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Landscape Weed Control Guide

This annual project is a collection of information from more than 20 weed scientists in the United States. Each year the content will build, be updated, and get more specific. The purpose is to gather the most current data on herbicide use and application for the user.

Reader input to this annual project is welcome. Comments or experiences from readers will also be included in the Guide the following year. Write to Weeds Trees & Turf magazine, 757 Third Ave., New York, NY 10017.

Illustrations were provided by the New York State Turfgrass Association from an audio/visual series developed by Dr. Arthur Bing. The slide set and script to the program are available from NYSTA, 210 Cartwright Blvd., Massapequa Park, NY 11762.

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Landscape Weed Control Guide

First the drought, and now a tight economy, have forced some compromises in weed control programs. The exercise of working within restrictions has been a constructive one showing us alternatives we never sought to find.

The result is a landscape manager who thinks for himself in adjusting herbicide programs to fit local conditions. To accomplish this he needs to know more about herbicidal characteristics, target weeds, and environmental factors that effect control results.

The weed control product manufacturer has also responded to local needs with state labels for more herbicides and products designed to place herbicides where they are most effective. Expanded labels for existing herbicides have proven very useful to the landscape industry.

Changes are taking place which go beyond short term solutions to drought and economic conditions. Native vegetation is being planted where management of higher maintenance vegetation proved costly and time consuming. Native shrubs, wildflowers, and native grasses have allowed landscape managers the time and resources to concentrate on areas requiring regular maintenance.

Vegetation does not have to be native to perform aggressively in a particular region. Renovation of turf areas to more vigorous cultivars may solve a recurring weed encroachment problem. Weeds generally get a foothold by seeding or vegetative spreading while desired grasses are dormant or thinned by mismanagement.

Landscape managers in the transition zone, and even the southern cool season region are switching to improved tall fescues and zoysiagrass to maintain hardiness in the summer heat. Southern landscape managers find overseeding and herbicide applications during winter dormancy help to protect

desired species from weed encroachment. Advances in seed production and viability for zoysiagrass and centipedegrass may make renovation to these species more practical.

These are not the only alternatives by any means. Attention to mowing height, irrigation, soil pH, drainage, and compaction can assure the best defense against weeds, a dense, healthy turf. Other factors to consider are air circulation, shade conditions, and slope.

Some locations are simply too harsh for turfgrass to succeed and should be converted to a more realistic form of vegetation or the site altered to fit the needs of the turfgrass. Maintaining a good turf cover under trees and shrubs is often impractical. Parking islands in asphalt lots are generally too harsh for turfgrass survival and impractical for maintenance. Alternate landscape plans are needed for such areas.

One of the biggest maintenance headaches is weed control in ornamental displays. Shrubs, flowers, and groundcovers require much more maintenance than turf. Advances in preemergence and longer residual selective herbicides for container and bedding ornamentals provide some maintenance efficiency for these important landscape elements.

Nonselective weed control around fences, structures and plants has not changed appreciably except for the rapid, systemic properties of glyphosate (Roundup, Kleenup). The loss of silvex has caused some adjustment in clearance weed control.

Weeds

The problem weed(s) must be identified before effective control can be implemented. Many factors are based upon the specific target weed(s). These include application timing, chemical used, type of control which is most effective (pre- or

postemergence), and application method.

The desirable plants must also be identified to avoid damage. For example, use of some preemergence herbicides for turf on fine fescue or bermudagrass may cause noticeable damage and defeat the purpose of weed control from health and appearance standpoints.

In this Guide, we will focus on the primary target weeds and the products that most effectively control them. Usually there are a number of weeds requiring control at one time and herbicides can be combined, such as broadleaf and grassy weeds in turf. There are very few one solution cures to standard weed control problems. Thought and planning are necessary. The primary distinction between weeds for control purposes is whether they are grasses (monocots) or broadleaf weeds (dicots). Herbicides designed for use against grassy weeds will be ineffective on broadleaf weeds. Furthermore, there is a separate set of herbicides for preemergence treatments and postemergence treatments.

Grasses

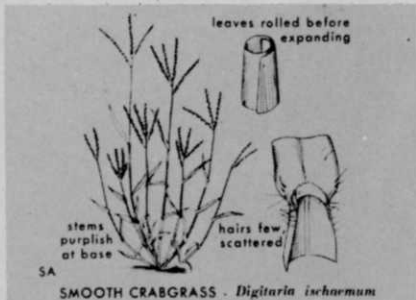
Bentgrass - A desirable grass in certain locations, creeping bentgrass can encroach on cool season turf consisting of Kentucky bluegrass, perennial ryegrass, and fine fescue. Bentgrass has extremely small seed and is a major target of seed producers during cleaning to provide seed buyers with certified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

Bermudagrass - Like bentgrass, bermudagrass encroaches on other desired grasses, but mainly in the South. This extremely hardy grass can outperform other warm season turfgrasses, even where it is not wanted. Bermudagrass is sensitive to a number of preemergence herbicides.

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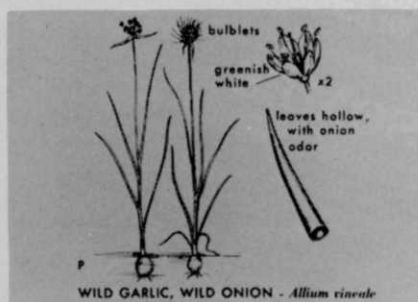
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Crabgrass - The number one spoiler of turf in many areas, crabgrass is an annual spreading grass. As a result, a great deal of research has gone into its control with much success. A properly timed preemergence program can effectively control crabgrass.

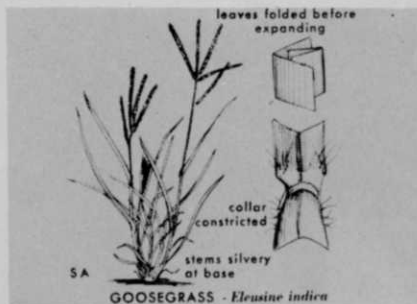


Tall Fescue - A coarse, hardy bunch grass, tall fescue damages the appearance of cool season turf. Tall fescue's drought tolerance and low fertilization requirement give it the advantage over cool season grasses. These same characteristics have led to selection of fine leaf types of tall fescue for low maintenance and transition zone turf.

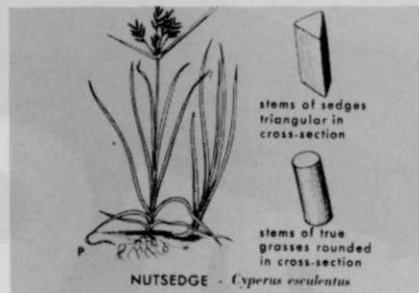


Wild Garlic - This perennial monocot, not a grass, has numerous

ways to spread. It produces seed, and can spread from above-ground and below-ground bulbets. Control must kill the bulbs and prevent germination of the seed.



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



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

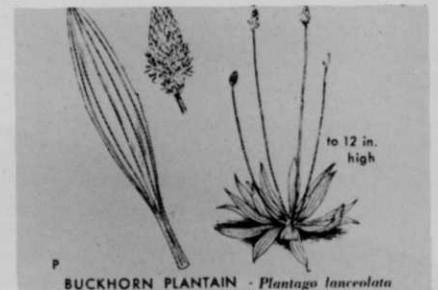
Poa annua - Persistent seedheads and blotches of summer-killed annual bluegrass make this a weed in the summer in the north and in the winter in the south. This weed thrives in well fertilized, irrigated, and low cut turf. Its light green color and white seedheads are easily spotted. Much effort is spent on trying to control this weed, mainly in preemergence applications.

Some success has been had with postemergence control of annual bluegrass in dormant bermudagrass fairways.

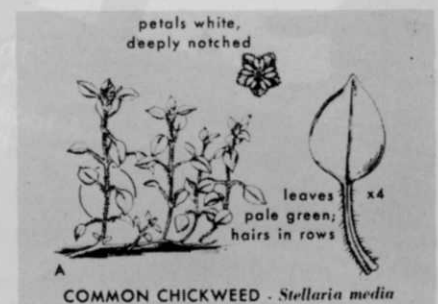
Quackgrass - This perennial grassy weed spreads vigorously by rhizomes and is extremely hard to control. Spot treatment with non-selective herbicides is often the only solution. Quackgrass is usually present when topsoil came from rural areas, such as in new home lawns.

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.



Buckhorn - Present in many low budget lawns and mow-only turf areas of parks, buckhorn has a taproot that defies hand weeding. This perennial broadleaf resembles plantain.

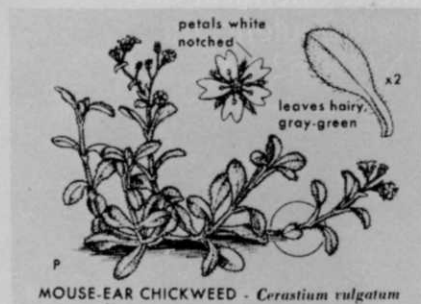


Common Chickweed - This annual spreading weed of shady, moist areas has a white flower and light green foliage.

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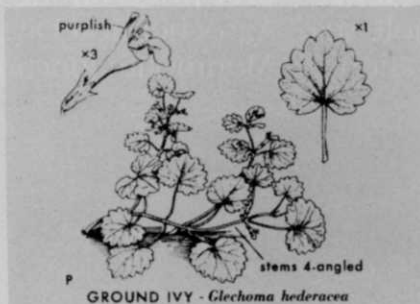
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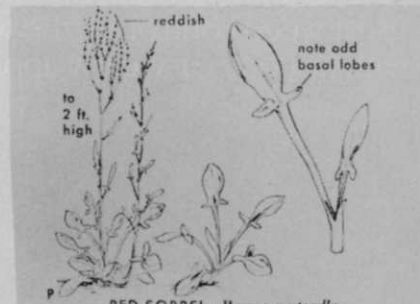
MOUSE-EAR CHICKWEED - *Cerastium vulgatum*

Mouse-Ear Chickweed - The perennial version of chickweed, prefers open sun and also has white flowers.



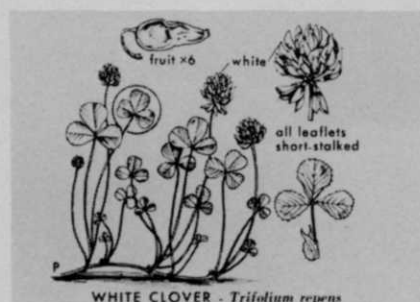
GROUND IVY - *Glechoma hederacea*

gressive spreader hugs the ground and produces a purple flower.



RED SORREL - *Rumex acetosella*

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.



WHITE CLOVER - *Trifolium repens*

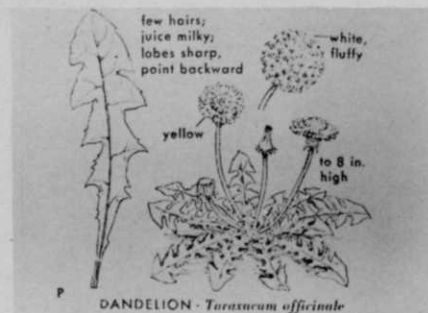
Clover - This perennial broad-leaf embarrasses turf managers with large pink flowers in the spring and tan patches of dead foliage in the summer.

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



HEAL-ALL - *Prunella vulgaris*

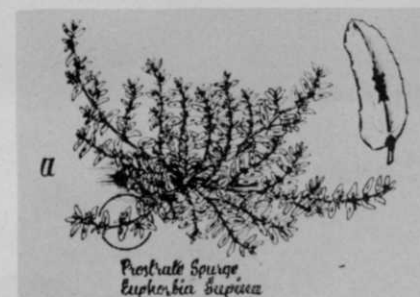
Heal-All - This hairy-leaved perennial is common in new and poorly maintained lawns throughout the U.S. It can spread beneath the level of mower blades.



DANDELION - *Taraxacum officinale*

Dandelion - This perennial, famous for its taproot and yellow flower, is a dead give-a-way to neighbors with poor lawn maintenance. All children flock to lawns with the puffy seedheads in late spring.

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



Prostrate Spurge
Euphorbia supina

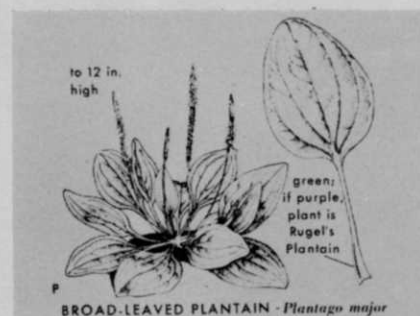
Spurge - The leaves contain a spot in the center of the upper surface. The seed of this heavy seed producer germinates in the early spring. The spreading branches of this annual when broken contain a milky substance.

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

Lambsquarter - A summer annual of large size if not mowed, lambsquarter foliage is light green.

Turf Herbicides

Once a weed is identified as grassy or broadleaf, and possibly winter or summer annual, control methods are narrowed down. Different sets of chemicals are used for preemergence or postemergence control of each type. Location of the weed also determines the chemical used.



BROAD-LEAVED PLANTAIN - *Plantago major*

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.

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The primary preemergence herbicides for grassy and broadleaf weeds in turf are benefin (Balan), bensulide (Betasan, Betamec-4, Pre-San), DCPA (Dacthal), oxadiazon (Ronstar), and siduron (Tuper-san). 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 turf and stands of overseeded cool-season grasses in the South have been reported. A list of grasses safe for preemergence application follows.

Benefin	Kentucky bluegrass perennial ryegrass fescue bahiagrass bermudagrass centipede St. Augustine zoysia
Bensulide	perennial bluegrass perennial ryegrass fescue bentgrass bermudagrass bahiagrass centipede St. Augustine zoysia
DCPA	well-established lawn grasses caution for some bent- grasses
Oxadiazon	perennial bluegrass perennial ryegrass bermudagrass St. Augustine
Siduron	perennial bluegrass fescue perennial ryegrass certain bentgrasses zoysia

Preemergence herbicides should be watered in to get the chemical to the seed prior to germination and should remain effective for six to

eight weeks.

Timing of application is critical. Check with local extension for precise dates for application.

The primary postemergence herbicides for grassy weeds in turf are the arsonates; CMA, DSMA, MAMA and MSMA. These chemicals have no residual toxicity so more than one application is required for good control. Treated areas can be seeded after two weeks.

Arsonates should not be used on centipede, St. Augustine, or carpetgrass. Bentgrass and fescue are more sensitive to the arsonates than other grasses. CMA is the safest for use on bentgrass.

Weed foliage should be sprayed while still young (2 to 3 leaf stage). Any discoloration of desired turfgrasses may be remedied by irrigation. Effectiveness of the arsonates improves with temperature and rates may need to be increased for temperatures under 80 degrees F.

The primary postemergence herbicides for broadleaf weeds are 2,4-D, dicamba (Banvel), and MCP. The 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 severely damage desirable turf.

Again, consult your local extension agent for precise application timing. At least two treatments are generally necessary. Wait four weeks between treatments. Winter annuals can be sprayed early in the year, followed by summer annuals and perennials. Fall treatment for perennials is possible. When consulting the extension agent, take samples of the target weeds for identification and timing advice.

Often postemergence broadleaf herbicides are combined. Trimec and Trex-san are combinations of all three. Weed-B-Gon is 2,4-D and

MCP. Super-D Weedone and Banvel + 2,4-D are dicamba, 2,4-D combinations.

Specialty Herbicides

Weeds in turf that seem to defy standard treatments, such as *Poa annua*, nutsedge, and goosegrass, require extra effort and specialty herbicides in some situations.

Poa annua is the most prevalent weed on golf courses in the U.S. In cool, moist climates it will dominate fairways if uncontrolled. This prolific seed producer also invades overseeded turf in the South.

Benefin, bensulide, and DCPA are used preemergence against *Poa*, but fall treatment with preemergence also disrupts seeding of desirable grasses. Glyphosate and metribuzin (Sencor 50W) have been used to stop annual bluegrass in dormant bermudagrass. Pronamide (Kerb) and Endothal have provided postemergence control of *Poa annua* in bermudagrass. These treatments for *Poa annua* are also effective against chickweed, henbit, and other broadleaf weeds.

Nutsedge can be controlled with 2,4-D and the arsonates. However, a special label was granted for control of yellow nutsedge with bentazon (Basagran) in established turf.

Goosegrass and crabgrass control in bermudagrass has been helped with a state local need label for metribuzin (Sencor 50W). Tests at North Carolina State have shown metribuzin as a postemergence control of *Poa annua*, chickweed, and henbit. Some bermudagrasses are partly sensitive to metribuzin. Preemergence treatments of oxadiazon are effective against goosegrass.

Preplant Control

Since many weed headaches are caused by weed seed present in the soil at planting, soil fumigation can prevent problems later. Insects and fungi are controlled at the same

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time.

Methyl bromide (Dowfume), metham (Vapam), dazomet (Mylone) and Vorlex are used for preplant fumigation. Residues can delay seeding up to three weeks or more. Fumigants are applied to loose soil. Lately, glyphosate (Roundup) has provided a faster alternative to fumigants, however, it controls only living plants, not seeds, fungi, or insects. Other nonselective herbicides for grasses are amitrole, cacodylic acid (Phytar), and dalapon. Glyphosate and cacodylic acid are deactivated within seven days, whereas amitrole and dalapon can remain active for four to six weeks.

Ornamental Weed Control

The emphasis on weed control in landscape displays is more on preplant and accurate application of nonselective herbicides than selective herbicides.

Some of the preplant and pre-emergence herbicides can effect bulbs so be sure to read labels carefully for restrictions and uses. In addition to bensulide, DCPA, and oxadiazon, are many other preemergence and preplant products not used for turf. They include chloramben, chlorpropham (Furloe), dichlobenil (Casoran), diphenamid (Dymid, Enide), EPTC (Eptam), oryzalin (Surflan), pronamide (Kerb), trifluralin (Treflan), and simazine (Princep). For certain landscapes, you may want to fimi-gate prepared soil three weeks prior to planting with metham (Vapam), methyl bromide (Dowfume), dazomet (Mico-Fume), or Vorlex. Extra caution is required with use of fumigants. Both fumigants and preemergence and preplant materials must be soaked in or mixed with the soil for control. Glyphosate (Roundup) and paraquat can be applied prior to planting on a nonselective basis. These same herbicides can be used with rope wick applicators for postemer-

gence control of weeds. Since it has little or no residual toxicity, paraquat can be mixed with other herbicides (simazine, oryzalin) for extended control.

The primary postemergent herbicides for ornamentals are Devrinol (fall application best), diphenamid (Enide), oryzalin (Surflan), oxadiazon (Ronstar), simazine (Princep), and trifluralin (Treflan). These herbicides should only be applied under no or very low wind conditions, granular products should not be applied over wet

foliage, and all products should be watered in. Few landscape planting contain one type of plant and each plant should be judged for sensitivity to a number of herbicides. Postemergent herbicide toxicity changes with temperature as well.

Brush Control

The list of herbicides for brush control is much longer than for turf or ornamental weed control. The main concern is control of spray

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Herbicides and Manufacturers

Chemical	Brand Name	Company	Chemical	Brand Name	Company
amitrole	Amitrol-T	Union Carbide	Ethofumesate	Nortron	BFC
asulam	Asulox	Phone Poulenc	fenac	Fenatrol	Union Carbide
atrazine	Atratol	Ciba Geigy	fosamine	Krenite	Du Pont
benfen	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	Rhone Poulenc
chlorpropham	Furloe	PPG		Herbicide	
dalapon	Dalapon	Diamond Shamrock	MSMA	MCP	Cleary
dazomet	Mylone	Hopkins	oryzalin	Weedhoe	Vineland
DCPA	Dacthal	Diamond Shamrock	oxadiazon	Surflan	Elanco
dinoseb	Premerge 3	Dow	paraquat	Ronstar	Rhone Poulenc
	Dynamyte	Drexel	picloram		Ortho
Devrinol		Stauffer	prometon	Tordon	Dow
dicamba	Banvel	Velsicol	pronamide	Pramitol	Ciba Geigy
dichlobenil	Casoran	Thompson Hayward	siduron	Kerb	Rohm & Haas
diphenamid	Enide	Tuco/Upjohn	simazine	Tupersan	Du Pont
DSMA		Crystal	tebuthiuron	Princep	Ciba Geigy
dinitrophenol	Dinitro	Thompson Hayward	trifluralin	Spike	Elanco
diuron	Karmex	Du Pont	triclopyr	Treflan	Elanco
diquat	Ortho Diquat	Ortho	Vorlex	Garlon	Dow
endothall	Endothall	Pennwalt			Nor-Am
EPTC	Eptam	Stauffer			

Combinations

Amizine	amitrol and simazine	Union Carbide
Banvel plus	dicamba and 2,4-D	Velsicol
	dicamba and 2,4-D, dalapon	Velsicol
Broadside	MSMA and cacodylic acid	Crystal
Chlorea	diuron, sodium chlorate, sodium metaborate	Rhone Poulenc
Fenamine	amitrole, fenac, atrazine	Union Carbide
Hopkins Rout G-8	bromacil and diuron	Hopkins
Krovax	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

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drift. Combinations offer the best control in most cases. Products sold in combination formulations simplify handling and mixing since compatibility problems have been

solved in manufacturing (such as Trimec where the formulation process eliminates the tendency for 2,4-D or MCPP to crystallize out of solution). Manufacturers add sur-

factants to some products to improve product performance and adherence. Some of these combinations are Amizine (amitrole and

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

Treatments	Rate	Weed species ^a								
		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		Po	P
Benfenin	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	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.

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.

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simazine), various Banvel combinations (dicamba plus), Broadside (MSMA and cacodylic acid), Chlorea (sod, sodium chlorate, diuron), Dowpon (dalapon and sodium TCA), Fenamine (amitrole, fenac, atrazine), Hopkins Rout G-8 (bromacil and diuron), Krovar (bromacil and diuron), MonDak (MSMA and dicamba), Pramitol 5PS (prometon, simazine, chlorate), Tordon (picloram and 2,4-D), Urox (monuron and TCA), Vegemec (prometon and 2,4-D), Weedmaster (dicamba and 2,4-D), and Weedone (2,4-D and dichlorprop). See list for separate brush control herbicides.

Equipment and Methods

The greatest advances in equipment and methods have come from nurserymen and lawn care companies. These were adapted mainly from agriculture, such as the rope wick applicator and irrigation injection. One specialized technique currently being tried by Chem-Lawn is a holster-mounted canister of specialty herbicide which can be injected into the spray hose at the site by the applicator. When needed for a special situation, the

applicator can easily inject a proportioned amount of chemical into the flow of the spray at the gun.

The need or usefulness of chemicals has not diminished. Integrated pest management programs have not eliminated the need for landscape pesticides. If anything, it has improved the use of chemicals and put decision-making more in the hands of the applicator instead of the manufacturer. The safety of chemicals has been enhanced by this, especially for restricted use products applied by certified applicators. Chemicals, such as the phenoxy's, are safer than ever in the hands of trained personnel.

Brush Control Herbicides

amitrole	diuron (Karmex)
asulam (Asulox)	fenac
atrazine	fosamine (Krenite)
bromacil (Hyvar)	linuron (Lorox)
bromoxynil	MSMA (Ansar)
cacodylic acid	monuron (Urox)
dalapon (Dowpon)	picloram (Tordon)
dicamba (Banvel)	prometon (Pramitol)
dichlorprop	tebuthiuron (Spike)
dinitrophenol	triclopyr (Garlon)
dinoseb	2,4-D

Addresses

The Anderson's
P.O. 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, MI 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