The Leawood Office Centre in Kansas City, Ks. blends landscaping and hardscaping to fit the corporate, yet natural design. The custom-built redwood benches shown here stretch four feet and 11 feet. Gametime Inc. manufactures the wall-mounted benches in their line of Ultrum site furnishings. Landscape architect Fred Markham and Assoc., Kansas City, Mo. specified the plant materials, while Colonial Nursuries, Blue Springs, Mo. installed the site in August 1986. The turf near the entrance is bluegrass sod. Shrubs consist of Wards yews and blue carpet *(Wiltonii)* junipers. The tree near the entrance is a River birch. Architects Fullerton, Carey and Oman of Kansas City chose the Ultrum furnishings and Devine 50 watt high pressure sodium lights.

Gametime/Ultrum furnishings: Circle No. 202 on Reader Inquiry Card
Fred Markham and Assoc.: Circle No. 203 on Reader Inquiry Card
Colonial Nurseries: Circle No. 204 on Reader Inquiry Card
Fullerton, Carey and Oman: Circle No. 205 on Reader Inquiry Card
Devine lighting: Circle No. 206 on Reader Inquiry Card

The small park area between the Hillcrest professional buildings in Cleveland, Ohio allows patients or employees to take a leisurely break in the day. Park visitors can lunch or just relax on a redwood flat-top or contoured-back (rear of photo) bench manufactured by Kadee Industries. The entire park area is only about 2500 sq. ft. Jeff's Lawn Care Co. of Independence, Ohio renovated the park area in April 1987 after an irrigation pipe burst in the area. The company sodded the area with 200 sq. yards of Merion bluegrass. It is mowed about once a week, depending on growth. The crew uses string trimmers for the turf around the benches' concrete pedastals. The Colorado blue spruce is pruned as needed. The entire renovation, including a new Toro sprinkler system, sod, three benches and a Kadee trash receptacle cost about $3000.

Kadee Industries: Circle No. 207 on Reader Inquiry Card
Jeff's Lawn Care Co.: Circle No. 208 on Reader Inquiry Card

Residents at this private home in Potomac, Md. enjoy summer barbeques on their back porch. The paved patio, constructed of hand-made Cushwa brick, is a mutual design of the home owners and builder Patrick Cullinaine. The design allows for colorful annuals, such as the petunias shown here, to add flair to the red brick. The Country Casual Petite Lutyens bench highlights the patio. The solid teak bench, made in England, is both practical and beautiful in this setting. The seat area stretches six feet, one inch and is slightly contoured. The bench cost less than $1000, while the patio cost about $11 a square foot to install.

Country Casual benches: Circle No. 209 on Reader Inquiry Card.

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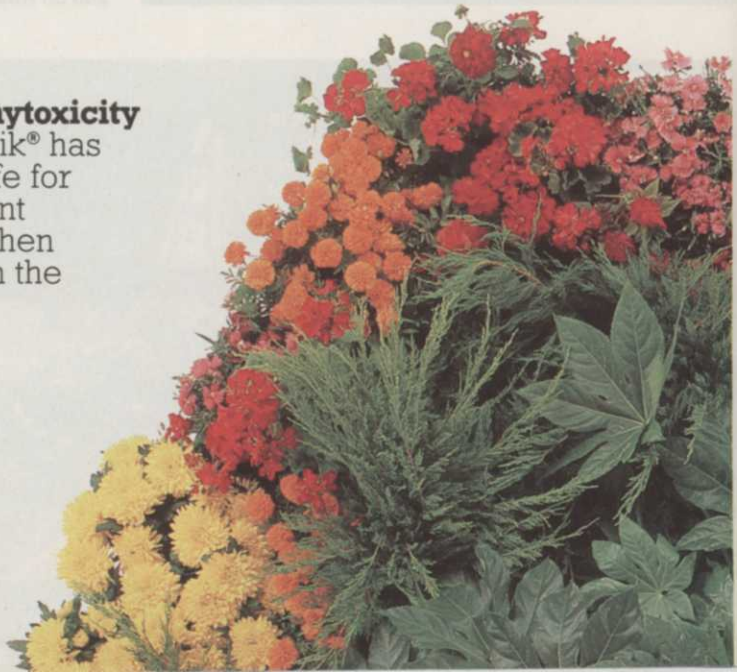

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POST-EMERGENCE WEED CONTROL

For successful post-emergence weed control, the landscape manager must first identify the target weed, then choose the proper material, then apply at the right time.

COOL-SEASON

by Bill Lewis, Ph.D., North Carolina State University

Post-emergence weed control is only one part of a total turf management program. Essential to the control of weeds in cool-season turfgrasses is a healthy competitive grass, one that has been fertilized, mowed and irrigated properly.

The post-emergence herbicides in turf may be classified as foliar-applied selective herbicides. The commonly-used herbicides in this group are the phenoxies (2,4-D, dichlorprop, MCPA and mecoprop), dicamba (Banvel), bromoxynil (Buctril) and the methanearsonates (CMA, MSMA and DSMA). These herbicides are absorbed through the foliage and, with the exception of bromoxynil, readily translocated. There is relatively little, if any, translocation of bromoxynil and bentazon (Basagran) once absorbed through the foliage.

These post-emergence herbicides are quite variable in the weed species they control (Table 1) and in turfgrass tolerance (Table 2).

If weed control is to be successful, weeds must be identified and the proper herbicide selected and applied at the correct time in relation to germination or growth of the target weed, and according to the proper application method. Applying herbicides in 30 to 45 gal. of water per acre (or 1 gal./1000 sq.ft.) should provide sufficient spray coverage.

Broadleaf weeds

Broadleaf weeds are primarily controlled with selective systemic post-emergence herbicides which are absorbed through the leaves and translocated through the plant. 2,4-D has long been the major herbicide for broadleaf control in turf. Today it is widely used in herbicide mixtures. Premixing 2,4-D with mecoprop and/or dicamba broadens the spectrum of weeds controlled.

In many ways, two-and three-way herbicide combinations have become the basic weed control in turf. However, the key to selecting a herbicide or herbicide combination rests on careful identification of the weed species present in the turf.

For example, it may be possible to select a herbicide product containing only one herbicide to provide effective control of the weeds present. If a lawn contained just dandelion and buckhorn plantain, 2,4-D would provide effective control.

By matching the herbicide with the broadleaf weeds present, it may be possible to reduce herbicide costs and lessen the possibilities for turfgrass injury.

Although two-and three-way combinations have been the backbone of weed management programs in turf, certain weed species remain difficult to control; for example, violets and oxalis species. The substitution of dichlorprop in the mixture has improved the control of winter annuals including henbit, chickweed and corn speedwell as well as summer weeds such as spurge, woodsorrel and ground ivy. Control of wild violets may be improved but control is still not consistent.

Herbicide mixtures have been introduced containing triclopyr which is active on many species not controlled by 2,4-D. The triclopyr plus 2,4-D combination has exhibited improved control of ground ivy, yellow woodsorrel, prostrate spurge, wild violet, purslane, corn speedwell and parsley piert. Examples of turf products for broadleaf control are presented in Table 3.

Bromoxynil (Buctril) is a contact herbicide often used for control of annual broadleaf weeds in newly-established turfgrasses since it does not injure seedling grasses. The label says it may be used on seedlings of certain species of Kentucky bluegrass, fine fescue, bentgrass and perennial ryegrass. Also, it may be post-emergence-applied to established bentgrass, Kentucky bluegrass, fescues and ryegrass. Buctril may also be tank-mixed with 2,4-D, mecoprop and dicamba for broadleaf weed control in established cool-season grasses except bentgrass.

Some of the more difficult-to-control weeds may require a repeat application after three to four weeks. It has also been reported that certain difficult-to-control weeds may be more effectively controlled by using ½ the label rate and repeating the applica-

tion in 10 days.

Perennial weeds sometime require a spring application and a fall application for successful control. When planning broadleaf herbicide applications, the normal seasonal fluctuations in turfgrass growth should be considered.

The most appropriate time to apply post-emergence herbicides are during the time when the turf and weeds are actively growing. First, the weeds are more susceptible to the herbicides. Secondly, the turf will more rapidly fill in bare spots which the weeds leave. Cool-season grasses tiller and root development is usually the greatest during the spring and fall.

Also consider the growth cycle of the weed species to be controlled. As the season progresses, the weeds age and become more difficult to control with herbicides. Winter annuals should be controlled early in the spring before flowering occurs. Later in the spring is the preferred time to control summer annual weeds soon after emergence. Perennial weeds are frequently easier to control in the spring as they begin new growth and before any flowering stalks are produced. Fall is another effective time to spray perennial weeds.

Table 1.

Susceptibility of Broadleaf Weeds to Turf Herbicides
Response of Weeds to Herbicides

Weed	Classification of Weed	2, 4-D	Mecoprop (or MCPP)	Dicamba (Banvel)
Bittercress, Hairy	WA	S	I	S
Black Medic	A	R	I	S
Buttercups	WA, B & P	S-I	I	I-R
Carolina Geranium	WA	S	S-I	S
Carpetweed	SA	S	I	S
Catsear	P	S-I	I	S
Chicory	P	S	S	S
Chickweed, Common	WA	R	S-I	S
Chickweed, Mousear	WA, P	I-R	S-I	S
Clover, Hop	WA	I	S	S
Clover, White	P	I	S	S
Dandelion	P	S	S	S
Dichondra	P	S	I	S-I
Dock, Broadleaf & Curly	P	I	I-R	S
Garlic, Wild	P	S-I	R	S-I
Ground Ivy	P	I-R	I	S-I
Hawkweed	P	S-I	R	S-I
Healall	P	S	R	S-I
Henbit	WA	I-R	I	S
Knawel	WA	R	I	S
Knotweed, Prostrate	SA	R	I	S
Lespedeza	SA	I-R	S	S
Mallow	SA	I-R	I	S-I
Mugwort	P	I	I-R	S-I
Parsley-piert	WA	R	S-I	S-I
Pennywort, lawn	P	S-I	S-I	S-I
Plantains	P	S	I-R	R
Purslane, Common	SA	I	R	S
Red Sorrel	P	R	S	S
Speedwell, Corn	WA	I-R	I-R	I-R
Spurge, Prostrate	SA	I	I	S
Spurge, Spotted	SA	I-R	S-I	S-I
Spurweed	WA	I	S-I	S
Strawberry, India Mock	P	R	I	S-I
Violet, Johnnyjumpup	WA	I-R	I-R	S-I
Violet, Wild	P	I-R	I-R	S-I
Woodsorrel, Common Yel.	P	R	R	I
Yarrow	P	I	I-R	S

A = annual; B = biennial; P = perennial; SA = summer annual; WA = winter annual; S = susceptible; I = intermediately susceptible, good control sometimes with high rates, however a repeat treatment 3 to 4 weeks later each at the standard or reduced rate is usually more effective; R = resistant in most cases.

Crabgrass, annual grasses

Methanearsonate herbicides provide an approach to post-emergence crabgrass control in turf. This offers the turf applicator a method of managing a crabgrass-infested turf if a pre-emergence herbicide was not applied in the spring or it fails to perform as expected. The methanearsonates are quite effective if used properly.

The principal methanearsonates are CMA, DSMA and MSMA. These herbicides selectively control large crabgrass, smooth crabgrass, dallisgrass, goosegrass, foxtail and yellow and purple nutsedge. Two- to four-leaf susceptible grassy weeds may be controlled with one application. Once the plant has begun to tiller, a repeat application, seven to 10 days following the first, is required to provide effective control. Two or more applications are necessary for the control of the perennial yellow nutsedge.

These materials have no residual activity so any seedlings which appear after spraying will not be controlled.

Methanearsonates must be applied with extreme care to cool-season turfgrasses because most show sensitivity to these herbicides. Leaf tip discoloration may be evident for one or two mowings. MSMA and DSMA usually cause unacceptable injury to bentgrass. Bentgrass shows more tolerance to CMA. Do not apply the herbicides to any turf growing under stress conditions. It is best to apply herbicides to cool-season grasses early in the summer, thus avoiding applications to these grasses in midsummer.

Another herbicide for post-emergence control of summer annual grassy weeds in selected cool-season turfgrasses is Acclaim (fenoxyprop). Acclaim is used for post-emergence control of smooth crabgrass, large crabgrass, goosegrass, barnyardgrass, foxtail species and panicum species in established perennial ryegrass, fine fescue, tall fescue and annual bluegrass. It may also be applied to Kentucky bluegrass grown east of the Rocky Mountains.

Young actively growing grassy weeds are more easily controlled than the larger grassy weeds. Application

Table 2.

Tolerance of Cool-Season Turfgrasses To Post-emergence Herbicides For Broadleaf and/or Grass Weed Control

Turfgrass	2,4-D	Meco-prop	Di-camba	Brom-omoxy-nil	Di-chlor-prop	Tri-clopyr	DSMA, MSMA, CNA	Bent-azon	Etho-fume-sate	Fenoxaprop
Bentgrass	S-I*	T	I	T	I	S-I	I	T	S	S
Kentucky Bluegrass	T	T	T	T	T	T	I	T	S	T
Tall Fescue	T	T	T	T	T	T	I	T	S	T
Fine Fescue	T	T	T	T	T	I	I	T	S	T
Perennial Ryegrass	T	T	T	T	T	T	T	T	T	T

*I = Intermediately tolerant, use with caution, use at reduced label rates, or minimum label rates; S = sensitive, do not use this herbicide; T = tolerant.

rates are based upon the size of the grassy weeds at the time of application. For example, three-leaf weeds with no more than one tiller can be controlled at minimum label rates. As with any post-emergence applied herbicide, avoid applications to turfgrass under drought stress.

Since Acclaim is absorbed primarily through the foliage, thorough spray coverage is essential for optimum results. It is suggested that 30 to 60 gallons of water per acre be used as the carrier.

Visual injury is usually evident within four to 10 days following application. Visual effects begin with general chlorosis or yellowing of the leaves followed by reddening. Since Acclaim is a systemic herbicide, do not mow treated areas for at least 24 hours following application to allow time for absorption into and translocation within the grassy weeds.

Also, for effectiveness, it is advisable not to mow immediately before application since mowing may reduce the available leaf surface for contact of the herbicide and also grass clippings may interfere with spray coverage of the grassy weeds. Occasionally a second application will be necessary if grassy weeds germinate following the initial application or with extremely dense weed populations or very large grassy weeds.

Acclaim does not have soil residual activity. Do not apply the second application sooner than 14 days after the first. Acclaim should not be applied as a tank mix with 2,4-D, mecoprop or dicamba because this will reduce its effectiveness.

Acclaim essentially has no activity on broadleaf weeds or sedges.

Yellow nutsedge

As previously indicated, the methanearsonate herbicides will control yellow nutsedge. In addition, Basagran may be used on established bluegrass, fescue, bentgrass and ryegrass.

For post-emergence control of yellow nutsedge, initiate application after yellow nutsedge has emerged.

Thorough spray coverage of yellow nutsedge is essential for maximum control. Therefore to do not mow three to five days before or after application.

Annual bluegrass

Prograss (ethofumesate) may be applied for post-emergence control of annual bluegrass and common chickweed in established and new seedings of perennial ryegrass. It is for use by professional applicators in turf sites such as golf courses, parks and lawns.

Prograss is more effective when ap-

Table 3.

Post-emergence herbicides and package combinations for selective control of broadleaf weeds in cool-season turfgrasses.

Common Name of Herbicide	Examples of Commercial Products for Professional Applicators
2,4-D	Various
mecoprop	Lescopex, Mecomec
dicamba	Banvel
bromoxynil	Buctril
2,4-D + dicamba	Lesco Eight-One
2,4-D + dichlorprop (2,4-DP)	Weedone DPC, Weedone DPC Amine
2,4-D + mecoprop (MCPP)	Turk Kleen, Lescopar, 2 Plus 2
triclopyr + 2,4-D	Turflon D, Turflon II amine
2,4-D + dichlorprop + dicamba	Super Trimec
2,4-D + mecoprop + dicamba	Trimec Classic, Trex-San, Lesco Three-Way
2,4-D + mecoprop + dichlorprop	Weedestroy Triamine, Weedestroy Tri-ester
MCPA + mecoprop + dicamba	Trimec Encore, Weedestroy Triamine II

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plied soon after emergence of the weeds. A repeat application may be needed to maintain control 30 to 60 days after the initial application. Prograss is also labeled for control of annual bluegrass in established Kentucky bluegrass on golf courses or other commercially-maintained turf. It is not for use on homeowner lawns. Application rates are slightly lower for Kentucky bluegrass than for perennial ryegrass.

Performance conditions

Environmental conditions, such as temperature, light intensity, rainfall after application, drought stress and relative humidity, can greatly influence the performance of foliar-applied herbicides. These conditions have been mentioned in various places in this article and can be briefly summarized as follows:

- Herbicides are readily absorbed when applied to actively growing weeds.
- Broadleaf herbicides are generally more active if sprayed when daily temperatures are 60 to 80°F. Methanearsonates are more effective from 70 to 85°F. Foliar penetration usually increases within these temperature ranges.
- Soil moisture should be adequate. Under dry conditions, it is advantageous to irrigate prior to herbicide application or wait for a rain. For broadleaf herbicides, there should be a rain-free period of four to six hours following the application. Rainfall or irrigation immediately followimg application is detrimental to the effectiveness of a post-emergence foliar-applied herbicide.
- Generally, high relative humidity increases herbicide action by increasing absorption and translocation.
- Post-emergence herbicides should be applied before mowing to have maximum leaf surface for absorption. When applying methanearsonates or Acclaim do not mow or water for at least 24 hours after application.
- Post-emergence herbicides are less effective if weeds are under stress conditions, and turfgrass tolerance is frequently also lower.

Understanding these and other factors influencing herbicide performance is helpful to explain results obtained and to maximize weed control.

The use of trade names in this article does not imply endorsement of the products named, nor criticism of similar ones not mentioned.

WARM-SEASON

by Tim R. Murphy, University of Georgia

A chemical weed control program in warm-season turfgrasses uses pre-emergence and post-emergence herbicides. Pre-emergence herbicides form the base of the chemical weed control program; post-emergence herbicides are used to control problem weeds that are not controlled by pre-emergents.

Additionally, in the event of a pre-emergence herbicide weed control failure, post-emergence herbicides can be relied on for a complete chemical weed control program provided multiple applications are used throughout the year.

In newly-established turfgrasses, most pre-emergence herbicides are not recommended. Some post-emergence herbicides may be used at low rates. A general rule is to delay the application until after three to four mowings or until the sprigged turfgrasses have rooted and are actively growing. Delaying the application allows the turfgrass sprigs or seedlings to become established and improves their tolerance to post-emergence herbicides.

Selection

Many post-emergence herbicides are available to control weeds in

continued on page 41

Table 1.

Common and trade names of turfgrass post-emergence herbicides.

Common Name	Company	Trade Name and Formulations[1]
asulam	Rhone-Poulenc	Asulox 3.34 lbs./gal.
atrazine	Security	Purge 4 lbs./gal.
	Ciba-Geigy	Aatrex 4L, 90DG, 80W
bentazon	BASF	4 lbs./gal.
bromoxynil	Rhone-Poulenc	Buctril - 2 and 4 lbs./gal.,
		Brominal - 2 and 4 lbs./gal.,
	Lesco	Brominal 2 lbs./gal.
2,4-D	Vertac, Lesco,	Numerous trade names and
	SDS Biotech,	formulations are available.
	Others	
2,4-D + dicamba	Rhone-Poulenc	Weedone SuperDPro Amine
	Lesco	Eight-One Selective Herbicide
	PBI/Gordon	Phenaban 801
2,4-D + dichlorprop	Rhone-Poulenc	Weedone DPC Amine, Weedone DPC
2,4-D + MCPP	Lesco	Lescopar
	Rhone-Poulenc	Turf Kleen
	PBI/Gordon	Phenomec 2+1
2,4-D + MCPP	PBI/Gordon	Trimec Classic
+ dicamba	Mallinckrodt	Trex-san
	Lesco	Three-Way
dicamba	Sandoz	Banvel 4 lbs./gal.
	PBI/Gordon	Dicamba 4
diquat[2]	Chevron	Diquat 2 lbs./gal.
DSMA	Vertac, Vineland	Numerous trade names and
	Others	formulations are available.
ethofumesate	Nor-Am	Prograss 1.5EC
glyphosate	Monsanto	Roundup 4 lbs./gal.
imazaquin	Lesco	Image 1.5 lbs./gal.
MCPP	Rhone-Poulenc	Turf Herbicide MCPP 2 lbs./gal.
	PBI/Gordon	Mecomec 4 4 lbs./gal.
	Lesco	Lescopex 2.5 lbs./gal.
metribuzin	Mobay	Sencor Turf 75W
MSMA	SDS Biotech,	Numerous trade names and
	Platte, Others	formulations are available.
MSMA + 2,4-D +		
MCPP + dicamba	PBI/Gordon	Quadmec
MCPP + 2,4-D + dicamba	PBI/Gordon	Southern Trimec
pronamide	Rhom-Haas	Kerb 50W
sethoxydim	BASF	Poast 1.5 lbs./gal.

[1]Numeral refers to percent or pounds of active ingredient.
[2]Diquat has a state label in Arkansas, Louisiana, Mississippi, Oklahoma, Tennessee and Texas for winter annual weed control in dormant bermudagrass.

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