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PRE-EMERGENCE WEED CONTROL IN COOL-SEASON TURF

Pre-emergence herbicides are generally safer to use on turf than post-emergence herbicides because they are being used to control seedlings rather than mature plants. Here are some tips.

by Prasanta C. Bhowmik, Ph.D., University of Massachusetts

Weeds are a fact of life. No turfgrass area or landscape will remain weed-free without intervention.

To establish and maintain an attractive, healthy lawn, weeds must be controlled. Maintenance practices such as mowing too low, over-irrigation, over-fertilization, using unnecessary heavy machinery, and poorly timed aeration can result in stress conditions that encourage

weed infestations.

A good management program with both cultural and chemical program will help reduce these stress factors. A successful weed control program in cool-season turf results from integrating a recommended cultural practice program and a complete weed control program.

An effective weed control program uses herbicides only when necessary. Producing a dense, healthy stand of

turfgrass is one way to control annual grassy weeds and other broadleaf weeds. Proper mowing height and frequency, fertilization and irrigation are part of the weed control program and should be practiced throughout the growing season.

Turfgrass managers should be familiar with the following steps for a successful weed control program.

1. Knowing the specific weed problems: in relation to weed identification (grassy weeds vs. broadleaf weeds), life cycle of the weeds (annuals vs. perennials).

2. Selection of the right herbicide: in relation to effective weed control, turfgrass tolerance.

The most common annual grassy weeds include large crabgrass, small crabgrass, yellow foxtail, green foxtail, fall panicum, barnyardgrass and goosegrass. Crabgrass and goosegrass are the most troublesome weeds in turf. Crabgrass (*Digitaria spp.*) is among the most difficult weeds to control in turf.

In northern regions, seeds of crabgrasses (smooth and large) begin to germinate in late April to late May and continue to germinate throughout the summer. However, in transition regions, germination can occur as early as late March. Crabgrass germination is related to soil temperature. When the soil temperature reaches 65°F crabgrass begins to germinate.

This varies with the local conditions of soil type, rainfall, and weather in the spring. In general, most



This picture, taken 10 weeks after a pre-emergence herbicide application, shows the effective control of annual grassy weeds.

crabgrass seeds germinate during a six- to eight-week period. And most other annual grassy weed seeds germinate during this germination period.

Selective weed control

The selective control of these grassy weeds and some broadleaf weeds can be obtained with pre-emergence herbicides. Pre-emergence herbicides provide effective control for several weeks or months, depending upon dosage and products.

The effectiveness of these compounds is based upon their ability to provide good weed control, turfgrass tolerance, and long residual control. The primary pre-emergence herbicides for grassy weed control in cool-season turfgrasses are benefin, bensulide, DCPA, oxadiazon, pendimethalin, and siduron (Table 1).

Benefin, Team (a pre-mix combination of benefin and trifluralin), DCPA is also effective in controlling common chickweed, carpetweed and common purslane.

In addition, pendimethalin controls goosegrass, barnyardgrass, fall panicum and some annual broadleaf weeds such as hop clover, yellow woodsorrel and prostrate spurge. Pendimethalin applied during the late summer to early fall can control common chickweed, mouseear chickweed, and henbit. Repeat application at the recommended rate eight weeks after the initial application may prevent goosegrass and heavy infestations of spurge. Oxadiazon controls hop clover, prostrate spurge and speedwell. Oxadiazon is more effective in goosegrass control than DCPA. Pendimethalin and DCPA control prostrate spurge, while benefin and bensulide are ineffective in controlling this weed.

Prodiamine (Blockade) is a new pre-emergence herbicide. It is expected to be in the market in the near future. It is very effective in controlling most annual grassy weeds such as crabgrass, goosegrass, bluegrass and several broadleaf weeds. It provides long residual control of weeds.

Timing applications

Timing is very important for herbicide applications. The best time for annual grassy weed control is to apply before weeds emerge. The key point is that pre-emergence herbicides need to be applied before grasses germinate in the spring. Treatments made too late (i.e. after germination) will not control emerged grassy weeds.

If application timing does not coincide with the normal germination period of annual grassy weeds, weed

Table 1.

Common name, trade names, formulations, and rate of pre-emergence herbicides.

Common Name	Trade Name(s)	Formulation	Recommended Rate (pound active per acre)	Company
Benefin	Balan	2.5G	2.0-3.0	Elanco
		2.5G	"	Lesco
Benefin & Trifluralin	Team (1:2)	2G	1.5-3.0	Elanco
		1G	"	Lesco
Bensulide	Betasan	4E, 7G, 12.5G	7.5-10.0	ICI
		4E, 7G, 12.5G	"	Mallinckrodt
		Lescosan	"	Lesco
		Betamac	"	PBI Gordon
		Weedgrass Preventer	8.5	12.5
DCPA	Dacthal	75WP	10.5	Fermanta
		5G	"	Lesco
Oxadiazon	Ronstar	50WP, 2G	3.0-4.0	Rhone Poulenc
Oxadiazon + Bensulide	Goosegrass/ Crabgrass Control	6.56G	7.5	Scotts
Pendimethalin	Lesco Pre-M Weedgrass Control	60DG,	1.5-3.0	Lesco
		60WDG	"	Scotts
		Halts Crabgrass Turf Weedgrass Control	2.45G	"
Siduron	Tuperson	1.71G	"	Scotts
		50WP	2.0-6.0	Du Pont

control results may be erratic or poor. In general, pre-emergence herbicides should be applied two weeks prior to the expected weed seed germination period. Therefore, the application dates of pre-emergence herbicides will vary from one part of the country to another.

The herbicides should be watered-in so that the chemical can form a barrier in the soil prior to weed seed germination. The resulting chemical barrier should not be disturbed during key weed germination period.

Complementary effects

Post-emergence grass control can complement a pre-emergence weed control program when poor weed control results are obtained. The primary post-emergence herbicides for grassy weed control in cool-season turfgrass are the arsenates: MSMA, DSMA, and AMA. These compounds can be phytotoxic, especially when applied during hot weather. A new post-emergence herbicide, fenoxaprop (Acclaim) is now available for annual grassy weed control. Fenoxaprop is very effective in large crabgrass, goosegrass, fall panicum, giant foxtail, barnyardgrass and other grassy weed control. This compound offers a wider window of post-emergence control than the arsenates with less potential for turfgrass injury. Fenoxaprop is

recommended for use on perennial ryegrass, fine fescue, tall fescue and Kentucky bluegrass turf.

Longevity of pre-emergents

A complete weed control program aims at controlling weeds for the entire season. Season-long control of weed species is dependent upon the activity and longevity of the herbicide in use.

Oxadiazon, pendimethalin, Team and bensulide provide long residual weed control, while benefin is of short residual. On the other hand, DCPA is an intermediate type. Turfgrass managers should keep in mind that soil residual activity is also dependent upon the rate of herbicide being used.

In general, the higher the rate of application, the longer is the residual control over the growing season. Initial application determines the concentration in the soil for pre-emergence activity. It must maintain a critical soil residue level during the growing season for season-long weed control.

Turfgrass managers should keep in mind that application made early in the season may break in the soil to below the threshold level. When this occurs, one can expect less than desirable control following late germinating weeds. Repeat application of certain herbicides may be made 10 to

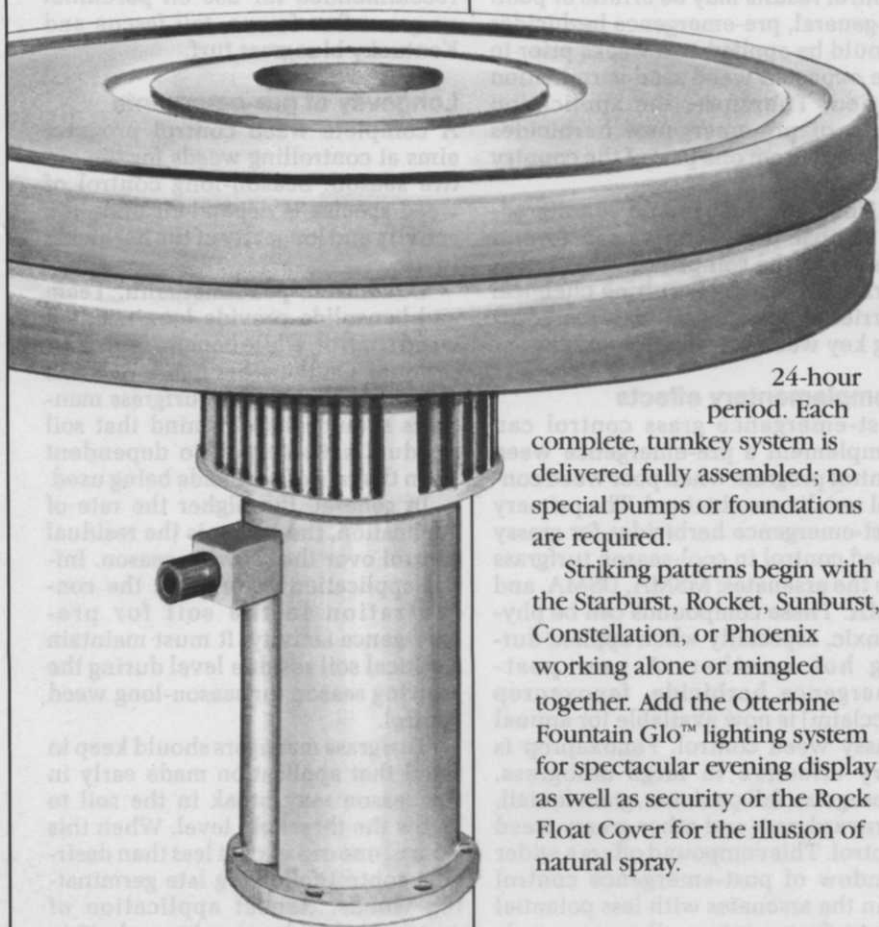
continued on page 55

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12 weeks after the initial application for continued control of late germinating weeds over the entire season.

Turfgrass tolerance

Cool-season turfgrasses vary in their tolerance to pre-emergence herbicides. Siduron is the only pre-emergence herbicide that is recommended for newly-seeded turfgrass. All other pre-emergence herbicides are recommended for use on established fine fescues, Kentucky bluegrass, perennial ryegrass and tall fescue. How-

In general, the higher the rate of application, the longer is the residual control over the growing season.

ever, bensulide and DCPA can be applied in the spring following a fall seeding of cool-season turfgrasses.

Pendimethalin is not recommended for use on bentgrass or where annual bluegrass is the desired species. Benefin, DCPA and oxadiazon are not recommended for use on fine fescues or bentgrass turf. However, bensulide can be used on bentgrass. Team is recommended for use on most cool-season grasses. It may thin established annual bluegrass turf and fine fescues at rates above 1½ lbs. active ingredient per acre.

It should not be applied in the spring to turfgrass planted the previous fall. Team is not recommended for use on creeping bentgrass. However,

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it can be used on bentgrass fairways.

Reseeding time interval

Time for reseeding is very important in relation to the application date of pre-emergence herbicides. In general, pre-emergence herbicides persist in the soil for a length of time, allowing season-long weed control. Reseeding

interval is dependent upon the herbicide and dosage used (Table 2).

For example, reseeding should be delayed at least six weeks after application of Team at the lower end of recommended rate. However, when using the highest recommended rate, reseeding should be delayed 12 to 16 weeks after the application. When reseeding, it is essential that proper cultural practices such as soil cultivation, irrigation and fertilization be followed.

In summary, a successful pre-emergence weed control program results from selecting the right herbicide and applying it uniformly at the proper time and appropriate dosage. The herbicide selection depends on the weeds to be controlled and the turfgrass to be treated.

Choose the most effective herbicide with maximum safety to the turfgrass. Changing the use of one class of herbicide to another class in a weed management program may provide a broad spectrum weed control in lawns. For crabgrass and other grassy weed control, turf managers and lawn care operators should emphasize a pre-emergence herbicide program along with a good management program. This approach will minimize the competitive advantage of efficient species like crabgrass.

Table 2.

Minimum time necessary for reseeding after various pre-emergence herbicide application.

Common Name	Trade Name(s)	Formulation	Recommended Rate (pound per acre)	Minimum Time Before Reseeding (Weeks)
Benefin	Balan	2.5G	2.0-3.0	6
Benefin & Trifluralin	Team (1:2)	2G	1.5-3.0	6
Bensulide	Betasan	4E, 7G, 12.5G	7.5-10.0	16
DCPA	Dacthal	75WP	10.5	8
Oxadiazon	Ronstar	50WP, 2G	3.0-4.0	16
Oxadiazon + Bensulide	Goosegrass/ Crabgrass Control	6.56G	7.5	16
Pendimethalin	Lesco Pre-M	60DG,	1.5-3.0	16
Siduron	Tuperson	50WP	2.0-6.0	N/A

PRE-EMERGENCE WEED CONTROL FOR WARM-SEASON TURF

by Clyde Elmore, Ph.D., University of California-Davis



Crabgrass will germinate in open areas of turf.

Pre-emergence weed control is more than applying the right herbicide at the right rate. It requires a knowledgeable turf manager. Often the manager must be able to manage the turf for multiple uses such as recreation, visual effects and athletic events.

Frequently, several species are involved. Knowing cultural practices needed to make the turf vigorous without inviting damage from diseases or other stresses is essential. Management practices are generalized about mowing height and frequency, fertilization amount, and frequency, time of aeration and irrigation. These practices need to be site-specific. Assuming all of the practices are correct, the manager must then think of tipping the balance against weeds.

Before beginning a weed control

program, determine the weed species to be controlled using identification aids.

Local university advisors, nurserymen, industry representatives or people at the botanic gardens are available to assist. If there are many species or if perennial weeds are present, a single pre-emergence material will not be adequate.

Choosing a herbicide

Many herbicides are available for warm-season turf. They differ by the weeds controlled, their safety to the various turf species and residual control. Some herbicides (atrazine, simazine and pronamide) also give some post-emergence control.

	Prostrate Spurge Control	Crabgrass Control
EXCELLENT	Pendimethalin	Bensulide, pendimethalin, oryzalin, trifluralin
GOOD	DCPA	Benefin, siduron, oxadiazon, DCPA, napropamide
FAIR	Oxadiazon, siduron	
POOR	Bensulide, napropamide	

(Based on consistence, length of control, and completeness of control)

Pre-emergence materials form the basis for controlling annual grass and many broadleaf weeds in turf. Once the weeds are controlled and the management practices have been changed to keep the weeds from re-invading, then good vigorously-growing turf can exclude most weeds.

Herbicides are applied in the spring to control summer annual grasses or broadleaves. They are applied in the fall for winter annuals. The germination times of large crabgrass, smooth crabgrass, prostrate spurge, goosegrass or foxtails all differ.

Timing applications

The manager must be able to time the application so the herbicide is in the germination zone at the first germination. One application may not be long enough to control the weeds for the full season, as is often the case in southern California, Texas, Florida, Georgia, etc.

These areas have an exceptionally long weed germination period. Since the soils are warmer and the temperature higher, herbicides degrade faster than in cooler climates. Greater amounts of water increase the loss of herbicides. A second application must be made to have enough herbicide in the germination zone to control all weeds.

The turf manager can affect timing of germination by turf quality. Areas

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Table 1.

Directory of turfgrass pre-emergence herbicides.

Common Name	Trade Name	Formulations	Company
Atrazine	Aatrex	80W,90DG,4L	Ciba-Geigy
Benefin	Purge	4L	Security
	Balan	2.5G	Elanco
Benefin + oryzalin	2.5 Benefin Granular	2.5G	Lesco
	XL	2G	Elanco
Benefin + trifluralin	Team	2G	Elanco
Benefin + oxadiazon	Regalstar		
Bensulide	Betasan	2.9E,4E,7G,12.5G	Stauffer
	Iescosan	4E,7G,12.5G	Lesco
	Pre-san	4E,7G,12.5G	Mallinckrodt
	Bensumec 4LF	4E	
Bensulide + Oxadiazon	Goosegrass/Crabgrass Control	5.25G + 1.31G	Scotts
DCPA	Dacthal	75W	Fermenta
	Dacthal	5G	Lesco
Ethofumsate	Prograss	1.5E	Nor-Am
Fenarimol	Rubigan	50W	Elanco
Napropamide	Devrinol	50W,5G	Stauffer
Oryzalin	Surflan	4AS	Elanco
Pendimethalin	Southern Weedgrass Control	2.5G	Scotts
	Turf Weedgrass Control	1.71G	Scotts
	Weedgrass Control	60DG	Scotts
	Pre-M	60DG	Lesco
	Pendimethalin	60DG	Clean Crop
Pronamide	Kerb	50W	Rohm-Haas
Siduron	Tupersan	50W	Du Pont
Simazine	Princep	80W,90DG,4L,4G	Ciba-Geigy

that have bare soil warm up quicker in the spring and weeds germinate in these areas before cooler, tight-growing areas. With good quality turf, the herbicide can be applied later giving better control that lasts longer.

Pre-emergence herbicides are usually used in the early spring for crabgrass (large and smooth), goosegrass, sandbur, foxtails and prostrate spurge.

Knotweed can sometimes be a problem. In the fall of the year, materials are used for annual bluegrass, common chickweed, henbit and speedwells.



Goosegrass should be treated in the early spring with a pre-emergence herbicide.

continued on page 59

The choice is yours. Whether your customers need season-long preemergence weed control by itself or on fertilizer from leading formulators, Team fits.

Either way, you can control crabgrass and goosegrass season-long with just one application. Or even a split application, if need be, to better fit your program.

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Other weeds can be found locally, or are isolated problems. If perennial weeds have been established in the turf and have seeded, then pre-emergence herbicides may be needed to control the germinating seeds of these weeds (Dallisgrass or Bermudagrass for example). The established plants must be controlled by post-emergence herbicides.

Overseeded turf

Overseeding of warm-season grasses is a concern when using herbicides. The pre-emergence material controlling crabgrass or goosegrass must be broken down so annual ryegrass can germinate and establish. Applications of herbicides for annual bluegrass control can be a problem.

Benfen has been used for annual bluegrass control. It can also be applied early in the season (August), giving early control. The ryegrass can be seeded about 45 days later. Bensulide has stunted overseeded ryegrass turf at 45 days. The residual of bensulide is usually two or three times longer than benfen in California turf.

Ethofumesate may be applied 20 to 30 days after overseeding. It should be applied to dormant Bermuda or suppression can occur in the spring.

Fenarimol, a fungicide, applied two weeks prior to overseeding, controls several turf diseases in addition to controlling the annual upright form of annual bluegrass. It has not controlled the low-growing perennial form in mild climate areas.

Careful water management going into the fall will help reduce annual bluegrass invasion. Conditions that allow alternate wetting (rainfall or irrigation) and drying, so the seedlings

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can dry out and die, will decrease weed populations.

Mechanical cultivation

Also, timing of aeration or other mechanical cultivations is important. Aeration or verticutting during annual bluegrass germination allows

Table 2.

Tolerance of Warm-Season Turf to Pre-emergence Herbicides

Herbicide	Bahia	Bermuda	Centipede	St. Augustine	Zoysia
Atrazine	NR	I	T	T	I
Benfen	T	T	T	T	T
Benfen*oryzalin	T	T	T	T	T
Benfen*trifluralin	T	T	T	T	T
Bensulide	T	T	T	T	T
Bensulide*oxadiazon	NR	T	NR	NR	T
DCPA	T	T	T	T	T
Ethofumesate	NR	I	NR	NR	NR
Napropamide	T	T	T	T	TR
Oryzalin	T	T	T	T	T
Oxadiazon	NR	T	NR	T	T
Oxadiazon*benfen	NR	T	NR	NR	T
Pendimethalin	T	T	T	T	T
Pronamide	NR	T	NR	NR	NR
Siduron	NR	NR	NR	NR	NR
Simazine	NR	T	T	T	T

T = tolerant; I = Intermediate tolerance, apply only to dormant grass
NR = Not registered

	Pre-emergence Herbicide Soil Longevity
SHORT	benfen, DCPA, siduron
MEDIUM	oxadiazon, trifluralin
LONG	bensulide, pendimethalin, oryzalin

(Based on turf use and rates used in turf)

open spaces in the turf for weeds to invade.

Always aerate or verticut before—an application of pre-emergence herbicide. These operations just before herbicide treatment will reduce the thatch and give the herbicide a better chance to get to the soil where it is effective.

Pre-emergence herbicides, when properly timed at the right rate, can effectively control most annual weeds and be a good tool to help manage turf. They generally are safer to use on turf than post-emergence herbicides because they are being used to control seedlings rather than mature plants. There are many good materials from which to select to control your weeds. **LM**

TURFGRASS CULTURE AND WATER USE

Different turfgrass species use water in different ways.
New research helps to better explain this process.

by David Minner, Ph.D., University of Missouri

Over the last seven years, researchers have made advances in understanding turfgrass water use rate (WUR). Much emphasis is being given to the WUR associated with a particular turfgrass species, cultivar or cultural practice.

The idea is to develop grass systems that lose less water to the atmosphere and maintain more favorable

soil moisture condition for plant growth.

Indeed, these low water use grasses and management practices are being defined, but turfgrass managers must understand that low water use does not necessarily mean less irrigation.

For example, WUR of creeping red fescue is nearly 15 percent less than that of tall fescue. But less water is

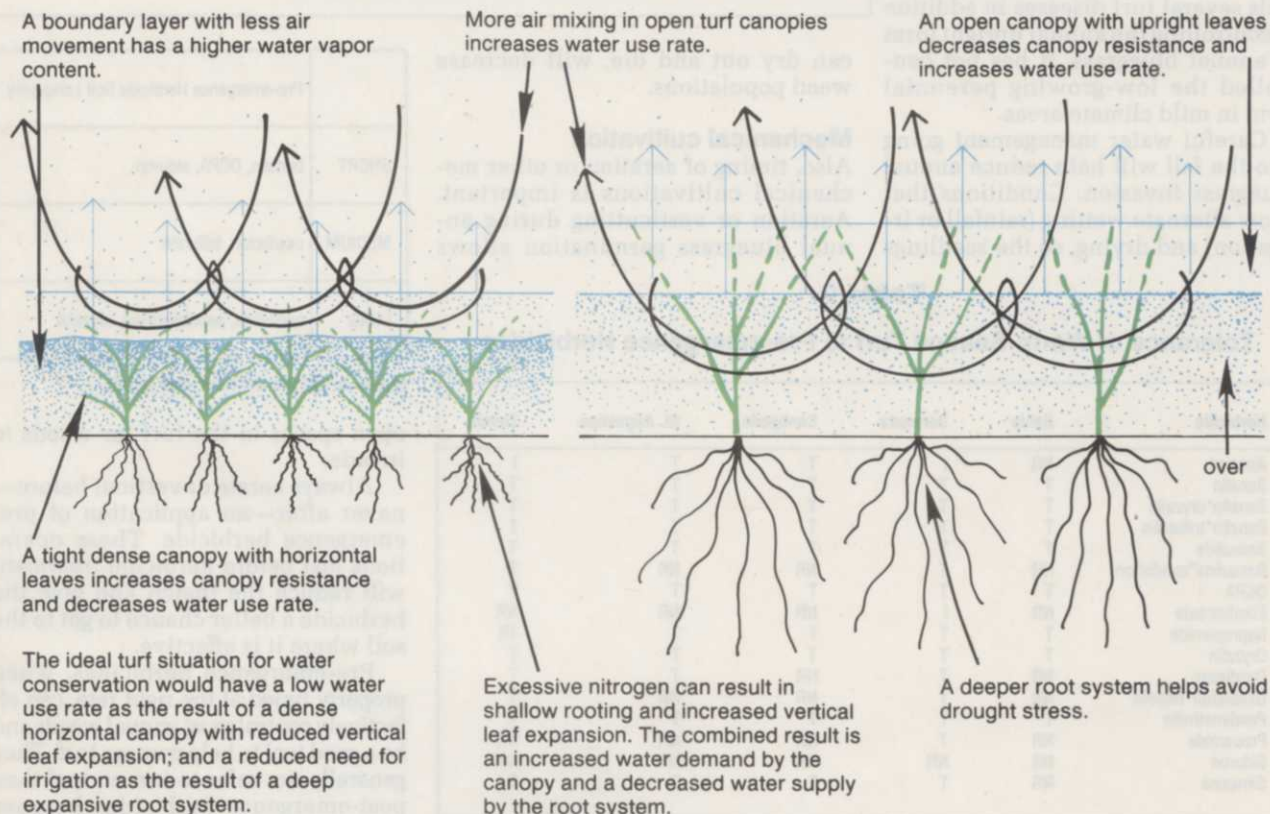
needed by tall fescue to keep it at acceptable turf quality than the creeping red fescue.

Similarly, taller mowed grasses have higher WUR than shorter mowed grass, but the amount of irrigation needed to keep turfs at acceptable levels is less for the taller grass than the shorter.

In both examples, a deeper root system associated with tall fescue and

continued on page 62

A RELATIVE COMPARISON BETWEEN TURFGRASS GROWTH AND WATER USE



Important Note: The intent of the above diagram is to show the relationship between turfgrass growth and water use. It should be understood that a decreased water use rate does not always result in water conservation and a reduced need for irrigation.