

Weed Control Guide

WEEDS TREES & TURF



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The WEED CONTROL GUIDE is updated and published each March. This year Dr. Euel Coats, associate professor of weed science at Mississippi State University, and Dr. Elton Smith, professor of horticulture at Ohio State University, improved the Guide from last year. Considerably more attention has been given to weed control in non-turf areas and to warm-season turf weed control. O.M. Scott & Sons contributed the use of its weed identification drawings. The Weed Control Quiz illustrations are courtesy of the New York State Turfgrass Association.



In this Guide, the focus will be on the primary target weeds and the products or practices that most effectively control them. It is a collection of current herbicide usage information as reported by two weed scientists. A separate section on landscape weed control follows the section on turf weed control. Herbicide labels, as well as your university weed control specialists, are sources of additional specific information.

Weeds

Proper identification of weed species enables the landscape manager to time preemergence and postemergence applications correctly and use the most effective herbicide for that particular weed.

Many of the weed problems a landscape manager faces are solved by knowing the weed history of the area. Records should be kept to show what weed species are indigenous to the area and, consequently, what weed seeds are present in the soil and are likely to appear year after year in problem proportions.

If a weed problem develops which doesn't conform to the history, the weed seed was brought into your area in soil, seed, or another carrier. By using identification illustrations, the new problem weed can be classified for control.

All plants can be classified as either annual, biennial or perennial.

Annuals complete their life cycle in one growing season. They are further subdivided into summer annuals and winter annuals. Summer annuals germinate in the spring or summer and complete their life cycle during the warm growing season. Winter annuals germinate in the fall, complete their life cycle during the winter, and die in the early part of the next growing season. Annual bluegrass, henbit, and common chickweed are examples of winter annuals. Large crabgrass and goosegrass are summer annuals.

Efficiency and economy are two very important factors in landscape weed control today. Understanding the details of each part of a weed management program contributes to the efficiency of the whole program.

Rarely do herbicides alone completely eliminate, or maintain at acceptable levels, the weeds in turf or landscape. Chemical control without adequate fertilization, disease control, irrigation, and soil conditions is ineffective and very short term. The best aid to control is a healthy, vigorous turf and landscape.

Weed control with herbicides in warm season turf is rather complex primarily because the number of species and cultivars. There are at least six turfgrasses used in the Southern United States; bahiagrass, bermudagrass, carpetgrass, centipedegrass, St. Augustine, and zoysia. Two of these, bahiagrass and carpetgrass, are often weed problems in the other Southern turfgrasses.

Dichondra can be added to the list but it is limited to areas of the Southwest that are irrigated. In the Southeast, dichondra is almost exclusively a weed problem.

A few species of cool-season

turfgrasses are used in the South, maintained for the most part as annuals and used in overseeding programs for color during the dormant season. These include annual and perennial ryegrass, rough bluegrass, creeping bentgrass and red fescue. The Southern landscape manager may require weed control programs for both warm season turf and the overseeded cool-season turf.

Turfgrass species are often mixed in cool-season turf. Mixtures of Kentucky bluegrass, perennial ryegrass, and red and chewings fescues are standard. Tall fescues, including dwarf and fine-leaved tall fescues, are the backbone of many utility turfs. The bentgrasses (creeping and colonial) are used primarily for specialty turf such as golf greens. Chewings fescues and an increasing degree of sheep fescue are working their way into cool-season turf programs.

Woody ornamentals and annual plantings are even more complicated than turfgrasses owing to the large number of species and varieties. It is important to consider the effects of soil amendments, particularly organic matter, on herbicide effectiveness in ornamentals.

Turf Weed Identification

Germination of weed seed will occur only if the necessary environmental conditions exist; moisture, temperature, light, oxygen, etc. One significant aspect of the control mechanism of germination is each particular weed species has a definite and predictable pattern of germination. This is known as periodicity. Few species germinate freely throughout the year.

Characteristically, a large percentage of the seed of a given species will germinate when the conditions for germination are first met, with subsequent lower germination throughout the remainder of the growing season. Annual bluegrass, henbit, common chickweed, and clovers usually fit this category. Other species such as large crabgrass and goosegrass tend to germinate freely after the initial flush of seed germination.

Biennials and perennials germinating from seed also exhibit periodicity. They are treated as annuals when preemergence control is applicable.

Biennials require two years to complete their life cycle. In the first year, plants of this type form rosettes (radial clusters of leaves growing close to the soil) and during the second year they send up flower stalks and produce seed.

Perennials live for more than two years and are especially difficult to control because they reproduce by vegetative means as well as by seed. Dallisgrass, torpedograss, dandelion, wild onion, wild garlic, and nutsedges are among the more commonly occurring perennial weeds.

Once established, control of perennials becomes increasingly difficult. Perennials germinating from seed are not significantly different from annuals. However, perennials are established before the problem is usually recognized.

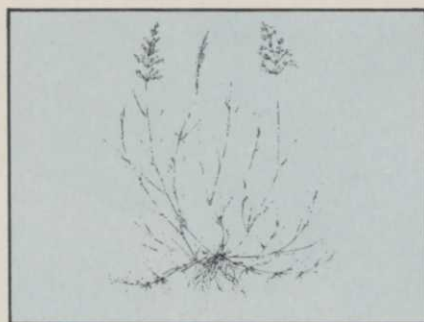
Perennials spread from specialized vegetative structures both above and below the soil surface. Effective selective control of established plants can be obtained only

with postemergence herbicides that will translocate to these reproductive structures.

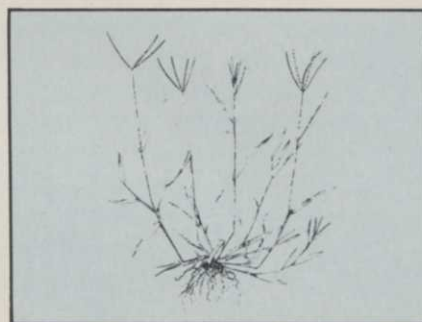
A second distinction important to weed control is whether the weed is a grass (monocot) or broad-

leaf (dicot). Herbicides are often selected by how they disrupt the life processes of either grasses or broadleaf weeds. The effectiveness of these herbicides depends greatly upon this distinction.

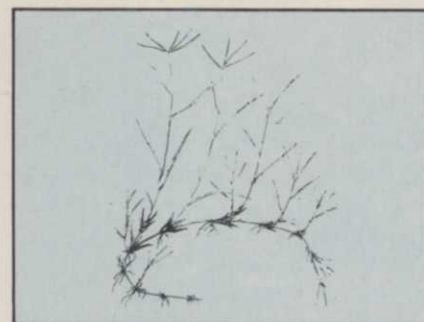
Grasses



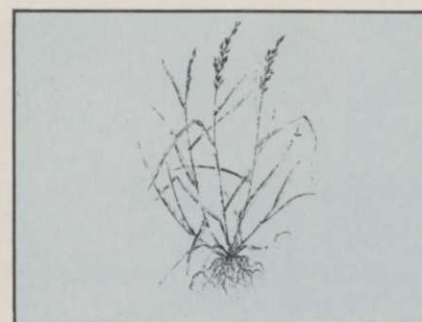
Bentgrass - A desirable grass in certain locations, creeping bentgrass can encroach on cool season turf consisting of Kentucky bluegrass, perennial ryegrass, and fine fescues. Bentgrass has extremely small seed and is a major target of seed producers during seed cleaning for certification. It is extremely difficult to treat lawns to remove bentgrass.



Crabgrass - The predominant target of many turf weed control programs, crabgrass spreads by seed and by rooting at lower nodes (where stem and leaf join). This pale green grass forms dense patches damaging the appearance of a lawn. This annual grass can be controlled to great degree with preemergence herbicides.

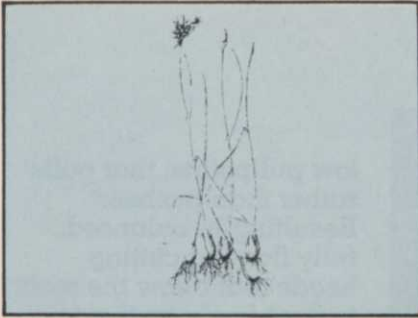


Bermudagrass - Like bentgrass, bermudagrass encroaches on other desired turfgrasses. A desirable turfgrass for the South, bermudagrass can be a problem in cool-season turf. This extremely hardy grass can outperform other warm-season turfgrasses. It spreads by stolons and rhizomes. Bermudagrass turns brown early in the fall in cooler climates while other grasses remain green.

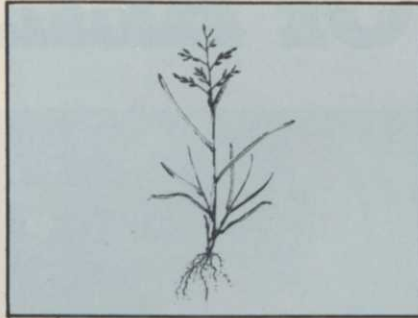


Tall Fescue - A coarse, hardy bunch grass often planted for utility turf. This perennial sends down roots far below other cool-season turfgrasses and consequently exhibits drought tolerance. Tall fescue can withstand poor soils and has a low fertilization requirement. These characteristics have caused researchers to develop finer bladed selections for lower maintenance lawns. It is difficult to eliminate from stands of other turfgrasses.

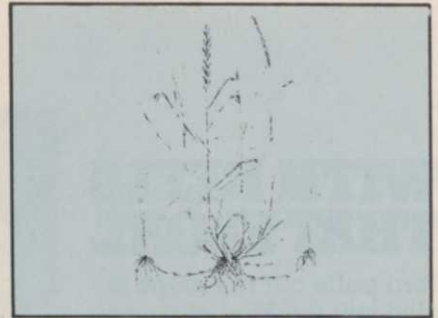
Turf Weed Identification



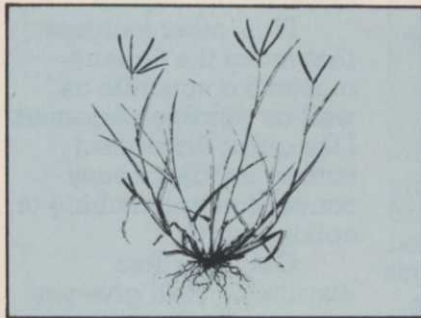
Wild Garlic - This perennial monocot is not a grass and spreads not only by seed, but from above and below ground bulbets. Control must stop germination of seed AND kill the bulbets.



Poa annua - Persistent seed-heads and blotches of summer-killed annual bluegrass make this a weed in the summer in the north and in the winter in the South. This weed thrives in well-fertilized, irrigated, and low cut turf. Its light green color and white seedheads are easily spotted.

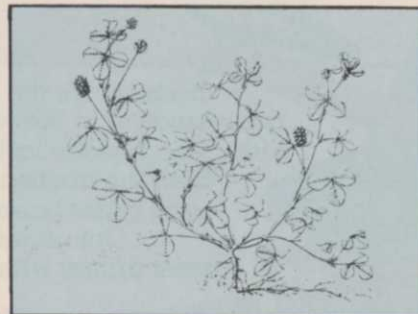


Quackgrass - This perennial grassy weed spreads vigorously by rhizomes and is extremely hard to control. Spot treatment with nonselective herbicides is often the only solution. Quackgrass is usually present when topsoil came from rural areas, such as in new lawns.



Goosegrass - This annual grass takes advantage of exposed areas with compacted soil. Postemergence treatments work best on this wiry grass.

Broadleaf Weeds

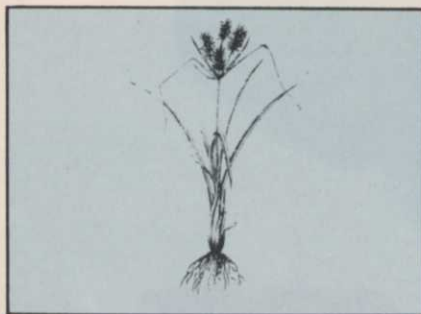


Black Medic - Occasionally confused with clover, black medic is an annual legume. It is common throughout the U.S. and has small yellow flowers.

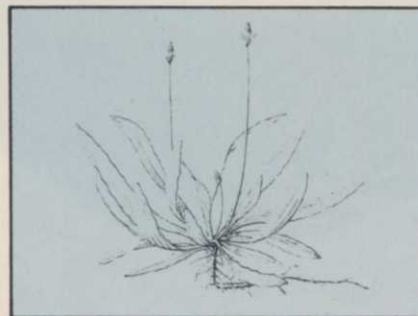
This perennial resembles plantain.



Common Chickweed - This annual spreading weed of shady, moist areas has a white flower and light green foliage.



Nutsedge - Yellow nutsedge is a major weed problem of turf. The perennial weed reproduces both from seed and underground tubers. The yellow color makes it stand out. Systemic herbicides are required to kill the tubers.

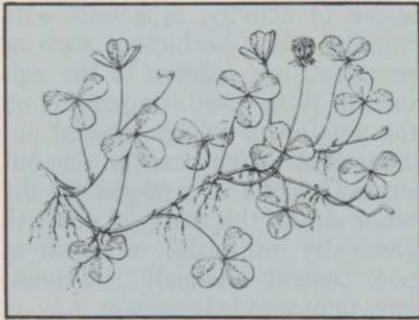


Buckhorn - Present in many low budget lawns and mow-only turf areas of parks. Buckhorn has a taproot that defies hard weeding.



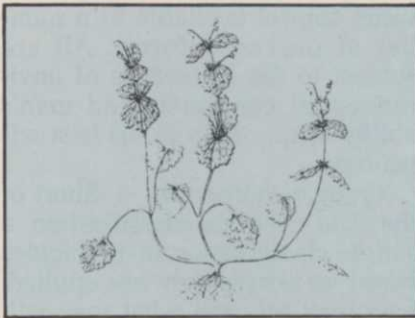
Mouse-Ear Chickweed - The

perennial version of chickweed prefers open sun and also has white flowers.

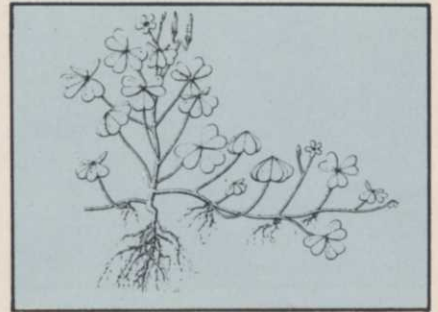


Clover - This perennial broadleaf embarrasses turf managers with large pink flowers in the spring and tan patches of dead foliage in the summer.

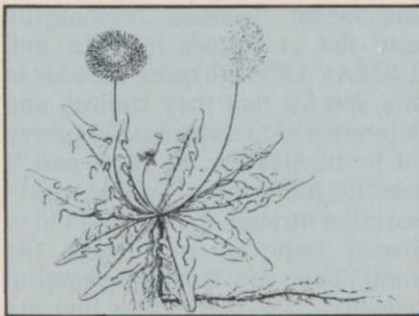
gressive spreader hugs the ground and produces a purple flower.



Henbit - Taller than ground ivy, despite purple flowers and scallop-shaped leaves, henbit is a winter annual most noticeable in early spring.



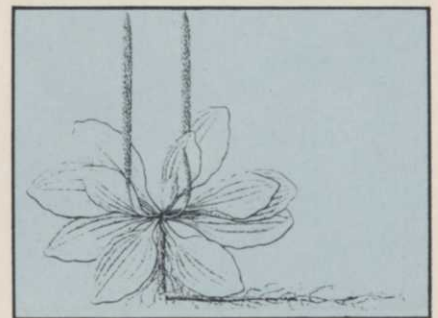
Oxalis - This perennial broadleaf spreads by rooting at the nodes and by seed from pods following flowering. Small yellow flowers mature into long, narrow seedpods. Selective control is ineffective.



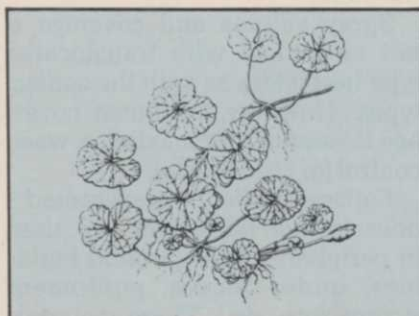
Dandelion - This perennial is famous for its taproot and yellow flower which later becomes a puffy seedhead in late spring.



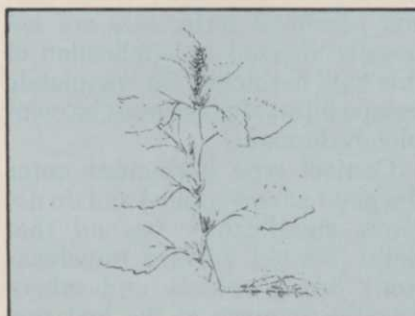
Heal-All - This hairy-leaved perennial is common in new and poorly maintained lawns throughout the U.S. It can spread beneath the level of mower blades.



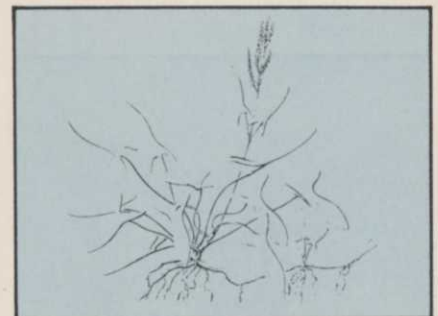
Plantain, broadleaf - Hosta-like leaves of this perennial surround tall purple stalks containing seeds. The leaves, unlike hosta, lay flat on the surface of the soil.



Ground Ivy - This perennial can dominate in poor, shady soil. A member of the mint family, this ag-



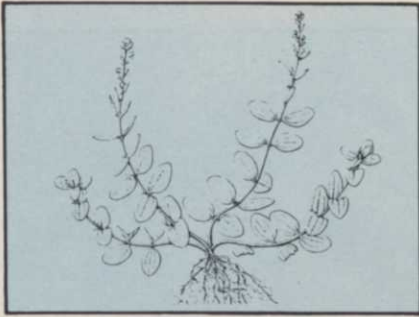
Lambsquarter - A summer annual of large size if not mowed. Foliage is bright light green.



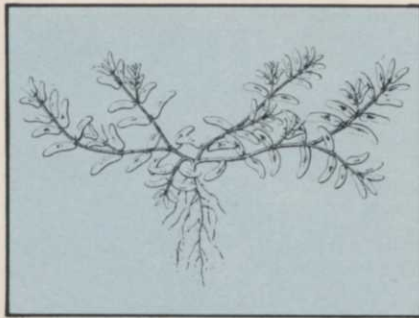
Red Sorrel - This tenacious perennial has arrow-shaped leaves and spreads by roots and rhizomes. It can quickly overtake desirable turf weakened by acid soil. Alkaline soils can discourage Red Sorrel from getting established.

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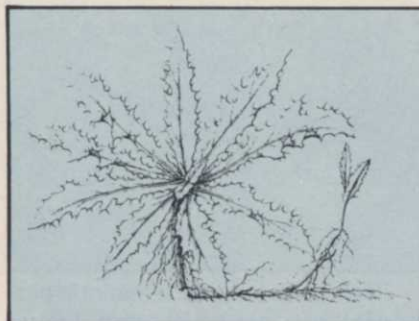
Turf



Speedwell - There are both annual and perennial members of this weed family. White to purple flowers bloom above heart shaped seedpods. Spot treatment is often the only control once established.



Spurge - The leaves of spurge contain a spot in the center of the upper surface. The seed of this heavy producer germinates in early spring. The spreading branches of this annual contain a milky substance.



Sow Thistle - This annual has flowers similar to dandelion but its leaves have spines on the edges and deeper indentations. Selective control is effective.

Herbicides

Herbicides are chemicals used to kill or inhibit the growth of plants. There are many kinds of herbicides for general and specific weed control available in a number of packaged forms. All are subject to the influences of environmental conditions and man's ability to use them to his best advantage.

Types of herbicides — Short of the rigid chemical classification, a simple classification of herbicides based on where they are applied, how they act, and what they will control is perhaps most useful.

I. Foliage Applied

A. Contact

1. Selective
2. Nonselective

B. Translocated

1. Selective
2. Nonselective

II. Soil Applied

A. Short residual

1. Selective
2. Nonselective

B. Long residual

1. Selective
2. Nonselective

Foliage applied - contact - selective herbicides are of little importance in turf or landscape.

Foliage applied - contact - nonselective herbicides used in turf landscape include paraquat and cacodylic acid (Phytar 560). These herbicides will kill all green and growing foliage contacted by spray solutions. Foliage of plants such as dormant bermudagrass, zoysiagrass, and other warm season perennial turfgrasses are not usually affected by application of this type herbicide. To completely escape injury, foliage must be completely dormant.

Contact type herbicides enter the plant where applied and do not move significantly beyond that point (limited upward translocation). Spray volume and subsequently coverage of the leaf surface of the target plants is very critical for maximum control. Extremely low volume applications

will often result in inadequate coverage and will kill the upper layer of the foliage canopy. Regrowth occurs in a comparatively short period of time.

With contact herbicides increases in control and possibly in speed of activity, especially with rapidly acting herbicides such as paraquat, are relative to the volume of water used. Depending on the amount of foliage present, increases in activity can be demonstrated beyond 50 to 60 gpa. On the other end of the scale, 20 gpa will generally minimize, or result in poor control, especially if a dense growth of weeds is present. A good compromise is perhaps 30 to 40 gpa.

Foliage applied - translocated - selective herbicides are absorbed into and move to points beyond the point of entry and kill plants. The most common herbicides in this group are the phenoxys (2,4-D, mecoprop), dicamba, bromoxynil, and the arsenicals (MSMA and DSMA). Although quite variable in the species that they control, and tolerance of turf species, this group of herbicides for the most part is readily translocated following absorption through the foliage (and of lesser importance through the root). They are the only group of selective type herbicides that are effective on perennial weeds. They are more effective than contacts since translocation (downward) of the herbicide to reproductive structures can take place following uptake by the foliage of the plant.

Spray volume and coverage is not as critical with translocated type herbicides as with the contact types. However, adequate coverage is essential for maximum weed control (of 30 to 40 gpa).

Foliage applied - translocated - nonselective herbicides are used in peripheral areas (around buildings, under fences, equipment storage lots, etc.). These materials are applied to the foliage of the target species and generally control

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Turf

all weed species present. Many of the foliage applied translocated selective herbicides above may become non-selective at extremely high rates. More often than not at higher rates they behave as contact type herbicides.

More pertinent examples of these foliage applied-translocated non-selective herbicides are dalapon (Dowpon), amitrole, and glyphosate (Roundup). In many respects, although somewhat of an oversimplification, this group of herbicides differs from the translocated-selected types only in that they are nonselective.

Soil applied - short residual - selective herbicides include the widely used preemergence herbicides DCPA, benefin, bensulide, atrazine, simazine, and pronamide. Pronamide and simazine applied to the soil also control established annual bluegrass (post-emergence). Maximum residual activity of these herbicides is a matter of weeks to a few months as compared to the long term residual herbicides in which control for several months would be expected.

Application technique, as with all types of herbicides, is important. While volume of spray solution is not as critical as with postemergence herbicides, even distribution is necessary for uniform effective control. These herbicides (preemergence) represent our best approach to the control of annual and biennial or perennial weeds germinating from seed. Where effective, these herbicides eliminate the competition effects that are encountered from the time of germination to the time of control where postemergence herbicides are also used.

Soil applied - short residual - non-selective herbicides are the temporary soil sterilants. They are usually referred to as fumigants and include methyl bromide and metham (Vapam). They are active in the vapor forms. Methyl bromide is a gas at atmospheric pres-

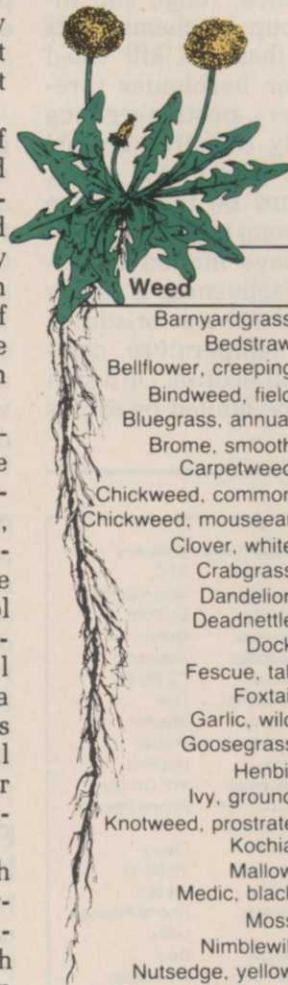


CHART 1
Growth and treatment periods

Weed	SPRING			SUMMER			FALL			WINTER		
	Early	Mid	Late	Early	Mid	Late	Early	Mid	Late	Early	Mid	Late
Barnyardgrass												
Bedstraw												
Bellflower, creeping												
Bindweed, field												
Bluegrass, annual												
Brome, smooth												
Carpetweed												
Chickweed, common												
Chickweed, mouseear												
Clover, white												
Crabgrass												
Dandelion												
Deadnettle												
Dock												
Fescue, tall												
Foxtail												
Garlic, wild												
Goosegrass												
Henbit												
Ivy, ground												
Knotweed, prostrate												
Kochia												
Mallow												
Medic, black												
Moss												
Nimblewill												
Nutsedge, yellow												
Pigweed, prostrate												
Plantain												
Puncturevine												
Purslane, common												
Quackgrass												
Sanbur												
Shepherdspurse												
Sorrel, red												
Speedwell												
Spurge, prostrate*												
Thistle, Canada												
Thistle, musk												
Vervain, prostrate												
Violets												
Waterleaf (nyctelea)												
Woodsorrel, yellow												
Yarrow												

— Active period of plant growth. Varies from year to year and from north to south.
 — Apply preemergence chemicals.
 — Apply postemergence treatments. Approximate periods may vary two weeks from season to season. Use granular or wax bar formulations of 2,4-D, Banvel D, Silvex, and 2,4,5-T from late spring through early fall.
 * Preemergence herbicide applications should be made a second time in late June or early July.

sure while metham, although formulated in liquid form, is converted to a toxic gas in the soil. Because of their volatile nature, both compounds require some kind of sealing to prevent evaporation into the atmosphere. Methyl bromide must be applied under a gas-tight cover (usually plastic) while vapam can be sealed by watering (irrigation), although weed control is more consistent if the soil is sealed with plastic following application.

Both herbicides are excellent for killing vegetative structures of perennial plants such as bermuda-

grass, nutsedge, and torpedograss and are effective on a large number of weed seed, fungi, and insects. This group of chemicals is the only one that will kill weed seed. All other herbicides (pre-emergence or postemergence types) are only effective against germinating or germinated seeds, i.e., growth must be taking place for this latter group to be effective.

Fumigants have limited usefulness. Their effectiveness is highly dependent on the characteristics of soil moisture, temperature, compaction, and soil texture. Diffusion of vapors can be limited by excess

moisture and/or compacted soils. And fumigants are extremely expensive. However, in certain turf establishment situations there is no alternate to these herbicides.

Soil applied - long term residual - selective and non-selective. Both groups will be combined in this discussion. Although certain examples could possibly be given of the selective type, for the turf user this group constitutes the non-selective soil sterilants. Their use is very limited in turf facilities and specifically are used in peripheral areas (to the turf or ornamentals where total vegetation control is desired and are usually effective for several months.

Bromacil (Hyvar®), karbutylate (Tandex®) and borate compounds are just a few examples of soil sterilants. These are active via the soil. Several mixtures of these and other compounds containing materials such as amitrole to give quick foliage kill are also available. Lateral movement of soil sterilants into turf areas can be a significant problem.

Factors Affecting Herbicide Activity

Most herbicidal failures aren't failures of the herbicide. Conditions (temperature, moisture, timing, application method, herbicide selection, etc.) are usually responsible for most "failures" we hear about. If we understand the conditions necessary for maximum effectiveness of a herbicide, many of the variables contributing to "failure" can be minimized.

To be most effective, herbicides must be applied at the appropriate time in relation to germination or growth of the target species. Herbicides may be applied in a number of ways but basically for applications to turf we are dealing with those that are applied directly to the target weed (post-emergence) and those that are applied to the soil (pre-emergence). In both cases we are making applications in es-

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Herbicides and Manufacturers

Chemical	Brand Name	Company	Chemical	Brand Name	Company
amitrole	Amitrol-T	Union Carbide	Ethofumesate	Prograss	BFC
asulam	Asulox	Phone Poulenc	fenac	Fenatrol	Union Carbide
atrazine	Atratol	Ciba Geigy	fosamine	Krenite	Du Pont
benefin	Balan	Elanco	glyphosate	kleenup	Ortho
bensulide	Betamec	P.B.I. Gordon		Roundup	Monsanto
	Betasan	Stauffer	linuron	Lorox	Du Pont
	Pre-San	Mallinckrodt	methyl bromide	Dowfume	Dow
bentazon	Basagran	BASF	metham	Vapam	Stauffer
bromacil	Hyvar	Du Pont	metribuzin	Sencor	MoBay
bromoxynil	Brominal	Union Carbide	monuron	Urox	Hopkins
cacodylic acid	Phytar	Crystal	MCP	Mecomec	PBI Gordon
chloramben	Amiben	Union Carbide		Chipco Turf Herbicide	Rhone Poulenc
chlorpropham	Furloe	PPG		MCP	Cleary
dalapon	Dalapon	Diamond Shamrock	MSMA	Weedhoe	Vineland
dazomet	Mylone	Hopkins	oryzalin	Surflan	Elanco
DCPA	Dacthal	Diamond Shamrock	oxadiazon	Ronstar	Rhone Poulenc
dinoseb	Premerge 3	Dow	paraquat		Ortho
	Dynamyte	Drexel	picloram	Tordon	Dow
Devrinol		Stauffer	prometon	Pramitol	Ciba Geigy
dicamba	Banvel	Velsicol	pronamide	Kerb	Rohm & Haas
dichlobenil	Casoron	Thompson Hayward	siduron	Tupersan	Du Pont
diphenamid	Enide	Tuco/Upjohn	simazine	Princep	Ciba Geigy
DSMA		Crystal	tebuthiuron	Spike	Elanco
dinitrophenol	Dinitro	Thompson Hayward	trifluralin	Treflan	Elanco
diuron	Karmex	Du Pont	triclopyr	Garlon	Dow
diquat	Ortho Diquat	Ortho	Vorlex		Nor-Am
endothall	Endothall	Pennwalt			
EPTC	Eptam	Stauffer			
Combinations					
Amizine		amitrol and simazine		Union Carbide	
Banvel plus		dicamba and 2,4-D		Velsicol	
Broadside		dicamba and 2,4-D, dalapon		Velsicol	
Chlorea		MSMA and cacodylic acid		Crystal	
		diuron, sodium chlorate, sodium metaborate		Rhone Poulenc	
Fenamine		amitrole, fenac, atrazine		Union Carbide	
Hopkins Rout G-8		bromacil and diuron		Hopkins	
Krovar		bromacil and diuron		Du Pont	
MonDak		MSMA and dicamba		Velsicol	
Pramitol 5PS		prometon, simazine, chlorate		Ciba Geigy	
Tordon		picloram and ammonium sulfate		Dow	
Trimec		2,4-D, MCP, and dicamba		PBI Gordon	
Urox		monuron and TCA		Hopkins	
Vegemec		prometon and 2,4-D		PBI Gordon	
Weedmaster		dicamba and 2,4-D		Velsicol	
Weedone		dichlorprop and 2,4-D		Union Carbide	

tablished turf and, consequently, this application is also made directly to the turf. In the case of preemergence herbicidal applications either supplemental irrigation or natural rainfall are employed to wash the herbicide from the turf foliage and get it to the soil surface and into the soil. Rainfall and/or irrigation are detrimental to the effectiveness of a postemergence herbicide immediately following an application. An understanding of the factors influencing the efficiency of both preemergence and postemergence herbicides is certainly helpful in explaining results obtained and maximizing the control obtained with herbicides.

Preemergence applications: Application of a herbicide before weed seed germinate. Preemergence herbicides are not effective against perennial weeds or established annuals. To be effective, herbicides must be applied uniformly over the area. Their action is exerted only during or after germination as growth commences. Therefore, application to a dry soil severely reduces the effectiveness of preemergence herbicides unless moisture is added soon after treatment. Time of application must correspond to periods of germination. If annual bluegrass germinates starting September 1, an application of a preemergence herbicide such as DCPA, benefin, or bensulide on December 15 will be of little value. In contrast, if goosegrass germinates June 1, then a March 15 application will probably be ineffective. The residual level of the herbicide at this time would be too low to give control.

Postemergence applications: Application after weed seed have germinated or broken through the soil surface. The herbicide is applied to the foliage of the weed plant. Postemergence herbicides act as contact or as systemic (absorbed and translocated) herbicides. Contact herbicides act rapidly while translocated herbicides

usually require several days for their phytotoxic action to be observed. Translocated types usually kill the entire plant while contact types kill only the contacted part of the foliage.

Best results will usually be obtained with postemergence herbicides if plants are young, actively growing and the temperature is above 70 F. Foliar applied herbicides are less effective if soil is dry. Consult label for growth stage and environmental conditions for best results with a given herbicide.

Surfactants are frequently recommended for use with postemergence herbicides. For consistent results use nonionic agricultural surfactants, sold specifically for use with herbicides.

Selection of Herbicide and Formulation

Two or more herbicidal products may be equally effective in a given weed situation. Also the same chemical may be available in a variety of commercial formulation trade names.

Your selection of herbicide and formulation will be determined by (1) the weed species involved, (2) the availability of the herbicide, (3) type of equipment at your disposal, (4) established residue tolerances, (5) hazards to humans, domestic animals, wildlife, and desirable plants, (6) relative total costs of materials and application, and (7) time of application.

All recommended rates of application are based on either active ingredient (most chemicals) or acid equivalent. Different commercial products vary in the percentage of active ingredient or acid equivalent. The label will give you the exact amount of weed-killing chemical present in the container. It is wise to figure the price of an available chemical on the basis of its active ingredient or acid equivalent. For example, Herbicide X can be obtained in liquid formulations varying from 6 pounds to less than 1 pound acid equivalent per gal-

lon. Usually, the more concentrated products are more economical on a per acre basis.

Granular formulations of many herbicides are also available. In comparison to sprays, granular herbicides offer both advantages and disadvantages. Some of the advantages are: simpler application - no water or mixing required, less drift, and a tendency toward longer activity in the soil. The problem of accurate calibration of granular equipment and the slightly higher per-acre cost of granular herbicides may offset these advantages. The range of concentration, particle size of product, and varying rates of application complicate calibration. More concentrated materials are usually more economical but errors in calibration are more critical. Calibration charts are supplied by manufacturers of granular applicators.

Control Strategy For Warm Season Turf

Comments in this section will be restricted mainly to weed control in bermudagrasses. Zoysia, bermudagrass, centipedegrass and St. Augustine vary in their susceptibility to both preemergence and postemergence herbicides. However, it is possible in most cases to discuss bermudagrass and zoysiagrass as a group and include centipedegrass and St. Augustine in a second group. In general, herbicides that can be used on bermudagrass can be used safely on zoysiagrass. Centipede and St. Augustine are similar in their tolerance to herbicides.

Winter grass weeds

Annual bluegrass is by far the most severe grassy weed infesting southern turf areas during the late growing season through the dormancy period and into the early growing season. It occurs in all turf environments. Aside from decreasing the aesthetic value of turf, the primary objection to annual bluegrass is its rapid die-back in

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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 preemergence herbicides is usually accomplished with either benefin, bensulide, DCPA, Pronamide, simazine, or terbutol. Two applications may be necessary during the dormant season for acceptable control except with Pronamide or simazine.

Pronamide has shown excellent potential for either preemergence or postemergence control of annual bluegrass in bermudagrass.

There are two choices for annual bluegrass control on bermudagrass greens overseeded with perennial

ryegrasses. Bensulide may be applied prior to overseeding. Ethofumesate may be applied 15-30 days after overseeding. Check both labels for timing to avoid delaying spring transition.

A third approach, employed particularly on many golf courses, is to use a postemergence application of a non-selective herbicide such as paraquat or cacodylic acid prior to breaking of dormancy. This usually does an excellent job on annual bluegrass as well as those annual broadleaved weeds present. Injury is often encountered if application is delayed until the bermudagrass starts breaking dormancy. The degree of injury is dependent on the amount of green foliage present at the time of application.

Winter broadleaved weeds

Important broadleaf weed spe-

cies include: common chickweed, henbit, clovers, spurweed, mouse-ear chickweed, lawn burweed, common dandelion, wild onion, wild garlic, plaintains, and speedwells.

Preemergence control can be obtained with benefin, bensulide, DCPA, 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 a combination containing dicamba are most used. The phenoxy herbicides are safe on completely dormant turfs. Actively growing turfs vary considerably in tolerance to phenoxy type materials. St. Augustinegrass will usually tolerate a .5 lb/A of 2,4-D with only

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Summary of herbicide treatments on control of weeds in turfgrasses in Georgia. (B.J. Johnson)

Treatments		Weed species ^a								
Herbicide	Rate	Crab-grass	Goose-grass	Henbit	Common chick-weed	Spur-weed	Parsley-piert	Hop clover	Corn speedwell	Annual bluegrass
Atrazine	2.0			Po	Po	Po	Po	Po	Po	Po
Bensulide	10.0	P					P			P
Benefin	3.0	P		P	P				P	P
DCPA	10.0	P			P				P	
DSMA	3.0	Po								
Ethofumesate										P, Po ^c
Glyphosate ^b	0.5			Po	Po	Po	Po	Po	Po	Po
Metribuzin	0.5		Po	Po	Po	Po	Po	Po	Po	Po
Metribuzin + MSMA	0.12+									
	2.0	Po	Po							
MSMA	2.0	Po								
Oxadiazon	3.0	P					P	P	P	P
Paraquat ^b	0.5			Po	Po	Po	Po	Po	Po	Po
Pronamide	0.75				P				P, Po	P, Po
2,4-D ^d	1.0			Po	Po	Po	Po	Po	Po	
2,4-D+dicamba ^d	1.0+									
	0.5			Po	Po	Po	Po	Po	Po	
2,4-D+mecoprop + dicamba ^d	1.0+									
	0.5+									
	0.1			Po	Po	Po	Po	Po	Po	

^aWeeds controlled from preemergence treatments are represented with P and those with postemergence treatments are represented with Po.

^bTurfgrass must be completely dormant when paraquat and glyphosate are used. Paraquat has restricted use and applicator must be certified. Glyphosate does not have specific label for turf except for renovation.

^cSafe to apply to bermudagrass overseeded with ryegrass.

^dRepeated treatments at 2-week interval may be needed for effective control.

minimal injury. At rates above .5 lb/A St. Augustinegrass is usually injured. This may seem unimportant when using phenoxy on dormant warm season turfs, but invariably application is made at various stages during spring transition. All turfgrasses are more susceptible to phenoxy injury during this transition period. The combination of mecoprop plus chlorfurenol is often used, especially by the homeowners on St. Augustine.

Summer grass and sedge 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, atrazine, and simazine. Certain formulations of atrazine and simazine are labeled for use on St. Augustinegrass, zoysiagrass, and centipedegrass for sod production while other commercial products containing atrazine and simazine are labeled for homeowner use.

Postemergence control of these two weeds in St. Augustinegrass and centipedegrass can be accomplished only with asulam (Asulox®). In bermudagrass and zoysiagrass, MSMA (monosodium methanearsonate) and DSMA (disodium methanearsonate) are effective. In fact, dallisgrass control is accomplished almost exclusively in bermudagrass and zoysiagrass with the arsonates.

In terms of difficulty of control, goosegrass is the number one summer grass problem in the Southern United States. Timing of application of preemergence herbicides (DCPA, benefin, bensulide or oxadiazon) is of paramount importance if control is to be achieved. We generally think goosegrass starts germinating in significant quantities 4 to 6 weeks after crabgrass. However, this can and does vary. If application of a preemergence herbicide is delayed, this means that large crabgrass will escape because it germinates

earlier than goosegrass. In bermudagrass and zoysiagrass, large crabgrass can be controlled quite effectively with post applications of the arsonate herbicides. The use of preemergence herbicides would appear to be a better approach to goosegrass control than postemergence control with arsonates.

Oxadiazon (Ronstar®) gives excellent control of goosegrass, however, cost may be a limitation. Research has shown that MSMA + metribuzen (Sencor) will postemergently give good control of goosegrass.

Other grass weed problems in southern turfs include sandbur,

Preemergence herbicides

for goosegrass control should be applied four to six weeks after application for crabgrass control.

bahiagrass, crowfootgrass, torpedograss, and others. Sandbur and bahiagrass can be controlled with arsenicals. No means of selective control of torpedograss in any southern turf species has been developed at the present time.

Both annual and perennial sedges are problems in the Southern United States. Purple nutsedge and to a lesser extent, yellow nutsedge are the most severe problems. Multiple applications of arsenicals or an arsenical plus a phenoxy are generally recommended at the present time for purple nutsedge. Successful control is dependent on repeated applications at appropriate intervals. This is the only method commonly used for selective control in southern turf and can be used only on bermudagrass and zoysiagrass. Basagran® can be used if yellow nutsedge is a problem.

Summer broadleaf weeds

Broadleaved weeds are a prob-

lem through the Southern United States in turf. However, no single species would appear to reach the level of infestation over large areas equivalent to that observed with large crabgrass, dallisgrass or goosegrass. Among the more important broadleaved weeds are prostrate spurge and Virginia buttonweed. As a group these are rather difficult to control. Multiple applications of 2,4-D + dicamba, Trimec® or Trex-San® are almost always necessary. Researchers generally observe that the use of a good agricultural grade nonionic surfactant is warranted.

Control Strategy For Cool Season Turf

The primary preemergence herbicides for grassy and broadleaf weeds in cool season turf are benefin (Balan), bensulide (Betasan, Betamec-4, Pre-San), DCPA (Dacthal), oxadiazon (Ronstar), and siduron (Tupersan).

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 has been reported.

Preemergence herbicides should be watered in to get the chemical to the seed prior to germination and should remain effective for two or more weeks. Timing the application is critical. Contact local extension personnel for recommended dates for application.

The primary postemergence herbicides for grassy weeds in turf are the arsonates; CMA, DSMA, MAMA, and MSMA. Treated areas should not be reseeded soon after application. See labels for delay period. Bentgrass and fescue are more sensitive to arsonates

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than other cool season grasses. CMA is the safest for bentgrass.

Weed foliage should be sprayed while still young (2 to 3 leaf stage) if possible. The effectiveness of arsonates improves with temperature and rates may need to be increased for temperatures below 80 degrees F.

The primary postemergence herbicides for broadleaf weeds are 2,4-D, dicamba (Banvel), and MCPP. These herbicides should not be applied until a new lawn has had at least three mowings. The target weeds should be actively growing for best results. The temperature should be at least 60 degrees F. Applications during extreme heat or drought can cause severe damage to desirable turf.

Again timing information can be obtained from your local extension service. Two treatments are generally necessary. See label for the right amount of time 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 chooses to fumigate a seedbed prior to planting to reduce weed seed, control insects and fungi, and eliminate any off-type grasses. Methyl bromide (Dowfume), metham (Vapam), dazomet (Mylone) and Vorlex are used for preplant fumigation. See the labels for the recommended time of delay before seeding.

Turf renovation of existing stands is becoming common. Glyphosate (Roundup, Kleenup) has been very useful in killing actively growing weeds and grasses prior to reseeding. Amitrole, cacodylic acid (Phytar) and dalapon are also used for renovation. Glyphosate and cacodylic acid are deactivated within a few days of application.

For Information Contact Your Nearest Ransomes Distributor

EAST

Bearco, Inc. (North OH)
Cleveland, OH 44136, 216/238-2442

Brodner Equipment, Inc. (Upstate NY)
Rochester, NY 14606, 716/247-5218

The Clapper Co. (ME, VT, RI & East, MA)
West Newton, MA 02165, 617/244-7900

Conaway, Inc. (MD, North VA, & Wash. D.C.)
Lawrence, PA 15055, 412/341-6447

EDM Distributors, Inc. (CT, VT & West, MA)
Agawam, MA 01001, 413/786-6977

S.P. Lumms Supply Co. (East, PA)
Pottstown, PA 19464, 215/327-4920

Ross Lawn Equipment (Upstate NY)
Tonawanda, NY 14150, 716/691-7642

Steven Willand, Inc. (NJ, NY & LI)
Fairfield, NJ 07006, 201/227-5656

SOUTH

Adrian Metal & Tractor, Inc. (East, NC & SC)
Conway, SC 29526, 803/365-5501

Archdale Small Engine (West, NC & SC)
Charlotte, NC 28210, 704/554-7944

Florida Outdoor Equipment, Inc. (FL)
Orlando, FL 32804, 305/295-5010

Goldthwaite's of Texas, Inc. (TX)
Fort Worth, TX 76107, 817/332-1521

Goldthwaite's of Dallas (TX)
Dallas, TX 75234, 214/241-3103

Goldthwaite's of Houston (TX)
Houston, TX 77025, 713/666-4233

Goldthwaite's of San Antonio (TX)
San Antonio, TX 78217, 512/653-9660

Hudson Small Engine Sales (AL)
Huntsville, AL 35800, 205/536-9637

Lawn Care Sales & Service (TN)
LaVergne, TN 37086, 615/793-6052

Moore's Cycle & Supply (OK)
Oklahoma City, OK 73106, 405/236-3785

South Central Turf Equipment (MS & LA)
Jackson, MS 39209, 601/922-7437

Stovall & Co., Inc. (GA)
Atlanta, GA 30318, 404/352-1555

MIDWEST

Brentom Lawn & Turf Corp. (KY & South, IN)
Louisville, KY 40299, 502/491-0865

Conniff's Power Equipment, Inc. (IN & South, OH)
Richmond, IN 47374, 317/935-2344

Eagle Green Corporation (NB, MO & West, IA)
Omaha, NB 68144, 402/334-9019

Ideal Mower Sales (MI & West, OH)
Ferndale, MI 48220, 313/541-4200

Kaye Corporation (MN & ND)
Mankato, MN 56001, 507/345-5083

Olsen Distributing Company (IL)
Barrington, IL 60010, 312/381-9333

WEST

Colorado Outdoor Power Equip., Inc. (CO, WY & NM)
Denver, CO 80223, 303/733-4651

J. & J. Power Equipment, Inc. (OR)
Eugene, OR 97402-0129, 503/344-1483

Jenkins Machinery Company (CA & AZ)
Concord, CA 94520, 415/685-6685

MHT Distributing Co., Inc. (CA)
Pasadena, CA 91103, 213/798-0741

The Bob Randick Co. (CA)
San Mateo, CA 94402, 415/574-7366

Sunset Northwest (East, WA)
Bellevue, WA 98009, 206/455-5640

Turfgo Northwest (West, WA & OR)
Seattle, WA 98133, 206/771-4885

Ward Enterprises, Inc. (UT)
Salt Lake City, UT 84104, 801/972-3287

CANADA

Consolidated Western Ind. Co., Ltd. (Alta & Sask)
Edmonton, Alta T5S 1H4, 403/484-7181

Duke Lawn Equipment Ltd. (Ont, Que, & Maritime Provinces)
Burlington, Ont L7S 1W6, 416/637-5216

Par Equipment Ltd. (Man)
Winnipeg, Man R3E 3J8, 204/775-8988

Rollins Machinery Ltd. (B.C.)
Vancouver, B.C. V5T 1H8, 604/874-6404

RANSOMES

Landscape

by Dr. Elton Smith

Increasing labor costs in recent years have caused an increase in the use of both pre-emergence and post-emergence herbicides. Herbicides are a useful tool on golf courses, cemeteries, parks, arboreta, schools, as well as commercial and residential landscapes.



They are used to control weeds under trees, delineate turf areas, in and around sand traps, around grave markers, in patios, driveways, under fences and in flower, ground cover and woody plant beds.

The effectiveness of a weed control program is only as successful as the person responsible for selection, calculation, calibration, and application of herbicides. It's up to the applicator to create the proper conditions necessary to achieve the desired results. The label specifies those conditions.

Weeds typically found in the landscape are classified as either annuals or perennials. Annual weeds, such as crabgrass, foxtail or purslane, are relatively easy to keep under control by either mulching, cultivation, hand pulling, pre-emergence herbicide application, or a combination.

Perennial weeds, such as bindweed, thistle, quackgrass, or nutsedge, are much more difficult to control by the above methods principally due to their extensive root systems.



Chemical control of weeds at tree bases (top) reduces physical damage caused by mowers and trimmers. The key to weed-free plant beds is to control perennial grasses and broadleaved weeds prior to planting.

Weeds can be controlled prior to or after planting, however, many fail to recognize the importance of eliminating weeds, especially perennials, prior to planting.

Prior to planting

The most successful approach to a weed-free landscape is to control perennial grasses, and perennial broadleaved weeds, prior to preparing the area for planting. Spraying the weeds in the area with one of several post-emergence herbicides which will be translocated to the root system for total plant control is one of the most effective methods of control. Examples of such products would be 2,4-D and related products for broadleaf weed control, dalapon for grass control and amino triazole and glyphosate for general weed control. Each of these normally has to be applied more than once and most have a specific waiting period prior to planting. Glyphosate, a very effective product for perennial grass and broadleaf weed control, has no soil residue.

A number of pre-emergence herbicides are labelled for landscape plants and two are recommended for use prior to planting. Incorporate into the soil, following tillage, either Eptam or Treflan to control annual and some perennial weeds for a period of 4-6 weeks. Following incorporation to a depth specified on the label, planting of the ornamentals can begin. The incorporation of these two herbicides have been used extensively by commercial nurserymen and is now being used by landscape contractors to a large extent, especially where maintenance for a specified period of time is in the contract.

Tillage as a method of weed control prior to planting is a successful practice for the control of annual weeds but not as effective against perennial weeds. In some cases, tillage only cuts up the root system

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into smaller pieces and redistributes them.

Following planting

In recent years the landscape industry has made extensive use of mulches to prevent weeds in the landscape. Many types of mulches are available, however, the most popular in the Midwest include hardwood, Cypress and pinebark mulches along with wood chips, peat moss, and an assortment of hulls and numerous inorganic types. These should be applied at least 2-inches deep and renewed annually or as needed. Avoid the use of black plastic near woody plants as plastic contributes to excessive soil moisture.

Some weeds will come through

the mulches. These must be hand pulled or sprayed. Seeds will be carried into planting beds by wind and birds and will often germinate in the mulch. Again, hand pulling is the most satisfactory control measure in small areas, however, landscape personnel are using more & more herbicides, such as glyphosate.

As an alternative to, or in combination with mulches, are several pre-emergence herbicides that can be applied between or over the plants to control annual weeds for a period of 4 to 8 weeks. Reapplications are usually necessary to achieve season-long control depending on selection of herbicide, soil and climatic conditions. Typically, the first application

should be made prior to weed seed germination and subsequent treatments as needed based on re-growth of annual weeds.

The soil should be weed-free and moist prior to application or the treatment should be followed by rain or irrigation. It's important to know how much area is included in the beds to be treated. Once the area has been calculated, determine the amount of herbicide needed for that area, and apply with equipment that is properly calibrated and in working order. Many types of application equipment are available. Select a sprayer and/or granular applicator that is large enough to complete anticipated needs and is easy to calibrate and clean.

Calculating rates and quantities

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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

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

Calculation

$$4 \text{ lbs. aia} \times \frac{4,000}{44,000} \times \frac{100}{4} = 9.1 \text{ lbs. 4\% granular RONSTAR}$$

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

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

Calculation

$$10 \text{ lbs. aia} \times \frac{4,000}{44,000} \times \frac{100}{50} = 1.8 \text{ lbs. 50\% DEVRINOL W.P. to be mixed in enough water to cover 4,000 sq. ft.}$$

Liquid Concentrate

Example—The recommendation is to apply trifluralin at 2 lbs. aia. Since TREFLAN contains 4 lbs. active ingredient/gal., how many gallons should be applied on 1/2 acre of area to be planted to Purple Wintercreeper.

Formula

$$\text{lbs. aia} \times \frac{\text{sq. ft. to be treated}}{44,000} \times \frac{1}{\text{lbs. active ingredient/gallon}} = \text{gallons required to treat area}$$

Calculation

$$2 \text{ lbs. aia} \times \frac{22,000}{44,000} \times \frac{1}{4} = .25 \text{ or } \frac{1}{4} \text{ gal. TREFLAN to be mixed in enough water to cover } \frac{1}{2} \text{ acre}$$

Landscape

Pre-emergence herbicides for landscape use

There are approximately 18 pre-emergence herbicides registered for the nursery industry but only the 12 listed below are utilized in landscape plantings.

Check the label for sensitive plant materials before using any herbicide. Consider using a drift preventer (cone) for liquid materials to reduce damage to desirable plants and to increase application speed. Bulbs can be affected by many preemergence herbicides. Soil type can reduce effectiveness. Foliage of desirable plants should be dry to prevent granular materials from sticking.

BETASAN, LESCOSAN (Bensulide)—used at the rate of 10-12 lbs. aia to control annual grasses, especially crabgrass, and annual bluegrass in established flower gardens. Use the 12.5% granular formulation (80-96 lbs.), the 3.6% G (278-333 lbs.), or the 4 E formulation at 3 1/8 gals./A in 80-100 gals. of water and irrigate after application. This is the only pre-emergence herbicide labelled for use with tulip and daffodil.

CASORON, DYCLOMEC (Dichlobenil)—effectively controls a wide spectrum of annual and perennial grasses and broadleaved weeds when used at 5 to 6 lbs. aia (125-150 lbs. of G-4). CASORON is one of the most effective pre-emergence herbicides against mugwort (wild chrysanthemum), thistle, nutsedge, quackgrass and bindweed, particularly if used for 2 successive years. CASORON is not especially effective in fine sandy soils. It should be incorporated 2-3 inches if the soil temperature is above 45°F, however, no incorporation is necessary if applied in late fall or winter. CASORON may injure fir, spruce, hemlock, certain Japanese hollies, viburnum and most herbaceous plants.

DACTHAL (DCPA)—is used at the rate of 10.5-12.0 lbs. aia in 75% wettable powder (14-16 lbs.) or 5% granular form (210-240 lbs.) to con-

trol annual grasses and many broadleaved weeds including dodder. DACTHAL is not effective against wild mustard, ragweed, smartweed, and velvet leaf. It can be safely used with nearly all woody ornamental and many herbaceous crops.

DEVRI-NOL (Napropamide)—controls annual grasses and broadleaf weeds including chickweed, groundsel, lambsquarters and red-root pigweed. DEVRI-NOL is ap-

plied at the rate of 4-6 lbs. aia in 10% granular form (40-60 lbs.) or 50% WP (8 to 12 lbs. in 50 gals. water). For small areas, apply the 10 G at 15 oz.—1 lb. 6 oz./1000 sq. ft. or the 50 WP at 3 oz. to 4.4 oz./2 1/2 gals. water/1000 sq. ft. DEVRI-NOL is registered on a wide selection of trees, shrubs, evergreens and ground covers.

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TABLE 1. **Woody plants tolerant to pre-emergence herbicides**

The following evergreen and deciduous plants are labeled for use with the pre-emergence herbicides across the top of the chart. An (X) in the column indicates the herbicide can be safely used for that plant listed. The list includes only those plants with company label registration.

	BETASAN	CASORON	DACTHAL	DEVRI-NOL	ENIDE	EPTAM	FURLOE	CHLORO IPC	ORNAMENTAL WEEDER	PRINCEP	RONSTAR	SURFLAN	TREFLAN
Narrowleaf Evergreens													
Arborvitae		X	X	X	X		X	X	X	X	X	X	X
Chamaecyparis				X	X	X							
Eastern Red Cedar		X		X	X					X			X
Fir			X	X		X	X						
Fir, Balsam							X			X			X
Fir, Douglas				X						X	X		X
Fir, Fraser										X			
Hemlock				X	X	X	X	X	X	X	X		X
Juniper	X	X	X	X	X	X	X	X	X	X	X	X	X
Pine			X	X		X	X	X					
Pine, Austrian										X	X		X
Pine, Japanese Black											X	X	X
Pine, Mugo										X		X	
Pine, Red										X			X
Pine, Scotch										X	X		X
Pine, White										X	X	X	X
Spruce			X	X		X	X						
Spruce, Blue										X	X	X	X
Spruce, Norway										X	X		X
Spruce, White										X	X		X
Yew		X	X	X	X	X	X	X	X	X	X	X	X
Broadleaf Evergreens													
Boxwood	X	X	X	X		X					X	X	X
Cherry Laurel					X							X	X
Euonymus				X	X		X	X			X	X	X
Firethorn	X	X		X	X						X	X	X
Holly	X	X	X	X	X	X		X			X	X	X
Holly, Japanese						X					X	X	X
Japanese Pieris			X			X		X				X	X
Leucothoe		X				X					X	X	
Magnolia grandifolia											X	X	
Mahonia					X		X		X		X	X	
Mountain Laurel	X	X		X	X		X			X	X	X	X
Rhododendron	X	X	X	X	X	X	X	X			X	X	X

continued

Landscape

ENIDE (Diphenamide)—is used at the rate of 6-8 lbs. aia (12-16 lbs. 50% WP, 6.6-8.8 lbs. 90% WP) to control annual grasses and broad-leaved weeds. ENIDE, available as a 50% and 90% wettable powder, is particularly effective in sandy soils and quite safe on evergreens, deciduous plants, numerous ground covers and flowers.

EPTAM (EPTC)—is available as a 7 EC and 10% granular and can be used to rid an area of certain weeds the season prior to planting. It must be incorporated 2-3" for annual weed control and at least 6" in the soil, preferably by cross discing at 3-6 lbs. aia (30-60 lbs. G-10, 5¼-7 pts. of 7 EC in 10-50 gal. of water) for the suppression of nut-

sedge, quackgrass, and certain other weeds. Mugwort can be controlled at 17 pts. of 7 E in 10-50 gals. of water/A. Unless thoroughly incorporated into the soil, EPTAM will not give as long lasting control of broadleaf weeds as many other herbicides. EPTAM should be considered for nutsedge and mugwort control the season prior to planting only.

FURLOE CHLORO-IPC (Chloropropham)—is used at the rate of 6-10 lbs. aia as a 20% granular (30-50 lbs.) or 10% granular (60-100 lbs.) formulation to control chickweed and other annual winter weeds. FURLOE CHLORO-IPC should be applied when landscape plants are in a dormant stage. It kills established chickweed and is a most useful autumn herbicide.

ORNAMENTAL WEEDER (Chloramben 4 G)—controls annual broadleaf weeds and grasses at the rate of 4.0 lbs. aia (100 lbs. 4 G). Use in the spring on weed free soil, irrigate with ½" of water within 1 week of application but do not incorporate. Controls chickweed, crabgrass, foxtails, lambsquarters, mustard, pigweed, ragweed, seedling johnsongrass, smartweed and velvetleaf. Chloramben is more effective in clay loam soil than in sandy soils.

PRINCEP (Simazine)—is used from 1 to 3 lbs. aia in the 4% granular (25-75 lbs. G-4), 4 L (1-3 qts.) or 80% wettable powder (1.3-3.8 lbs. 80 W) formulations to control annual and perennial grasses and broadleaf weeds. PRINCEP CALIBER 90, a water dispersible granule, should be used at 2.2-3.4 lbs. of product in 25 gal. water. Princep is effective for 3 months or longer if applied in the spring. PRINCEP will injure birch, euonymus, deutzia, lilac, linden, privet, spirea, and herbaceous plants. Autumn or early winter applications at 2-3 lbs. aia are recommended with a lower rate (1 lbs. aia) suggested for summer use alone or preferably, in combination with

TABLE 1. **Woody plants tolerant to pre-emergence herbicides**
Continued

	BETASAN	CASORON	DACTHAL	DEVIRINOL	ENIDE	EPTAM	FURLOE CHLORO IPC	ORNAMENTAL WEEDER	PRINCEP	RONSTAR	SURFLAN	TREFLAN
Deciduous Trees												
Ash		X	X	X	X					X		X
Ash, White					X							X
Bald Cypress					X							X
Beech					X							
Birch		X	X		X		X			X		
Birch, European					X							X
Chinese Chestnut			X		X							X
Corktree, Amur		X										
Crabapple		X	X	X	X					X		X
Dogwood		X	X		X	X		X	X	X		X
Dogwood, Kousa												X
Elm		X	X									
Elm, American								X				
Elm, Siberian								X				
Ginkgo										X	X	
Goldenchaintree		X		X								
Goldenraintree		X									X	
Hackberry		X										
Hawthorn			X	X								
Honeylocust				X				X				X
Linden		X				X						
London Planetree												X
Magnolia		X	X			X	X			X		
Maple		X	X	X	X	X	X					
Maple, Amur										X		
Maple, Norway												X
Maple, Red							X					X
Maple, Silver												X
Maple, Sugar					X							X
Mountain Ash		X										
Oak		X	X		X	X				X		
Oak, Pin												X
Oak, Red								X	X	X		X
Oak, Scarlet												X
Poplar		X	X	X	X		X					
Redbud			X		X							X
Russian Olive		X	X		X			X	X			
Sassafras							X					
Sweetgum			X		X						X	X
Sycamore			X		X							X
Tuliptree			X		X							X
Tupelo												X
Walnut		X	X	X	X							X
Willow		X	X		X							X

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Landscape

TABLE 2. Ground covers and flowers tolerant to pre-emergence herbicides

	BETASAN	DACTHAL	DEVIRINOL	ENIDE	EPTAM	ORNAMENTAL WEEDER	PRINCEP	RONSTAR	SURFLAN	TREFLAN
Ground covers										
Ajuga	X		X		X			X		
Boston Ivy		X								
Cotoneaster		X		X		X	X	X	X	X
English Ivy	X	X	X	X	X	X		X	X	
Euonymus		X		X		X		X	X	X
Honeysuckle		X		X						X
Juniper	X	X		X		X	X	X	X	X
Liriope			X						X	
Myrtle	X		X	X	X			X		
Pachistima		X								
Pachysandra	X		X		X			X		
Potentilla										X
Sedum	X				X			X		
Stonecrop									X	
St. John's Wort	X		X	X	X					
Flowers										
Achillea			---				---			X
Ageratum		X			X					X
Alyssum	X	X		X	X					
Amaranthus					X					
Aster	X	X		X	X					X
Baby's Breath		X		X						
Bachelor's Button	X									
Balsam					X					X
Begonia				X	X				X	
Bell Flower		X	---				---			
Bleeding-Heart		X	---				---			
Bugloss		X	---				---			
Calendula	X		---				---			X
California Poppy			---				---			X
Calliopsis			---				---			X
Campanula	X		---				---			
Candle Larkspur		X	---				---			
Candytuft	X	X	---				---			
Carnation			---				---			X
Celosia			---			X	---			
Centaurea			---				---			X
Chrysanthemum		X	---	X	X	X	---		X	X
Coleus		X	---				---			
Columbine		X	---				---			
Coral Bells	X	X	---				---			
Coreopsis		X	---				---			
Cosmos		X	---				---			X
Daffodil	X		---				---			
Dahlia	X	X	---	X	X	X	---			X
Daisy	X		---				---			
Daylily			---		X	X	---			
Delphinium		X	---	X			---			
Dianthus			---		X		---			X
Evening Primrose		X	---				---			
Fernleaf Yarrow		X	---				---			
Feverfew		X	---	X			---			
Forget-Me-Not		X	---				---			X
Four-O'Clock		X	---				---			X
Foxglove		X	---	X			---			
Gaillardia		X	---				---			X
Gazania	X		---				---		X	

continued

DACTHAL, DEVIRINOL, ENIDE, or SURFLAN.

RONSTAR (2 G), PRO GROW ORNAMENTAL HERBICIDE 1 (4 G) (Oxadiazon)—labelled for the control of many annual grasses and broadleaved weeds in trees, shrubs, vines and ground covers. This material is effective in controlling bittercress, common groundsel, galinsoga, Pennsylvania smartweed, yellow woodsorrel (oxalis) and barnyardgrass but not chickweed. Apply at 4.0 lbs. aia (100 lbs./A of the 4% G or 200 lbs./A of the 2% G formulation). Avoid application to wet foliage to prevent granules from attaching to the leaves and causing phytotoxicity.

SURFLAN (Oryzalin)—for use in landscape plantings to control annual grasses, chickweed, purslane, lambsquarters and pigweed. Apply at the rate of 2.0-4.0 aia (2 2/3-5 1/3 lbs. of 75% WP in 20-40 gals. of water) on established plants. This herbicide is labeled for numerous shrubs, evergreens, ground covers, and flowers. SURFLAN is similar to TREFLAN but does not require incorporation and can be used in existing plantings of most ornamentals. One-half inch of water is necessary to activate the herbicide following application.

TREFLAN (Trifluralin)—is primarily used as a pre-plant treatment to control annual grasses and some broadleaf weeds. The 5% granular and 4 lbs. emulsifiable concentrate forms are used 1-4 lbs. aia (20-80 lbs. G-4, 1.4 qts. EC) and must be incorporated 2-3 inches into the soil. Effectiveness is increased if shallow (1/2-2") cultivation follows application by 2-3 weeks.

Post-emergence herbicides for landscape use

Post-emergence herbicides are used for general weed clean-up around buildings, waterways, fence rows, etc. Used with extreme caution, these materials may be

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Landscape

TABLE 2. Ground covers and flowers tolerant to pre-emergence herbicides
Continued

	BETASAN	DACTHAL	DEVIRINOL	ENIDE	EPTAM	ORNAMENTAL WEEDER	PRINCEP	RONSTAR	SURFLAN	TREFLAN
Flowers										
Geranium		X	---	X			---		X	
Gladiolus	X	X	---				---			X
Gold Dust		X	---				---			
Golden Marguerite		X	---				---			
Golden Tuft		X	---				---			
Impatiens			---				---		X	
Iris		X	---			X	---			
Ixora			---				---			X
Lavendercotton		X	---				---			
Lily		X	---				---			
Lobelia			---	X			---			X
Lupine		X	---				---			X
Marigold	X	X	---	X	X	X	---		X	X
Morning Glory		X	---				---			
Mother-of-Thyme		X	---				---			
Nasturtium		X	---		X		---			X
Nicotiana			---				---			X
Pansy	X		---		X		---		X	
Peony		X	---	X		X	---			
Periwinkle			---				---			X
Petunia		X	---	X	X		---		X	X
Phlox			---	X			---		X	X
Pink Heath		X	---				---			
Pinks		X	---				---			
Poker Plant		X	---				---			
Portulaca			---				---			X
Primrose	X		---				---			
Purple Cone Flower		X	---				---			
Ranunculus	X		---				---			
Rudbeckia			---				---			X
Salvia		X	---	X			---			X
Scabiosa			---				---			X
Scarlet Sage		X	---				---			
Shasta Daisy			---	X			---			X
Snapdragon		X	---	X		X	---			X
Snow on the Mountain			---				---			X
Stock			---	X			---			X
Stone Crop		X	---				---			
Strawflower		X	---				---			
Sundrops		X	---				---			
Sunflower		X	---				---			X
Sweet Alyssum			---				---			X
Sweet Pea	X	X	---				---			X
Sweet William			---	X			---			X
Tulip	X		---				---			X
Verbena		X	---	X			---			
Violet		X	---				---			
Virginia Spiderwort		X	---				---			
Wall Flower	X		---				---			
Wormwood		X	---				---			
Zinnia	X	X	---	X	X	X	---	X		X

continued

used in tree plantings. Avoid herbicide contact with foliage, trunks or stems with green, yellow or red tissue of desired crops as damage can result from each of these materials.

AMITROLE (amino triazole)—is applied to the foliage of perennial broadleaved weeds and is absorbed and translocated to the stems and roots. It is very effective against poison ivy. If it should contact foliage of desired plants, leaves turn yellow, white, and then brown. Use only as a spot treatment for perennial weeds in or near landscape crops.

2,4-D and related compounds—the non-volatile forms of 2,4-D can be used among trees to control broadleaved weeds when there is no air movement. If grasses are also a problem, 2,4-D should not be used.

DOWPON (Dalapon)—in non crop areas, is recommended for control of quackgrass at the rate of 10-15 lbs. aia (13-19.5 lbs. of commercial product) and plowed down 10-14 days later. This treatment will also control common reed and cattails. DOWPON is available as an 85% wettable powder.

PARAQUAT—is used at the rate of .5 to 1.0 lb. aia or 1 to 2 qts. of the commercial formulation per sprayed acre for control of annual weeds and grasses and for top kill of perennial weeds and grasses around the base of trees. Avoid use on green barked trees including littleleaf linden. Repeat applications, as necessary, to control newly germinated seedlings and to control regrowth of perennials. A surfactant should be used. There is no soil residue. Use protective clothing and gloves while handling the concentrate to avoid contact with skin. PARAQUAT is a restricted use pesticide.

RAD-E-CAT 25 or PHYTAR 560 (Cacodylic Acid)—is used to control annual and perennial weeds around trees, for lawn renovation,

continued on page 66

Landscape

TABLE 2. Ground covers and flowers tolerant to pre-emergence herbicides

Continued

	BETASAN	CASORON	DACTHAL	DEVIRINOL	ENIDE	EPTAM	FURLOE CHLORO IPC	ORNAMENTAL WEEDER	PRINCEP	RONSTAR	SURFLAN	TREFLAN
Deciduous Shrubs												
Abelia	X		X	X							X	
Azalea	X	X	X	X	X	X		X		X	X	X
Azalea, Mollis		X	X									
Barberry		X	X		X	X	X		X	X	X	X
Beautybush		X			X							
Cinquefoil												X
Cotoneaster		X	X		X			X	X	X	X	X
Currant			X		X							
Deutzia		X										X
Dogwood, Red Osier										X		
Euonymus, Winged		X	X	X	X	X				X	X	X
Flowering Almond		X										
Flowering Quince		X										
Forsythia		X	X		X		X			X	X	X
Hibiscus				X	X		X				X	X
Honeysuckle		X	X		X		X	X	X	X	X	X
Hydrangea			X		X		X					
Hypericum				X	X							
Lilac		X	X		X	X	X			X	X	X
Mockorange		X	X		X		X				X	
Mockorange, Lemoine												X
Nandina		X		X				X				
Peashrub		X										
Photinia		X		X							X	
Privet	X	X	X	X	X		X			X	X	X
Rose		X	X	X	X		X	X		X	X	X
Spirea		X	X		X		X	X				
Spirea, Vanhoutte												X
Viburnum			X		X	X	X		X	X		X
Viburnum, Doublefile											X	
Weigela		X	X		X							

and general weed control in non-crop areas. A surfactant is not needed and it's inactivated upon contact with the soil. If regrowth occurs, re-apply as required. Apply at the rate of 3 gallons per acre.

ROUNDUP (Glyphosate)—controls annual and perennial weeds when used prior to planting and in established ornamentals. Registered as a directed spray toward the base of arborvitae, azalea, boxwood, crabapple, euonymus, fir, Douglas fir, holly, lilac, magnolia, maple, oak, privet, pine, spruce and yew. To control weeds apply to actively growing grasses and broadleaf weeds. Use 1 qt./A in 10-40 gallons of water if weeds are less than 6 in. tall. Apply 2-3 qts./A to control Canada thistle and 3-4 qts. for field bindweed control. Most effective control of perennial weeds is obtained when weeds are in the flower bud or bloom stage at treatment. There is no soil residue, however, a waiting period of 3-5 days, is necessary, following treatment and prior to tillage to obtain maximum weed control.

COMBINATION TREATMENTS—of post-emergence with pre-emergence herbicides are used to kill existing weeds and prevent emergence of others. The

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Lawn grass tolerance to herbicides in Georgia. (B.J. Johnson, Univ. of Georgia)

Turfgrasses	Herbicides									
	Benfenin	DCPA	Bensulide	Oxadiazon	Atrazine	DSMA MSMA	2,4-D ¹	Paraquat	Glyphosate	
Bermuda	T	T	T	T	S*	T	T	S*	S*	
Zoysia	T	T	T	T	S*	S-I	T	S	S	
Centipede	T	T	T	T	T	S	S*	S	S	
St. Augustine	T	T	T		T	S	S	S	S	
Tall fescue	T	T	T	T	S	T	T	S	S	
Bahia	T	T	T		S-I	S-I	T	S	S	

T = Tolerance; safe to use herbicide at recommended rates.
 S = Sensitive; Do not use this herbicide.
 S-I = Intermediately tolerant; use herbicide with care since grass may be injured.
 *Tolerant to herbicides when turfgrass is dormant.
¹Includes mecoprop and/or dicamba.

Weed Identification Quiz

Quiz yourself. Answers are on the next page.



A. _____



E. _____



F. _____



G. _____



J. _____



K. _____



L. _____



M. _____



Q. _____



R. _____



S. _____



B. _____



C. _____



D. _____



H. _____



I. _____



P. _____



N. _____



O. _____



T. _____



U. _____



V. _____



W. _____

Landscape

TABLE 3. Weeds controlled by pre-emergence herbicides

The following list of grasses and broadleaf weeds are labeled as being controlled by the pre-emergence herbicides. An (X) in the column indicates the weed is controlled for the herbicide listed.

	BETASAN	CASORON	DACTHAL	DEVIRINOL	ENIDE	EPTAM	FURLOE CHLORO IPC	ORNAMENTAL WEEDER	PRINCEP	RONSTAR	SURFLAN	TREFLAN
Grasses												
Annual Bluegrass	X	X	X	X	X	X	X		X	X		X
Barnyardgrass	X		X	X	X	X	X		X	X	X	X
Bermudagrass						X						
Cheat (Chess)				X	X							X
Crabgrass	X	X	X	X	X	X	X	X	X	X	X	X
Downy Bromegrass				X			X		X	X	X	X
Fall Panicum	X			X	X	X			X	X	X	X
Foxtail	X	X			X			X	X		X	X
Bristly Foxtail				X							X	X
Giant Foxtail				X		X					X	X
Green Foxtail			X	X		X			X	X	X	X
Yellow Foxtail			X	X		X				X	X	X
Goosegrass	X		X	X	X	X			X		X	X
Johnsongrass												
(from seed)			X	X	X	X	X				X	X
Nutsedge						X						
Quackgrass		X				X						
Ryegrass (annual)				X	X	X	X		X			
Sandbur			X		X	X						X
Stinkgrass												
(lovegrass)			X	X	X	X	X					X
Wild Oats				X		X	X		X		X	
Witchgrass		X	X		X	X	X		X			
Broadleaf Weeds												
Annual Morningglory						X			X			
Carpetweed		X	X	X	X	X	X		X	X	X	X
Chickweed		X	X	X	X	X	X	X	X	X	X	X
Common Groundsel				X			X		X	X		
Dandelion		X										
Deadnettle (Henbit)	X	X				X			X			X
Dodder			X				X					
Dogfennel		X										
Evening Primrose		X								X		
Galinsoga										X		
Knotweed		X		X	X		X					X
Lambsquarters	X	X	X	X	X	X	X	X	X	X	X	X
Lesser Bittercress											X	
Mugwort												
(Chrysanthemum Weed)		X				X						
Mustards		X						X	X			
Nightshades						X			X			
Peppergrass		X			X				X			
Pigweed					X			X	X			X
Prostrate Pigweed						X					X	X
Redroot Pigweed	X	X	X	X		X				X	X	X
Tumble Pigweed						X						
Plantain		X										
Prickly Lettuce				X								
Prickly Sida						X						
Purslane		X	X	X	X	X	X		X	X	X	X
Ragweed		X		X		X		X	X			

continued

combinations below have been used extensively in trees with excellent success.

PARAQUAT at 1-2 qt./A plus PRINCEP 80 W 1-2 lbs. aia (1.3-2.5 lbs.) Use as a directed spray and treat regrowth as needed with PARAQUAT only. Avoid contact with foliage and green, yellow or immature bark.

RAD-E-GATE or PHYTAR 560 at 3 gal./A plus PRINCEP 80 W 1-2 lbs. aia (1.3-2.5 lbs.) can be used in the same way as PARAQUAT and PRINCEP with the same precautions.

ROUNDUP at 1-3 qts./A plus SURFLAN 75 W at 2 1/2-5 1/3 lbs. is labelled for use on crops which appear on both labels.

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ANSWERS TO PHOTO QUIZ

- A. Mouse-ear chickweed
- B. Crabgrass
- C. Yarrow
- D. Goosegrass
- E. Prostrate knotweed
- F. Creeping speedwell
- G. Dandelion
- H. Goosegrass
- I. Broadleaved plantain
- J. Perennial white clover
- K. Yellow nutsedge
- L. Annual bluegrass
- M. Tall fescue
- N. Buckhorn plantain
- O. Corn speedwell
- P. Red sorrel
- Q. Mugwort
- R. Nutsedge
- S. Heal-all
- T. Prostrate spurge
- U. Black medic
- V. Ground ivy
- W. Oxalis

Photos courtesy of New York State Turfgrass Association.

Landscape

TABLE 3. Weeds controlled by pre-emergence herbicides

Continued

	BETASAN	CASORON	DACTHAL	DEVIRINOL	ENIDE	EPTAM	FURLOE	CHLORO IPC	ORNAMENTAL WEEDER	PRINCEP	RONSTAR	SURFLAN	TREFLAN
Broadleaf Weeds													
Red Sorrel					X		X						
Shepherdspurse	X	X			X	X				X			
Smartweed (Pennsylvania)		X			X		X	X		X	X		
Sow Thistle				X								X	
Speedwell			X							X	X		
Spurge, Leafy		X											
Spurge, Petty		X	X								X		
Spurge, Prostrate												X	
Thistle, Bull		X											
Thistle, Canada		X											
Timothy		X											
Velvetleaf								X					
Wild Aster		X											
Wild Carrot		X											
Yellow Rocket		X									X		
Yellow Woodsorrel (Oxalis)		X											

Precautions

Read the entire label on the container.

All directions and safety precautions should be followed, store herbicides in closed, clearly-labelled, original containers, in dry places, out of the reach of children and pets.

If herbicides are spilled on the skin, wash thoroughly with soap, if herbicides are swallowed, come in contact with the eyes or are absorbed to the point of showing symptoms, call a doctor immediately.

Emergency first aid directions and the telephone number of the nearest Poison Control Center should be posted in a conspicuous place in the workshop and in the truck.

Herbicide Manufacturers

The Anderson's
PO Box 119, Illinois Ave.
Maumee, OH
419-893-5050

BASF Wyandotte Corp.
100 Cherry Hill Rd.
Parsippany, NJ 07054
201-263-3400

BFC Chemicals Inc.
4311 Lancaster Pike
PO Box 2867
Wilmington, DE 19805

Ciba Geigy Corp.
PO Box 11422
Greensboro, NC 27409
919-292-7100

W.A. Cleary Chemical Corp.
1049 Somerset St.
Somerset, NJ 08873
201-247-8000

Crystal Chemical Co.
1525 N.
Post Oak Rd.
Houston, TX 77055

Diamond Shamrock
1100 Superior Ave.
Cleveland, OH 44114
216-694-5000

Dow Chemical USA
PO Box 1706
Midland, MI 48640
517-636-0968

Drexel Chemical Co.
2487 Pennsylvania
PO Box 9306
Memphis, TN 38109
901-774-2132

E.I. du Pont de Nemours
Wilmington, DE 19898
302-774-2132

Elanco Products Co.
730 S. Alabama St.
Indianapolis, IN 46285
317-261-3638

PBI Gordon Corp.
300 S. Third St.
Kansas City, KS 66118
816-421-4070

Hopkins Ag. Chemical Co.
PO Box 7532
Madison, WI 53707
608-222-0624

Lakeshore Eqpt. & Supply Co.
300 So. Abbe Road
Elyria, OH 44035
216-323-7544

Mallinckrodt Inc.
3600 N. Second St.
St. Louis, MO 63147
314-982-5043

MoBay Chemical Corp.
Box 4913
Hawthorn Rd.
Kansas City, MO 64120
816-242-2000

Monsanto
800 N. Lindbergh Blvd.
St. Louis, MO 63166
314-694-1000

Nor-Am Ag. Products
350 W. Shuman Blvd.
Naperville, IL 60540
312-961-6500

Ortho Div.
Chevron Chemical Co.
575 Market St.
San Francisco, CA 94105

Pennwalt Corp.
Three Parkway
Philadelphia, PA 19102
215-587-7000

PPG Industries Inc.
One Gateway Center
Pittsburgh, PA 15222
412-434-2252

Rhone Poulenc Chemical Co.
Box 125
Black Horse Lane
Monmouth Junction, NJ 08852
201-297-0100

Rohm & Haas Co.
Independence Mall West
Philadelphia, PA 19105
215-592-3000

Stauffer Chemical Co.
Ag. Chem Div.
Westport, CN 06880
203-222-3000

Thompson Hayward
5220 Speaker Rd.
Kansas City, KS 66101
913-321-3131

TUCO Div., Upjohn
9823-190-45
Kalamazoo, MI 49001
616-385-6609

Union Carbide, Ag. Prod. Co.
7825 Baymeadows Way
Jacksonville, FL 32216

Velsicol Chemical Corp.
341 E. Ohio
Chicago, IL 60611
314-670-4665

Vineland Chemical Co.
W Wheat Rd.
PO Box 745
Vineland, NJ 08360

WTT