oak	sweetgum
wedgeleaf ceanothus	white oak	sycamore
currants	Osage-orange	thimbleberry
deer weed	pea -tree	tree-of -heaven
flowering dogwood	poison-ivy	tuliptree
elderberry	poison-oak	mapleleaf viburnum
gooseberries	poison-sumac	black walnut
sand sagebrush	redbay	willow
	prairie rose	willowweed
	big sagebrush	witch-hazel
		yerba-santa

Silvex

2-(2,4,5-trichlorophenoxy) propionic acid

Silvex is formulated as a low-volatile ester (propylene glycol butyl ether, iso-octyl, butoxyethanol), liquid potassium salt, and a potassium salt granular product. "Pesticides Handbook", by D. E. H. Frear, 1966 edition lists 14 silvex products.

Commercial ester products usually are a formulation of mixed low-volatile esters of silvex to contain 4-pounds acid equivalent per gallon. The ester formulations of silvex are more effective than 2,4,5-T esters as a foliage spray on maple, redbud, cherokee rose, saltcedar, and trumpet creeper. They are not so effective for basal-bark and cut-surface applications. Silvex esters also are more effective than 2,4,5-T on mouse-ear chickweed, henbit, and yucca.

Aquatic species satisfactorily controlled with silvex include arrowhead, bladderwort, coontail, elodea, fanwort, parrotfeather, pickerelweed, pondweed, spatterdock, waterhyacinth, waterlily, watermilfoil, waterplantain, watershield, waterstargrass, and waterstarwort.

Application of silvex on Bureau of Sport Fisheries and Wildlife lands must not exceed 8 pounds acid equivalent per acre, per year. Forty pounds acid equivalent per acre, per year is permitted for scattered spot treatments. Topical application to individual plants is unrestricted. Terrestrial vegetation control on Bureau lands with silvex is limited to the following derivatives: potassium salt, propylene glycol butyl ether ester, iso-octyl ester, butoxyethanol ester, and free acid. It is difficult to wash silvex out of spraying equipment and, if possible, equipment used to apply silvex should not also be used in areas where crops or ornamental plants might be damaged.

Satisfactory control of several aquatic plants usually can be obtained in mid-eastern and northeastern States and possibly elsewhere with the low-volatile esters (iso-octyl, butoxyethanol, or propylene glycol butyl ether) or potassium salt of silvex without harm to fish if the following precaution and application rates are used:

Alligatorweed - Alternanthera philoxeroides

Alligatorweed, a serious problem for fish and waterfowl management, is difficult to control and many chemicals and formulations have been tried. Complete and permanent control has seldom been achieved. The best chemical results probably can be obtained with silvex. Patuxent Wildlife Research Center, Section of Wetland Ecology, has found that the following treatments give good results and at these rates no adverse effect on fish or waterfowl has been observed:

Silvex propylene glycol butyl ether ester spray at 8 pounds acid equivalent per acre and repeat treatment every 4 to 6 weeks (not to exceed 8 pounds acid equivalent per year without prior approval).

Silvex butoxyethanol ester granular at 10 to 30 pounds per acre.

Satisfactory control of several other aquatic plants usually can be obtained with silvex without harm to fish or waterfowl if the following formulations and application rates are used (see page 22 for list of abbreviations):

Vegetation

Bladderwort

(Utricularia spp.)

Potassium salt or
PGBEE

1.0-2.0 ppm in
ponds and lakes

Apply early in period of vigorous growth.

Elodea

(Elodea canadensis
and E. densa)

Potassium salt,
PGBEE, or IOE

1.0 ppm in soft
water ponds and
lakes

Apply early in period of vigorous growth.

Curlyleaf pondweed

(Potamogeton
crispus)

Potassium salt,
PGBEE, IOE, or
BEE

0.5 ppm in ponds
and lakes

Apply early in period of vigorous growth.

Watermilfoil

(Myriophyllum spp.)

Potassium salt,
PGBEE, IOE, or BEE

1.0 ppm in ponds
and lakes

Apply during period of vigorous growth.

Dacthal
dimethyl-2,3,4,6 -tetrachloroterephthalate
(also DCPA)

Dacthal is formulated as a water-dispersible powder containing 75 percent active ingredient. It is a useful pre-emergent control for crabgrass and other annual grasses. Dacthal prevents germination of seeds and has proved effective in controlling alfilaria, carpetweed, common chickweed, redstem filaree, Florida pusley, foxtail, lambsquarters, Texas millet, panicum, common **purslane**, and stinkgrass. It is no hazard to warm-blooded vertebrates. Toxicity of dacthal to aquatic animals has not been well established. However, the data now available indicates that used in accordance with label instructions the hazard to aquatic resources will be insignificant.

Dalapon
2,2-Dichloropropionic acid, sodium salt
(also Radapon; Dowpon)

Dalapon is formulated as the sodium salt of dichloropropionic acid. It is a water-soluble powder applied in solution. Dalapon is used principally to control grasses, cattail, phragmites, and rushes. It also is effective against white-cedar, jack pine, and white pine. Dalapon is translocated from leaves to roots and rhizomes of perennial grasses. It also is absorbed by the roots.

Dalapon has a characteristic salty taste which might attract salt-hungry livestock or **possibly** wildlife. Although acute and subacute oral toxicity is low, dalapon should be kept in closed containers. There is virtually no hazard to fish and other aquatic animals at application rates required for vegetation control.

Diquat
1,1'-Ethylene-2,2' -dipyridinium dibromide
(also FB/2; Reglone)

Diquat is formulated as a water-soluble liquid which makes a true solution in water and will not separate. Diquat is registered for preharvest desiccation of certain plants to facilitate harvesting; for general weed control in noncrop areas; and for aquatic vegetation control. Diquat is readily absorbed on clay particles and should not be used in muddy water. It diffuses rapidly throughout water treated, and uptake by vegetation occurs quickly. Plant kill results soon after exposure to diquat. Effectiveness is greatly reduced when the temperature is below 40° F. It is nonvolatile and nonflammable.

There is no significant hazard to fish and wildlife at the recommended application rates. Application of diquat on Bureau of Sport Fisheries and Wildlife lands must not exceed 3 pounds active ingredient per acre, per year on land nor 15 pounds active ingredient per acre, per year on water areas.

Endothall
1,2- dicarboxy-3,6 -endoxocyclohexane
(frequently called 3,6-endoxohexahydrophthalic acid)

The sodium and potassium salts of endothall are effective for control of aquatic vegetation. The dimethylcocoamine derivative is somewhat more effective for control of submersed vegetation but is more than 100 times as toxic to fish than either disodium endothall or dipotassium endothall. Consequently, it is imperative that either the sodium or potassium salts be selected for use. At the rates needed for aquatic vegetation control, disodium endothall or dipotassium endothall will not harm fish. The oral toxicity to mammals is high and endothall must be handled with care. The hazard to birds related to use of endothall has not been demonstrated.

BENZOIC ACID COMPOUNDS

The benzoic acid compounds include 2,3,6-TBA and Dicamba. These compounds kill through both root and foliage absorption. They are temporary soil sterilants and affect both perennial and annual plants.

Dicamba

2-methoxy-3,6-dichlorobenzoic acid
(also Banvel D; Mediben)

Dicamba is formulated as the dimethylamine salt of 2-methoxy-3,6-dichlorobenzoic acid in water, containing 4 pounds acid equivalent, per gallon.

Dicamba is effective on several hard-to-kill broadleaf species including tartary buckwheat, wild garlic, knotweed, Russian-thistle, green smartweed, perennial sowthistle, corn spurry, Canada thistle, and wild buckwheat.

Used at the recommended rates of application dicamba will not be a significant hazard to fish or wildlife.

2,3,6-TBA

2,3,6-trichlorobenzoic acid
(also TBA; HC-1, 281; Benzac 1,281; Trysben; T-2; Tryben 200; TCB)

2,3,6-TBA is formulated as the dimethylamine salt of trichlorobenzoic acid, containing 2 pounds acid equivalent per gallon. It is nonvolatile, non-corrosive, and nonflammable.

2,3,6-TBA is more effective than the phenoxy compounds for control of field bindweed, bur-franseria, whitecockle, halogeton, Russian knapweed, and leafy spurge.

2,3,6-TBA can be used effectively without hazard to fish or wildlife.

PHENYLUREA COMPOUNDS

The phenylurea compounds are used primarily as soil sterilants and include monuron, diuron, and fenuron. They are low in volatility, noncorrosive, and nonflammable. These compounds are formulated as water-dispersible powders, liquids, granules, and pellets. Except for the granular and pelleted materials, all forms are applied as suspensions in relatively large volumes of water and require agitation in the spray tank.

Diuron
3-(3,4-Dichlorophenyl)-1,1-dimethylurea
(also Karmex; Marmer)

Diuron is formulated as a water-dispersible powder containing 80 percent active ingredient and as a liquid suspension containing 2.8 pounds active ingredient per gallon.

Diuron is more readily absorbed by all soils than monuron and; consequently, it is more persistent. It is more effective than monuron where rainfall exceeds 25 inches per year and diuron is not recommended for areas of low rainfall. Application of diuron on Bureau of Sport Fisheries and Wildlife lands must not exceed 4 pounds per acre, per year. It is not approved for aquatic vegetation control, and is not to be used in irrigation or domestic water supplies.

Data relative to toxicity of diuron to fish and other aquatic animals is somewhat conflicting, but for terrestrial use, there probably is no significant hazard to aquatic resources. Properly used, there should be no hazard to livestock and wildlife.

Fenuron
3-phenyl-1, 1 -dimethylurea
(also Dybar)

Fenuron is formulated in a pelleted product containing 25 percent active ingredient. It is inactivated more rapidly than monuron or diuron and is suitable as a soil sterilant only for dry areas.

When used in accordance with recommended procedures, fenuron is not a hazard to livestock or warm-blooded wildlife. The hazard to fish and aquatic resources cannot be properly evaluated because of inadequate toxicity data.

Monuron
3-(p - Chlorophenyl) -1, 1 -dimethylurea
(also CMU; Telvar)

Monuron is formulated as a granule and as a water-dispersible powder containing 80 percent active ingredient. Monuron, at equivalent rates, is more effective in light sandy soils than in heavy type soils. It is more active in mineral soils than those high in organic matter. At high application rates, it leaches readily from sandy soils and moves downward twice as fast as diuron in both clay and sandy soils. It is somewhat more effective on grasses than other vegetation. The phytotoxic effects of monuron are not immediately apparent. However, soil sterility may last 1 to 3 years depending upon application rates, soil type, and rainfall.

When used in accordance with recommended procedures, monuron will not be a hazard to livestock, fish, or wildlife.

TRIAZINES

The triazines are soil sterilants when applied at high rates and include simazine and atrazine. They are noncorrosive and nonflammable.

Atrazine

2-chloro-4-ethylamine-6-isopropylamino-s-triazine
(also Gesaprim)

Atrazine is formulated as an 80 percent water dispersible powder and a 4 percent granular product. It is more effective than simazine in dry areas and gives better control of horsetail, Indian hemp, prickly lettuce, yellow nutgrass, rush, sedge, and Canada thistle. Atrazine is absorbed through the leaves.

Application of atrazine on Bureau of Sport Fisheries and Wildlife lands must not exceed 4 pounds per acre, per year. It is not approved for aquatic vegetation control. When used in accordance with recommended procedures, atrazine will not be a hazard to fish or wildlife.

Simazine

2-chloro-4,6-bis(ethylamino)-s-triazine
(also CDT; CET; Simazine; Gestatop)

Simazine is practically insoluble in water. It is formulated as an 80 percent water dispersible powder and as a 4 percent granular product. Simazine has practically no contact action on foliage, consequently, there is no drift hazard. It is absorbed through the roots. Simazine is ineffective until water carries it to the root zone. Its action is slow.

Application of simazine on Bureau of Sport Fisheries and Wildlife lands must not exceed 4 pounds per acre, per year. It is not approved for aquatic vegetation control. When used in accordance with recommended procedures, simazine will not be a hazard to fish or wildlife.

COMMON NAMES FOR CHEMICALS USED AS HERBICIDES

<u>Common Name</u>	<u>Chemical Name</u>
AMS	Ammonium sulfamate
Atrazine	2-chloro-4-ethylamine-6-isopropyl-amino-s-triazine
Copper Sulfate	Copper sulfate
2,4-D	2,4-dichlorophenoxyacetic acid
AOHM	Alkanolamine salt
BEE	Butoxy ethanol ester
DMS	Dimethylamine salt
IOE	Iso-octyl ester
K Salt	Potassium salt
L. V. Ester	Low volatile ester
Na Salt	Sodium salt
PGBEE	Propylene glycol butyl ether ester
Dacthal	Dimethyl ester of tetrachloroterephthalic acid
Dalapon	Sodium salt of 2,2-dichloropropionic acid
Dicamba	2-methoxy-3,6-dichlorobenzoic acid
Diuron	3-(3,4-dichlorophenyl)-1,1-dimethylurea
Diquat	1,1'-ethylene-2,2'-dipyridinium dibromide
Endothall	1,2-dicarboxy-3,6-endoxocyclohexane
Fenuron	3-phenyl-1,1-dimethylurea
MCPA	2-methyl-4-chlorophenoxy acetic acid
Monuron	3-(p-chlorophenyl)-1,1-dimethylurea
Silvex	2-(2,4,5-trichlorophenoxy) propionic acid
BEE	Butoxy ethanol ester
IOE	Iso-octyl ester
K Salt	Potassium salt
Na Salt	Sodium salt
PGBEE	Propylene glycol butyl ether ester
Simazine	2-chloro-4,6-bis(ethylamino)-s-triazine
2,4,5-T	2,4,5-trichlorophenoxyacetic acid
DMS	Dimethylamine salt
BEE	Butoxy ethanol ester
IOE	Iso-octyl ester
PGBEE	Propylene glycol butyl ether ester
2,3,6-TBA	2,3,6-trichlorobenzoic acid
DMS	Dimethylamine salt

Table 1 - Plants Effectively Controlled with Herbicides

Refer to herbicide information sheet for restrictions and hazards.
Use in strict accordance with label instructions and recommendations.

Annual and Perennial Herbaceous Plants

Species	Herbicide
Absinth wormwood (<i>Artemisia absinthium</i>)	2,4-D (DMS)
Hoary alyssum (<i>Berteroa incana</i>)	2,4,5-T (DMS)
Palmer Amaranth (<i>Amaranthus palmeri</i>)	2,4 -D (DMS)
Ammannia (<i>Ammannia coccinea</i>)	2,4-D (DMS)
Jerusalum artichoke (<i>Helianthus tuberosus</i>)	2,4-D (DMS)
Manyflowered aster (<i>Aster ericoides</i>)	2,4-D (DMS)
Desert baileya (<i>Baileya multiradiata</i>)	2,4-D (DMS)
Foxtail barley (<i>Hordeum jubatum</i>)	Dalapon
Wild barley (<i>Hordeum lepoinum</i>)	Dalapon
Barnyardgrass (<i>Echinochloa crus galli</i>)	Dalapon
Bedstraw (<i>Galium aparine</i>)	Silvex (K salt)
Smooth bedstraw (<i>Galium mollugo</i>)	Silvex (K salt)
Beggarticks (<i>Bidens frondosa</i> and <i>B. vulgata</i>)	2,4 -D (DMS)
Creeping bellflower (<i>Campanula rapunculoides</i>)	2,3, 6-TBA (DMS)
Bermudagrass (<i>Cynodon dactylon</i>)	Dalapon
Field bindweed (<i>Convolvulus arvensis</i>)	2,3,6-TBA (DMS)
Hedge bindweed (<i>Convolvulus sepium</i>)	2,4-D (DMS)
Birdrape (<i>Brassica rapa</i>)	2,4 -D (DMS)
Biscuitroot (<i>Lomatium leptocarpum</i>)	2,4,5-T (DMS)
Bittercress (<i>Cardamine</i> spp.)	MCPA (DMS)
Blackeyed susan (<i>Rudbeckia serotina</i>)	2,4 -D (DMS)
Bloodweed (<i>Ambrosia aptera</i>)	2,4 -D (DMS)
Bluebells (<i>Campanula rotundifolia</i>)	2, 3, 6 -TBA (DMS)
Annual bluegrass (<i>Poa annua</i>)	Dacthal
Texas blueweed (<i>Helianthus ciliaris</i>)	AMS
Downy brome (<i>Bromus tectorum</i>)	Dalapon
Common broomweed (<i>Gutierrezia dracunculoides</i>)	2,4-D (DMS)
Tartary buckwheat (<i>Fagopyrum tartaricum</i>)	Dicamba
Wild buckwheat (<i>Polygonum convolvulus</i>)	Dicamba
Bullnettle (<i>Cnidocolus stimulosus</i>)	2,4-D (DMS)
California burclover (<i>Medicago hispida</i>)	Silvex (K salt)
Burcucumber (<i>Sicyos angulatus</i>)	MCPA (DMS)
Common burdock (<i>Arctium minus</i>)	MCPA (DMS)
Burhead (<i>Echinodorus cordifolius</i>)	2,4 -D (DMS)
Burweed (<i>Haplopappus tenuisectus</i>)	2,4-D (DMS)
Corn buttercup (<i>Ranunculus arvensis</i>)	MCPA (DMS)
Creeping buttercup (<i>Ranunculus repens</i>)	MCPA (DMS)
Smallflower buttercup (<i>Ranunculus abortivus</i>)	2,4 -D (DMS)
Tall buttercup (<i>Ranunculus acris</i>)	MCPA
Reed canarygrass (<i>Phalaris arundinacea</i>)	Dalapon

Species	Herbicide
Carpetweed (<i>Mollugo verticillata</i>)	2, 4 -D (DMS)
Wild carrot (<i>Daucus carota</i>)	AMS
Catnip (<i>Nepeta cataria</i>)	2,4-D (DMS)
Spotted catsear (<i>Hypochaeris radicata</i>)	2,4-D (DMS)
Centipedegrass (<i>Eremochloa ophiuroides</i>)	TCA
Common chickweed (<i>Stellaria media</i>)	Silvex (K salt)
Field chickweed (<i>Cerastium arvense</i>)	Silvex (K salt)
Mouse-ear chickweed (<i>Cerastium vulgatum</i>)	Silvex (BEE, JOE, PGBEE mixture)
Chicory (<i>Cichorium intybus</i>)	Silvex (K salt)
Common cinquefoil (<i>Potentilla canadensis</i>)	2,4-D (DMS)
Rough cinquefoil (<i>Potentilla norvegica</i>)	2,4-D (DMS)
Sulfur cinquefoil (<i>Potentilla recta</i>)	2,4-D (DMS)
White cockle (<i>Lychnis alba</i>)	2,3,6-TBA (DMS)
Common cocklebur (<i>Xanthium pennsylvanicum</i>)	2, 4 -D (DMS)
Coffeebean (<i>Sesbania exaltata</i>)	MCPA (DMS)
Coffeeweed (<i>Daubentonia texana</i>)	2, 4 -D (DMS)
Tall coneflower (<i>Rudbeckia laciniata</i>)	Silvex (K salt)
Cornflower (<i>Centaurea cyanus</i>)	2,4-D (DMS)
Coyotillo (<i>Karwinskia humboldtiana</i>)	Silvex (K salt)
Crabgrass (<i>Digitaria spp .</i>)	Dacthal
Lindheimer croton (<i>Croton lindheimeri</i>)	2,4-D (DMS)
Texas croton (<i>Croton texensis</i>)	Silvex (K salt)
Woolly croton (<i>Croton capitatus</i>)	Silvex (K salt)
Cutgrass (<i>Leersia spp.</i>)	Dalapon
Oxeye daisy (<i>Chrysanthemum leucanthemum</i>)	2,4,5-T
Dallisgrass (<i>Paspalum dilatatum</i>)	Dalapon
Dandelion (<i>Taraxacum officinale</i>)	2,4-D (DMS)
Dayflower (<i>Commelina communis</i>)	2,4-D (DMS)
Foothill deathcamas (<i>Zigadenus paniculatus</i>)	2,4-D (DMS)
Desertparsley (<i>Lomatium grayi</i>)	2, 4 -D (DMS)
Devilsclaw (<i>Proboscidea louisianica</i>)	2,4-D (DMS)
Broadleaf dock (<i>Rumex obtusifolius</i>)	2,4-D (DMS)
Curly dock (<i>Rumex crispus</i>)	2,4-D (DMS)
Fiddle dock (<i>Rumex pulcher</i>)	2,4-D (DMS)
Smooth dock (<i>Rumex altissimus</i>)	2,4-D (DMS)
Spreading dogbane (<i>Apocynum androsaemifolium</i>)	2, 4 -D (DMS)
Dogmustard (<i>Erucastrum gallicum</i>)	2,4-D (DMS)
Eveningprimrose (<i>Oenothera biennis</i>)	2, 4 -D (DMS)
Falseflax (<i>Camelina spp.</i>)	2,4-D (DMS)
Dog fennel (<i>Eupatorium capillifolium</i>)	2,4-D (DMS)
Coast fiddleneck (<i>Amsinckia intermedia</i>)	2,4-D (DMS)
Redstem filaree (<i>Erodium cicutarium</i>)	Dacthal
Annual fleabane (<i>Erigeron annuus</i>)	Silvex (K salt)
Rough fleabane (<i>Erigeron strigosus</i>)	2,4-D (DMS)
Flixweed (<i>Descurainia sophia</i>)	2,4-D (DMS)
Florida-pusley (<i>Richardia scabra</i>)	2,4-D (DMS)
Flower-of-an-hour (<i>Hibiscus trionum</i>)	2,4-D (DMS)

Species	Herbicide
Four-o'clock (<i>Mirabilis nyctaginea</i>)	2,4-D (DMS)
Foxtail (<i>Setaria</i> spp.)	Dalapon
Bristly foxtail (<i>Setaria verticillata</i>)	Dalapon
Knotroot foxtail (<i>Setaria geniculata</i>)	Dalapon
Burfranseria (<i>Franseria discolor</i>)	2,3,6-TBA (DMS)
Woollyleaf franseria (<i>Franseria tomentosa</i>)	2, 3, 6-TBA (DMS)
Hairy galinsoga (<i>Galinsoga ciliata</i>)	2,4-D (DMS)
Wild garlic (<i>Allium vineale</i>)	2, 3, 6-TBA (DMS)
Carolina geranium (<i>Geranium carolinianum</i>)	2,4-D (DMS)
Goatsbeard (<i>Tragopogon protensis</i>)	2,4-D (DMS)
Goldenrod (<i>Solidago</i> spp.)	AMS
Nettleleaf goosefoot (<i>Chenopodium murale</i>)	2,4-D (DMS)
Oakleaf goosefoot (<i>Chenopodium glaucum</i>)	2,4-D (DMS)
Goosegrass (<i>Eleusine indica</i>)	Dacthal
Wrights groundcherry (<i>Physalis wrightii</i>)	2,4-D (DMS)
Common groundsel (<i>Senecio vulgaris</i>)	Monuron
Cressleaf groundsel (<i>Senecio glabellus</i>)	2,4-D (DMS)
Riddell groundsel (<i>Senecio riddellii</i>)	2,4-D (DMS)
Gumweed (<i>Grindelia squarrosa</i>)	2,4-D (DMS)
Halogeton (<i>Halogeton glomeratus</i>)	2, 3, 6-TBA (DMS)
Mouseear hawkweed (<i>Hieracium pilosella</i>)	2,4-D (DMS)
Healall (<i>Prunella vulgaris</i>)	2,4-D (DMS)
Westernfalse hellebore (<i>Veratrum californicum</i>)	2,4-D (DMS)
Poison hemlock (<i>Conium maculatum</i>)	2,4-D (DMS)
Hemp (<i>Cannabis sativa</i>)	2,4-D (DMS)
Indian hemp (<i>Apocynum cannabinum</i>)	Atrazine
Henbit (<i>Lamium amplexicaule</i>)	Silvex (BEE, IOE, PGBEE mixture)
Hogpeanut (<i>Amphicarpa bracteata</i>)	2,4-D (DMS)
Hogpotato (<i>Hoffmanseggia densiflora</i>)	2,3, 6-TBA (DMS)
Water horehound (<i>Lycopus americanus</i>)	2,4-D (DMS)
Field horsetail (<i>Equisetum arvense</i>)	2,3,6-TBA
Horseweed (<i>Erigeron canadensis</i>)	Silvex (K salt)
Curly indigo (<i>Aeschynomene virginica</i>)	2,4,5-T (DMS)
Wild indigo (<i>Baptisia tinctoria</i>)	2,4,5-T (DMS)
Western ironweed (<i>Veinonia baldwini</i>)	2,4,5-T (DMS)
English ivy (<i>Hedera helix</i>)	2,4,5-T (DMS)
Ground ivy (<i>Glechoma heaeracea</i>)	Silvex (K salt)
Jewelweed (<i>Impatiens pallida</i>)	2,4-D (DMS)
Jimsonweed (<i>Datura stramonium</i>)	2,4-D (DMS)
Johnsongrass (<i>Sorghum halepense</i>)	Dalapon
Northern jointvetch (<i>Aeschynomene virginica</i>)	
See Curly indigo	
Klamath-weed (<i>Hypericum perforatum</i>)	Monuron
Black Knapweed (<i>Centaurea nigra</i>)	2,4-D (DMS)
Diffuse knapweed (<i>Centaurea diffusa</i>)	2,4-D (DMS)
Russian knapweed (<i>Centaurea repens</i>)	2, 3, 6-TBA (DMS)
Spotted knapweed (<i>Centaurea maculosa</i>)	MCPA
Knawel (<i>Scleranthus annuus</i>)	Silvex (K salt)

Species	Herbicide
Prostrate knotweed (<i>Polygonum aviculare</i>)	Dicamba
Sakhalin knotweed (<i>Polygonum sachalinense</i>)	2,4-D (DMS)
Kochia (<i>Kochia scoparia</i>)	2,4-D (DMS)
Ladysthumb (<i>Polygonum persicaria</i>)	Silvex (K salt)
Common lambsquarters (<i>Chenopodium album</i>)	2,4-D (DMS)
Tall larkspur (<i>Delphinium barbeyi</i>)	Silvex (K salt) plus 2,4,5-T (DMS)
Carrotleaf leptotaenia (<i>Leptotaenia multifida</i>)	2,4,5-T (DMS)
Prickly lettuce (<i>Lactuca scariola</i>)	2,4-D (DMS)
Bigbend locoweed (<i>Astragalus earlei</i>)	2,4-D (DMS)
Silvery lupine (<i>Lupinus argenteus</i>)	Silvex (K salt)
Tailcup (<i>Lupinus caudatus</i>)	2,4-D (DMS)
Marshelder (<i>Iva xanthifolia</i>)	2,4-D (DMS)
Black medic (<i>Medicago lupulina</i>)	Silvex (K salt)
Medusahead (<i>Elymus caput-medusae</i>)	Dalapon
Mexicantea (<i>Chenopodium ambrosioides</i>)	2,4-D (DMS)
Mexican-weed (<i>Caperonia castaneaefolia</i>)	Silvex (K salt)
Milkvetch (<i>Astragalus</i> spp.)	2,4-D (DMS)
Narrowleaf milkvetch (<i>Astragalus pectinatus</i>)	Silvex (K salt)
Twogrooved milkvetch (<i>Astragalus bisulcatus</i>)	2,4-D (DMS)
Bloodflower milkweed (<i>Asclepias curassavica</i>)	2,4-D (DMS)
Showy milkweed (<i>Asclepias speciosa</i>)	Silvex (K salt)
Texas millet (<i>Panicum texanum</i>)	Dacthal
Moneywort (<i>Lysimachia nummularia</i>)	2,4-D (DMS)
Morningglory (<i>Ipomoea</i> spp.)	Silvex (K salt)
Mulesears (<i>Wyethia amplexicaulis</i>)	Silvex (K salt)
Ball mustard (<i>Neslia paniculata</i>)	2,4-D (DMS)
Black mustard (<i>Brassica nigra</i>)	MCPA
Blue mustard (<i>Chorispora tenella</i>)	Silvex (K salt)
Haresear mustard (<i>Coringia orientalis</i>)	2,4-D (DMS)
Hedge mustard (<i>Sisymbrium officinale</i>)	2,4-D (DMS)
Indian mustard (<i>Brassica juncea</i>)	MCPA
Tumble mustard (<i>Sisymbrium altissimum</i>)	2,4-D (DMS)
White mustard (<i>Brassica hirta</i>)	2,4-D (DMS)
Wild mustard (<i>Brassica kaber</i>)	MCPA
Wormseed mustard (<i>Erysimum cheiranthoides</i>)	2,4-D (DMS)
Burning nettle (<i>Urtica urens</i>)	2,4-D (DMS)
Stinging nettle (<i>Urtica dioica</i>)	MCPA
Tall nettle (<i>Urtica procera</i>)	2,4-D (DMS)
Niggerhead (<i>Rudbeckia occidentalis</i>)	2,4-D (DMS)
Black nightshade (<i>Solanum nigrum</i>)	Silvex (K salt)
Nimblewill (<i>Muhlenbergia schreberi</i>)	Dacthal
Wild oats (<i>Avena fatua</i> and <i>Avena ludoviciana</i>)	Dalapon
Wild onion (<i>Allium canadense</i>)	Dicamba
Halberdleaf orache (<i>Atriplex patula</i> var. <i>hastata</i>)	2,4-D (DMS)
Panicum (<i>Panicum</i> spp.)	Dacthal
Fall panicum (<i>Panicum dichotomiflorum</i>)	Dacthal
Wild parsnip (<i>Pastinaca sativa</i>)	2,4-D (DMS)

Species	Herbicide
Partridgepea (<i>Cassia fasciculata</i>)	2,4-D (DMS)
Paspalum (<i>Paspalum</i> spp.)	Dalapon
Maypop passionflower (<i>Passiflora incarnata</i>)	Silvex (K salt)
Wild pea (<i>Lathyrus aphaca</i>)	2,4-D (DMS)
Peavine (<i>Astragalus emoryanus</i>)	2,4-D (DMS)
Pellitoryweed (<i>Parietaria floridana</i>)	2,4,5-T (DMS)
Field pennycress (<i>Thlaspi arvense</i>)	2,4-D (DMS)
Lawn pennywort (<i>Hydrocotyle sibthorpioides</i>)	Silvex (K salt)
Clasping pepperweed (<i>Lepidium perfoliatum</i>)	MCPA
Field pepperweed (<i>Lepidium campestre</i>)	MCPA
Greenflower pepperweed (<i>Lepidium densiflorum</i>)	2,4-D (DMS)
Perennial pepperweed (<i>Lepidium latifolium</i>)	MCPA
Virginia pepperweed (<i>Lepidium virginicum</i>)	MCPA
Yellowflower pepperweed (<i>Lepidium perfoliatum</i>)	
See Clasping pepperweed	
Prostrate pigweed (<i>Amaranthus graecizans</i>)	2,4-D (DMS)
Redroot pigweed (<i>Amaranthus retroflexus</i>)	2,4-D (DMS)
Russian pigweed (<i>Axyris amaranthoides</i>)	2,4-D (DMS)
Smooth pigweed (<i>Amaranthus hybridus</i>)	2,4-D (DMS)
Spiny pigweed (<i>Amaranthus spinosus</i>)	2,4-D (DMS)
Tumble pigweed (<i>Amaranthus albus</i>)	2,4 -D (DMS)
Blackseed plantain (<i>Plantago rugelii</i>)	2,4-D (DMS)
Bracted plantain (<i>Plantago aristata</i>)	2,4-D (DMS)
Broadleaf plantain (<i>Plantago major</i>)	2,4-D (DMS)
Buckhorn plantain (<i>Plantago lanceolata</i>)	2,4-D (DMS)
Slender plantain (<i>Plantago pusilla</i>)	2,4 -D (DMS)
Woolly plantain (<i>Plantago purshii</i>)	2,4-D (DMS)
Pokeweed (<i>Phytolacca americana</i>)	Silvex (K salt)
Poorjoe (<i>Diodia teres</i>)	2,4-D (DMS)
Roemer poppy (<i>Roemeria refracta</i>)	2,4-D (DMS)
Povertyweed (<i>Iva axillaris</i>)	2,4-D (DMS)
Mexican pricklepoppy (<i>Argemone intermedia</i>)	2,4-D (DMS)
Puncturevine (<i>Tribulus terrestris</i>)	2,4 -D (DMS)
Common purslane (<i>Portulaca oleracea</i>)	Dacthal
Quackgrass (<i>Agropyron repens</i>)	Atrazine
Wild radish (<i>Raphanus raphanistrum</i>)	2,4-D (DMS)
Common ragweed (<i>Ambrosia artemisiifolia</i>)	2,4-D (DMS)
Giant ragweed (<i>Ambrosia trifida</i>)	2,4-D (DMS)
Perennial ragweed (<i>Ambrosia psilostachya</i>)	2,4-D (DMS)
Tansy ragwort (<i>Senecio jacobaea</i>)	2,4 -D (DMS)
Wild rape (<i>Rapistrum rugosum</i>)	2,4-D (DMS)
Redstem (<i>Ammannia coccinea</i>)	2,4-D (DMS)
Redtop (<i>Agrostis</i> spp.)	Monuron
Rescuegrass (<i>Bromus willdenowii</i>)	Monuron
London rocket (<i>Sisymbrium irio</i>)	2,4 -D (DMS)
Yellow rocket (<i>Barbarea vulgaris</i>)	2,4-D (DMS)
Bitter rubberweed (<i>Hymenoxys odorata</i>)	2,4-D (DMS)
Colorado rubberweed (<i>Hymenoxys richardsoni</i>)	2,4-D (DMS)

Species	Herbicide
Ryegrass (<i>Lolium</i> spp.)	Dalapon
Creeping sage (<i>Salvia sonomensis</i>)	2,4-D (DMS)
Purple sage (<i>Salvia leucophylla</i>)	2,4 -D (DMS)
White sage (<i>Salvia apiana</i>)	2,4 -D (DMS)
Meadow salsify (<i>Tragopogon pratensis</i>)	
See Goatsbeard	
Western salsify (<i>Tragopogon major</i>)	2,4-D (DMS)
Sandburs (<i>Cenchrus</i> spp.)	Dalapon
Thymeleaf sandwort (<i>Arenaria serpyllifolia</i>)	2,4-D (DMS)
Sesbania (<i>Sesbania exaltata</i>)	
See Coffeebean	
Shepherdpurse (<i>Capsella bursa-pastoris</i>)	2,4-D (DMS)
Sicklepod (<i>Cassia tora</i>)	2,4-D (DMS)
Alkali sida (<i>Sida hederacea</i>)	2,3,6-TBA
Skeletonweed (<i>Lygodesmia juncea</i>)	2,4-D (DMS)
Skunkcabbage (<i>Symplocarpus foetidus</i>)	2,4-D (DMS)
Green smartweed (<i>Polygonum scabrum</i>)	Dicamba
Japanese smartweed (<i>Polygonum cuspidatum</i>)	AMS
Ladysthumb smartweed (<i>Polygonum persicaria</i>)	
See Ladysthumb	
Pennsylvania smartweed (<i>Polygonum pennsylvanicum</i>)	2 , 4 -D (DMS)
Swamp smartweed (<i>Polygonum coccineum</i>)	Monuron
Threadleaf snakeweed (<i>Gutierrezia microcephala</i>)	2,4-D (DMS)
Bitter sneezeweed (<i>Helenium tenifolium</i>)	2,4-D (DMS)
Snow-on-the-mountain (<i>Euphorbia marginata</i>)	2,4,5-T (DMS)
Sorrel (<i>Rumex acetosa</i>)	2,4-D (DMS)
Heartwing sorrel (<i>Rumex hastatulus</i>)	2,4-D (DMS)
Red sorrel (<i>Rumex acetosella</i>)	Dicamba
Annual sowthistle (<i>Sonchus oleraceus</i>)	2,4-D (DMS)
Perennial sowthistle (<i>Sonchus arvensis</i>)	Dicamba
Spiny sowthistle (<i>Sonchus asper</i>)	2,4-D (DMS)
Spanishneedles (<i>Bidens bipinnata</i>)	2,4-D (DMS)
Speedwell (<i>Veronica</i> spp.)	Monuron
Purslane speedwell (<i>Veronica peregrina</i>)	2,4-D (DMS)
Flowering spurge (<i>Euphorbia corollata</i>)	2,4 ,5-T (DMS)
Leafy spurge (<i>Euphorbia esula</i>)	2,3,6-TBA (DMS)
Corn spurry(<i>Spergula arvensis</i>)	Dicamba
Star -of -Bethlehem (<i>Ornithogalum umbellatum</i>)	2,3,6-TBA (DMS)
European sticktight (<i>Lappula echinata</i>)	2,4-D (DMS)
Stinkgrass (<i>Eragrostis cilianensis</i>)	Dacthal
Stinkwort (<i>Stellaria graminea</i>)	2,4-D (DMS)
St. Johnswort (<i>Hypericum perforatum</i>)	
See Klamath-weed	
Rough sumpweed (<i>Iva ciliata</i>)	2,4-D (DMS)
Sunflower (<i>Helianthus annuus</i>)	2 , 4 -D (DMS)
Prairie sunflower (<i>Helianthus petiolaris</i>)	2,4 -D (DMS)
Yellow annual sweetclover (<i>Melilotus indica</i>)	2,4-D (DMS)
Swinecress (<i>Coronopus didymus</i>)	2 , 4 -D (DMS)

Species	Herbicide
Tansymustard (<i>Descurainia pinnata</i>)	2,4-D (DMS)
Blessed thistle (<i>Cnicus benedictus</i>)	2,4-D (DMS)
Bull thistle (<i>Cirsium vulgare</i>)	2,4-D (DMS)
Canada thistle (<i>Cirsium arvense</i>)	Dicamba
Russian thistle (<i>Salsola kali</i>)	2,4-D (DMS)
Tickseed (<i>Coreopsis tinctoria</i>)	2,4-D (DMS)
Tievine (<i>Jacquemontia tamnifolia</i>)	Silvex (K salt)
Yellow toadflax (<i>Linaria vulgaris</i>)	Monuron
Velvetleaf (<i>Abutilon theophrasti</i>)	2,4-D (DMS)
Vervain (<i>Verbena spp.</i>)	2,4-D (DMS)
Common vetch (<i>Vicia sativa</i>)	2,4-D (DMS)
Narrowleaf vetch (<i>Vicia angustifolia</i>)	2,4-D (DMS)
Spotted waterhemlock (<i>Cicuta maculata</i>)	2,4-D (DMS)
Whiteclover (<i>Trifolium repens</i>)	2,4-D (DMS)
Witchweed (<i>Striga asiatica</i>)	2,4-D (DMS)
Yellow woodsorrel (<i>Oxalis stricta</i>)	Silvex (K salt)
Annual wormwood (<i>Artemesia annua</i>)	2,4-D (DMS)
Biennial wormwood (<i>Artemesia biennis</i>)	2,4-D (DMS)
Yellow-rattle (<i>Rhinanthus spp.</i>)	2,4-D (DMS)

Woody Vegetation

Mescat acacia (<i>Acacia constricta</i>)	Fenuron
Alianthus (<i>Alianthus spp.</i>)	2,4, 5-T (BEE, IOE, or PGBEE)
Black alder (<i>Ilex verticillata</i>)	Brush Killer*
Speckled alder (<i>Alnus incana</i>)	Brush Killer*
Tag alder (<i>Alnus tenuifolia</i>)	2,4,5-T (BEE, IOE, or PGBEE)
American aspen (<i>Populus tremuloides</i>)	+ TCA Na Salt
Quaking aspen (<i>Populus tremuloides</i>)	2,4, 5-T (BEE, IOE, or PGBEE)
Allegheny barberry (<i>Berberis canadensis</i>)	2,4,5-T (BEE, IOE, or PGBEE)
Fendler barberry (<i>Berberis fendleri</i>)	2,4-D (BEE, TOE, or PGBEE)
Beech (<i>Fagus grandifolia</i>)	AMS
Birch (<i>Betula spp.</i>)	2,4,5-T (BEE, TOE, or PGBEE)
Blackberry (<i>Rubus spp.</i>)	2,4,5-T (BEE, IOE, or PGBEE)
Boxelder (<i>Acer negundo</i>)	2,4,5-T (BEE, IOE, or PGBEE)
Coralberry buckbrush (<i>Symphoricarpos orbiculatus</i>)	2,4-D (BEE, TOE, or PGBEE)

*Brush Killer - One-third to one-half 2,4,5-T (**BEE, IOE, or PGBEE**) to two thirds to one-half 2,4-D (BEE, TOE, or PGBEE). See page 13.

Species	Herbicide
Woolly buckthorn (<i>Bumelia lanuginosa</i>)	2,4,5-T (BEE, IOE, or PGBEE)
Buttonball bush (<i>Cephalanthus occidentalis</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Varnishleaf ceanothus (<i>Ceanothus velutinus</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Wedgeleaf ceanothus (<i>Ceanothus cuneatus</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Northern white cedar (<i>Truja occidentalis</i>)	Dalapon
Cherry (<i>Prunus spp.</i>)	AMS
American chestnut (<i>Castanea dentato</i>)	AMS
Chittam (<i>Bumelia lanuginosa</i>)	
See Woolly buckthorn	
Jumping cholla (<i>Opuntia fulgida</i>)	Silvex (BEE, IOE, PGBEE mixture)
Kentucky coffeetree (<i>Gymnocladus dioica</i>)	AMS
Eastern cottonwood (<i>Populus deltoides</i>)	2,4-D (BEE, JOE, or PGBEE)
Coyotebrush (<i>Baccharis pilularis</i>)	2,4-D (BEE, IOE, or PGBEE)
Creosotebush (<i>Covillea tridentata</i>)	Fenuron
Currants (<i>Ribes spp.</i>)	2,4,5-T (BEE, TOE, or PGBEE)
Deer brush (<i>Ceanothus integerrimus</i>)	2,4-D (BEE, IOE, or PGBEE)
Deer weed (<i>Ceanothus papillosus</i>)	2,4,5-T (BEE, TOE, or PGBEE)
Dogwood (<i>Cornus spp.</i>)	Fenuron
Flowering dogwood (<i>Cornus florida</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Elderberry (<i>Sambucus spp.</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Elm (<i>Ulmus spp.</i>)	AMS
Winged elm (<i>Ulmus alata</i>)	Fenuron
Eucalyptus (<i>Eucalyptus spp.</i>)	AMS
Frigolito (<i>Sophora secundiflora</i>)	2,4,5-T (BEE, TOE, or PGBEE)
Gooseberry (<i>Ribes spp.</i>)	2,4-D (BEE, JOE, or PGBEE)
Fringed greenbrier (<i>Smilax bona-nox</i>)	AMS
Groundsel tree (<i>Baccharis halminifolia</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Common guava (<i>Psidium guajava</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Black gum (<i>Nyssa sylvatica</i>)	AMS
Hackberry (<i>Celtis occidentalis</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Hickory (<i>Carya spp.</i>)	AMS

Species	Herbicide
Honeysuckle (<i>Lonicera ciliosa</i>)	Silvex (BEE, JOE, PGBEE mixture)
Bush honeysuckle (<i>Diervilla lonicera</i>)	2,4-D (BEE, JOE, or PGBEE)
Hophornbeam (<i>Ostrya virginiana</i>)	AMS
Wild Hydrangea (<i>Hydrangea arborescens</i>)	2,4-D (BEE, JOE, or PGBEE)
Juniper (<i>Juniperus</i> spp.) (<i>Juniperus horizontalis</i> 'plumosa')	2,3,6-TBA Simazine
Kidneywort (<i>Baccharis pilularis</i>) See Coyotebrush	
Lantana (<i>Lantana camara</i>)	Fenuron
Leatherwood (<i>Dirca palustris</i>)	2,4-D (BEE, TOE, or PGBEE)
Lilac (<i>Syringa vulgaris</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Black locust (<i>Robinia pseudoacacia</i>)	2,4,5-T (BEE, IOE, or PGBEE)
Lotebush (<i>Condalia obtusifolia</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Lupine (<i>Lupinus rivularis</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Magnolia (<i>Magnolia</i> spp.)	2,4,5-T (BEE, IOE, or PGBEE)
Maple (<i>Acer</i> spp.)	Silvex (BEE, IOE, or PGBEE)
Mesquite (<i>Prosopis chilensis</i>)	Fenuron
Mountain misery (<i>Chamaebatia foliolosa</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Mulberry (<i>Morus</i> spp.)	Fenuron
Norcalbean (<i>Sophora secundiflora</i>) See Frigolito	
California blue oak (<i>Quercus douglasii</i>)	Fenuron
Jack oak (<i>Quercus ellipsoidal</i>)	AMS
Post oak (<i>Quercus stellata</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Northern red oak (<i>Quercus rubra</i>)	AMS
Scarlet oak (<i>Quercus coccinea</i>)	AMS
Shinnery oak (<i>Quercus havardii</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Turkey oak (<i>Quercus laevis</i>)	Silvex (BEE, IOE, PGBEE mixture)
White oak (<i>Quercus alba</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Osage-orange (<i>Maclura pomifera</i>)	2,4,5-T (BEE, IOE, or PGBEE)
Saw palmetto (<i>Serenoa repens</i>)	Silvex (BEE, JOE, PGBEE mixture)

Species	Herbicide
Pea-tree (<i>Caragana arborescens</i>)	2,4,5-T (BEE, TOE, or PGBEE)
Pecan (<i>Carya pecan</i>)	AMS
Persimmon (<i>Diospyros virginiana</i>)	AMS
Black persimmon (<i>Diospyros texana</i>)	2,4-D (BEE, IOE, or PGBEE)
Pin cherry (<i>Prunus pennsylvanicum</i>)	2,4-D (BEE, JOE, or PGBEE)
Jack pine (<i>Pinus banksiana</i>)	Dalapon
Northern white pine (<i>Pinus strobus</i>)	Dalapon
Chickasaw plum (<i>Prunus angustifolia</i>)	AMS
Poison-ivy (<i>Rhus toxicodendron</i>)	AMS
Poison-oak (<i>Rhus diversiloba</i>)	AMS
Poison-sumac (<i>Rhus vernix</i>)	AMS
Balsam poplar (<i>Populus balsamifera</i>)	2,4-D (BEE, TOE, or PGBEE)
Black raspberry (<i>Rubus</i> spp.)	2,4,5-T (BEE, JOE, or PGBEE)
Red raspberry (<i>Rubus</i> spp.)	2,4,5-T (BEE, JOE, or PGBEE)
Redbay (<i>Persea borbonia</i>)	2,4,5-T (BEE, IOE, or PGBEE)
Redbud (<i>Cercis canadensis</i>)	Silvex (BEE, TOE, PGBEE mixture)
Western redbud (<i>Cercis occidentalis</i>)	Silvex (BEE, JOE, PGBEE mixture)
Eastern red cedar (<i>Juniperus virginiana</i>)	Fenuron
Cherokee rose (<i>Rosa laevigata</i>)	Silvex (BEE, JOE, PGBEE mixture)
Multiflora rose (<i>Rosa multiflora</i>)	2,3,6-TBA
Prairie rose (<i>Rosa pratincola</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Big sagebrush (<i>Artemisia tridentata</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Coastal sagebrush (<i>Artemisia californica</i>)	2,4,5-T (BEE, TOE, or PGBEE)
Sand sagebrush (<i>Artemisia filifolia</i>)	2,4,5-T (BEE, IOE, or PGBEE)
Salmonberry (<i>Rubus spectabilis</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Saltcedar (<i>Tamarix gallica</i>)	Silvex (BEE, JOE, PGBEE mixture)
Saskatoon (<i>Amelanchier alnifolia</i>)	2,4-D (BEE, IOE, or PGBEE)
Sassafras (<i>Sassafras albidum</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Scotch broom (<i>Cytisus scoparius</i>)	2,4,5-T (BEE, JOE, or PGBEE)

Species	Herbicide
Seamyrrtle (<i>Baccharis halimifolia</i>) See Groundsel tree	
Serviceberry (<i>Amelanchier canadensis</i>)	2,4-D (BEE, JOE, or PGBEE)
Silverberry (<i>Elaeagnus argentea</i>)	2,4-D (BEE, JOE, or PGBEE)
Skunkbrush (<i>Rhus trilobata</i>) See Lemonade sumac	
Smilax (<i>Smilax</i> spp.)	AMS
Western snowberry (<i>Symphoricarpos occidentalis</i>)	AMS
Snowbrush (<i>Ceanothus velutinus</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Sourwood (<i>Oxydendrum arboreum</i>)	2,4-D (BEE, JOE, or PGBEE)
Spicebush (<i>Benzoin aestivale</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Spiraea (<i>Spiraea</i> spp.)	2,4,5-T (BEE, JOE, or PGBEE)
Spruce (<i>Picea</i> spp.)	AMS
Sumac (<i>Rhus</i> spp.)	2,4,5-T (BEE, JOE, or PGBEE)
Chinese sumac (<i>Ailanthus</i> spp.) See Alianthus	
Lemonade sumac (<i>Rhus trilobata</i>)	2,4-D (BEE, IOE, or PGBEE)
Smooth sumac (<i>Rhus glabra</i>)	Brush Killer*
Staghorn sumac (<i>Rhus typhina</i>)	Brush Killer*
Sweetgum (<i>Liquidambar styraciflua</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Sycamore (<i>Platanus occidentalis</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Tarbrush (<i>Flourensia cernua</i>)	2,4-D (BEE, JOE, or PGBEE)
Thimbleberry (<i>Rubus parviflorus</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Toyon (<i>Photinia arbutifolia</i>)	2,4-D (BEE, JOE, or PGBEE)
Tree-of-heaven (<i>Ailanthus altissima</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Trumpetcreeper (<i>Campsis radicans</i>)	Silvex (BEE, JOE, PGBEE mixture)
Tuliptree (<i>Liriodendron tulipifera</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Mapleleaf viburnum (<i>Viburnum acerifolium</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Black walnut (<i>Juglans nigra</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Whitethorn (<i>Acacia constricta</i>) See Mescat acacia	

Species	Herbicide
Willow (<i>Salix</i> spp.)	2,4,5-T (BEE, IOE, or PGBEE)
Willowweed (<i>Epilobium</i> spp.)	2,4,5-T (BEE, JOE, or PGBEE)
Witch-hazel (<i>Betula lutea</i> var. <i>macrolepis</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Wolfwillow (<i>Elaeagnus argentea</i>) See Silverberry	
California yerba-santa (<i>Eriodictyon californicum</i>)	2,4,5-T (BEE, JOE, or PGBEE)
Yucca (<i>Yucca smalliana</i>)	Silvex (BEE, IOE, PGBEE mixture)

Aquatic Vegetation

Algae (<i>Anabaena</i>)	Copper sulfate or Diquat
(<i>Aphanizomenon</i>)	Copper sulfate
(<i>Chara</i> spp.)	Copper sulfate or Diquat
(<i>Cladophora</i>)	Copper sulfate or Diquat
(<i>Hydrodictyon</i>)	Copper sulfate or Diquat
(<i>Mycrocystis</i>)	Copper sulfate
(<i>Mougeotia</i>)	Copper sulfate
(<i>Oedogonium</i>)	Copper sulfate
(<i>Oscillatoria</i>)	Diquat
(<i>Pithophora</i>)	Endothall (Na or K salt)
(<i>Spirogyra</i>)	Copper sulfate
(<i>Zygnema</i>)	Copper sulfate
Alligatorweed (<i>Alternanthera philoxeroides</i>)	Silvex (BEE or PGBEE)
Arrowarum (<i>Peltandra virginica</i>)	2,4-D (DMS, AOHM, or JOE)
Arrowhead (<i>Sagittaria calycina</i>)	Silvex (K salt)
(<i>Sagittaria longiloba</i>)	Silvex (K salt)
Bladderwort (<i>Utricularia</i> spp.)	Silvex (K salt or PGBEE)
Bulrush (<i>Scirpus</i> spp.)	
Threesquare burreed (<i>Sparganium americanum</i>)	Endothall (Na or K salt)
Cabomba (<i>Cabomba caroliniana</i>)	Silvex (K salt or PGBEE)
Common cattail (<i>Typha latifolia</i>)	Dalapon or 2,4-D (BEE, IOE or PGBEE)

Species	Herbicide
Narrowleaf cattail (<i>Typha angustifolia</i>)	Dalapon or 2,4-D (BEE, JOE, or PGBEE)
Common coontail (<i>Ceratophyllum demersum</i>)	Endothall (Na or K salt) or 2,4-D (IOE)
Ducksalad (<i>Heteranthera limosa</i>)	2, 4 -D (DMS)
Common duckweed (<i>Lemna minor</i>)	Diquat
Eelgrass (<i>Vallisneria americana</i>)	Silvex (K salt)
Elodea (<i>Elodea canadensis</i>)	Diquat or Silvex (K salt, PGBEE or JOE)
Fanwort (<i>Cabomba caroliniana</i>) See Cabomba	
Hibiscus (<i>Hibiscus moschoutos</i> , <i>H. militaris</i> , <i>H. lasiocarpus</i>)	2,4 -D (DMS, AOHM, or PGBEE)
Spiked loosestrife (<i>Lythrum salicaria</i>)	Silvex (K salt)
American lotus (<i>Nelumbo lutea</i>)	Silvex (K salt) or 2,4-D (DMS or JOE)
Maidencane (<i>Panicum hemitomon</i>)	Dalapon
Water mannagrass (<i>Glyceria fluitans</i>)	Dalapon
Southern naiad (<i>Najas guadalupensis</i>)	Diquat
Parrotfeather (<i>Myriophyllum brasiliense</i>)	Endothall (Na or K salt) or Silvex (K salt)
Paragrass (<i>Panicum purpurascens</i>)	Dalapon
Water pennywort (<i>Hydrocotyle umbellata</i>)	2,4-D (DMS or JOE)
Phragmites (<i>Phragmites communis</i>)	Dalapon
Pickernelweed (<i>Pontederia cordata</i>)	Silvex (K salt)
Pondweed (<i>Potamogeton</i> spp.)	Endothall (Na or K salt) or Silvex (K salt, BEE, PGBEE or JOE)
Horned pondweed (<i>Zannichellia palustris</i>)	Endothall (Na or K salt)
Leafy pondweed (<i>Potamogeton foliosus</i>)	Diquat
Sago pondweed (<i>Potamogeton pectinatus</i>)	Diquat
Giant reed (<i>Phragmites communis</i>) See Phragmites	
Rush (<i>Juncus</i> spp.)	2,4 -D (DMS)
Needle rush (<i>Juncus roemerianus</i>)	2,4 -D (DMS, AOHM, or JOE)
Sedge (<i>Carex</i> spp.)	Dalapon
Water smartweed (<i>Polygonum amphibium</i>)	2,4-D (DMS)
Spatterdock (<i>Nuphar advena</i>)	Silvex (K salt) or 2, 4 -D (DMS, AOHM, or JOE)

Species	Herbicide
Swamp loosestrife (<i>Decodon verticillatus</i>)	2,4-D (DMS, AOHM, BEE, IOE or PGBEE)
Floating sweetgrass (<i>Glyceria fluitans</i>) See water mannagrass	
Waterchestnut (<i>Trapa natans</i>)	2,4-D (DMS or JOE)
Watercress (<i>Nasturtium officinale</i>)	2,4-D (DMS)
Watercrowfoot (<i>Ranunculus aquatilis</i>)	Silvex (K salt)
Waterhyacinth (<i>Eichhornia crassipes</i>)	Silvex (K salt)
Waterlettuce (<i>Pistia stratiotes</i>)	Invert emulsion of 2,4-D (BEE, IOE or PGBEE) or 2,4,5-T (BEE, IOE or PGBEE)**
Waterlily (<i>Nymphaea</i> spp.)	2,4-D (DMS, BEE or JOE) or Silvex (K salt)
Broadleaf watermilfoil (<i>Myriophyllum heterophyllum</i>)	Silvex (K salt, BEE, IOE or PGBEE) or 2,4-D (IOE)
Common waterplantain (<i>Alisma triviale</i>)	2,4-D (DMS)
Waterprimrose (<i>Jussiaea</i> spp.)	Silvex (K salt) or 2,4-D (IOE)
Watershield (<i>Brasenia schreberi</i>)	Silvex (K salt or PGBEE)
Waterstargrass (<i>Heteranthera dubia</i>)	Silvex (K salt) or 2,4-D (IOE)
Waterstarwort (<i>Callitriche verna</i>)	Silvex (K salt)
Canada waterweed (<i>Elodea canadensis</i>) See Elodea	
Wildcelery (<i>Vallisneria</i> spp.) See Eelgrass	

**Water sprays are ineffective on waterlettuce . Use an invert emulsion of low volatile ester of 2,4-D, or 2,4,5-T or a mixture of 2,4-D and 2,4,5-T emulsified with 10 or 15 percent (by volume) diesel oil in water. Invert emulsions are water-in-oil mixtures in which spray droplets are surrounded by oil instead of water. Add water slowly to premixed herbicide-oil solution under constant mechanical agitation.

DEFINITIONS OF TERMS USED IN VEGETATION CONTROL

The definitions and explanations in this glossary apply to words as they are used in this manual and on herbicide labels.

Acid equivalent - The theoretical yield of parent acid from an active ingredient. It is used instead of or in addition to the active ingredient for certain herbicides.

Active ingredient - The chemical compound in a product that is responsible for the herbicidal effects.

Band application - An application to a continuous restricted area such as in or along a crop row rather than over the entire field area.

Annual - A plant that completes its life cycle from seed in 1 year.

Basal-bark applications - Herbicide treatments applied to the stems of woody plants at or just above the ground.

Biennial - A plant that completes its life cycle in 2 years. The first year it produces leaves and stores food. The second year it produces fruits and seeds.

Broadcast application - Uniform distribution of a herbicide over an entire area.

Broad-leaved plants - Botanically, those classified as dicotyledons. Morphologically, those that have broad, usually compound leaves.

Carrier - The liquid or solid material added to a chemical compound to facilitate its application in the field.

Cation exchange - The exchange of positive ions (H, Ca, Mg, Na, NH₄) from clay particles for other cations. Soils are able to filter out salts in much the same way a water softener removes them. Some soils have a larger capacity than others for doing this. Such soils can adsorb or filter out and hold large amounts of a herbicide so that it is not immediately effective. The cation exchange capacity of a soil can be learned from the State Agricultural Experiment station.

Chemical name - One that indicates the chemical composition of the compound and also the structure of the molecule in organic compounds.

Compatible pesticides - Compounds or formulations that can be mixed and applied together without undesirably altering their separate effects.

Concentration - The amount of active ingredient or acid equivalent in a given volume of liquid or in a given weight of dry material.

Contact herbicide - One that kills primarily by contact with plant tissue rather than as a result of translocation.

Cut-surface applications - Treatments made to frills or girdles that have been made with an ax through the bark and well into the wood of woody plants.

Deciduous trees - Those that lose their leaves during winter.

Defoliator or Defoliant - A compound which causes the leaves to drop from the plant.

Desiccant - A compound that promotes dehydration or removal of moisture from plant tissue.

Detergent - A chemical (not soap) having the ability to remove oil or grime. Household detergents can be used as surfactants in herbicide sprays.

Diluent - Any liquid or solid material that dilutes an active ingredient in the preparation of a formulation.

Dormant spray - A herbicide applied during the period after leaf-fall or death of leaves and before bud-break of deciduous trees.

Emulsifiable concentrates - Usually liquids in which the chemical is dissolved in one or more water-insoluble solvents such as oil or benzene to which an emulsifier is added.

Emulsifier - A surface active material that facilitates the suspension of one liquid in another.

Emulsion - The suspension of one liquid as minute globules in another liquid; for example, oil dispersed in water.

Formulation - A term used synonymously with product. It contains the herbicide in a form that can be (1) dissolved or suspended in a carrier and distributed in solution or suspension by sprayers, (2) distributed dry by dusters or spreaders, or (3) easily vaporized for fumigation.

Granular products - Formulations in which the chemical is impregnated on or in vermiculite, attaclay, or other suitable carrier and then formed into granules or pellets.

Growth regulator - An organic substance effective in minute amounts for controlling or modifying plant processes.

Hard water - Water that contains certain minerals, usually calcium and magnesium sulfates, chlorides, or carbonates, in solution in amounts that cause a curd or precipitate instead of a lather when soap is added. Generally defined as containing 322 ppm in terms of calcium carbonate. Very hard water may cause precipitates in some herbicidal sprays.

Herbaceous plant - A vascular plant that does not develop woody tissue.

Herbicide - A phytotoxic chemical used for killing or inhibiting the growth of plants.

Invert emulsion - One in which oil is the continuous phase and water is dispersed in it.

Isomers - Two or more substances having the same chemical composition but different properties.

Leaching - Movement of a substance in solution downward through the soil.

Low-volatile ester - Chemically, an ester with a heavy molecular weight such as the butoxyethanol, iso-octyl, or propylene glycol butyl ether esters. Low-volatile esters do not include the methyl, ethyl, propyl, isopropyl, butyl, amyl, and pentyl esters.

Nonselective herbicide - A chemical that is toxic to plants generally without regard to species.

Perennial - A plant that lives more than 2 years.

pH - The chemist's measure of acidity and alkalinity. It is a scale in which the figure 7 indicates neutral, figures below 7 indicate acidity, and figures above 7 indicate an alkaline reaction.

Photosynthesis - The process by which carbohydrates are manufactured by the chlorophyll-bearing cell granules (**chloroplasts**) from carbon dioxide and water by exposure to the energy of sunlight.

Phytotoxic - Poisonous to plants.

Postemergence - After emergence of specified plant.

Preemergence - Prior to emergence of specified plant.

Preplanting - Anytime before the crop is planted.

Product - The herbicide as it is sold commercially. It contains not only the active ingredients but also various solvents, cosolvents, surfactants, carriers, and other adjuvants that are designated as inert ingredients.

Rate - The amount of active ingredient or acid equivalent of a herbicide applied to a unit area.

Selective herbicide - A chemical that is more toxic to some plant species than to others.

Slurry - A watery mixture or suspension of an insoluble herbicide.

Soil application - Application of herbicide made primarily to the soil surface rather than to vegetation.

Soil sterilant - A herbicide that prevents the growth of green plants when present in the soil. Soil sterilization effects may be temporary or relatively permanent. It does not necessarily kill all life in the soil such as fungi, bacteria, and other microorganisms.

Solvent - The component of a solution that dissolves the other components.

Spray drift - The movement of airborne spray particles from the intended area of application.

Spreader-sticker - A surfactant closely related to wetting agents that facilitates spreading and increases sticking of a herbicide on vegetation.

Stem-foliage application - An application of a herbicide to both stems and leaves of a plant.

Surfactant - A material that improves the emulsifying, dispersing, spreading, wetting, and other surface-modifying properties of herbicide formulations.

Suspension - A system consisting of very finely divided solid particles dispersed in a liquid.

Topical or spot treatment - Application of a herbicide to individual plants or small clumps of plants.

Translocated herbicide - One that is moved within the plant from the point of entry.

Vapor drift - The movement of herbicidal vapors from the area of application.

Volatile - A compound is volatile when it evaporates or vaporizes (changes from a liquid to a gas) at ordinary temperatures on exposure to the air.

Water-dispersible powder - A finely ground powder plus a wetting agent plus a dispersing agent to keep the material in suspension.

Weed - A plant growing where it is not desired.

Weed eradication - The complete elimination of all live plants, plant parts, and seeds from an area.

Wettable powder - A finely ground powder plus a wetting agent to keep the particles from floating when added to water.

Wetting agent - A compound that when added to a spray solution causes it to contact plant surfaces more thoroughly.

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HERBICIDES THAT HAVE BEEN REGISTERED IN ACCORDANCE WITH
THE FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT
FOR USE IN AQUATIC SITES

Acrolein	Diquat
Irrigation canals	Lakes
Ponds	Ponds
Amitrole (Not approved for Bureau of Sport Fisheries and Wildlife use)	Irrigation canals
Non crop areas	Drainage ditches
Drainage ditches	Endothall
Amitrole T (Not approved for Bureau of Sport Fisheries and Wildlife use)	Lakes
Non crop areas	Ponds
Drainage ditches	Irrigation canals
Marshes	Drainage ditches
Ammonium Sulfamate	Fenac
Around lakes, ponds	Lakes
Around potable water reservoirs	Ponds
Along inflow streams	Reservoirs
Bromacil	Drainage ditches and banks
Ditch lands (drainage)	Petroleum Distillate (aromatic)
Copper Sulfate	Irrigation ditches
Farm ponds	Drainage ditches
Lakes	Irrigation, drainage ditches and banks
Dalapon	Silvex
Non crop areas	Lakes
Drainage ditches	Ponds
Dichlobenil	Sodium Arsenite (Not approved for Bureau of Sport Fisheries and Wildlife use)
Lakes	Lakes
Ponds	Ponds
Dichlone	Sodium TCA
Lakes	Non crop areas
Ponds	Ditch banks (drainage)
Irrigation canals	2,4-D
	Lakes
	Ponds
	2,4,5-T
	Lakes
	Ponds