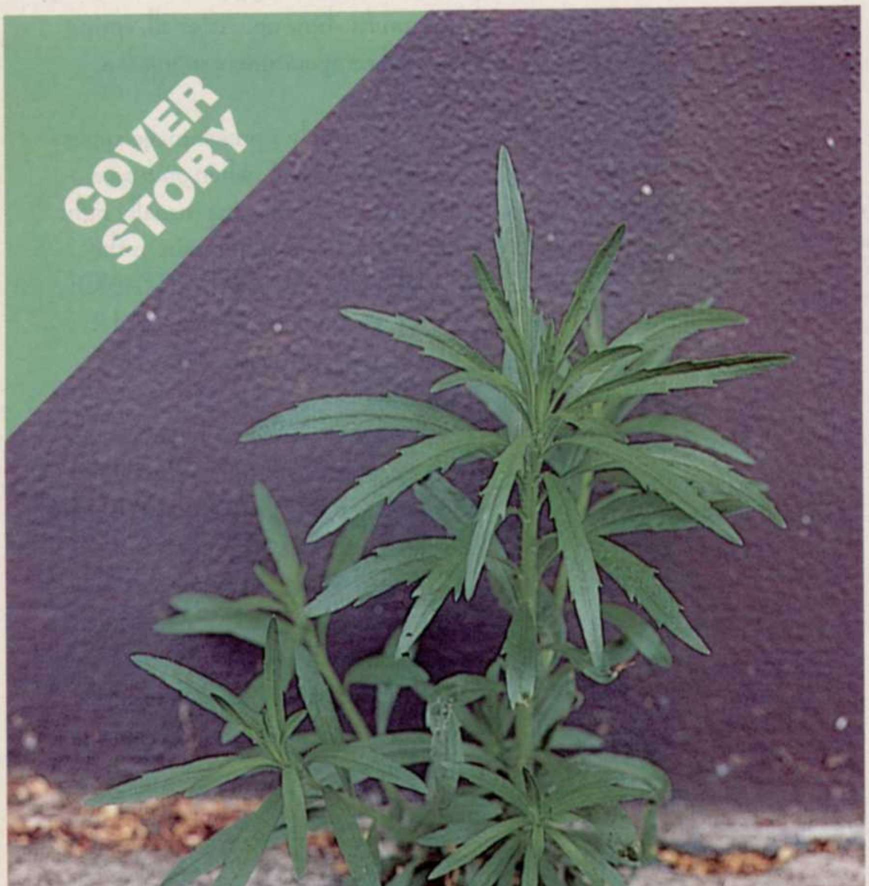
POST-EMERGENCE WEED CONTROL IN COOL-SEASON TURFGRASSES

For effective post-emergence weed control, the plants should be actively growing and the herbicide sufficiently absorbed.

by Bruce E. Branham, Ph.D., Michigan State University



Post-emergence weed control is the application of a herbicide to an established weed to achieve control. It is fundamentally different from pre-emergence weed, control in several ways. First, the herbicide is applied directly to the weed which permits the use of spot applications. Second, environmental conditions are important because they affect the amount of herbicide absorption which is ultimately related to control.

Principles of post-emergents

Effective post-emergence control depends on three simple principles. First, the growth stage of the plant is critical. In general, the younger the plant, the easier it is to control. This is most applicable to annual plants, however, even established perennials have growth periods where control is more easily achieved.

As an example, fall is an excellent time to control established perennials because they are storing food reserves in their root systems and the herbicide will be transported to the roots, killing the entire plant.

Second, the weeds must be actively growing in order to take up a sufficient dose of the herbicide for effective control.

When weeds are actively growing, they are translocating photosynthate to the plant's growing sites. The absorbed herbicide can be carried with the photosynthate to these growing sites which are often the site of the herbicide's action.

When weeds are actively growing, they tend to be more succulent and possess a thinner cuticle. The cuticle is the chief barrier to herbicide absorption, and when plants are actively growing the cuticle tends to be less well developed. As plants enter periods of high temperature and particularly drought stress they tend to develop thicker (i.e. waxier) cuticles.

Absorption is critical

Third, the herbicide's absorption by the plant is the controlling factor in getting sufficient herbicide activity.

It is estimated that, depending upon the herbicide, only 15 to 60 percent of the herbicide deposited upon the leaf is absorbed into the plant.

Thus, an area for fruitful research in the future is to examine methods to increase the absorption rates to 85 to 100 percent. Such advances would permit lower application rates to be used. In fact, significant advances are currently being made in the area of additives to increase herbicide absorption.

These factors—plant growth stage, herbicide absorption and plant growth rate—control the effectiveness of post-emergence herbicides.

This preliminary discussion sets the stage for the five weed control areas.

Broadleaf weed control

Controlling broadleaved weeds is an

TABLE 1.

Broadleaf weed control herbicides for use in cool-season turf

2, 4-D	dicamba
2, 4-DP	triclopyr
MDPP	clopyralid
MCPA	

Some commonly used broadleaf herbicide mixtures and the ratio of each product in the mix:

2, 4-D + MCPP
- 2 plus 2 (1/1) Fermenta
- Lescopar (1/2) Lesco
- 2, 4-D-MCPP (2/1) Cleary's

2, 4-D + dicamba
- Phenaban 801 (8/1) Gordons
- Eight-one selective herbicide (8/1) Lesco
- Riverdale 81 selective weed killer (8/1) Riverdale
- Riverdale 101 weed killer (10/1) Riverdale

2, 4-D + MCPP + dicamba
- Three way selective herbicide (1/0.5/0.009) Lesco
- Trimec (1/0.5/0.1) Gordons
- Trimec Bentgrass Formula (0.3/1/0.13) Gordons
- Trexsan (1.0/0.53/0.13) (Sierra)
- Trexsan Bent (0.3/1.0/0.13) (Sierra)

2, 4-D + 2, 4-DP
- Chipco Weedone DPC (1/1) [ester] Rhone-Poulenc
- Chipco Weedone DPC Amine (1/1) Rhone-Poulenc
- Turf D + DP (1/1) [ester] Riverdale

2, 4-D + 2, 4-DP + MCPP
- Weedestroy Triamine (1/1/1) Riverdale
- Weedestroy Triester 80.7/1.0/0.7) Riverdale

MCPA + MCPP + 2, 4-DP
- Weedestroy Triamine II (1/1/1) Riverdale

MCPA + MCPP + diacamba
- Trimec Encore (1.0/0:46/0.1) [amine] Gordons

2, 4-D + 2, 4-DP + dicamba
- Super Trimec (1.0/1.0/0.25) [ester] Gordons

2, 4-D + triclopyr
- Turflon D (2/1) [ester] Dow
- Turflon II (2.6/1) [amine] Dow

triclopyr + clopyralid
- Confront (3/1) [amine] Dow

TABLE 2.

Post-emergence grass and sedge control herbicides

Common Name	Trade Name	Manufacturer
MSMA + DSMA	Daconate	Fermenta
	Broadside, DSMA 81%	Vertac
	Ansar, DSMA liquid	Drexel
	Methar 30	W.A. Cleary
fenoxaprop	Acclaim	Hoechst
bentazone (sedges only)	Basagran	BASF

Special use situations

Sometimes we don't understand why things work the way they do, but we use them anyway. A good example of this is the control of creeping speedwell with DCPA (Dacthal).

Dacthal is a pre-emergence grass herbicide that effectively controls creeping speedwell (a difficult-to-control broadleaf weed) when applied after emergence of the speedwell. You figure it out.

Another special-use situation is the control of tall fescue in Kentucky bluegrass with chlorsulfuron (Lesco TFC).

This product will remove coarse-bladed tall fescue from Kentucky bluegrass with a single application. The product has a very long soil residual so be careful when using it.

It will also eradicate perennial ryegrass from Kentucky bluegrass, which opens up some interesting possibilities for golf courses and home lawns where a pure Kentucky bluegrass turf is desired but ryegrass was included in the seed mixture for establishment purposes.

It may be possible to gradually eliminate perennial ryegrass from a mixed Kentucky bluegrass and perennial ryegrass stand by using chlorsulfuron at low rates.

—Dr. Branham□

Using non-selective herbicides

Herbicides that kill all vegetation are called non-selective herbicides. These products have become widely used in turf renovation and for edging around trees, hard-to-mow areas, under fences, etc.

Although several non-selective herbicides are available, by far and away the most widely used product is glyphosate (Roundup). It is difficult to imagine a better herbicide for non-selective weed control than this product. It is irreversibly adsorbed to soil particles, and therefore has no soil residual. Therefore, renovation can begin also immediately after application, although time should be given for the glyphosate to translocate throughout the entire plant before beginning any processes that will disturb the vegetation you're trying to control.

Another reason that makes this such a good herbicide is that it is readily translocated in most plants, thus controlling the entire plant-foliage, roots, rhizomes and stolons. It is also an environmentally safe product with very low mammalian toxicity (oral LD_{50} of 5600 mg/kg for rats, which would be considered almost non-toxic).

—*Dr. Branham*□

important component in any turf weed control program.

Without exception, all of the herbicides used in general broadleaf weed control in turf have a similar mode of action. These herbicides, listed in Table 1, all concentrate in the meristematic areas of the plant and cause uncontrolled tissue growth, resulting in a bending and twisting of plant parts (called epinasty) and ultimately the plant's death.

In this category of herbicides is 2,4-D, the oldest organic herbicide known. It was discovered during World War II, has been in commercial use since the late 1940s, and is the most researched herbicide in existence.

The only other turf broadleaf herbicide which is not a growth regulator-type herbicide is bromoxynil (Buctril), which is a photosynthetic inhibitor.

However, bromoxynil was cancelled for use in turf by its manufacturer, Rhone-Poulenc, in 1989 and is currently only labelled for use on sod or grass seed production.

Broadleaf mixtures

With the exception of MCPP, these broadleaf herbicides are routinely sold in mixtures with 2,4-D being the primary component of most mixes (Table 1).

There are differences in efficacy among the different mixtures. However, the most important factor controlling efficacy is the type of formulation used.

All of the herbicides listed in Table 1 are organic acids and as such can be modified to other forms to improve herbicidal activity. The most common formulations are esters or amine salts. These formulations have a marked effect on the herbicidal activity.

Esters are better at penetrating the plant foliage but they are slightly volatile. The volatility can cause injury to non-target plants if conditions at application favor volatility.

Conditions favoring volatility would include high air temperatures, moderate winds and high relative humidities.

Evaluating amine salts

Amine salts, on the other hand, are essentially non-volatile but they don't penetrate the plant foliage as readily as esters. Therefore, ester-formulated herbicides are more efficacious than amines on an active ingredient basis, but they can cause non-target plant injury; so caution must be used when employing ester-formulated herbicides.

One well-timed post-emergence application can result in season-long control, but only if delayed sufficiently to catch germinating plants.

As a general rule-of-thumb, amine formulated mixtures of 2,4-D, MCPP and/or dicamba will control 90 percent of the broadleaf weed problems found in cool season turf if used properly.

Use in summer will routinely result in reduced levels of control while use of herbicides on drought-stressed weeds can reduce control levels to zero. However, a small number of turf weeds require either an ester-formulated herbicide combination or a herbicide with a different spectrum of weeds controlled. These weeds would include creeping speedwell, ground ivy, prostrate spurge, creeping yellow woodsorrel, wild violets and wild garlic.

Many of the ester-formulated products such as Turflon D, Super Trimec, Weedone DPC and Weedestroy Triester will control these weeds. Good to excellent control of these weeds often requires two applications spaced two to four weeks apart.

The loss of Buctril, a post-emergence broadleaf herbicide, for most turf situations means that on seedling turf, there really is no means of controlling broadleaf weeds.

Buctril could be applied to any size seedlings without injuring the desirable turf. The standard recommendation for controlling broadleaved weeds in seedling turf with phenoxy herbicides is to wait until the turf has been mowed one time before applying a ½x rate of the herbicide.

Annual grass weeds

Annual grass weeds, most commonly crabgrass, are probably the biggest weed problem most turf managers face.

Because of the large number of viable seeds in the soil and the ability of the grass weed seedlings to effectively compete in a turf stand, weeds such as crabgrass can be difficult to control.

The preferred method to control crabgrass is with a pre-emergence herbicide. However, when these do not adequately control crabgrass, post-emergence herbicides must be used.

Up until 1987, the only available choice to control crabgrass post-emergence was a formulation of methane arsonate such as MSMA or DSMA. These herbicides are sold under a variety of trade names as listed in Table 1. However, in 1987 a new herbicide was approved for use on cool-season turf. This herbicide, fenoxaprop (trade name Acclaim), provides a second option for post-emergence crabgrass control.

Checking conditions

While MAA compounds can provide effective crabgrass control, generally

TABLE 3.

Applications for controlling crabgrass

Herbicide	Rate	Date of Application	% Crabgrass 8/27/87
Acclaim	0.04	5/15	41
Acclaim + PreM	0.04 + 1.5	5/15	0
Acclaim	0.06	5/15	34
Acclaim + PreM	0.06 + 1.5	5/15	5
Acclaim	0.06	5/30	40
Acclaim + PreM	0.06 + 1.5	5/30	2
Acclaim	0.08	5/30	23
Acclaim + PreM	0.08 + 1.5	5/30	1
Acclaim	0.08	6/15	32
Acclaim + PreM	0.08 + 1.5	6/15	15
Acclaim	0.12	6/15	55
Acclaim + PreM	0.12 + 1.5	6/15	5
Acclaim	0.12	6/30	3
Acclaim	0.12 + 1.5	6/30	1
Untreated			30

Source: Dr. Branham

two applications 10 to 14 days apart are required for effective control. In addition, these products can be phytotoxic under the hot, humid conditions of summer.

Because of these drawbacks, use of these herbicides was primarily limited to controlling crabgrass that was not controlled pre-emergence. That is, it would be uncommon to use MAA as your only method of controlling crabgrass.

Acclaim offers some interesting possibilities because it is a very effective crabgrass herbicide. On young crabgrass (two tillers or smaller), 95 percent or higher control is often seen.

This product, and others that may be available in future years, should cause turf managers to re-evaluate their crabgrass control strategy.

Serious crabgrass control

For those areas where crabgrass is a very serious problem, use of a pre-emergent will still be the best method of control. However, in the more northern parts of the cool-season region, alternative strategies can be developed.

Remember, a pre-emergence application is a preventative application that requires treating the entire area. A post-emergence application can be directed on the weedy areas only and thus less total area could potentially require treatment.

For turfs that have not had a history of crabgrass invasion, a strategy of skipping the pre-emergence application and spot treating with a post-emergence product could be employed with a potential for cost savings.

By using a "post"-only application the manager has more flexibility, as was dramatically shown during the drought of 1988. Pre-emergence applications were essentially wasted in 1988 because there was no water available for crabgrass germination. However, once the drought was broken in July, the crabgrass germinated and the pre-emergence herbicide had dissipated, resulting in tremendous crabgrass populations.

Pre- and post-emergence combinations exemplify the different control strategies that are available.

These populations had to be treated with a post-emergence application since practically no pre-emergence control was seen. Thus, if you had waited to see the crabgrass problem develop you would have saved the cost of the pre-emergence application and used the post-emergence product to get control.

The advantage of this approach is flexibility and potential cost savings while the drawback is that you must tolerate a certain level of crabgrass before treating.

Pre-, post- combos

The use of pre- and post-emergence combinations is another example of the different grass control strategies now available.

The data in Table 3 displays some of the results of using pre/post combinations and post-only applications for controlling crabgrass.

The data show that the pre/post combinations are effective and could result in either a lower rate of pre-emergent or elimination of the second pre-emergence application. Also, note that one well-timed post-emergence application can result in season-long control, but only if delayed sufficiently to catch all of the germinating crabgrass plants.

Nutsedge control

For control of yellow nutsedge, either MSMA or Basagran is effective. However, Basagran is usually preferred because the potential for phytotoxicity is reduced.

Because the root tubers of the yellow nutsedge are not killed by these herbicides, multiple applications are needed to kill the plants sprouting from the tubers.

In essence, you try to prevent the plants from getting enough growth to produce more tubers. Thus, as many as one to three applications per season could be required to eliminate a serious yellow nutsedge problem.

The above summarizes the major types of post-emergence weed control applications. With any post-emergence application, make sure the plants are actively growing and treat them at the proper weed growth stage to achieve effective control. As always, follow the manufacturer's label to assure consistent, safe results. **LM**

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POST-EMERGENCE WEED CONTROL IN WARM-SEASON TURFGRASSES

There are many ways to control unwanted plants. Just be sure you know what you're treating and don't promise more than can be delivered.

by Bert McCarty, Ph.D., University of Florida, Gainesville

Weeds can be defined simply as unwanted plants or plants growing out of place. Therefore, beauty is in the eye of the beholder, meaning that some people simply want ground cover with any green plants—weeds and all.

Others desire a uniform turf stand with no weeds or additional undesirable characteristics, such as damage from insects, diseases, or other pests. For these, weed control is rapidly becoming better defined as "weed management."

Weed control methods

Several means of weed control are available. Incorporating as many as possible by turf managers will increase their effectiveness.

Encourage healthy turf growth and be prepared to hand-pull weeds from an area.

If only a few weeds are present, especially in newly-established areas, hand removal is the safest alternative. Obviously, this is practical only on a

Treat weeds before they begin to tiller or produce seedheads. Otherwise multiple applications of herbicide spaced 7 to 10 days apart are necessary for control.

Table 1.

Warm-season turfgrass tolerance to post-emergence herbicides.

Herbicide	Bahia-grass	Bermuda-grass	Carpet-grass	Centipede-grass	St. Augustine-grass	Zoysia-grass
Postemergence						
asulam	D[1]	S-I[2]	D[3]	D	S-I	NR
atrazine	I	S-I(D)	I	S-I	S-I	I
bentazon	S	S	I	S	S	S
2,4-D	S	S	I	I	I	S
2,4-D + dicamba	S	S	I	I	I	S
2,4-D + dichlorprop	S	S	I	I	I	S
2,4-D + MCPP	S	S	I	I	I	S
2,4-D + MCPP + dicamba	S	S	I	I	I	S
2,4-D + MCPP + dichlorprop	S	S	I	I	I	S
dicamba	S	S	I	I	I	S
DSMA, MSMA	D	S	D	D	D	I
imazaquin	D	S	I	S	S	S
MCPA + MCPP + dichlorprop	S	S	I	I	I	I
MCPP	S	S	I	I	I	S
metribuzin	D	S-I	D	D	D	NR
pronamide	NR	S	NR	NR	NR	NR
sethoxydim	D	D	D	S	D	D

[1]S = Safe at labeled rates; I = Imtermediate safety, use at reduced rates; D = Damaging, do not use; NR = Not Registered for use on this turfgrass.
[2]Asulam is labeled for 'Tifway'(419) bermudagrass and St. Augustinegrass.
[3]Carpetgrass tolerance to herbicides has not fully been explored.

Table 2.

Common and trade name examples, manufacturers and uses of post-emergence herbicides in warm-season turfgrasses.

Common Name	Manufacturer	Trade Name(s)	Uses
asulam	Rhone-Poulenc	Asulox 3.34 lb/gas	Grass weed control in St. Augustinegrass.
atrasine	Ciba-Geigy + others	Aatrex + others	Pre and early Post-emergence broadleaf and grass weed control.
bentazon	BASF	Basagran 4 lb/gal	Nutsedge (yellow) control.
2,4-D	Dow/Elanco Fermenta Rhone-Poulenc + others		
dicamba + 2,4-D	Sandoz Lesco + others	Banvel 720, Weedmaster Eight-One Selective + others	Broadleaf weed control.
dicamba	Sandoz + others	Banvel 4 lb/gal + others	Broadleaf Weed Control. Usually mixed with 2,4-D and other broadleaf herbicides for wider weed control spectrum.
dichlorprop + 2,4-D	Rhone-Poulenc	Weedone DPC	Broadleaf weed control.
DSMA	Fermenta + others	DSMA Liquid + others	Grass weed control in bermuda and zoysiagrasses.
glyphosate	Monsanto	Roundup 4 lb/gal	Non-selective, systemic weed/brush control.
imazaquin	American Cyanamid	Image 1.5 lb/gal	Nutsedge (purple) and selective broadleaf weed control in southern turf except bahiagrass.

small area with only a few weeds present, but may be appropriate for some homeowners.

Mowing at the proper height and frequency will suppress many weeds, especially annual broadleaves. Mowing prior to weed seedhead formation will also reduce soil seed reserves.

Other good housekeeping practices, such as washing mowers after cutting weed-infested areas and maintaining hard-to-mow areas such as fence lines, will help prevent introduction of new seeds. Always incorporate and follow a mowing schedule as suggested by your local extension service.

Smothering weeds

The use of non-living material to exclude light (smothering) is effective in certain areas such as flower beds, foot paths, or nurseries where turf is not grown. Materials used include straw, sawdust, hay, wood chips and plastic.

Care must be taken to prevent mowing accidents that can arise when these materials move into a maintained turf area.

Recently, several mat-type products impregnated with herbicides to extend the time of weed suppression have been introduced. Contact with these by living plant parts will not allow further growth; therefore, care must be taken to prevent root injury to desirable trees, shrubs, and ornamentals that may be exposed to these.

Herbicides defined

A herbicide is simply any chemical that injures or kills a plant. For herbicides to be effective, the following decision making sequence is suggested:

Identification. This is the backbone of any herbicide weed control program. Identification begins with classifying the weed type. Are they broadleaves or dicotyledonous plants? Broadleaves have two seed cotyledons (young leaves) at emergence and have net-like veins in their true leaves. They also often have colorful flowers. Examples include clover, spurges, lespedeza, plantain, henbit, parsley, beggarweed, matchweed and many others.

Grasses, or monocotyledonous plants, have only one seed cotyledon present when seedlings emerge from the soil. Grasses also have hollow, rounded stems with nodes (joints), and parallel veins in their true leaves. Examples include crabgrass, goosegrass, dallisgrass, thin paspalum and annual bluegrass.

Sedges and rushes generally favor a moist habitat and have either stems that are triangular-shaped and solid (sedges), or round and solid (rushes).

Weeds complete their life cycles in either one growing season (annuals), two growing seasons (biennials), or three or more years (perennials).

Annuals that complete their life cycles from spring to fall are generally referred to as summer annuals, and those that complete their life cycles from fall to spring are winter annuals (summer annual grasses, as a class, are generally the most troublesome in turf).

Herbicide selection. Deciding if and which herbicide(s) to use can be confusing. There is, however, a checklist to help make this decision.

After identifying the weed, read the chemical label thoroughly to decide which turf species tolerate exposure to those particular products (Tables 1 and 2 list most common-use turf herbicides, trade name examples, and turfgrass tolerance).

Table 2. (cont.)

Common and trade name examples, manufacturers and uses of post-emergence herbicides in warm-season turfgrasses.

Common name	manufacturer	trade name(s)	uses
MCPA	Rhone-Poulenc	Weedar MCPA 4 lb/gal + others	Broadleaf weed control. Usually mixed with other herbicides for wider spectrum of weed control.
MCPA + MCPP + 2,4-DP	Riverdale	Weedestroy Triamine II	Broadleaf weed control.
MCPP	Fermenta Lesco PBI/Gordon Rhone-Poulenc	MCPP Lescopex 2.5 lb/gal Mecomec 4 lb/gal Weedone MCPP Turf Herbicide	Broadleaf weed control. Usually mixed with other herbicides for wider spectrum of weed control.
MCPP + chlorflurenol	Ortho	Weed-B-Gon for Southern Lawns	Selective broadleaf weed control.
MCPP + 2,4-D + dicamba	PBI/Gordon Lesco Sierra + others	Trimex Southern Three-Way Selective Trex-San + others	Wide spectrum broadleaf weed control.
metribusin	Mobay	Sencor 4L, 50W, 75DF	Mixed with MSMA/DSMA for goosegrass control in bermudagrass.
MSMA	Fermenta Helena	Bueno 6 lb/gal MSMA 6 lb/gal	Grass weed control in bermuda and zoysiagrasses.
paraquat	ICI Americas	Gramoxone	Non-selective, contact weed control.
pronamide	Rohm & Haas	Kerb 50WP	*Poa annua* control in bermudagrass.
sethoxydim	BASF	Poast 1.5 lb/gal	Grass weed control in centipedegrass.
simazine	Ciba Geigy + others	Princep 4 lb/gal, 80WP + others	Pre and early Post-emergence grass and broadleaf weed control.
triclopyr + 2,4-D	Dow/Elanco	Turflon-D	Broadleaf weed control.
triclopyr + clopyralid	Dow/Elanco	Confront 3 lb/gal	Broadleaf weed control.

Source: Dr. McCarty

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Next, look at one of the numerous publications available that list the susceptibility of the weeds to the herbicide in question.

Reread the label to learn everything possible about a product. Information includes: site of uptake (foliar, root, or both); length of effectiveness; effects of UV light; effects of water pH on the product; whether it can be tank-mixed with fertilizer, insecticides or other herbicides; whether a surfactant is needed, etc.

Other information on the label includes safety precautions, effects on surrounding (non-target) plants, overseeding or replanting waiting periods, and environmental influences (such as rainfall) on control.

Manufacturers invest millions of dollars and many years of research and development on each product, and the label reflects their findings. Always read and follow these before use.

Herbicide application. Proper application is the last link in the chain of successful herbicide use. Misapplication and/or the use of wrong materials are the main reasons for most weed control failures.

Equipment calibration and proper coverage are two important factors in correct application procedures. For those using tractor-mounted or pull-behind sprayers with a boom of constant width, equipped with nozzles that produce a constant flow rate at a given pressure, moving over open terrain, calibration is fairly straight forward. However, LCOs often use a handgun. In using this method, one is sure of only one variable—the volume of water being applied, assuming the pump and regulator are constant.

One suggestion for handgun use is that you calibrate every applicator separately. Individuals do not walk or use the same swing pattern (motion) exactly alike. Other suggestions:

- limit overlap;
- emphasize the importance of maintaining consistent walking speed and overlap each day;
- check regularly that the nozzle output, pump pressure, and engine speed are similar as when calibration was performed;
- and don't mow treatment areas for two to four days before or after application. This delay will allow time for herbicide penetration and translocation throughout the weeds before mowing.

Post-emergence herbicides

Post-emergence herbicides are generally effective only for weeds that have emerged (are visible). Post-emergence herbicide effectiveness is reduced when the weed is under drought stress, has begun to produce seedheads, or is mowed before the applied chemical has had time to work.

Post-emergence herbicides should never be applied when temperatures are hot (>85°F), unless some degree of turf discoloration is acceptable.

Many turf managers wait until weeds become mature before applying post-emergence herbicides. By waiting this late, multiple applications (2 to 3) spaced 7 to 10 days apart are necessary for control, though this increases the probability of damaging the turf.

Generally, the younger the weed, the easier it will be controlled. Try to treat weeds when they are at the 2 to 3 leaf growth stage (Figure 1). Don't wait until it begins to tiller or produce seedheads (Figure 2). Waiting this late will usually result in reduced control.

Broadleaf weed control

Most broadleaf weeds are controlled with atrazine and/or various combinations of 2,4-D, MCPP, MCPA, dicamba, or triclopyr. It is suggested for young broadleaf weed control in St. Augustine, centipede, and zoysiagrasses that atrazine be used.

For weeds that escape control, follow-up with a treatment consisting of dicamba and 2,4-D.

For best control, the weeds should be actively growing and not under moisture stress. Control may be reduced if weeds are not actively growing due to less herbicide uptake and translocation by the plants.

For the more difficult-to-control broadleaf weeds, two applications of 2,4-D, dicamba, MCPP and/or triclopyr, spaced 7 to 1O days apart, are required. However, repeat applications also increase the chance of damage to the turfgrass. In these cases, using one-half the normal herbicide rate will reduce turf injury.

It is suggested that one-half the normal rates of 2,4-D and/or MCPP never be exceeded on St. Augustinegrass.

Grass weed control

Atrazine applied early as a post-emergent will provide fair control of many annual grass weeds and also provide good to excellent control of broadleaf weeds.

For older weeds in bermudagrass and zoysiagrass, repeat applications of DSMA/MSMA are necessary.

On centipedegrass, Poast will provide good to excellent control of most annual grass weeds. In St. Augustinegrass, Asulox provides fair to good control of some annual grasses.

Repeat applications are usually necessary but this increases the risk of turf injury, especially if the turf is treated when temperatures are hot or under moisture stress.

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Don't underestimate proper agronomic practices

The first and most important strategy in weed management begins with proper agronomic practices, which encourage a dense, growing turf.

A healthy, dense turf serves several important roles in weed management. The first is that turf shades the soil so sunlight can not reach the soil surface. Sunlight reaching the soil will warm the surface quicker, resulting in earlier spring seed germination.

Second, many weed seeds require a certain quantity and quality of sunlight for optimum germination. Therefore, dense turf minimizes sunlight penetration to the seed. Dense turf also minimizes the physical space available for weeds to become established.

When turf is not present, Mother Nature quickly fills bare ground with plants in an attempt to minimize soil erosion. A race begins between her and the turf manager as to who can fill the weakened turf areas first.

Steps for proper turf management involve the following:

Turf managers must decide which turf variety is best adapted for a particular area or use. For example, bermudagrass has very poor shade tolerance. Therefore, it will become too thin after being planted under these conditions. This thinning allows the opportunistic weeds to become established.

Proper turf cultural practices such as fertilizing, watering, and mowing. These practices are necessary to encourage healthy growth. For example, if a turf area is over-watered or fertilized, or mowed too low or too infrequently, it is usually weakened (thinned) and weed encroachment results.

Traffic control. Areas constantly damaged or compacted by traffic usually result in thin turf, allowing weeds to become established. Goosegrass, annual bluegrass and certain sedges are examples of weeds that tend to thrive in compacted or continuously wet soils.

Other pest control. Turf weakened by other pests such as insects, diseases, and nematodes often cannot recover quick enough to out-compete weed encroachment. Soil disturbances, such as mole cricket tunneling, also expose additional weed seeds, and therefore add another avenue for establishment.

—Dr. McCarty□

Post-emergence herbicides are generally effective only for weeds that have emerged, and are less effective when the weed is under heat or drought stress.

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Currently there are no selective weed controls available for bahiagrass used in the landscape.

Nutsedge control

Nutsedges, as a class, are very difficult to control, especially in wet areas. Many sedges produce numerous tubers, rhizomes and/or seed which provide reproductive means long after the mother plant has died.

Atrazine will provide fair to good control of several annual-type sedges if treated when the weeds are just emerging. Yellow nutsedge is best controlled with Basagran while purple nutsedge is best controlled with Image.

Repeat applications will be necessary for complete control and treatment for several consecutive years may be necessary for long-term control.

Record-keeping

Environmental stresses (heat, drought, cold, shade) can have an effect on the amount of material absorbed by the plant and its effectiveness. It is suggested that the environmental conditions at the time of application be recorded, in the event failure occurs, or to more accurately evaluate effectiveness.

These variables include air and soil temperatures, relative humidity, wind speed and direction and leaf and soil moisture.

Other discussions between you and your client should include explaining the strengths and weaknesses of herbicides being considered and which (if any) weeds you do not feel will be controlled.

No one herbicide can control all weeds, so it must be decided if more than one material should be used.

Outline your strategy (program) to your client. Explain when and how treatments will be made, what can be expected (percenatge of control) from these, how long it takes for weed mortality, and who is responsible for proper cultural practices (i.e., watering, mowing, fertilizing, etc.) following treatment.

Finally, do not promise more than can be delivered. Every operation has its limitations, and promises that exceed these usually result in repeated callbacks and cancellations.

Remember, weed control begins with proper turf management, and without this, herbicides are only a temporary fix. **LM**

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LANDSCAPE *Guide* MANAGEMENT

CHOOSING AN IRRIGATION SYSTEM

A quality irrigation system requires a lot of work, even before the first piece of pipe is ever buried.

by Scott D. Knowles, Wolf Creek Company

Having an irrigation system designed and installed can be a rewarding experience. But you must focus on needed criteria like site surveys, water source determination, applied design principals and formulas, selection of qualified consultants and contractors and service.

An irrigation system is a mechanical system that efficiently takes water from one place and delivers it to the rootzone of plant material in another place, at the right time and in the right amount. This simple objective can often become a disaster, if the criteria set forth are not followed.

1. Initial factors

Logically, the first step is to create a design. Whether the turf manager, irrigation consultant or contractor is going to do the design work, all system designs should follow several steps.

Before any actual design work can begin, the designer must fully understand where the system is to be installed and what it is expected to do. This is the purpose of the site review.

Many factors must be considered, but the first step is to create a scaled drawing of the area that accurately depicts the shape, size and location of all structures and planting areas.

Notes about elevation changes and wind direction will prove very helpful if either is present in an appreciable amount. Also, investigate utility rights-of-way and other areas that may preclude the installation of irrigation equipment.

2. Soil type

Soil type considerations must be made. Though not crucial for some systems, ignoring soil variations may be deadly on others.

Consider that a large system, such as a golf course, may encompass several soil types—each with its own rate of absorption and water retention ability. To apply water equally to each area would cause over-watering in some areas and under-watering in others. The result would be unhealthy turfgrass from too much or too little water, wasted money in water and power costs, and even ero-

This article is divided into 16 different considerations for designing an irrigation system. Here they are, for easy reference:

1. Initial factors
2. Soil type
3. Analyzing water
4. Water sources
5. Pump system
6. System prelims
7. Water amount
8. Coverage patterns
9. Money considerations
10. Zoning
11. Valves
12. Pipe materials
13. 'Accessorizing'
14. Final design
15. Specifications
16. The contractor

sion from run-off.

An irrigation system needs a sufficient quality and quantity of water. Lakes, rivers, wells and municipal water systems all may be used, if satisfactory and cost effective. It is advisable to have local experts make recommendations and provide data for both quality and quantity.

3. Analyzing water

Each source has individual concerns the designer must consider. Water should be analyzed for pollutants and organic matter that may harm the turf or cause problems with equipment.

Lakes tend to collect chemicals from turf via run-off and agricultural lands. Rivers and wells may have industrial or sewage contaminants; city water may contain harmful chemicals. Algae, marine plants and silt may clog pumps, valves and sprinklers, or sand may cause premature wear throughout the system.

Many solutions exist for the designer for quality problems. If, however, the quantity is insufficient, other measures must be taken.

4. Water sources

It is not uncommon to have a combination of water sources, at least as a recharge supply for the main source. For example, a large turf system may use one or more ponds as the water supply but uses wells, rivers or city water to re-charge the ponds when the natural supply is weak.

The re-charge system can normally operate within a 24-hour window, while the irrigation system has a shorter watering time frame, such as 10 hours for many situations.

As the water supply becomes more complicated, it increases the cost to purchase and operate the system. The designer must derive the proper equipment balance for performance, efficiency, reliability and cost effectiveness.

Other information to gather regarding the water source includes static water pressure, pipe size, and type of connection for city water. Can a deduct meter be installed? Where would a pump station be installed? Is there electrical power close by sufficient to power a booster pump, including three-phase?

5. Pump system

Additionally, local backflow preventer codes must be determined and implemented into the design. In some areas, backflow protection is also required for wells.

Unless an abundant supply of water, at the required pressures, can be obtained from a municipal water supply, the irrigation system will probably need a pump, or series of pumps, to supply water at the pressure and quantity required.

Whether as a pressure booster or as the supply pump, this phase of design should be left to an experienced pump station designer.

For many large turf systems the pump station may be 15 to 50 percent of the total system cost. Be sure to consider quality, performance, and service from the vendor.

While on site, many designers find it beneficial to mentally conceive the system as it would be installed. Installation problems can be foreseen and the design adjusted accordingly, instead of allowing the installer or owner to discover a problem during installation.

6. System prelims

The designer can double-check his preliminary work and form mental images of the area, which are helpful while working at the drawing table.

After creating the scaled drawing and reviewing the site, the designer can now make some preliminary decisions about the system, such as type of sprinklers, controllers, etc. Now is the time to consider the variations of plant materials and soil profiles in order to make the proper selection of equipment to be recomended.

At this time the brand and model numbers of the major components can be established as well as the overall concept concerning the system layout.

Also, some of the system operational guidelines can be established to help size the water supply and supporting equipment. For example, the designer should now know the soil conditions, the percolation rates, and the acreage to be covered.

7. Water amount

The designer now determines the amount of water to be applied on a weekly basis and the available watering window. With this information, the initial water requirements and the times of operation can be determined. From this, the designer will size the pumps, pipe, valves and sprinklers.

Armed with this data the designer can start the actual system layout, usually beginning with the sprinkler head placement. The most important criteria when laying out sprinklers is to insure an even amount of precipitation throughout the system's area of coverage. Normally this means the throw radius of one sprinkler reaching the next sprinkler, or "head-to-

Though today's irrigation equipment is engineered for quality and performance, proper application of the technology is crucial for a good installation.

head" coverage.

Since the actual amount of water applied decreases toward the outer ranges of the sprinkler's throw radius, head-to-head coverage allows a more even application rate, or coefficient of uniformity (CEU), which means all areas receive about the same amount of precipitation.

8. Coverage patterns

There are two common sprinkler layout patterns, square and triangular spacing. Most systems include a combination due to the odd shapes of the irrigated areas.

Triangular spacing offers uniform coverage with fewer sprinklers. Instead of "head-to-head" coverage, or 50 percent diameter spacing (which is normally used in square spacing), triangular spacing allows 55 to 60 percent of diameter of throw spacing, therefore accomplishing the desired precipitation rate with fewer sprinklers.

Always remember, the wind factor can adjust these formulas up or down. Trying to save money by using the fewest heads should be discouraged, so always make sure the designer stays within the manufacturer's performance specifications.

9. Money considerations

A poorly designed or installed sprinkler system is extremely difficult and costly to renovate. Do not allow price to overshadow quality. If funds are not available to install a quality system, consider installing it in phases instead of skimping on the materials.

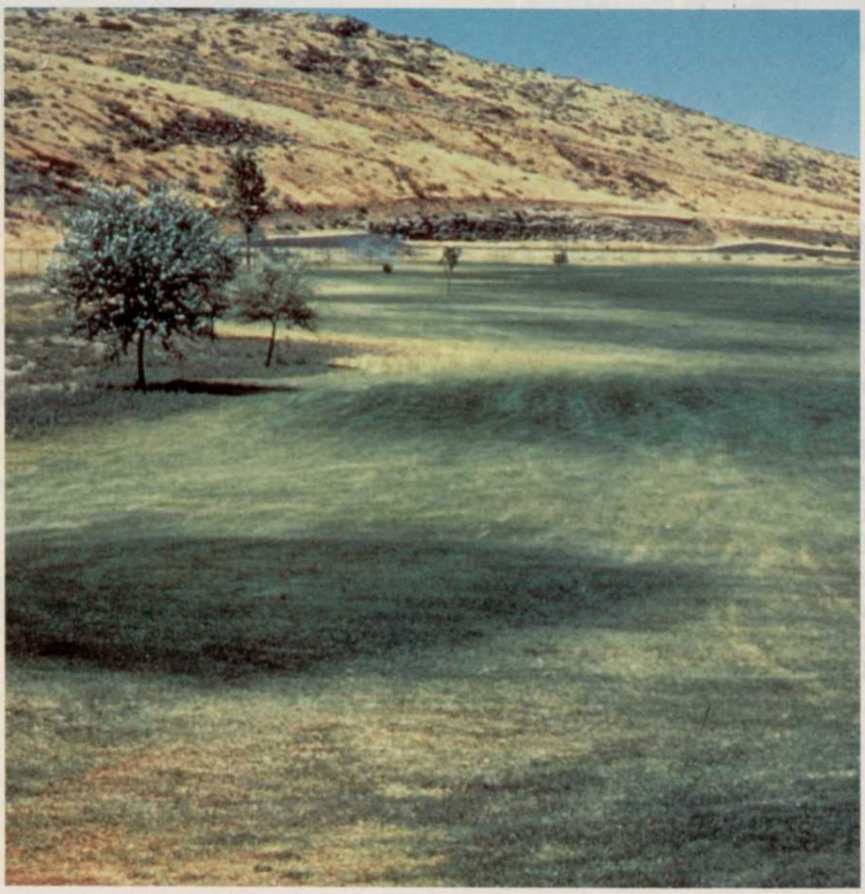
Once the sprinklers are laid out according to the design criteria and manufacturer's specifications, the next step is to divide each area into "zones" or groupings of sprinklers. This is necessary because enough water to run all the sprinklers at the same time is not normally available. Also, sprinklers with different precipitation rates can cause unequal amounts of water to be applied in an area, if operated on the same zone.

10. Zoning

Separating into zones also allows greater control over each area, which will be important because of differing soil types, exposure and plant water requirements.

Some sprinkler manufacturers provide "matched precipitation rate" (MPR) nozzles for their sprinklers. This allows the designer to put part circle heads on the same zone with full circle heads and still maintain an even precipitation rate throughout the area of coverage.

Each zone is controlled by a remote automatic control valve turned on by the controller. In the case of larger heads, such as those used on a golf course or large turf project, each head may have a valve built into it's casing, which means every head is, in effect, a separate zone.



The effects of a poorly-designed irrigation system include over-watering, pest and disease problems.

11. Valves

Control valves, all of which are hydraulic, are normally operated by electrical solenoids, or a pressurized hydraulic valve block and tubing.

Both the electrical and hydraulic control systems have merits which should be explored. The number of heads on each zone would be determined by the amount of water needed by each head compared to the amount of water available from the water source. If a sprinkler needs 10 gallons per minute (gpm) to operate properly, then a 70-gpm water supply would allow seven sprinklers to run at the same time.

After all the sprinklers are located and zoned, the designer can now design the piping system. Since the volume of water to each zone is established, the size of the pipe and valves supplying each zone can be determined according to the flow and velocity characteristics of the pipe used. Pressure loss charts provide an easy way to size pipe and stay within acceptable velocity ranges.

12. Pipe materials

Pipe materials vary according to the requirements of the system, but most systems are now installed with polyvinyl chloride (PVC) pipe. An experienced irrigation designer will make recommendations concerning the pressure ratings and strength of the pipe. These should be followed explicitly.

Allowing lower-rated or undersized pipe to be installed will cause costly problems and may cripple the entire system. The pipe design should try to minimize the amount of trenching and pipe installation to help control the system's cost.

Certain methods for using smaller pipe sizes, such as designing in "looping," can reduce friction loss and the system cost, but the designer should never undersize pipe. If anything, use larger pipe sizes, especially if the system may be expanded in the future, or if friction losses are bordering on the unacceptable.

13. 'Accessorizing'

At this point, the ancillary items are designated, such as wiring and wire sizes, valve boxes and controller accessories. The type of controller and controller location should also be decided.

Today's controllers range from the older style mechanical clocks to the newer computer-based systems.

Mechanical clocks are reliable and tend to be easier to learn how to operate, but lack the impressive array of functions provided by the computerized systems. Water management is now a reality with the computer-based controllers. Weather stations supply up-to-the-minute information about the field environmental conditions, which then alter the watering schedules to provide just the right amount of water when it is needed.

Another impressive feature is the ability to operate remote controllers via the telephone lines or radio communications, all from a central location. An irrigation computer can:

- control fountains and lighting systems;
- allow, because of "flow management," pump stations to run at their peak efficiency; and
- most importantly, water and power are saved, so the life of system components is extended.

After double-checking the hydraulic calculations, the plan is nearly completed.

14. Final design

To finish the design, a final copy is created with detail for each component of the system. Assumptions and bits of information that would be helpful to an installer should be included in the notes. The legend should include a complete list of material symbol designations. Even the hydraulic calculations can be part of the finished package.

Most designers will have completed an irrigation schedule by this time. It helps to have this prepared prior to installation as a double check of the design, and to aid in making changes in the field during installation.

Once the design is complete, the designer should develop a set of specifications for the installation of the system. This is crucial if the system is to be released for bids.

15. Specifications

Specifications assist in establishing a level of quality and expectations for bidders. Substandard contractors will be obvious since they will fail to meet the requirements of the specifications. Subjects to consider including in the specifications are who is to locate all underground utilities; who arranges for permits and inspections; and who installs backflow preventers.

Include statements binding the contractor to install according to local building codes and the equipment manufacturer's recommendations. Outline in detail how components are to be installed and the procedure for starting up the system. Cover payment terms, retainers, and clean-up expectations.

Establish how the contractor is to store materials and equipment and any other special working conditions. But, most of all, be specific about what needs to be done. Don't force the contractor to make assumptions.

16. The contractor

Several sources are available for assistance and to obtain sample specifications, including manufacturers, distributors, trade associations and some attorneys.

When a contractor is to be chosen to install the system, it pays to give careful attention to the selection process. Most contractors are honest, competent installers and are eager to provide the information you need for consideration. But, there are the bad apples.

A professional contractor is usually well prepared for meetings, knowledgeable about the product and the industry, and provides complete and accurate documentation. The poor contractor is usually ill-prepared, late for appointments and callbacks, offers vague answers and usually has the lowest price.

Ask for references, and really contact them. The questions asked will determine the quality of the information received, so ask specific questions about issues important to the job. Listen carefully about how problems were resolved and how well the contractor handled callbacks and service calls. Good contractors like to talk about their service because it is part of their success.

Inquire about their warranty and service procedures, especially if there is an emergency. Establish service costs up front; expect, and be willing, to pay a fair price for good service, because it is most definitely worth it.

A new irrigation system is a long term investment, offering the end user years of reliable performance, if proper care is applied to the planning phases. **LM**

Give a lot of thought to who you want as your irrigation contractor. Request and follow up on references and ask plenty of tough questions.

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