No turf or landscape will remain weed-free without the intervention of man and his technology. This fact of nature has provided, and will continue to provide, work for the landscape manager.

Manmade landscapes, left alone to heat, drought, poor soil, shade, and traffic, will surrender to weeds.

The landscape manager's job is to shift the balance in favor of the desirable species and keep it that way. He does this by putting stress on the weeds and reducing the stress on the desirable plants.

Stress can come from many sources: poor soil; excessive shade, slope, moisture, wind; improper plant selection; and even maintenance practices such as mowing too low or too much at one time, using unnecessarily heavy machinery on turf areas, overirrigating, and overfertilization. Beneficial practices such as aerification or cultivation at the wrong time increase weed pressure.

Correction of stress factors is an important component of a weed control program. If stress can't be corrected, plants tolerant to the stress should be selected and planted in the area.

In this Guide, weed control is divided into four categories; turf, ornamental, rights-of-way and aquatic. Each area requires a separate approach, even though many of the chemicals and weeds are the same. It's important that a landscape manager approach each in the proper way.

Warm-Season Turf

by Ray Dickens, Auburn University, Auburn, AL., and Euel Coats, Mississippi State University, MS.

Bermudagrass is the dominant turf species in warmer climates. In general, herbicides that can be used on bermudagrass can be used safely on zoysiagrass. However, special attention should be paid to herbicide labels regarding applications to centipedegrass and St. Augustine, which are similar to each other in their tolerance to herbicides.

Summer Grass Weeds. Large crabgrass and dallisgrass invade more turf acreage in the southern United States than any other grasses. Germinating seeds of both can be satisfactorily controlled with benefin, bensulide, DCPA, pendamethalin, atrazine, and simazine. Certain formulations of atrazine are labelled for use on St. Augustine, zoysia, and centipede for sod production while other commercial products containing atrazine are labeled for homeowner use. A combination of acetamide (Dual) and either atrazine or simazine is currently being tested for effectiveness.
Only asulam is used for postemergence control of crabgrass and dallisgrass in St. Augustine. MSMA and DSMA are effective postemergence herbicides for these weeds in bermudagrass. The arsonates are used almost exclusively for dallisgrass control in bermuda and zoysia.

Goosegrass is the most difficult summer grass to control in the South. Timing of application of preemergence herbicides is of paramount importance if control is to be achieved. We generally think goosegrass starts germinating in significant quantities four to six weeks after crabgrass. However, this can and does vary.

If application of a preemergence is delayed, large crabgrass will escape because it germinates earlier than goosegrass. In bermudagrass and zoysia, large crabgrass can be controlled quite effectively with postemergence applications of the arsonates. Use of preemergence herbicides would appear to be a better approach to goosegrass control than postemergence control with arsonates.

Oxadiazon (Ronstar) gives excellent season-long control of goosegrass. Research has shown postemergence applications of MSMA plus metribuzen (Sencor) gives good control of goosegrass.

Sandbur and bahiagrass in bermuda and zoysia can be controlled with arsenicals. There is no selective control of torpedograss in southern turf at the present.

Both annual and perennial sedges are problems in the South. Purple nuttsege and, to a lesser degree, yellow nuttsege are the most severe problems. Multiple applications of arsenicals or an arsenical/phenoxy combination are generally recommended for purple nuttsege, only on bermuda or zoysia. Basagran can be used for yellow nuttsege control.

**Summer Broadleaf Weeds** are a problem throughout the South in turf, but not to the extent of the grassy weeds, such as dallisgrass, large crabgrass, and goosegrass. Prostrate spurge and Virginia buttonweed are important and difficult to control broadleaf weeds. Multiple applications of 2,4-D plus dicamba, Trimec, or Trex-San are almost always necessary. Researchers suggest the use of a nonionic surfactant with the herbicide.

**Winter Grass Weeds.** Annual bluegrass is by far the most severe grassy weed infesting southern turf continued on page 50
Suggested Timing for Preemergence Herbicides to Control Crabgrass and Annual Bluegrass

During the late growing season, through the dormancy period and into the early growing season.

Besides decreasing the aesthetic value of turf, the primary objective to annual bluegrass is its rapid dieback in late spring. Bermudagrass coverage is usually slow following fade out of annual bluegrass leaving large sections of bare ground exposed. Other weeds, such as goosegrass, tend to move into bare areas.

Annual bluegrass control with pre-emergence herbicides is usually accomplished with either benefin (Balan), bensulide (Betasan), DCPA (Dacthal), pendamethalin, Pronamide (Princept), or oxadiazon (Ronstar). Two applications may be necessary during the dormant season for acceptable control except with Pronamide or simazine.

Pronamide and simazine provide either pre-emergence or post-emergence control of annual bluegrass in bermudagrass.

There are two choices for annual bluegrass control on bermudagrass greens overseeded with perennial ryegrass. Bensulide may be applied prior to overseeding as a pre-emergence approach. Ethofumesate (Prograss) may be applied 15 to 30 days after overseeding. Check label for timing to avoid delaying spring transition back to bermudagrass.

Another approach employed particularly on golf courses, is to use a postemergence nonselective herbicide such as paraquat, glyphosate or cacodylic acid prior to the warm-season turf breaking dormancy. This usually does an excellent job on annual bluegrass as well as annual broadleaf weeds present. Injury is often encountered if bermudagrass starts breaking dormancy. The degree of injury is dependent upon the amount of green foliage at the time of application.

Winter Broadleaf Weeds. Important warm-season winter broadleaf weeds include common chickweed, henbit, clovers, spurweed, mouse-ear chickweed, lawn burweed, common dandelion, wild onion, wild garlic, plantains, and speedwells.

Preemergence control of some species can be obtained with benefin, bensulide, DCPA, pendamethalin, simazine, and other herbicides.

Henbit, chickweed, and clovers usually require something other than 2,4-D for postemergence control. In dormant bermudagrass and zoysiagrass, dicamba or combinations with dicamba are used often for postemergence control.

The phenoxy's are safe on completely dormant turfs. However, actively growing turfs vary considerably in tolerance to phenoxy materials.

St. Augustine will usually tolerate a .5 lbs./acre of 2,4-D with only minimal injury. At rates above .5 lbs./acre St. Augustine is usually injured. This may be unimportant when using phenoxy's on dormant warm-season turfs, but invariably application is made during spring transition. All turfgrasses are more susceptible to phenoxy injury during this transition period. The combination of mecoprop plus chlorfurecol is often used, especially by the homeowner on St. Augustine.
A complete weed control program includes both preemergence and postemergence herbicides, as well as cultural practices.

The primary preemergence herbicides for grassy and broadleaf weeds in cool-season turf are benefin, bensulide, DCPA, pendamethalin, oxadiazon, and siduron.

Siduron is the only preemergence herbicide that can be applied near time of seeding. Bensulide and DCPA can be applied in the spring following a fall seeding.

Benefin and oxadiazon should be applied to established turf. Bensulide can affect rooting of existing bermudagrass and caution is advised for use of most preemergence herbicides on bermudagrass greens. Thinning of fine fescue stands from preemergence herbicides has also been reported.

Preemergence herbicides should be watered in to get the chemical to the seed prior to germination. The resulting chemical barrier in the soil should not be disturbed during key weed germination periods.

The herbicides should be applied two weeks prior to the expected germination period. Second applications may be necessary to provide control for the full germination period. Contact your local turf extension specialist for germination times for primary weeds. Also, see the germination map for crabgrass and annual bluegrass in this guide.

The primary postemergence herbicides for grassy weeds in turf are the arsonates; MSMA, DSMA, CMA, and MAMA. Treated areas should not be reseeded for a month or more after application. See labels for delay periods.

Bentgrass and fescue are more sensitive to arsonates than other cool-season grasses. CMA is the safest for bentgrass.

Weed foliage should be sprayed while still young (two or three leaf stage) if possible. The effectiveness of arsonates improves with temperature and rates need to be increased for temperatures below 80 degrees F.

The primary postemergence herbicides for broadleaf weeds are 2,4-D, 2,4-DP, dicamba (Banvel), and MCPP. Formulations of these products, such as Trimec and Weedone DPC, provide increased effectiveness on hard-to-control species. Turflon-D (triclopyr plus 2,4-D) is effective on some of the more difficult to control broadleaf weeds, such as knotweed and yellow wood sorrel.

These herbicides should not be applied until a new lawn has been mowed at least three times. The target weeds should be actively growing for best results. The temperature at applications should be at least 60 degrees F. Applications during extreme heat or drought can cause severe damage to desirable turf.

Two treatments of postemergence herbicides are generally necessary to control broadleaf weeds. See labels for the proper interval between applications.

Winter annuals can be sprayed early in the year, followed by summer annuals and perennials. Fall treatment for perennials is possible.

Postemergence herbicides are often combined to achieve improved control and reduce application time. Occasionally, a landscape manager or sod producer chooses to fumigate a seedbed prior to planting to reduce weed seed, control insects and disease, and eliminate other type grasses. Methyl bromide (Dowfume), metham (Vapam), dazomet (Mylone), and Vorlex are used for preplant fumigation. See labels for delay period following treatment and before seeding.

Renovation of turf stands is gaining acceptance, especially since the development of glyphosate (Roundup). During renovation all existing vegetation is killed and the area is reseeded in a matter of weeks without major cultivation. Glyphosate is deactivated within a few days following application, but a delay of two weeks is recommended. Amitrole, cacodylic acid, and dalapon can also be used, but the delay period is longer.

Progress is being made in selectively killing annual bluegrass in perennial ryegrass, Kentucky bluegrass, and bentgrass fairways.
Rising labor costs and increased use of ornamentals in commercial and residential landscapes are causing an increase in use of both preemergence and postemergence herbicides in landscape maintenance.

The landscape manager has to control weeds around a variety of desirable plant material, including deciduous and evergreen shrubs, trees, groundcovers, annual and perennial flowers, bulbs, and ornamental grasses. These plants are located in a wide variety of locations, such as plant beds, containers, greenhouses, atria, and even in sand traps.

Attention to the label is especially important in ornamental weed control due to the varying sensitivity of plants to herbicides. Manufacturers attempt to provide products safe to the largest possible number of species.

Before planting
The most successful approach to a weed-free landscape is to control perennial grasses and broadleaf weeds prior to planting.

Spraying the weeds in the planting area with postemergence systemic herbicides will kill the root system as well as the topgrowth. Such herbicides include 2,4-D and related products for broadleaf weed control, dalapon for grass control, and amitrole for general weed control. These may have to be applied more than once for complete kill. Each has a specific waiting period prior to planting. Glyphosate is very effective and has no soil residue.

Fumigation of plant beds is another alternative. Vapam is one of the simplest fumigants to use. It is applied and watered into the soil. The water seals the surface, but plastic can also be used to cover the bed after the fumigant is applied and watered in. The fumigant will also kill insects and some fungi detrimental to plants. Planting can take place within days following treatment.
Broadleaf Weeds

Even though selective controls exist to remove broadleaf weeds from grass they exhibit amazing tenacity often requiring multiple treatments.

Buckhorn  
Mouse-eared Chickweed  
Common Chickweed

Dandelion  
Ground Ivy  
Heal-all

Henbit  
Plantain  
Speedwell

Spurge  
White Clover  
Yellow Wood Sorrel

continued on page 62
Active period of plant growth varies from year to year and from north to south—apply preemergence chemicals.

Approximate periods may vary two weeks from season to season.

Fumigants and nonselective herbicides will kill desirable plant material contacted by them. Care must be taken to protect nearby trees and shrubs which cannot be moved.

A number of preemergence herbicides are labelled for ornamentals and two are recommended for use prior to planting. Eptam or Treflan can be incorporated into the soil, following tillage, to control annual and some perennial weeds for a period of four to six weeks. Following incorporation to a depth specified on the label, ornamentals can be planted. This method has been used extensively by commercial nurseries and is now being used by landscape contractors to a large extent, especially where maintenance for a specified period of time is in a planting contract.

Tillage as a method of weed control prior to planting is a successful practice for the control of annual weeds but not perennial weeds. In some cases, tillage only cuts up the root systems of perennials into smaller pieces and distributes them.

Landscape fabrics are growing in use for low maintenance areas. The black plastic cover has been improved to a knitted fabric which allows water and nutrients through but blocks light and growing weeds. These are useful in mulched beds where plants are spaced out. They are impractical for groundcover areas and they do not control germination of weed seeds in the mulch above the fabric.

The most successful approach to a weed-free landscape is to control perennial grasses and broadleaf weeds prior to planting.

After planting

In recent years, the landscape industry has made extensive use of mulches to prevent weeds in the landscape. Mulches should be applied two-inches deep and renewed to that depth annually. Mulch layers deeper than two inches accomplish little and actually harm shallow-rooted ornamentals which will root into the mulch instead of into the soil.

The most popular mulches are Cypress and pinebark mulches, as well as wood chips, peat moss, and various hulls. Materials which are not composted or inorganic, can rob the soil below of important nitrogen. Composting or sterilization also kills any weed seeds in the mulch.

Preemergence materials can be used in combination with mulches to stop germination of weed seeds in the mulch or those deposited by birds and wind. They control annual weeds for a period of four to eight weeks. Reapplication is usually necessary for season-long control.

Determine the amount of preemergence herbicide to be applied by figuring the area of the plant bed, measuring the proper amount for that area, and distributing it evenly in the area.
Many areas around buildings, ditches, billboards, poles, factories, shops, golf courses, parking areas, parks, industrial plant sites, vacant lots, schools, airports, roadsides, fences, lawns, pipelines, and other public or non-cropland areas may harbor unwanted trees and brush.

If these undesirable woody plants resprout after top removal, they may be difficult to kill and remove and cause unsightly appearance or interfere with the intended use of the property. The landscape manager has many options at his disposal to control and remove undesirable woody vegetation and replace it with desirable cover.

Woody plants can be removed by two primary methods or combinations of these methods which include mechanical or chemical means. The selection of the method depends upon 1) size of the area to be cleared; 2) size of the brush; 3) difficulty of control and kind of brush; 4) proximity to valuable vegetation, water sources, and population centers; and 5) use to be made of the area following brush removal.

**Control methods**

It is essential that problem plants be accurately identified so the proper control methods can be used. If the species cannot be identified, consult the local county agent, extension specialists, or personnel from the State Agricultural Experiment Station or U.S. Department of Agriculture. Some well illustrated circulars, bulletins, and books are also available.

**Mechanical Control.** Hand methods of brush control, although effective, are slow, costly, and laborious. They are practical on small areas or in scattered stands.

Hand methods include grubbing, cutting, girdling, and burning.

Grubbing consists of using a grubbing hoe, shovel, or similar tool to dig enough of the root system out of the soil to kill the plants. The operation is difficult and time consuming, but effective if properly done.

Cutting down brush with axes or saws is most effective on woody species that are killed when the top growth is removed, such as eastern redcedar and blueberry juniper. Species that resprout can be treated with herbicides to prevent resprouting.

Girdling is cutting a ring through the bark and cambium layer to prevent movement of water and nutrients to top growth. Girdling is practical in scattered stands of large trees 6-inches in diameter or greater. It is most effective during the summer months. Herbicides can be applied to the cut ring for improved kill.

Portable chain or power saws and girdlers are available for brush control. They reduce labor, time, and cost in brush removal but have limited use in dense stands or large areas.

Dozing is one of the more widely used methods of brush control. Much clearing is done with straight dozer blades; however, many modifications and attachments are available for specialized clearing jobs.

Ideally, dozing removes brush and large trees by pushing or pulling the plants out with as much of the roots intact as possible. Special attachments to the straight blade include teeth or U-shaped “stingers” to allow cutting the plant off below the ground line and lifting out the roots.

Dozing is most commonly practiced in open stands of large trees and brush or on rocky soils where other mechanical control methods are limited. It is not desirable in dense stands of brush that sprout from the roots after top removal.

Dozed trees can be windrowed or stacked so the brush can be burned or left to decay. The equipment and fuel required for dozing are costly. Dozing heavily damages the turf and grounds.

Mowing and shredding are temporary control methods for weeds and small brush in landscape manage-
ment. Repeated mowing, once or twice a year, is needed for maintenance on most weed-infested areas.

Mower types vary, but most consist of sharp rotary blades. Heavy duty shredders can be used on large brush and small trees, three- to four-inches in diameter.

Disking. Large disk plows or tandem disks will destroy stands of small brush. They may also destroy the grass stand. Disking is limited to tillable soils. Disking prepares a good seedbed, although compaction by a cultipacker, roller, or other implement may be desired. The operation is expensive.

Cost of mechanical treatments is usually closely correlated with degree of soil disturbance and size and density of brush to be removed. Dozing, disk ing, and grubbing are among the most effective mechanical brush control treatments, but are the most costly to perform, while mowing is less expensive. Hand methods, such as sawing, axing or grubbing, are sometimes effective, but are slow, costly, and laborious.

Chemical Control. Herbicides are an important means of weed and brush control. Compared to mechanical practices, herbicides are usually less expensive, less damaging to the environment, and often more effective.

Herbicide sprays, however, are subject to drift and may damage susceptible crops or valuable vegetation on nearby areas if improperly applied.

A variety of herbicides and herbicide combinations are commercially available. It is necessary to understand the properties and effects of herbicides in order to safely and effectively use them.

Individual herbicides and combinations of herbicides are used for weed and woody plant control. After manufacturing, technical (pure) herbicide must be formulated with other ingredients to prepare usable products for ease of handling and to obtain the desired effects.

Since very small amounts are sometimes required per unit of land, uniform application is essential. Herbicides are formulated as liquid concentrates, wettable powders, and granules or pellets. It is important to know the characteristics and precautions to be taken when using herbicides.

**Characteristics of Herbicides**

Phenoxy herbicides, such as 2,4-D, 2,4-DB, dichlorprop, and MCPA have been used for over 30 years and are effective for the control of many weed and brush species. They are used to produce changes and shifts in plant cover from crops, pastures, lawns, or wildlife habitat.

The phenoxy compounds are toxic to livestock or man at dosages labelled for weed control and disappear rapidly from the soil, vegetation, and water. They do not accumulate in the food chain.

Susceptible vegetation, especially broadleaf plants, may be damaged from spray drift or from volatilization. Following label instructions and making applications during favorable weather should prevent drift and volatilization problems.

The phenoxy herbicides selectively control broadleaf weeds in grasslands or grass crops. Rates of 0.25 to 2 pounds per acre effectively control many broadleaf plants.

The phenoxy compounds are relatively inexpensive and easy to apply. They are usually marketed as liquid concentrates as salts or esters.

The ester formulations are often more effective as foliar sprays on trees and brush than the salts. Amine formulations commonly available include dimethylamine, triethylene, diethanolamine, trimethylamine, triethanolamine, and others.

Other inorganic salts of the phenoxy that have been sold include the ammonium, sodium, potassium, and lithium salts. Salts are sprayed in water carriers.

Esters are classified as high volatile or low volatile, depending upon how readily they vaporize. Low volatile esters should be used in areas where sensitive crops or vegetation are grown.

The concentration of the active ingredient, the "acid equivalent," is indicated on the label as pound-per-gallon. If a herbicide concentrate has an acid equivalent of 4 pounds per gallon, then 1 gallon of the concentrate contains 4 pounds by weight of the parent acid, regardless of formulation. Usually the most concentrated formulations cost less per pound and are more economical to use than weaker concentrates.

The phenoxy compounds are readily absorbed by leaves and are translocated throughout the plant along with the products of photosynthesis. Oil soluble formulations, usually esters, applied in kerosene or diesel oil will penetrate the bark of most woody plants, and can be used as basal sprays or foliar sprays to individual plants.

Phenoxy herbicides, however, are more commonly applied broadcast to large areas containing dense stands of brush. These herbicides are sprayed on above-ground parts and foliage since they are not effective at economical rates as soil-applied herbicides.

Organic arsenicals. The organic arsenicals include DSMA, MSM, and cadycyclac acid and are available as liquid concentrates. These compounds have been used successfully in foliage sprays on trees and brush. The following are examples of calculations and formulas for herbicide application:

### Granular Materials

**Example—** A landscaper needs to treat 4,000 sq. ft. of Juniper with 4% RONSTAR granules at 4 lbs. aia. How much RONSTAR is required?

**Formula**

\[
\text{lbs. aia} \times \frac{\text{sq. ft. to be treated}}{44,000 \text{ sq. ft./acre}} \times 1000 = \text{lbs. required to treat area}
\]

**Calculation**

\[
4 \text{ lbs. aia} \times \frac{4000}{44000} \times 100 = 9.1 \text{ lbs. 4% granular RONSTAR}
\]

### Wettable Powders

**Example—** A landscape firm needs to treat 4,000 sq. ft. with 50% DEVRINOL wettable powder at the rate of 10 lbs. aia.

**Formula**

\[
\text{lbs. aia} \times \frac{\text{sq. ft. to be treated}}{44,000 \text{ sq. ft./acre}} \times 100 = \text{lbs. required to treat area}
\]

**Calculation**

\[
10 \text{ lbs. aia} \times \frac{4000}{44000} \times 100 = 1.8 \text{ lbs. 50% DEVRINOL W.P. to be mixed in enough water to cover 4000 sq. ft.}
\]

### Liquid Concentrate

**Formula**

\[
\text{lbs. active ingredient/gallon} \times \frac{1}{44,000} = \text{gallons required to treat area}
\]

**Calculation**

\[
2 \text{ lbs. aia} \times \frac{1}{44000} = 0.00022 \text{ or } 74 \text{ gal. TREFLAN to be mixed}
\]

**Example—** A landscaper needs to treat 4,000 sq. ft. of Juniper with 4% RONSTAR granules at 4 lbs. aia. How much RONSTAR is required?

**Example—** A landscape firm needs to treat 4,000 sq. ft. with 50% DEVRINOL wettable powder at the rate of 10 lbs. aia.

**Example—** A landscaper needs to treat 4,000 sq. ft. of Juniper with 4% RONSTAR granules at 4 lbs. aia. How much RONSTAR is required?

**Example—** A landscape firm needs to treat 4,000 sq. ft. with 50% DEVRINOL wettable powder at the rate of 10 lbs. aia.
have limited use for woody plant control as foliar sprays.

DSMA and MSMA are used for postemergence weed control in tolerant lawn grasses and noncrop areas. Cacodylic acid is used as a general desiccant and defoliant (contact) spray on many crop and non-crop areas.

The organic arsenicals can be used for quick dieback of woody species, but plants tend to recover. They can be injected into the trunk to kill unwanted trees. As foliar sprays, they are applied in water. Complete coverage by spray is required for best results. They are inactivated by soil contact.

Organic arsenicals may injure desirable plants. By directed spraying, desirable plants can be avoided. Organic arsenicals have a moderate to low mammalian toxicity but are highly toxic to insects such as honey bees. They are mildly corrosive to spray equipment.

Bipyridyliums. Diquat and paraquat are desiccant (drying agents) and defoliant herbicides used for general contact activity against weeds and brush. In some situations, they are used as selective herbicides.

Paraquat is water soluble and is inactivated by soil contact. Woody species will usually resprout from foliar sprays of diquat and paraquat. Paraquat may be more effective as an injection treatment against some undesirable trees.

Paraquat is highly toxic when ingested. Extreme care must be taken to avoid breathing the spray mist or getting the concentrate on the skin. Use of protective clothing and respirators are recommended when making applications.

Get immediate medical care in the event of ingestion. If treated within 12 hours, chances of survival are excellent.

Benzoxics. Dicamba is a selective translocated herbicide. It controls many wideleaf weeds in pasture crops and turf and some woody plants. Dicamba is similar to the phenoxy herbicides in activity and use. It is absorbed through roots, as well as foliage. It may be applied by either ground or aerial sprays or as granules, depending upon the weeds to be controlled and their proximity to susceptible crops.

Dicamba may be applied in mixtures with 2,4-D to broaden the spectrum of weed species controlled. It has a low order of toxicity to wildlife, fish, livestock, and humans. It rapidly degrades and does not accumulate in the environment. Dicamba has a low corrosion hazard to spray equipment.

It is formulated as a liquid as the dimethylamine or sodium salt and is sprayed in water carrier. It is also formulated in granular form as the acid. Dicamba is highly water soluble. Care must be taken to prevent its movement into water sources. Spray drift of dicamba to sensitive crops, conifers, and certain woody plants should be prevented. Granular formulation may be preferred where drift of sprays would present a hazard to crops.

Dichlobenil is also a benzoic. It is a selective herbicide for control of annual and perennial grasses and weeds in non-crop areas. Dichlobenil inhibits weed seed germination and plant cell division at the growing points.

Because of its relatively high volatility, application when the temperature exceeds 70 F. must be followed by a quarter-inch irrigation or rainfall soon after. Downward movement of active ingredient does not exceed two inches, so deeper-rooted woody ornamentals will not be affected. The control is achieved from a chemical barrier in the top one to two inches of soil.

Ureas and uracils. These compounds include bromacil, diuron, fenuron, fenuron-TCA, monuron, monuron-TCA, tebuthiuron, and hexazinone.

Ureas and uracil-type herbicides can be selective at low rates and nonselective at high rates. They are usually formulated as wettable powders for water sprays or as granules or pellets for dry application.

Bromacil (a uracil) will control a wide variety of woody species. If rates above 5 pounds per acre are used, it will also kill many desirable grasses and forbs on grazing lands.

Fenuron is no longer produced commercially, but a fenuron-TCA combination is available and is used to control certain woody plants and weeds on non-crop areas. Monuron and monuron-TCA combinations are commercially available, but have limited use for brush control since high rates are required for effectiveness. The monuron-TCA or fenuron-TCA combinations are generally used for non-selective, temporary sterilization in non-crop areas.

Tebuthiuron provides excellent control of a variety of undesirable woody plants. This herbicide is formulated as pellets and contains 20 or 40 percent active ingredient. A new "brush bullet" containing 13.8% active ingredient is also available. Tebuthiuron is commercially available for grazing lands and weed control on non-crop areas.

Hexazinone is a relatively new compound showing promise for woody plant control and use on non-crop areas. Hexazinone is recommended for forestry site preparation and pine release where loblolly, longleaf and shortleaf, slash, and Virginia pines are grown.

The pelleted product can be spread in a grid pattern for hardwood brush control. It also shows promise for total vegetation control including perennial grasses. It is highly water soluble.

The ureas and uracils mentioned
### Herbicide Directory

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Brand Name(s)</th>
<th>Company</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>amitrole</td>
<td>Amitrole-T</td>
<td>Union Carbide</td>
<td>Non-selective grass and broadleaf control in non-crop areas including ditches, roadsides, industrial areas and marshes.</td>
</tr>
<tr>
<td>arsenal</td>
<td>Arsenal</td>
<td>American Cyanamid</td>
<td>Non-selective grass and broad leaf control in non-crop areas.</td>
</tr>
<tr>
<td>ammonium sulphanate</td>
<td>Ammate</td>
<td>DuPont</td>
<td>Non-selective rights of way herbicide</td>
</tr>
<tr>
<td>asulam</td>
<td>Asulox</td>
<td>Rhone Poulenc</td>
<td>Postemergence grassy weed control for turf and ornamentals</td>
</tr>
<tr>
<td>atrazine</td>
<td>Ciba Geigy</td>
<td></td>
<td>Non-selective control in non-crop areas.</td>
</tr>
<tr>
<td>benefin</td>
<td>Balan</td>
<td>Elianco</td>
<td>Preemergence control of annual grasses and broadleaf weeds in established turf.</td>
</tr>
<tr>
<td>bensulide</td>
<td>Betasan</td>
<td>Stauffer, Mallinckrodt, Lesco, PBI Gordon</td>
<td>Preemergence control of annual grasses and broadleaf weeds in established turf and established flower gardens. Safe near tulip and daffodil bulbs.</td>
</tr>
<tr>
<td>bentazon</td>
<td>Basagran</td>
<td>BASF</td>
<td>Selective postemergence control of nutsedge in warm-season turf.</td>
</tr>
<tr>
<td>bromacil</td>
<td>Hyvar</td>
<td>duPont</td>
<td>Nonselective control of weeds and grasses in non-crop areas. usually mixed with diuron for roadsides and rights-of-way.</td>
</tr>
<tr>
<td>bromoxynil</td>
<td>Brominal</td>
<td>Union Carbide, Rhone Poulenc</td>
<td>Postemergence control of broadleaf weeds in seedling turf, established turf and non-crop areas.</td>
</tr>
<tr>
<td>cacodylic acid</td>
<td>Phytar, Rad-E-Cate</td>
<td>Vertac, Vineland</td>
<td>Nonselective control for turf renovation, edging and in plant beds.</td>
</tr>
<tr>
<td>chloramben</td>
<td>Amiben</td>
<td>Union Carbide</td>
<td>Preemergence control in ornamentals.</td>
</tr>
<tr>
<td>chlorfurecol</td>
<td>Maintain</td>
<td>Uniroyal</td>
<td>Growth regulator. Also controls broadleaf weeds and vines.</td>
</tr>
<tr>
<td>copper</td>
<td>Cutrine-Plus</td>
<td>Applied Biochemists</td>
<td>Control algae, chara and hydriola in potable water.</td>
</tr>
<tr>
<td>dalapon</td>
<td>Dalapon 85</td>
<td>SDS Biotech, Dow</td>
<td>Selective control of perennial and annual grasses in non-crop areas and ditchbanks.</td>
</tr>
<tr>
<td>dazomet</td>
<td>Mylone</td>
<td>Hopkins Ag.</td>
<td>Preplant sterilant for turf and ornamental beds.</td>
</tr>
</tbody>
</table>

**Continued on page 78**

are absorbed primarily through the roots of plants. They may be applied in spring or fall when weeds and brush are actively growing and when adequate rainfall leaches them into the soil.

Fall, winter, and early spring applications of tebuthiuron and hexazinone can be timed to reduce injury to forage plants and eliminate hazards of drift. These compounds may kill trees at a considerable distance from the point of application, depending upon the size of the root system and whether it extends into the treated areas. Therefore, extreme care should be taken near desirable trees.

Ureas and uracils are non-volatile and do not corrode equipment. Most of the urea and uracil herbicides can be injurious to some forage and turf species when applied broadcast, especially as sprays. Applying herbicides as pellets or balls to confine the herbicide to a few spots in the treated area reduces exposure to desirable forage or turf plants. Also, application of granules, pellets, or sprays to the soil surface or sprays applied subsurface in rows or bands spaced 6 to 10 feet apart may reduce injury to forage or turf and may increase kill of some woody plants.

Most of the ureas and uracils persist in the soil for several months at rates used for brush control. They are low in toxicity to warm-blooded animals.

**Other Organic Herbicides**

**Arsenal** (AC 252,925) is a new broad spectrum herbicide with activity against herbaceous and woody plants. It will control sedges, grasses and broadleafed weeds applied either preemergence or postemergence.

**Arsenal** is readily absorbed through foliage and roots. Complete kill may take several weeks.

Most herbaceous weeds are susceptible to Arsenal at rates of 0.4 to 1 pound per acre whereas woody species may require higher rates of 0.75 to 3 pounds per acre depending upon species to be controlled.

Arsenal is being tried experimentally for conifer release and weed control in bermudagrass. Arsenal should be applied postemergence to perennial weeds when they are actively growing and the herbicide is readily translocated.

It has a low order of toxicity to warm-blooded animals. It persists for 3 to 12 months in the soil depending upon rate applied and soil moisture content.

**Picloram** is a selective, translocated herbicide that effectively controls many weed and brush species in
### Herbicide Directory

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Brand Name(s)</th>
<th>Company</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCPA</td>
<td>Dacthal</td>
<td>SDS Biotech</td>
<td>Preemergence control of annual grasses and broadleaf weeds in turf and ornamental beds.</td>
</tr>
<tr>
<td>dicamba</td>
<td>Banvel</td>
<td>Velsicol</td>
<td>Selective postemergence control of broadleaf weeds in turf and for noncrop control of brush.</td>
</tr>
<tr>
<td>dichlobenil</td>
<td>Dyclomec</td>
<td>PBI Gordon</td>
<td>Selective weed control in ornamental beds and for total weed control on roadsides, fencerows, etc.</td>
</tr>
<tr>
<td>dichloprop</td>
<td>2,4-DP</td>
<td>SDS Biotech</td>
<td>Brush control and aquatic weed control.</td>
</tr>
<tr>
<td>diphenamid</td>
<td>Enide</td>
<td>TUCO, Upjohn</td>
<td>Selective control of annual grasses and broadleaf weeds in bermudagrass, dichondra and around ornamentals.</td>
</tr>
<tr>
<td>DSMA</td>
<td>Methar 30</td>
<td>W.A. Cleary</td>
<td>Selective postemergence control of sedges and grasses in turf and ditchbanks and storage yard.</td>
</tr>
<tr>
<td></td>
<td>Ansar</td>
<td>SDS Biotech</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSMA Liquid</td>
<td>Drexel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSMA 81%</td>
<td>Vertac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weed-E-Rad</td>
<td>Vineland</td>
<td></td>
</tr>
<tr>
<td>diuron</td>
<td>Karmex</td>
<td>du Pont</td>
<td>Generally used at high rates for nonselective total weed control in industrial sites.</td>
</tr>
<tr>
<td></td>
<td>Dynex</td>
<td>Vertac</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diuron 80WP</td>
<td>Drexel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Urox</td>
<td>Hopkins</td>
<td></td>
</tr>
<tr>
<td>diquat</td>
<td>Diquat</td>
<td>Ortho, Chevron</td>
<td>Aquatic weed control.</td>
</tr>
<tr>
<td>endothall</td>
<td>Aquathol K</td>
<td>Pennwalt</td>
<td>Aquatic weed control and turf herbicide and dessicant.</td>
</tr>
<tr>
<td></td>
<td>Endothall</td>
<td>Pennwalt</td>
<td></td>
</tr>
<tr>
<td>EPTC</td>
<td>Eptam</td>
<td>Stauffer</td>
<td>Selective control of annual grassy weeds, nutgrass, and perennial weeds.</td>
</tr>
<tr>
<td>Ethofumesate</td>
<td>Prograss</td>
<td>Nor-Am</td>
<td>For control of Poa annua and white clover in fairways.</td>
</tr>
<tr>
<td>fenac</td>
<td>Fenac</td>
<td>Union Carbide</td>
<td>Preemergence long-term control of weeds, usually mixed with other herbicides.</td>
</tr>
<tr>
<td>fosamine</td>
<td>Krenite</td>
<td>du Pont</td>
<td>Brush control.</td>
</tr>
<tr>
<td>fluazifop-butyl</td>
<td>Fusilade</td>
<td>ICI Americas</td>
<td>Selective postemergence control of grassy weeds in ornamentals.</td>
</tr>
<tr>
<td>floridone</td>
<td>Sonar</td>
<td>Elanco</td>
<td>Broad spectrum herbicide for submersed and emerged aquatic weeds.</td>
</tr>
<tr>
<td>Glyphosate</td>
<td>Rodeo</td>
<td>Monsanto</td>
<td>For control of emerged aquatic weeds and broad leaf weeds in or near aquatic sites, such as ditchbanks.</td>
</tr>
<tr>
<td>glyhosphate</td>
<td>Roundup</td>
<td>Monsanto</td>
<td>Nonselective, short-term herbicide for turf renovation and total weed control along fences and plant beds.</td>
</tr>
</tbody>
</table>

Glyphosate is a nonselective herbicide effective against both grasses and broadleaf plants. Glyhosphate is readily translocated from leaf and stem tissue to roots, resulting in a high degree of kill on many weeds. It is inactivated by contact with the soil and should not injure newly-seeded plants in treated soil.

Glyphosate is sprayed in water carrier. It is presently registered for use for noncrop and pre-till weed control and as a directed spray for orchards, plantations, Christmas trees, and many other crops. It is corrosive to some equipment.

Broadcast sprays over woody species will damage desirable forage plants. Applications should be made to individual plants on noncrop areas or areas to be renovated.

Glyphosate has a low order of mammalian toxicity.

Amitrole is effective against poison ivy and poison oak. If amitrole is accidentally sprayed on desirable plants, they are less likely to be severely injured than sprays of phenoxys, dicamba, or picloram.

Amitrole is available as a powder
Herbicide Directory continued

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Brand Name(s)</th>
<th>Company</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>imidazoline</td>
<td>Arsenal</td>
<td>American Cyanamid</td>
<td>Broad spectrum systemic industrial herbicide</td>
</tr>
<tr>
<td>linuron</td>
<td>Lorox</td>
<td>du Pont</td>
<td>Short-term control of annual weeds in roadsides and fence rows.</td>
</tr>
<tr>
<td>mefluidide</td>
<td>Embark</td>
<td>3M</td>
<td>Growth regulator that suppresses Poa annua.</td>
</tr>
<tr>
<td>methyl bromide</td>
<td>Dowfume</td>
<td>Dow</td>
<td>Fumigant for pre-plant control. Also kills weed seed.</td>
</tr>
<tr>
<td>metham</td>
<td>Vepam</td>
<td>Stauffer</td>
<td>Preplant soil fumigant killing weeds, weed seed, insects and fungi.</td>
</tr>
<tr>
<td>metribuzen</td>
<td>Sencor</td>
<td>MoBay</td>
<td>Postemergence control of goosegrass in warm-season turf.</td>
</tr>
<tr>
<td>MCPP</td>
<td>MCPP</td>
<td>SDS Biotech</td>
<td>Selective broadleaf weed control in turf. Often combined with other herbicides.</td>
</tr>
<tr>
<td>MSMA</td>
<td>Ansar Broadsid Weed-Hoe</td>
<td>SDS Biotech Vertac Drexel Vineland</td>
<td>Postemergence selective control of crabgrass and broadleaf weeds in turf. Also, grassy weed control in ditches, roadsides, industrial areas.</td>
</tr>
<tr>
<td>napropamide</td>
<td>Devinol</td>
<td>Stauffer</td>
<td>Selective control of weeds in ornamental beds and containers. Experimental combination with Betasan for season-long crabgrass control in turf.</td>
</tr>
<tr>
<td>oryzalin</td>
<td>Surflan</td>
<td>Elanco</td>
<td>Preemergence control of weeds in established ornamentals.</td>
</tr>
<tr>
<td>oxadiazon</td>
<td>Ronstar</td>
<td>Rhone Poulenc</td>
<td>Preemergence control of weeds in ornamentals and turf.</td>
</tr>
<tr>
<td>oxyfluoren</td>
<td>Goal</td>
<td>Rohm &amp; Haas</td>
<td>Selective control of weeds in ornamentals.</td>
</tr>
<tr>
<td>paraquat</td>
<td>Parquat</td>
<td>Ortho, Chevron</td>
<td>Nonselective control of weeds in rights-of-way, industrial areas and fencerows.</td>
</tr>
<tr>
<td>pendamethalin</td>
<td>Proturf Weedgrass Control</td>
<td>Scotts</td>
<td>Preemergence turf herbicide for control of grassy and broadleaf weeds.</td>
</tr>
<tr>
<td>picloram</td>
<td>Tordon</td>
<td>Dow</td>
<td>Systemic, long-term killer of woody plants and broadleaf weeds.</td>
</tr>
<tr>
<td>prometon</td>
<td>Pramitol</td>
<td>Ciba Geigy</td>
<td>Nonselective herbicide with long residual for industrial weed control.</td>
</tr>
</tbody>
</table>

continued on page 82

containing 50% active ingredient or as a liquid formulation. Another formulation, Amitrole-T, contains 2 pounds per gallon of ammonium thiocyanate in addition to 2 pounds per gallon of amitrole. 

Amitrole is effective through the roots and tops of plants. Amitrole cannot be used where there is any possibility of residues on food or feed crops.

Fosamine (Krenite) applied as foliar spray will kill or suppress several different woody species on non-crop land. If it is applied to trees or brush in late summer or early fall, susceptible species will fail to leaf out the following spring and subsequently die.

Rates of 1-1/2 to 3 gallons of fosamine are applied per acre during the two month period before fall leaf coloration. If rainfall occurs within 24 hours of application, effectiveness may be decreased. Use only in accordance with recommendations on the label. Fosamine cannot be used on cultivated land or in pastures.

Inorganic Herbicides

Ammonium sulfamate (AMS, Ammate) is a nonselective herbicide. It is used extensively to kill all plants growing on rights-of-way.

AMS kills trees. It can be used as a foliage spray or in cuts through the bark. When applied to stumps, it prevents sprouting. AMS kills or suppresses herbaceous plants as readily as woody plants.

It is corrosive. Spray equipment should be cleaned immediately and coated with diesel oil or similar light oils after use.

Oils

Diesel oil and kerosene are commonly used to control honey mesquite and huisache. One cup to 1 gallon of oil is used per tree, depending upon its size. The oil is applied around the base of the tree during dry weather when the soil is pulled away from the trunk. Application at this time enables the oil to penetrate to the lower buds on the stem.

Oils alone are not very effective herbicides when applied to the foliage of woody plants. However, diesel fuel is commonly used as a diluent and carrier for many oil soluble herbicides.

It is also used as a carrier in aircraft spraying, usually as a 1:4 oil-in-water emulsion. The oil reduces evaporation of the herbicide and helps in penetrating stems and foliage of some woody plants. Water carrier, however, is equally effective as oil carriers in some situations, such as use of 2,4-D on sagebrush.

continued on page 82
Lakes, ponds, and streams are central features for many landscapes. Weeds in water features not only destroy their appearance, they also ruin the impact of the entire landscape.

Lagoons, holding ponds and ditches, although not landscape features, serve useful functions which are inhibited by weeds.

Control measures are limited by local regulations, desirable plants in the water, and uses, such as swimming, irrigation, fish farming, and air conditioning.

If a lake is part of a natural watershed area, there may be restrictions on the use of certain chemicals or weed-eating fish. Check with your local extension agent before treating, diverting, draining, or filling in any lake, even if it is on private property.

**Preventative control**

Typical conditions causing an aquatic weed problem are shallowness (less than 8 ft. deep), poor circulation of water in the lake and air above the lake, fertilizer runoff into the lake, and presence of dead organic material in the lake (such as fish, plants, or sewage). Concentrate on these faults first.

Bottom-rooted aquatic plants require light to grow. Below eight feet this light is inadequate for many aquatic plants. If a lake cannot be deepened, dyes or bottom liners can be added to shade the lake bottom.

Pond aerators add needed oxygen to water and help avoid temperature stratification of water layers. Without mixing, water tends to form layers of water based upon temperature, the warmest layer on top.

*continued on page 86*
## Herbicide Directory

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Brand Name(s)</th>
<th>Company</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>pronamide</td>
<td>Kerb</td>
<td>Rohm &amp; Haas</td>
<td>Poa annua control in warm season grasses. Also weed and grass control around woody ornamentals and Christmas trees.</td>
</tr>
<tr>
<td>sethoxydim</td>
<td>Poast</td>
<td>BASF</td>
<td>Postemergence control of grassy weeds around broadleaf ornamentals.</td>
</tr>
<tr>
<td>siduron</td>
<td>Tupersan</td>
<td>du Pont</td>
<td>Preemergence control of annual grasses in newly seeded turf areas.</td>
</tr>
<tr>
<td>simazine</td>
<td>Princep</td>
<td>Ciba Geigy</td>
<td>Selective control of annual grasses and broadleaf weeds in established bermudagrass. Also, used in industrial and aquatic weed control.</td>
</tr>
<tr>
<td>sulfometuron</td>
<td>Oust</td>
<td>du Pont</td>
<td>Non-selective industrial and selective in bermudagrass.</td>
</tr>
<tr>
<td>tebuthiuron</td>
<td>Spike</td>
<td>Elanco</td>
<td>Total vegetation control in non-crop areas.</td>
</tr>
<tr>
<td>trifluralin</td>
<td>Treflan</td>
<td>Elanco</td>
<td>Selective preemergence weed control in established ornamentals.</td>
</tr>
<tr>
<td>trichlopyr</td>
<td>Garlon</td>
<td>Dow</td>
<td>Systemic control of woody plants in rights-of-way and industrial sites.</td>
</tr>
<tr>
<td>2, 4-D</td>
<td>2, 4-D</td>
<td>Dow</td>
<td>Selective control of weeds in turf and numerous other areas. Usually mixed with other herbicides.</td>
</tr>
<tr>
<td>Vorlex</td>
<td>Vorlex</td>
<td>Nor-Am</td>
<td>Preplant fumigant. Broadleaf weed control in established turf.</td>
</tr>
</tbody>
</table>

### Herbicide Combinations

<table>
<thead>
<tr>
<th>2, 4-D plus MCPP</th>
<th>Chipco Turf Kleen</th>
<th>Rhone Poulenc</th>
<th>Broadleaf weed control in established turf.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2, 4-D plus dicamba</td>
<td>Scotts I Barvel Plus Lesco Selective Herbicide</td>
<td>OM Scott Velsicol Lesco</td>
<td>Selective postemergence control of weeds in turf.</td>
</tr>
<tr>
<td>2, 4-D plus MCPP plus dicamba</td>
<td>Trimec Ester</td>
<td>PBI Gordon Mallinckrodt</td>
<td>Selective, Broad spectrum control of weeds in turf.</td>
</tr>
<tr>
<td>2, 4-D plus dichlorprop</td>
<td>Weedone DPC</td>
<td>Union Carbide</td>
<td>Selective postemergence control of weeds in turf.</td>
</tr>
<tr>
<td>2, 4-D plus 2,4-D plus dicamba</td>
<td>Trimec Ester</td>
<td>Bulkem</td>
<td>Selective, Broad spectrum control of weeds in turf.</td>
</tr>
<tr>
<td>2, 4-D plus dicamba plus dalapon</td>
<td>Barvel Plus</td>
<td>Velsicol</td>
<td>Broadspectrum, post-emergence turf weed control.</td>
</tr>
</tbody>
</table>

---

**Water temperatures down by mixing upper layers with lower, colder ones can discourage algae. Algae does not readily establish until surface water temperature reaches 60 degrees F.**

Decaying organic matter removes oxygen from the water. Do not throw debris or clippings into the water. Dead plants should be removed from treated lakes if possible.

In certain states, various weed-eating fish are legal. They are restricted in certain states due to the fear they may reach major rivers and lakes.

Drawdown, or draining to expose aquatic plants to full sun or freezing temperatures, is used where fish or irrigation aren't factors. Dredging and aquatic weed harvestors are expensive and cause a disposal problem, but they may be the only way to get initial control over a serious aquatic weed problem.

Lakes require some vegetation to produce needed oxygen, to provide cover for fish and wildlife, and to appear a natural part of the landscape. Portions of the lake can be kept shallow to provide for aquatic plants. Another method is removable containers of plants submerged close to the water's surface. Desirable water plants, such as water hyacinth, are available from specialized nurseries. These container plants can be removed if necessary during treatment periods.

Certain aquatic herbicides may be absorbed by roots of nearby trees or plants which extend into the water. Read labels carefully for susceptible land plant species.

### Curative control

In warmer climates aquatic weed control is an ongoing struggle with nature. In the North it is a seasonal fight beginning when water temperatures get above 60 degrees F. **Algae.** If preventative measures aren't enough to stop algae, then copper compounds (Cutrine) are effective. Used at correct rates, these compounds do not restrict water use.

If a lake has a history of algae problems, start using copper compounds as soon as water temperatures get above 60 degrees F. Periodic retreatment may be necessary for season-long control.

Copper compounds are often mixed with other aquatic herbicides for control of a variety of weeds. **Floating Weeds.** Floating weeds can be either free-floating or bottom-rooted plants which have leaves on the surface. They include hydrilla, duckweed, water lettuce, floating fern, water pennywort, and salvinia.

The primary herbicides for floating...
2, 4-D plus prometon
   Vegemec  PBI Gordon  Selective postemergence control of weeds in turf.

2, 4-D plus triclopyr
   Turf-D  Dow Chemical  Selective postemergence turf herbicide for broadleaf weeds.

Balan plus Ronstar
   Regalstar  Regal Chem.  Broad spectrum preemergence control of weeds in turf.

amitrol plus simazine
   Amizine  Union Carbide  Season-long control of weeds and grasses around ornamentals.

MSMA plus cacodylic acid
   Broadside  Crystal  Nonselective, broad spectrum weed control.

diuron plus sodium chloride plus sodium metaborate
   Chlorea  Rhone Poulenc  Nonselective weed and grass killer.

Amitrole plus fenac plus atrazine
   Fenamine  Union Carbide  Pre- and postemergence control of weeds for industrial sites and rights-of-way.

bromacil plus diuron
   Rout  Krovar  Hopkins du Pont  Wide range control of weeds in industrial sites and rights-of-way.

MSMA plus dicamba
   Mondak  Velsicol  Noncropland general weed control.

prometon, simazine and chlorate
   Pramitol  Ciba Geigy  Full-season weed control in industrial sites.

Weeds are 2,4-D and Diquat. Sonar (Fluridone) is a broad-spectrum aquatic herbicide under experimental use.

**Submersed Weeds.** Weeds which are bottom-rooted and totally under water are called submersed weeds. They include hydrilla, pondweed, watermilfoil, and coontail.

The primary herbicides for submersed weeds are 2,4-D, endothall (Aquathol K). Diquat, and Sonar (experimental use only). Combinations of endothall and Diquat with copper are often used.

**Emersed Weeds.** These are weeds growing in shallow areas with stems and leaves above the water surface. They include cattails, duckweed, hyacinths, alligatorweed, torpedo grass, and arrowhead.

Primary herbicides for these are Banvel, 2,4-D, dalapon (Dowpon), diuron (Karmex), Rodeo (glyphosate), Sonar (experimental use only) and amitrole.

Products registered for aquatic weeds are also the best to use for ditchbank weed control, since there is always the possibility water containing herbicides in ditches will drift to other locations. Check labels for ditchbank applications.

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Parsippany, NJ 07054
(201) 253-0200.

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Normal, IL 61761
(800) 447-4131.

Ciba Geigy Corp.
PO Box 18300
Greensboro, NC 27419
(919) 292-7100.

Crystal Chemical Co.
1049 Somerset St.
Somerset, NJ 08873
(201) 247-8000.

Dow Chemical USA
PO Box 1706
Midland, MI 48640
(517) 636-1105.

Drexel Chemical Co.
2487 Pennsylvania St.
Memphis TN 38109
(901) 774-4370.

E.I. du Pont de Nemours
1007 Market St.
Wilmington, DE, 19898
(302) 774-7547.

Elanco Products Co.
740 S. Alabama St.
Indianapolis, IN 46285
(317) 261-3759.

Hopkins Agric. Chem. Co.
PO Box 7532
Madison, WI 53707
(608) 222-0624.

ICI Americas
PO Box 751
Wilmington, DE 19987

Lebanon Chemical Corp.
P.O. Box 180
Lebanon, PA 17042

LESCO Products
20005 Lake Rd.
Rocky River, OH 44116
(216) 333-9250.

Mallinckrodt Inc.
PO Box 5439
St. Louis, MO 63147
(314) 982-5044.

MoBay Chemical Group
PO Box 4913
Kansas City, MO 64120

Monsanto Co.
800 North Lindbergh Blvd.
St. Louis, MO 63167
(314) 694-1000.

3M Agricultural Products
Bldg. 223-1N-05, 3M Center
St. Paul, MN 55144
(612) 736-0569.

Nor-Am Chemical Co.
3509 Silverside Rd.
PO Box 7495
Wilmington, DE 19803.

Ortho Div., Chevron
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- Special one-piece Ultra High lift blade with tempered cutting edges. Adjustable cutting heights from 1½ to 3½ inches.
- Equipped with regreasable double ball bearing wheels. 8 x 1.75 tires on front, 10 x 1.75 on rear.
- Special crankshaft protector.
- Dual filter air cleaner.
- Extra-large 3 bushel nylon bag grass catcher available.

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Prices:

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<th>Gallon</th>
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