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# Turfgrass Pest Management Manual

A Guide to Major Turfgrass Pests & Turfgrasses

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# Turfgrass Pest Management Manual

## A Guide to Major Turfgrass Pests & Turfgrasses

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# Introduction



The causes of turfgrass problems are many and varied. Adverse soil conditions, improper cultural practices, environmental stresses, chemical injury, planting of unadapted grasses, and pest attacks are just a few of the possible causes. Regardless of the difficulty at hand, correct diagnosis (defined as the investigation into the cause or nature of a problem) is the first step in correcting the problem and preventing its recurrence. Rapid and correct diagnosis can mean the difference between success and failure to a turf manager.



**This book will help turf managers and extension agents identify the major turfgrass pests found in North Carolina and better understand the life cycles, symptoms, and biology of these pests.**

Knowing the symptoms of problems and the biology of each major turfgrass pest may prevent extensive turf damage and help to ensure that appropriate control measures are used. This book will help turf managers and extension agents identify the major turfgrass pests found in North Carolina and better understand the life cycles, symptoms, and biology of these pests. Color photographs and line drawings of the major turfgrass diseases, insects and weeds will aid in identification.

Man-made and environmental turf damage are often confused with pest-induced injury. Drought and mismanagement, for example, are frequently mistaken for insect or disease injury. Symptoms of man-made or environmental problems are too diverse to be discussed at length in this field guide. The ability to correctly diagnose such problems can only come from experience. However, accurately distinguishing between the two is important because pesticides are not effective in controlling non-pest problems.

Regardless of the turfgrass problem, there are considerations that each turf manager must address to make a correct diagnosis. The turf manager must

1. identify the turfgrasses being maintained and become familiar with their strengths, weaknesses, and requirements;
2. know what healthy turf looks like to aid in early detection of problems; and
3. know the host plant to help pinpoint potential turf pests. Use the grass identification chart on pages 12 and 13 to help determine the grasses being maintained.

The environment and the soil in which the turf is being grown and how the host plant and pests react in such conditions are other important considerations. Take note of specific environmental conditions that may weaken turf or favor certain pests. Powdery mildew, for example, is frequently observed in shade. Turf damage from hail, lightning, and early or late frosts can be misdiagnosed as pest damage. Soil pH, nutrient content, and structure are often overlooked as causes of turf deterioration and should be monitored to ensure that they are adequate to maintain healthy turf. Environmental and soil conditions that favor pest activity are discussed throughout this field guide where appropriate.

Keep abreast of the day-to-day care that the turf receives, whether it be a putting green, home lawn, or park, and make sure that the turfgrass needs are being met. Advise trained personnel to report any unscheduled changes in the management regimen or changes in the appearance of the turf being maintained.

While this manual does not guarantee correct diagnosis and control of all turfgrass problems encountered, it is designed to help you in your plant management program. Many other resources are available, including accurate and timely records, past experience, fellow turf managers, turfgrass specialists, and numerous publications. Workshops, clinics, field trips, and conferences are excellent means of keeping abreast of the latest developments concerning plant and pest management. If you are uncertain about the exact cause of a turfgrass problem, by all means obtain assistance from one of these sources. One or more turf specialists, weed specialists, plant pathologists, or entomologists may be required to correctly diagnose a given turfgrass problem.



# VEGETATIVE IDENTIFICATION OF TURF AND WEEDY GRASSES

BY ART BRUNEAU, GREG BUOL, EMILY ERICKSON AND GAIL WILKERSON

Identification of turfgrasses is a skill that is critical to effective turfgrass management. Proper management of turf depends on knowledge of the species growth habits, tolerances of cultural methods, and susceptibilities to damage from environmental stresses, including pests. ***Incorrect identification can result in improper cultural and pest management methods, which can damage the turfgrass.***

Most botanical identification keys are based on floral and reproductive structures of plants. While this approach is dependable, it is usually of little practical use for turf managers because most grass seedheads are constantly being removed by mowing. Turfgrass identification depends heavily on the vegetative characteristics of the grass plant. Additional clues are often obvious factors like the time of year, cutting height, predominant soil moisture conditions, and degree of shade present. For example, an actively growing turf during the summer is apt to be a warm-season turf, whereas turf actively growing during the cool portion of the year is most likely a cool-season species. Also, bermudagrass is not likely to be found in a deeply shaded site, particularly one with a northern exposure.

Vegetative identification of grasses requires careful inspection of the primary vegetative characteristics. These characteristics will vary somewhat depending on cultural and environmental conditions. A correct identification can be made by combining the botanical information with both the environmental conditions of growth and the cultural system being imposed on the unknown specimen.

## BROADLEAF, RUSH, SEDGE, OR GRASS?

The first step in the identification process is to decide whether the plant is a broadleaf, rush, sedge, or grass. Both rushes and sedges are similar to grasses in several respects, so first make sure that the plant you are attempting to identify is indeed a grass. This can be determined by stem and leaf shape, and type of root system. The following summarizes the characteristics of each family, and pages 10 through 14 explain the characteristics that can be used to distinguish between grass species (vernation, ligule, auricles, etc).

## Broadleaf Families

[various]

Broadleaf weeds belong to several different taxonomic families, and plant characteristics are widely varied. Leaves are generally wide, and have net-like veins. Broadleaf plants have round or square stems and leaf shapes vary (round, heart, oval or linear arrangements). Most notably, the leaves are typically found in clusters or bunches with one or more leaflets. Root systems include tap root, bulbous root, and fibrous root systems. Growth habits include upright, vining, rosette, and prostrate (or spreading). Generally broadleaf weeds have showy flowers.

## Rush Family

[Juncaceae]

Leaves are arranged in groups of three. Leaves are usually round and wiry. Auricles tend to be absent. Ligules are very small or absent. The stems are solid, not hollow.

## Sedge Family

[Cyperaceae]

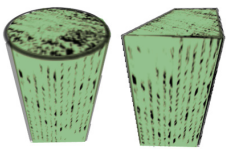
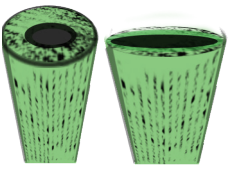
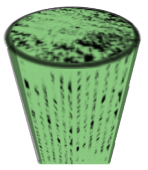
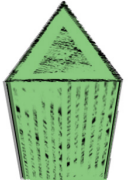
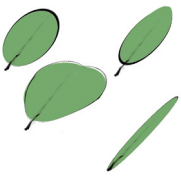
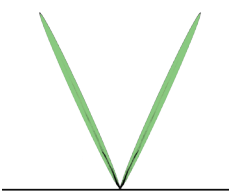
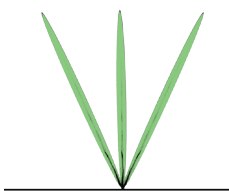
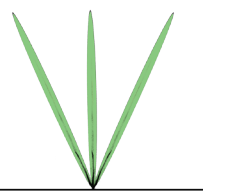
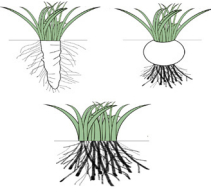
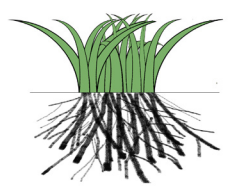
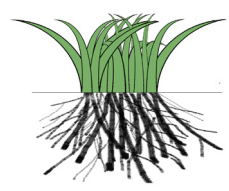
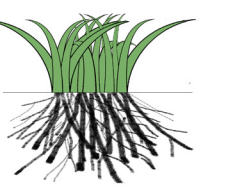
Sedges can be easily distinguished from grasses by comparing the shape of the stem. Sedges generally have solid triangular stems with leaves in groups of three, while grasses have round or flattened stems with leaves in groups of two. Leaf edges are usually rough; leaf sheaths are tubular, not split; the collar is usually indistinct; auricles are absent; and ligules are small or absent.

## Grass Families

[Poaceae and Gramineae]

Grasses are typically upright, bunching plants with fibrous roots. Some possess rhizomes or stolons. Their hollow stems are either round or flattened. Leaves have parallel veins, are in groups of two, and are much longer than they are wide. Generally, grasses have inconspicuous flowers. Leaf sheaths are usually split with overlapping edges; the collar is usually distinct.

# WHICH PLANT TYPE DO I HAVE?

	Broadleaves	Grasses	Rushes	Sedges
STEM	 <p>Round or Square with Solid or Hollow Stems</p>	 <p>Round or Flattened with Hollow Stems</p>	 <p>Round with Solid Stems</p>	 <p>Triangular, Solid Stems</p>
LEAF	 <p>Round, Heart, Oval, or Linear</p>	 <p>Linear, 2 Leaves per Node</p>	 <p>Linear, 3 Leaves per Node</p>	 <p>Linear, 3 Leaves per Node</p>
ROOT	 <p>Tap, Bulbous, or Fibrous</p>	 <p>Fibrous</p>	 <p>Fibrous</p>	 <p>Fibrous</p>

## 1. Is it a Broadleaf?

Broadleaf weed characteristics are widely varied. Leaves are generally wide (wider than they are long), and have net-like veins. Broadleaves can have either round or square stems, and growth can be upright, prostrate or vining. They generally have showy flowers.

A few key indicators help categorize a plant almost definitively as a broadleaf, eliminating the possibility of it being a grass, rush or sedge. As can be seen on the chart above, only broadleaves can have a square stem, a non-linear leaf shape, and a non-fibrous root system.

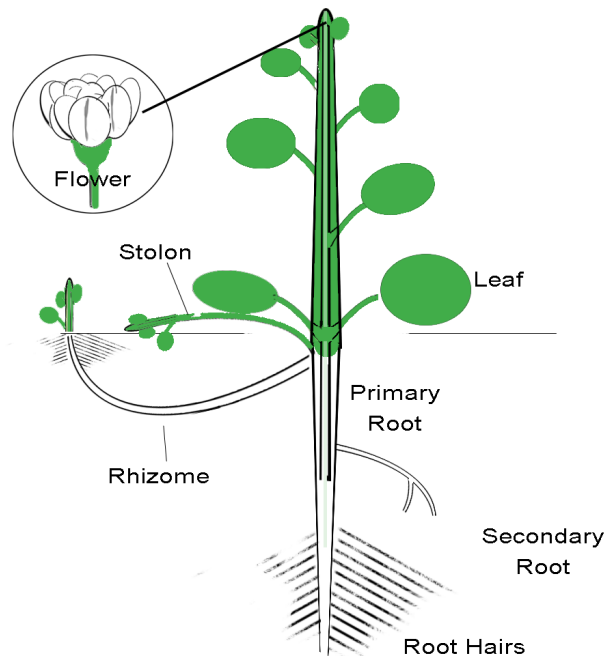


Figure 1. Fundamental characteristics of a generalized broadleaf weed.

### GROWTH HABIT

#### upright

Plant is self-supporting, and grows upright.



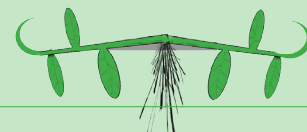
#### vining

Long trailing stems; not self-supporting. Vining plants tend to use other structures to form.



#### prostrate/decumbent

Low growing; hugging the ground. Lying flat with apex tip growing upward.



## 2. It's not a Broadleaf.

### How to distinguish Rushes and Sedges from Grasses

Sedges can easily be distinguished from grasses by comparing the shape of the stem. Sedges almost always have solid triangular stems with leaves in groups of three, while grasses have round or flattened stems and leaves in groups of two. Rushes have round, solid stems, while grasses have round hollow stems. The phrase, "**sedges have edges and rushes are round**" will help you remember. Both grasses and sedges have inconspicuous flowers while the flowers of rushes are solitary and usually quite obvious.

#### WHEN WATER IS NEARBY

If an established water area is located near the plant you are identifying, you may be looking at a rush. Cattails are among the most recognized rushes common to wetland areas. Rushes, more so than sedges, prefer year-round wetland conditions.

#### RUSHES

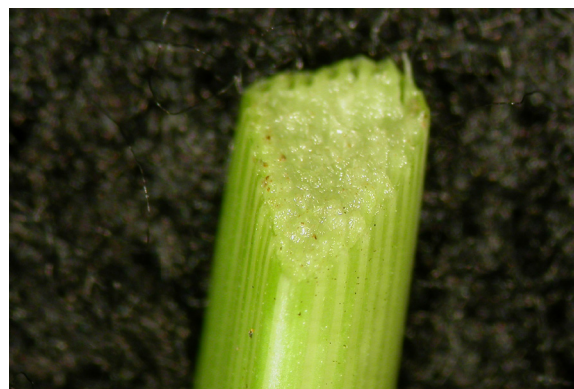
Rushes are upright plants with fibrous roots. Rushes have round, solid stems. Their leaves are borne in groups of three, are either alternate or basal, parallel veined, and are much longer than they are wide. Rushes are also considered semi-aquatic, and like sedges, will be found where there is an abundance of water. Rush flowers are solitary and arranged in heads, making them distinctly different from both grasses and sedges.



Rushes have solitary heads on flowers.

#### SEDGES

Sedges are upright plants with fibrous roots and stolons. Sedges have solid stems that are almost always triangular. Leaves are borne in groups of three (one for each side of the stem) and are found either basally or alternately along the stem. Sedges are considered semiaquatic, and will be found where there is an abundance of water but are also found in drier areas. Sedge flowers are usually one to many spikelets.



Sedges have triangular solid stem.

#### GRASSES

Grasses are upright bunching plants with fibrous roots. Some have rhizomes or stolons. Grasses have hollow stems that are either round or flattened. Their leaves are borne in groups of two, have parallel veins, and are much longer than they are wide. Leaves can be basal, as well as alternate or oppositely arranged along the stem. Stems of grasses are almost always distinct because of their nodes. Most grass leaves have a ligule where the leaf blade and stem meet. Grasses usually have flowers characterized by spikelets, panicles or racemes.



Grasses have a linear growth pattern with presence of nodes.

# 3. Identification of Grasses.

## A. VERNATION

Vernation is the arrangement of leaves in the budleaf (newest emerging leaf) and the surrounding sheath. Vernation in turfgrass is characterized as either FOLDED or ROLLED. There are several techniques used in determining veneration. The most reliable involves cutting across the stem and viewing the exposed cross section.

If a knife is not handy, you can peel back a leaf from the stem and see if the sheath of the leaf curls into a circle, or folds flat.

While not as reliable, you can roll the sheath between your thumb and fingers. If it is difficult to roll and feels flattened or compressed, it is likely folded. If it rolls easily and feels round, it likely indicates rolled veneration. There are grasses with rolled veneration that have compressed sheaths, making this test somewhat unreliable.

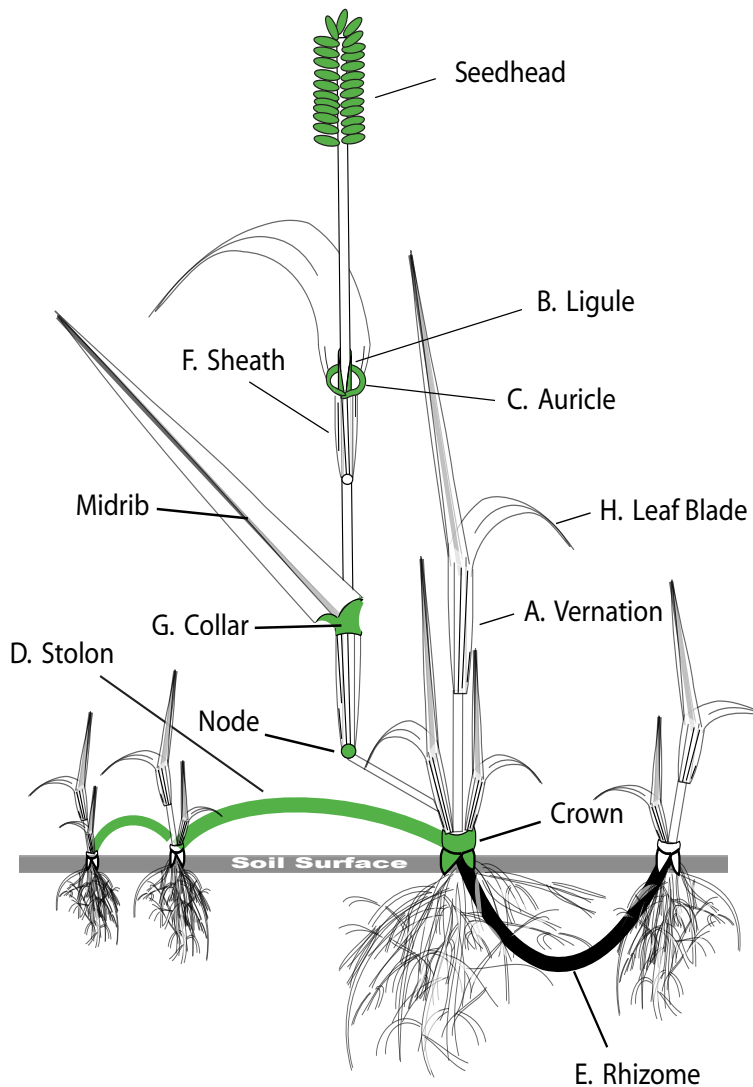
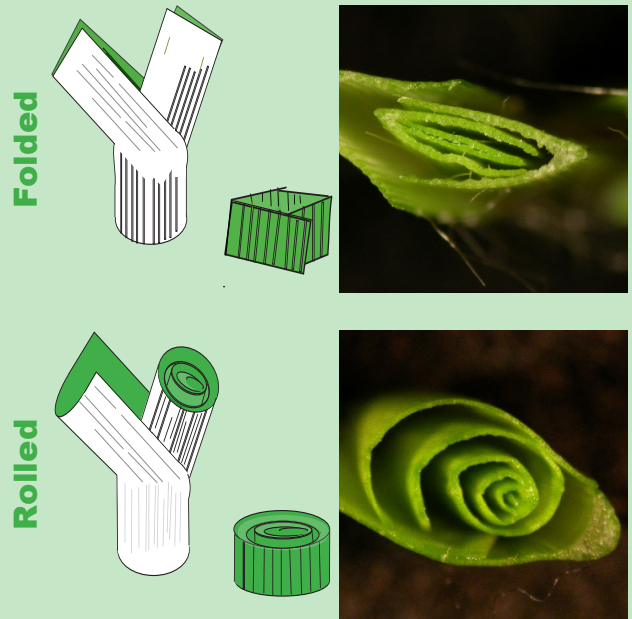
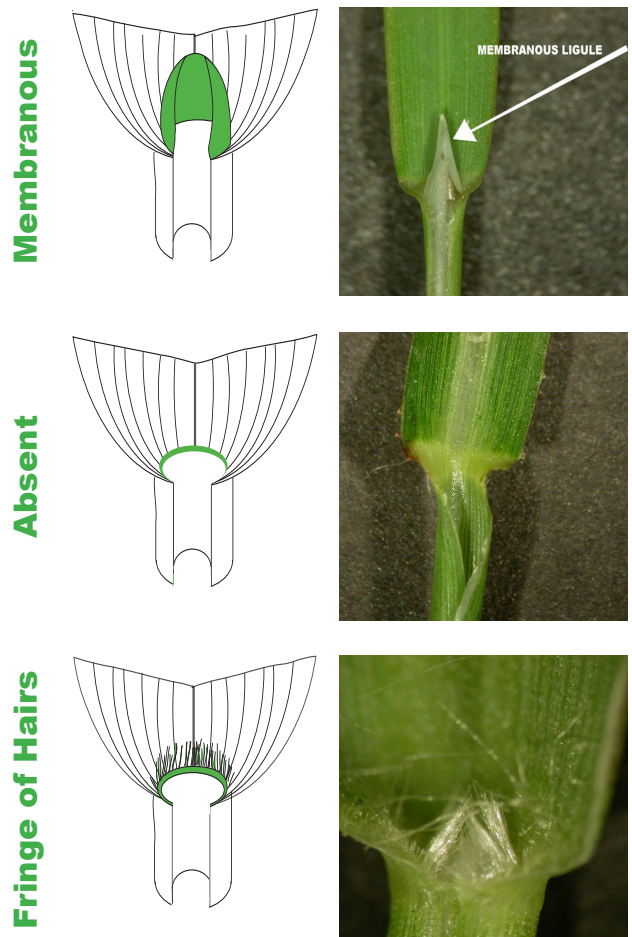


Figure 2. Generalized grass plant. The Grass Identification Chart on the following pages is based primarily on the lettered plant parts.

## B. LIGULE

A ligule is a protruding structure from the upper surface of the leaf where the blade and sheath are joined. If present, this structure may be membranous, absent, or a membrane with a fringe of hairs. The ligule can vary in both shape and size.



## USING THE GRASS IDENTIFICATION CHART

If possible, you should have a sample of the grass you are trying to identify in front of you and use a 10x magnifying lens. **For the Grass Identification Chart (pages 12 and 13) to work, the plant specimen must belong to the grass family. Grasses are often confused with members of the sedge and rush families. If you haven't already done so, use the descriptions on pages 7 through 10 to determine the family to which a plant specimen belongs.**

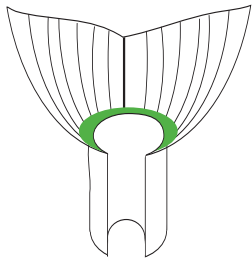
Plant part descriptions A through H are described on pages 10, 11, and 14 in the order they are used for the Grass Identification Chart (found on pages 12 and 13). The remaining plant descriptions (F through H) are found on page 14. Using your grass sample and magnifying lens, work your way across the Grass Identification Chart on pages 12 and 13 from left to right: first determine whether the grass has folded or rolled vernation, then determine type of ligule. Continue across the key until you reach a cell that is colored bright green this indicates that you have reached a characteristic that separates your grass from all other grasses listed on the chart. Look to the far right side of the chart on the same line for the name of the grass. **Verify your identification by referring to the complete description for each specimen.**



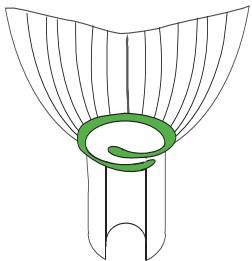
### C. AURICLE

An auricle is a pair of appendages protruding from the side of the grass leaf at the junction of the blade and sheath. Auricles may be rudimentary (short and blunt), large and claw-like, or absent. Some may have short hairs attached.

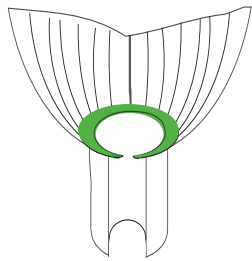
Absent



Claw-like  
(Clasping)

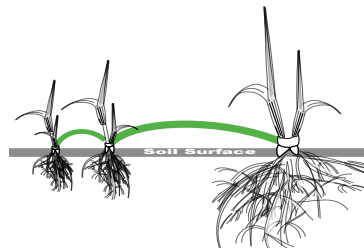


Rudimentary



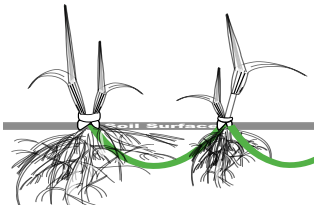
### D. STOLONS

Stolons are an above-ground creeping stem that can produce roots and shoots at each node. This horizontal stem grows aboveground, and roots at the nodes or tip to give rise to a new plant.





### E. RHIZOMES

Rhizomes are underground creeping stems that can produce roots and shoots at each node. This horizontal stem grows underground and gives rise to a new plant.



# Grass Identification Chart

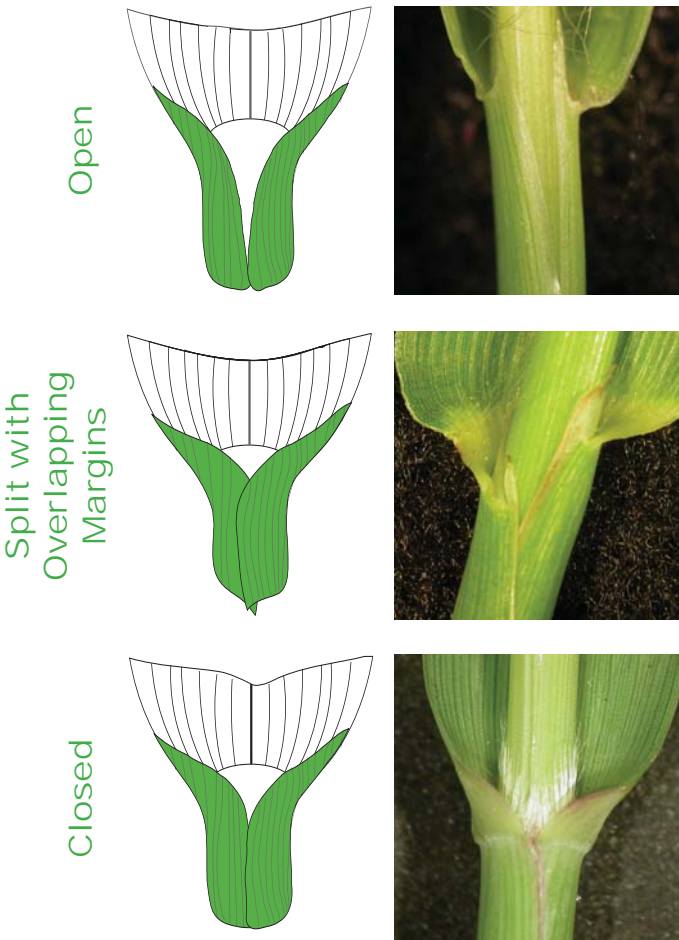
Vernation	Ligule		Auricles	Stolons	Rhizomes	Sheaths					
folded 	membranous	hairs present	absent	absent	absent	flattened	split /w overlapping margins				
				present	absent	flattened	split /w overlapping margins				
				present	flattened	open, usually not hairy					
		no hairs present	absent	absent	absent	absent	flattened	open part way			
					present	flattened	closed, opens at maturity, not hairy				
					present	round	open part way, may be hairy				
	fringe of hairs	absent	absent	claw-like	absent	absent	flattened	closed or open, not hairy			
				absent	present	absent	flattened	usually not hairy			
				present	present	absent	flattened	open			
					present	flattened or round	open				
	rolled 	membranous	hairs present	absent	absent	absent	absent	flattened	split w/ overlapping margins		
						absent	absent	flattened	open, no hairs		
present						present	flattened or round	open			
claw-like, no hairs					absent	absent	present	absent	round	split w/ overlapping margins, not hairy	
							present	present	round	open	
							present	flattened	open, usually not hairy		
no hairs present			absent	absent	absent	absent	absent	round	open, hairy		
						absent	absent	flattened	open, hairy		
						absent	absent	round	split w/ overlapping margins, not hairy		
					claw-like, no hairs	absent	absent	present	present	flattened	split w/ overlapping margins
								present	present	round	closed
								present	present	round	open
fringe of hairs		absent	absent	absent	absent	absent	flattened	open, long hairs			
					absent	absent	flattened	open, no hairs			
					absent	absent	round	open			
				rudimentary, hairs on edges	absent	absent	present	present	flattened	open, few long hairs on edges	
							present	present	round	split w/ overlapping margins	
							present	present	round	open, not hairy	
					absent	absent	round	split w/ overlapping margins, not hairy			
					present	present	round	open, hairy			
					absent	occasional	round	open			
					absent	absent	flattened	split w/ overlapping margins, hairy edges			
					absent	absent	flattened	split w/ overlapping margins, edges not hairy			
					present	present	flattened	split w/ overlapping margins, edges not hairy			
				absent	absent	round	open				
				present	present	flattened or round	open				
				present	present	flattened or round	split w/ overlapping margins				

	<b>Collar</b>	<b>Leaf Blade</b>	<b>Grass</b>	<b>Page</b>
	continuous, hairs on edges	blunt tip, sparse long hairs near base, width 5-10 mm	goosegrass	28
	divided, hairy edges	sharp-pointed tip, rough edges with hairs, width 3-7 mm	broomsedge	21
	continuous, constricted	boat shaped or sharp-pointed tip, hairs along edge at base, width 3-5 mm	centipedegrass	23
	divided	boat-shaped tip, tip edges rough, width 1-4 mm	bluegrass, rough	20
	continuous, hairs on edges	sharp-pointed tip, base sparsely hairy on edges	bahaigrass	17
	continuous, not hairy	sharp-pointed-tip, smooth edges	fescue, chewings	**
	divided	boat-shaped tip, width 2-3 mm	bluegrass, annual	19
		sharp-pointed tip, rough edges, width 6-12 mm	orchardgrass	30
		sharp-pointed tip, bristle-like, top deeply ridged	fescue, hard (fine); sheepsfescue	26
	slightly divided	boat-shaped tip, width 2-4 mm	bluegrass, Kentucky; Canada	20
	continuous, not hairy	sharp-pointed tip, smooth edges, width .5-1.5 mm	fescue, red	**
	divided	boat-shaped tip, tip edges rough, width 1-4 mm	bluegrass, rough	20
	divided, not hairy	sharp-pointed tip, edges slightly rough, width 2-5 mm	ryegrass, perennial	32
	divided	sharp-pointed tip, width 2-6 mm	sandbur	33
	divided, not hairy	boat-shaped or blunt tip, width 4-8 mm	carpetgrass	22
	continuous, constricted	boat-shaped or blunt tip, not hairy, width 4-10 mm	St. Augustinegrass	33
	continuous	sharp-pointed tip, rough edges, width 1.5-3 mm	Bermudagrass	18
	continuous, may have hair	sharp-pointed tip, rough edges, width 10-20 mm	barnyardgrass	17
	continuous	sparse hairs on edges, width 2-9 mm	crowfootgrass	25
	continuous	sharp-pointed tip, wavy edges	paspalum, thin (bull)	31
		sharp-pointed tip, width 10-30 mm	johnsongrass	29
	may be divided	stiff, width 5-10 mm	beachgrass	**
	divided	sharp-pointed tip, rough edges, width 2-5 mm	bentgrass, creeping	18
	continuous, hairs on edges	sharp-pointed tip, base sparsely hairy on edges	bahiagrass	17
	may be divided	sharp pointed tip, width 5-12 mm	quackgrass	**
	divided, hairy	sharp-pointed tip, dense short hairs, width 5-10 mm	velvetgrass	34
	continuous, hairs on edges	sharp-pointed tip, rough edges, width 4-8 mm	timothy	**
	continuous	sharp-pointed tip, width 7-15 mm	dallisgrass	25
	divided, not hairy	w-shaped watermark midway, width 8-12 mm	bromegrass, smooth	**
	divided, not hairy	sharp-pointed tip, rough edges, width 3-5 mm	redtop	**
	mostly divided, hairy edges	sharp-pointed tip, short hairs, rough edges, width 5-15 mm	crabgrass, large	24
	often divided, few hairs on edges	sharp-pointed tip, may have few hairs on edges, width 5-10 mm	crabgrass, smooth	24
	continuous	sharp-pointed tip, rough edges, width < 1 mm	bentgrass, velvet	**
	continuous, hairs on edges	sharp-pointed tip, not hairy, width 2-2.5 mm	nimblewill	29
	often divided	sharp pointed tip, width 1-3 mm	bentgrass, colonial	**
	mostly divided, not hairy	rough edges, width 3-5 mm	fescue, meadow	**
	continuous, not hairy	sharp-pointed tip, smooth edges, width 3-7 mm	ryegrass, annual (Italian)	31
	may be divided	sharp pointed tip, width 5-12 mm	quackgrass	**
	divided, may have hairy edges	sharp-pointed tip, rough edges	fescue, tall	26
	divided	sharp-pointed tip, not hairy	foxtail, green	27
	continuous	sharp-pointed tip, long hairs on upper surface	foxtail, yellow	28
	continuous	sharp-pointed tip, may have long hairs on upper surface	foxtail, knotroot	**
	continuous, hairy	sharp-pointed tip, sparsely hairy, width 1-3 mm	buffalograss	22
	continuous, may have hairy edges	sharp-pointed tip, rough edges, width 1.5-3 mm	bermudagrass	18
	continuous, hairy edges	sharp-pointed tip, long hairs near base, width 2-4 mm	zoysiagrass	34

\*\* This plant not featured in this manual.

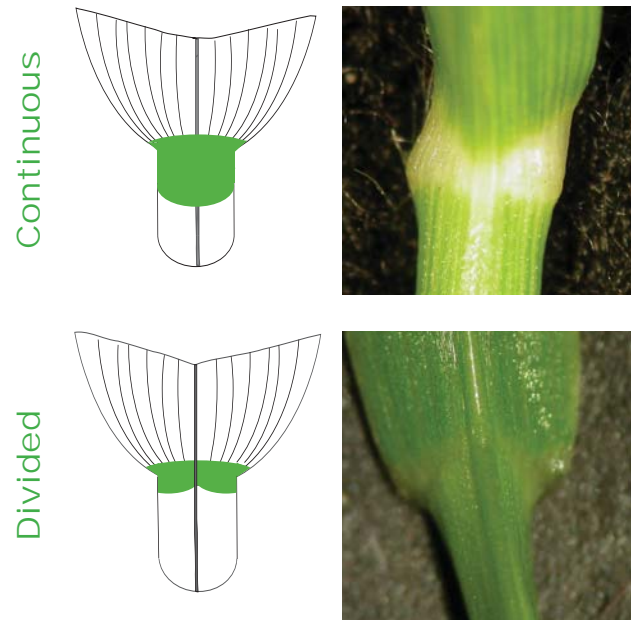
## F. SHEATH

A sheath is the basal portion of the grass leaf between the crown and blade. The sheath margins may be open, split with overlapping margins, or closed. Sheaths may also be rounded or flattened (compressed).



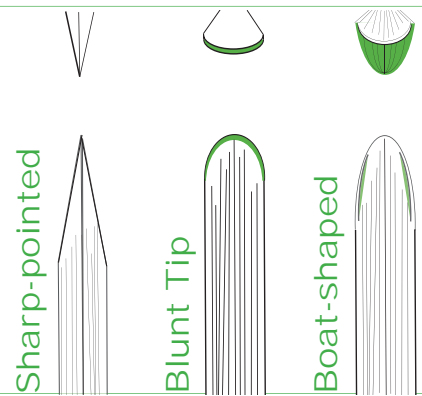
## G. COLLAR

A collar joins the leaf blade to the sheath. Collar thickness varies from narrow to broad and may appear divided by the midrib. A continuous collar has a less visible midrib. Some plants have both divided and continuous characteristics.



## H. LEAF TIP SHAPE

There are three leaf tip shapes: boat-shaped, blunt tip, and sharp-pointed. Be certain to look at the uncut, natural edge of the leaf blade's tip.



### EXAMPLE

Suppose your grass has folded vernation. You should next check whether the grass has a membranous ligule or a fringe of hairs. If the grass has a membranous ligule, then the next thing to determine is whether there are any hairs present on the ligule. According to the chart, if there are hairs on the ligule, then the grass should not have auricles. You should next determine whether the grass has stolons or not. If the answer is yes, then next determine whether the grass has rhizomes or not. If rhizomes are absent, the grass should be centipedegrass. In this example, if the grass is centipedegrass, then it should also have a sheath that is flattened and split with overlapping margins; a continuous, constricted collar; and a boat-shaped or sharp-pointed leaf tip with hairs along the edge of the leaf blade at the base.

### STILL NOT SURE WHICH GRASS SPECIES YOU HAVE?

See the Turf and Weed Descriptions chapter beginning on page 15 for detailed lists of characteristics and multiple images for selected turf and weedy grasses. Note that seedhead/flower can be used to distinguish between grass species, if the plant does happen to reach the flowering stage.

### REMEMBER

Grass identification can be checked using the Grass Identification Chart on the pages 12 and 13. Once you believe you have the correct species, verify your identification by referring to the complete descriptions on pages 17 through 69. You may also refer to the TurfFiles Decision Aids on the Web (<http://www.turf-files.ncsu.edu/turfid/>) for additional pictures of each plant.



# Turf & Weed Descriptions

BY FRED YELVERTON, BRIDGET ROBINSON, ART BRUNEAU, LEON WARREN, GAIL WILKERSON, CASEY REYNOLDS AND TRAVIS GANNON

**Pictures By Bridget Robinson, Jodie Moffitt, and Leon Warren**

Weeds are described as plants growing where they are not wanted. They can disrupt the appearance and use of lawns, recreational areas, and other turfs. In addition, they compete with desired turfgrasses for space, water, nutrients, and light. Turf weeds may be grasses, grass-like plants, or broadleaf plants with annual, biennial, and/or perennial life cycles.

Turf professionals should become familiar with weed characteristics, growth habits, and life cycles. These factors play an important role in weed identification and control. A weed management program is based upon identifying the desired turfgrasses and existing weeds, including knowledge of other weeds that may potentially germinate. However, an effective program begins with a vigorous turf; one that has been correctly fertilized, watered, and mowed. Weeds can quickly invade thin turf. Cultural and management practices that enhance turfgrass growth generally reduce weed competition and encroachment. When selecting a herbicide, consider the weeds present, those that will potentially germinate, and the tolerance of the turfgrass.



## TURF & WEEDY GRASSES

Weedy grasses are classified as summer annuals, winter annuals, and perennials. Some of the most common ones are listed in the Grassy Weeds chart (below). Annuals complete their life cycles in one season by flowering, maturing seed, and dying. Their high seed production serves as a ready source for infestation when conditions are favorable. Summer annuals germinate from late March through July, depending on the location. They flower in the summer and either die in the fall or are killed by frost. Winter annuals germinate in the fall and early winter and usually die with warm weather in the spring or summer; however, they may continue to grow into early summer in cool seasons. Perennials live more than two years and may produce seed each season.

### WEED MANAGEMENT PRACTICES

Selection of adapted turfgrass species and cultivars and the use of cultural practices are important in minimizing weedy grass encroachment and competition. Management practices include (1) mowing at the recommended height for the selected turfgrass species and removing clippings when seedheads of grassy weeds are present; (2) applying the proper amount of nitrogen at the correct time according to the turfgrass present; (3) using soil tests to determine needed nutrients and lime; and (4) applying preemergence herbicides before weeds germinate. Specific comments relating to selected weedy grasses are included in the following paragraphs.

**For more information on control of specific weeds, see *Pest Control for Professional Turfgrass Managers*, or the *Decision Aid for Weed Management*, on the *TurfFiles* Web site (<http://www.TurfFiles.ncsu.edu>).**

GRASSY WEEDS		
Summer Annuals	Winter Annuals	Perennials
Large Crabgrass Smooth Crabgrass Goosegrass Barnyardgrass Yellow and Green Foxtail Sandbur* Japanese Stiltgrass	Annual Bluegrass Annual Ryegrass (Italian) Annual Blueeyed Grass	Dallisgrass Field Paspalum Thin Paspalum (Bull) Nimblewill Orchardgrass Smutgrass Quackgrass Bahiagrass Perennial Ryegrass Velvetgrass
		
*or short-lived perennial		

# GENERAL DESCRIPTIONS AND CONTROL PRACTICES

## WEEDS

Weeds by definition are any plant(s) that grow where not intended. Whereas some turfgrass species are classified as both turfgrasses and weeds, all of the broadleaves and sedges listed in this book are considered weeds to any successful turfgrass program. Categorization depends upon several factors including: geographic location, plant species, subspecies, and climate. Weedy grasses are generally placed into one or more of the following categories: summer annuals, winter annuals, or perennials.

## SUMMER ANNUALS

Summer annuals germinate from late March through July, depending on the location. They flower in the summer and either die in the fall or are killed by frost. The two most common summer annual grass weeds in North Carolina are the crabgrass species (usually smooth) and goosegrass. These weeds invade thin turf quite easily, so a year-round turf management program is important to help prevent these weeds from becoming major problems. Winter weed control is especially important because when these weeds begin to die out in the spring, thin turf occurs where the weeds were located. As the turfgrass begins to grow in the spring, so do crabgrass and goosegrass seedlings. These weed seedlings usually will fill in the bare or thin turf areas before the turfgrass can recover in the spring. Summer annual grass weeds can be controlled with preemergence and postemergence herbicides in warm and cool-season turf.

## WINTER ANNUALS

Winter annuals germinate in the fall and early winter and usually die with warm weather in the spring or summer; however, they may continue to grow into early summer in cool seasons. The most common and troublesome winter annual grassy weed in North Carolina is annual bluegrass. This weed is found in every sector of the turfgrass industry. Annual bluegrass thrives in moist, cool environments and can become quickly established in thin turf stands, particularly thin warm-season turf stands. Turf should be managed aggressively all year long to prevent weed, insect, or disease injury; as these will result in thin turf. Annual bluegrass can be controlled with preemergence and postemergence herbicides in warm- and cool-season turf.

## PERENNIALS

Perennials live more than two years and may produce seed each season. Perennial grass weeds, such as dallisgrass, are not desirable as turfgrass species under any conditions. Therefore, every effort should be made to prevent these weedy grasses from becoming established in turf, as selective control measures are usually difficult. Maintaining a dense, healthy turf year round by proper mowing and fertilization helps prevent encroachment and weed establishment. Perennial grass weeds generally cannot be controlled with preemergence herbicides, and postemergence options are usually limited due to turf tolerance issues.

### **TURFGRASSES AS PERENNIAL WEEDY GRASSES**

Desirable turfgrasses may be classified as perennial weedy grasses. Tall fescue in a bermudagrass lawn is considered a weed. Most turfgrasses are difficult to control within another turfgrass, so select clean seed free of “crop” seed or vegetative sources for establishment, use an adapted turfgrass species and cultivar for your location, and use proper mowing and fertilization techniques to maintain a dense, actively growing, desired turf. Digging or removal with hand or mechanical equipment (for example, a sod cutter) is one way to control undesired perennial turfgrasses. You may spot treat an infested area with an appropriate non-selective herbicide, realizing it will also kill the desired turfgrass.

***For more information on control of specific weeds, see *Pest Control for Professional Turfgrass Managers*, or the *Decision Aid for Weed Management*, on the TurfFiles Web site (<http://www.turffiles.ncsu.edu>).***



## Bahiagrass

[*Paspalum notatum* Fluggé]

Bahiagrass is a warm-season grass that is easily recognized by the characteristic “Y” shape of its seedhead, as well as its stoloniferous growth habit. It is frequently planted on roadsides and highway rights of way because it has good drought tolerance. In addition, bahiagrass has the ability to tolerate a wide range of soils. Unfortunately, it can be a very competitive and unsightly weed in highly maintained turf.



seedhead



field

### CONTROL PRACTICES

As with other perennial paspalums, bahiagrass can be difficult to control. Bahiagrass may be removed with multiple applications of arsonate herbicides or metsulfuron in the early spring in tolerant turfgrass species. Spot applications of a nonselective herbicide may also be used.

Characteristic	Type	Description
Seedhead / Flower	raceme	V-shaped seedhead
Vernation Type	rolled OR folded	leaves rolled in the bud, may appear to be folded
Ligule Type	membranous	dense white hairs on back, 0.04 in (1 mm) long
Growth Season / Life Cycle	warm-season turf OR perennial weed	
Auricle Type	absent	
Leaf Blade Tip Shape	sharp-pointed	usually sparsely hairy along edge toward base, smooth on both surfaces
Leaf Blade Width	medium, 0.1 - 0.2 in OR broad, greater than 0.2 in	leaf blade mostly greater than 0.2 in wide, 0.16 - 0.31 in (4 - 8 mm)
Stolon Presence	present	stout
Rhizome Presence	present	occasional
Collar Type	continuous	collar and its edge with hairs
Sheath Margin	open	
Sheath Type	flattened	sheath usually not hairy; sharply creased, rather glossy



## Barnyardgrass

[*Echinochloa crus-galli* (L.) Beauv.]

Barnyardgrass is an upright summer annual weed of turfgrass. It is found in moist, disturbed sites, marshes, and wet turf areas. Barnyardgrass can most easily be distinguished from other grasses by its seedhead, and the fact that it has no ligule.



seedhead

### CONTROL PRACTICES

Barnyardgrass can be controlled with preemergence and postemergence crabgrass herbicides.

Characteristic	Type	Description
Seedhead / Flower	panicle	seedhead often purple, spikelets end in a bristle
Vernation Type	rolled	leaves rolled in the bud
Ligule Type	absent	
Growth Season / Life Cycle	summer annual weed	
Auricle Type	absent	
Leaf Blade Tip Shape	sharp-pointed	edges rough, blades all in same plane
Leaf Blade Width	broad, greater than 0.2 in	0.4 - 0.8 in (10 - 20 mm) wide
Stolon Presence	absent	
Rhizome Presence	absent	

Characteristic	Type	Description
Collar Type	continuous	may have hair on collar, white band on collar
Sheath Margin	split with overlapping margins	
Sheath Type	flattened	sheath occasionally has short hairs; red- to purple-tinged at base



## Bentgrass, Creeping

**[*Agrostis stolonifera* L.]**

Creeping bentgrass is the most widely used cool-season grass on golf course putting greens. It is a fine-textured species that can tolerate close mowing heights and spreads by stolons. This allows it to recover from traffic and golf ball marks. However, it has very high maintenance requirements including fertilization, topdressing, mowing, and frequent fungicide applications, particularly during the summer months.



Characteristic	Type	Description
Seedhead / Flower	panicle	seedhead is a compressed panicle; each spikelet is elliptical, with a single seed
Vernation Type	rolled	leaves rolled in the bud
Ligule Type	membranous	rounded or blunt, finely irregular-toothed or entire, minutely hairy on back, 0.04 - 0.08 in (1 - 2 mm) long
Growth Season / Life Cycle	cool-season turf	
Auricle Type	absent	
Leaf Blade Tip Shape	sharp-pointed	flat, distinctly ridged upper surface, slightly creased on lower surface, surfaces and edges rough
Leaf Blade Width	narrow, less than 0.1 in OR medium, 0.1 - 0.2 in	0.08 - 0.2 in (2 - 5 mm) wide
Stolon Presence	present	slender
Rhizome Presence	absent	
Collar Type	divided	indistinct, usually slanted with unequal sides
Sheath Margin	open	
Sheath Type	round	sheath is smooth



## Bermudagrass

**[*Cynodon dactylon* (L.) Pers.]**

Bermudagrass is a medium- to fine-textured warm-season turfgrass that spreads by rhizomes and stolons. It has excellent heat, drought, and salt tolerance but does not do well in shade. Bermudagrass is the most widely used species on athletic fields and golf course fairways/tee boxes due to its high wear tolerance and rapid recovery.

It can also be a very invasive and hard to control weed in some turf settings. Bermudagrass can be confused with nimblewill. However, nimblewill has a

membranous ligule, which can be distinguished from the hairy ligule of bermudagrass. Bermudagrass is also often confused with zoysiagrass, but zoysiagrass has upright hairs on the leafblade, whereas bermudagrass does not. Zoysiagrass is also stiff to the touch and offers more resistance to your hand than bermudagrass. There are many different hybrids of bermudagrass that range from fine to coarse in leaf texture. As a weed, bermudagrass is sometimes referred to as wiregrass.



### CONTROL PRACTICES

Bermudagrass can be controlled in tall fescue or zoysiagrass turf, but it takes monthly applications of postemergent herbicides from June through September to gradually phase out the bermudagrass. Bermudagrass suppression can also be achieved with spring and fall applications of a postemergent herbicide. Nonselective herbicides will provide control, but the desired turfgrass will have to be reestablished.

Characteristic	Type	Description
Seedhead / Flower	raceme	3-5 spikes that join at the top of a main stem.
Vernation Type	folded	leaves folded in the bud
Ligule Type	fringe of hairs	fringe of hairs 0.04 - 0.12 in (1 - 3 mm) long
Growth Season / Life Cycle	warm-season turf OR perennial weed	
Auricle Type	absent	
Leaf Blade Tip Shape	sharp-pointed	sparsely hairy, edges rough, leaf blade soft
Leaf Blade Width	narrow, less than 0.1 in	0.06 - 0.1 in (1.5 - 3 mm) wide
Stolon Presence	present	stout
Rhizome Presence	present	stout
Collar Type	continuous	not hairy, may be hairy on edges
Sheath Margin	open	
Sheath Type	flattened OR round	sheath is sparsely hairy; loose



## Bluegrass, Annual

[*Poa annua* L. ssp. *annua* and ssp. *reptans*]

Annual bluegrass is a light green bunch-type to slightly spreading winter annual weedy grass. Some subspecies exist which are classified as short-lived perennials (*Poa annua* ssp. *reptans*). These perennial types are particularly evident in bentgrass golf greens. One reason annual bluegrass is so unsightly is its light colored seedhead produced even at very low mowing heights.



### CONTROL PRACTICES

Management practices encouraging the persistence of annual bluegrass are

1. excessively close mowing;
2. shallow, frequent irrigation;
3. poor soil drainage;
4. improperly timed fertilization;
5. aerifying or dethatching during primary periods of annual bluegrass germination;
6. use of heavy equipment causing compaction; and
7. shade.

Preemergence herbicides applied in the fall before annual bluegrass germinates give effective control in home lawns, athletic fields, and golf course fairways. However, many preemergence herbicides prevent seeding of cool-season turf species in home lawns or overseeding on golf courses. Annual bluegrass can be effectively controlled in dormant bermudagrass with selective or nonselective herbicides. Recently registered sulfonylurea herbicides provide excellent postemergence control in fall or winter in non-overseeded warm-season turfgrass species. In overseeded turfgrasses, preemergence herbicides that are applied at a reduced rate eight weeks prior to overseeding offer annual bluegrass control. Preemergence herbicides are not effective on the perennial subspecies; however, research suggests that long-term use of some plant growth regulators may shift the competition in favor of the bentgrass over the perennial subspecies of annual bluegrass. Therefore, a well-planned program involving plant growth regulators may increase the bentgrass/bluegrass ratio in putting greens.

Characteristic	Type	Description
Seedhead / Flower	panicle	light-colored panicle seedhead
Vernation Type	folded	leaves folded in the bud
Ligule Type	membranous	sharp pointed entire, 0.04 - 0.12 in (1 - 3 mm) long
Growth Season / Life Cycle	winter annual weed OR perennial weed	
Auricle Type	absent	

Characteristic	Type	Description
Leaf Blade Tip Shape	boat-shaped	smooth above and below, not glossy, light green; two distinct, clear lines, one on each side of the midrib
Leaf Blade Width	narrow, less than 0.1 in	0.08 - 0.1 in (2 - 3 mm) wide
Stolon Presence	absent	
Rhizome Presence	absent	
Collar Type	divided	distinct, not hairy, V-shaped
Sheath Margin	open	open part way only
Sheath Type	flattened	slightly sharply creased



## Bluegrass, Kentucky

[*Poa pratensis* L.]

Kentucky bluegrass is the second most widely grown cool-season species in North Carolina because it has a dark green color, a medium to fine texture, and, due to its aggressive rhizome system, can recover from stresses. It prefers fertile, well-limed soils and full sun to moderate shade. Kentucky bluegrass is often mixed with other cool-season grasses like tall fescue

to enhance the ability of the turfgrass stand to recover from stresses. Kentucky bluegrass is often confused with tall fescue and/or perennial ryegrass. However,

Kentucky bluegrass has a boat-shaped leaf tip and distinctive light-colored lines on both sides of the midrib.



Characteristic	Type	Description
Seedhead / Flower	panicle	seedhead is an open panicle. spikelets are flattened, with 3-5 seeds each.
Vernation Type	folded	leaves folded in the bud
Ligule Type	membranous	very short, collar-like, 0.008 - 0.04 in (0.2 - 1 mm) long
Growth Season / Life Cycle	cool-season turf	
Auricle Type	absent	
Leaf Blade Tip Shape	boat-shaped	usually V-shaped, sharply creased below; two distinct, clear lines, one on each side of the midrib
Leaf Blade Width	narrow, less than 0.1 in OR medium, 0.1 - 0.2 in	0.08 - 0.16 in (2 - 4 mm) wide
Stolon Presence	absent	
Rhizome Presence	present	
Collar Type	divided	slightly divided by midrib, may have fine hair on edge
Sheath Margin	closed OR open	closed, but splits with maturity
Sheath Type	flattened	not hairy

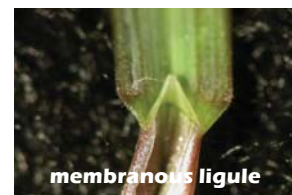


## Bluegrass, Rough

[*Poa trivialis* L.]

Rough (also called roughstalk) bluegrass is rarely used as a turf species because of intolerance to heat, drought, and traffic. It also has a very patchy appearance and, therefore, does not perform well in mixtures. However, rough bluegrass is sometimes used alone or in combination with perennial ryegrass for winter overseeding of golf course putting greens. Rough bluegrass can often be confused with Kentucky bluegrass. One way to distinguish them is

to examine the stem structures: rough bluegrass has stolons (above ground) and Kentucky bluegrass has rhizomes (below ground).



## CONTROL PRACTICES

Rough bluegrass can be controlled postemergence with select sulfonylurea herbicides. In cool-season turfgrasses, spot applications of a nonselective herbicide and reestablishment are required as no selective option exists.

Characteristic	Type	Description
<b>Seedhead / Flower</b>	panicle	seedhead is a panicle with flattened spikelets with 2-3 seeds each
<b>Vernation Type</b>	folded	leaves folded in the bud
<b>Ligule Type</b>	membranous	sharp pointed, entire, may be hairs along the edge, 0.16 - 0.24 in (4 - 6 mm) long
<b>Growth Season / Life Cycle</b>	cool-season turf OR perennial weed	
<b>Auricle Type</b>	absent	
<b>Leaf Blade Tip Shape</b>	boat-shaped	flat, sharply creased, glossy, edges rough at least near tip; two distinct, clear lines, one on each side of the midrib
<b>Leaf Blade Width</b>	narrow, less than 0.1 in OR medium, 0.1 - 0.2 in	0.04 - 0.16 in (1 - 4 mm) wide
<b>Stolon Presence</b>	present	
<b>Rhizome Presence</b>	absent	
<b>Collar Type</b>	divided	divided by midrib, distinct
<b>Sheath Margin</b>	open	open part way only
<b>Sheath Type</b>	flattened	sheath is usually rough; sharply creased



## Broomsedge

### [*Andropogon virginicus* L.]

Broomsedge is a perennial weed frequently found in fields, along roadsides, and in openings to forests and pastures. It can be distinguished from other grasses by the flattened leaf sheaths with obvious leaf hairs. Leaves with folded vernation arise from a basal crown. Immature plants are bluish-green; mature leaves turn light brown and appear to be dry. These upright plants remain standing throughout the year.



## CONTROL PRACTICES

Broomsedge control is achieved with repeat applications of an arsonate herbicide in tolerant turf.

Characteristic	Type	Description
<b>Seedhead / Flower</b>	raceme	spikelets are in racemes of groups of 2-4
<b>Vernation Type</b>	folded	leaves folded in the bud
<b>Ligule Type</b>	membranous	sharp pointed to collar-like, hairs along edge, no hairs on back of ligule
<b>Growth Season / Life Cycle</b>	perennial weed	
<b>Auricle Type</b>	absent	
<b>Leaf Blade Tip Shape</b>	sharp-pointed	flat, hairy near base above, smooth to rough below, edges rough and with hairs
<b>Leaf Blade Width</b>	medium, 0.1 - 0.2 in OR broad, greater than 0.2 in	0.1 - 0.28 in (3 - 7 mm) wide
<b>Stolon Presence</b>	absent	
<b>Rhizome Presence</b>	absent	
<b>Collar Type</b>	divided	mostly hairy on edges
<b>Sheath Margin</b>	split with overlapping margins	sheath has long hairs on edges
<b>Sheath Type</b>	flattened	very flattened, sharply creased



## Buffalograss

[*Buchloe dactyloides* (Nutt.) Engelm.]

Buffalograss is a low-growing, perennial, warm-season turfgrass native to the Great Plains of the U. S. It is not well-suited for planting in the Carolinas.



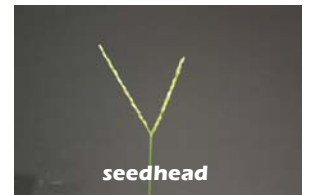
Characteristic	Type	Description
Seedhead / Flower	spike	
Vernation Type	rolled	
Ligule Type	fringe of hairs	0.02 - 0.04 in (0.5 - 1.0 mm) long
Growth Season / Life Cycle	warm-season turf OR perennial weed	
Auricle Type	absent	
Leaf Blade Tip Shape	sharp-pointed	flat, sparsely hairy, bluish-gray
Leaf Blade Width	narrow, less than 0.1 in	0.04 - 0.12 in (1 - 3 mm) wide
Stolon Presence	present	stout
Rhizome Presence	absent	
Collar Type	continuous	broad, hairy
Sheath Margin	open	
Sheath Type	round	



## Carpetgrass

[*Axonopus affinis* Chase]

Carpetgrass is a slow-growing, medium-green (and sometimes greenish yellow), coarsely textured turfgrass that is adapted to low-maintenance, general-purpose turf. It prefers full sun to moderate shade and performs well in wet, shady, acidic soils where other grasses may not. Carpetgrass looks very similar to centipedegrass except that it produces a crabgrass-like seedhead, and centipedegrass has hairs along the edges of the leaves.



### CONTROL PRACTICES

Carpetgrass can be controlled postemergence with an arsonate herbicide.

Characteristic	Type	Description
Seedhead / Flower	raceme	2-5 spikes in each head; spikes broad at base, and tapering to a point.
Vernation Type	folded	leaves folded in the bud
Ligule Type	fringe of hairs	short, fringe of hairs fused at the base, 0.04 in (1 mm) wide
Growth Season / Life Cycle	warm-season turf OR perennial weed	
Auricle Type	absent	
Leaf Blade Tip Shape	blunt	not hairy or hairs along edge at base, edges rough near top
Leaf Blade Width	medium, 0.1 - 0.2 in OR broad, greater than 0.2 in	0.16 - 0.31 in (4 - 8 mm) wide
Stolon Presence	present	
Rhizome Presence	absent	
Collar Type	continuous	not hairy or with only a few hairs
Sheath Margin	open	sheath has few long hairs on margin



Characteristic	Type	Description
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Sheath Type	flattened	
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## Centipede grass

[*Eremochloa ophiuroides* (Munro) Hack.]



Centipede grass is a slow-growing, coarse-textured, warm-season turf that is adapted for use in low maintenance situations. It is often referred to as “lazy man’s grass” due to its infrequent mowing and fertilization requirements. It has a light-green color and spreads by stolons. It does not tolerate traffic, compaction, high pH, excessive thatch, drought, or heavy shade.

Centipede grass can be confused with St. Augustine grass; however, centipede grass has alternating leaves at the nodes whereas St. Augustine grass has

opposite leaves at the nodes. Centipede grass also has a more pointed, slender leaf blade than St. Augustine grass. Both leaf blades are V-shaped in cross section, but that of St. Augustine grass has a more obviously boat-shaped tip.

Characteristic	Type	Description
Seedhead / Flower	spike	seedhead a slender spike
Vernation Type	folded	leaves folded in the bud
Ligule Type	membranous	short, membranous with fine hairs, hairs longer than purplish membrane, 0.02 in (0.5 mm) long
Growth Season / Life Cycle	warm-season turf	
Auricle Type	absent	
Leaf Blade Tip Shape	boat-shaped OR sharp-pointed	flattened, short, sharply creased, hairs along edge at base
Leaf Blade Width	medium, 0.1 - 0.2 in	
Stolon Presence	present	
Rhizome Presence	absent	
Collar Type	continuous	constricted by fused crease, hairs tufted at lower edge
Sheath Margin	split with overlapping margins	sheath has grayish tufts of hairs at throat
Sheath Type	flattened	very flattened



## Crabgrass



Crabgrass is a common weed in turfgrass situations, and can germinate from March through early May in North Carolina when soil temperatures reach 53 to 58°F at a 4-in depth. This weed is found in a variety of habitats. Germination is encouraged by the alternating dry and wet conditions at the soil surface in the spring. Stems have a prostrate growth habit and may root at the lower nodes. Crabgrass will grow under close mowing conditions. This weed prefers open areas with thin turfgrass stands, so the best prevention is healthy turfgrass. Goosegrass is similar to crabgrass, but does not root at the nodes.

### CONTROL PRACTICES

For crabgrass control, follow WEED MANAGEMENT PRACTICES on page 15. Where there is a crabgrass history, apply a preemergence herbicide in late winter or early spring when soil temperatures approach 50°F, which corresponds to about the time that forsythia blooms in North Carolina. These herbicides may be used effectively on home lawns, athletic fields, golf fairways, and parks; however, extreme care should be used when applying them to golf course greens because of variable management practices and turf tolerance. A second preemergence treatment eight weeks after the initial application may be necessary to maintain season-long control of crabgrass. Postemergence herbicides control emerged crabgrass early in the summer in certain turfgrasses. Because turfgrasses vary in tolerance to preemergence and postemergence herbicides, check labels for tolerance information.





## Crabgrass, Large

**[*Digitaria sanguinalis* (L.) Scop]**

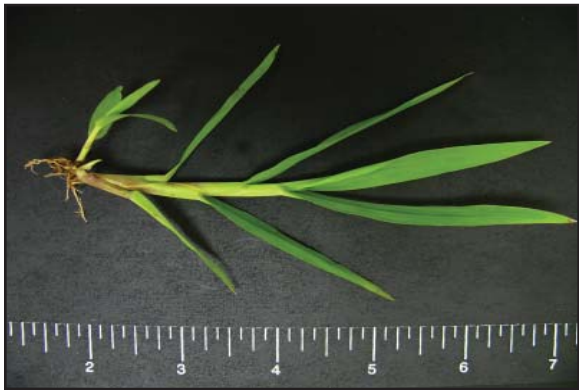
Large crabgrass (also called hairy crabgrass) is similar to smooth crabgrass, however, the leaf blade of smooth crabgrass is not as hairy, featuring only a few hairs near the base of the blade. The leaf blade edges of smooth crabgrass are either not hairy or have sparse hairs.



### CONTROL PRACTICES

See CONTROL PRACTICES under CRABGRASS on page 23.

Characteristic	Type	Description
<b>Seedhead / Flower</b>	raceme	2 - 9 spikelets arising from different points along the top of stems
<b>Vernation Type</b>	rolled	leaves rolled in the bud
<b>Ligule Type</b>	membranous	0.04 - 0.08 in (1 - 2 mm) long, rounded to sharp pointed, toothed, often reddish
<b>Growth Season / Life Cycle</b>	summer annual weed	
<b>Auricle Type</b>	absent	
<b>Leaf Blade Tip Shape</b>	sharp-pointed	covered with short hairs on both surfaces, sharply creased below, edges rough with scattered hairs
<b>Leaf Blade Width</b>	broad, greater than 0.2 in	0.2 - 0.6 in (5 - 15 mm) wide
<b>Stolon Presence</b>	present	
<b>Rhizome Presence</b>	absent	
<b>Collar Type</b>		mostly divided, hairy edges
<b>Sheath Margin</b>	open	
<b>Sheath Type</b>	flattened	sheath has long hairs; often with purple veins



## Crabgrass, Smooth

**[*Digitaria ischaemum* (Schreb.) Schreb. ex Muhl.]**

Smooth crabgrass is similar to large crabgrass. However, the leaf blade of smooth crabgrass is not as hairy as that of large crabgrass, with a few hairs near the base of the blade. Leaf blade edges of smooth crabgrass are either not hairy or have sparse hairs.



### CONTROL PRACTICES

See CONTROL PRACTICES under CRABGRASS on page 23.

Characteristic	Type	Description
<b>Seedhead / Flower</b>	raceme	2 - 6 spikes at top of stems
<b>Vernation Type</b>	rolled	leaves rolled in the bud
<b>Ligule Type</b>	membranous	0.06 - 0.12 in (1.5 - 3 mm) long, blunt to collar-like, slightly wavy
<b>Growth Season / Life Cycle</b>	summer annual weed	
<b>Auricle Type</b>	absent	
<b>Leaf Blade Tip Shape</b>	sharp-pointed	smooth above, with mostly a few hairs near base, edges not hairy or sparse hairs along edge, dull green or tinged with purple
<b>Leaf Blade Width</b>	broad, greater than 0.2 in	0.2 - 0.4 in (5 - 10 mm) wide
<b>Stolon Presence</b>	present	
<b>Rhizome Presence</b>	absent	
<b>Collar Type</b>		often divided, distinct, few hairs at the edge
<b>Sheath Margin</b>	open	

Characteristic	Type	Description
Sheath Type	flattened	sheath is not hairy, lower sheaths may be sparsely hairy



## Crowfootgrass

**[*Dactyloctenium aegyptium* (L.) Willd.]**

Crowfootgrass is an annual grassy weed of turf that roots at the nodes. It is characterized by a unique seedhead of four or more spikelets that radiate outwards, resembling a crow's foot.



### CONTROL PRACTICES

Preemergence herbicides used for crabgrass and goosegrass will provide control.

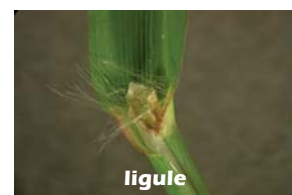
Characteristic	Type	Description
Seedhead / Flower	raceme	2-5 fingers radiating from central point at stem tip, tips of spikelets resemble claws
Vernation Type	rolled	leaves rolled in the bud
Ligule Type	membranous	with fringe of hairs
Growth Season / Life Cycle	summer annual weed	
Auricle Type	absent	
Leaf Blade Tip Shape		row of hairs extending outward from the margin on lower portion of leaf blade
Leaf Blade Width		0.08 - 0.35 in (2 - 9 mm) wide
Stolon Presence	absent	
Rhizome Presence	absent	
Collar Type	continuous	
Sheath Margin	open	
Sheath Type	flattened	



## Dallisgrass

**[*Paspalum dilatatum* Poir.]**

Dallisgrass, field paspalum, and thin paspalum are common perennial weeds in turf, and are some of the more difficult-to-control weeds. All three species resemble each other very closely, and field paspalum and thin paspalum are often mistakenly called dallisgrass. Thin paspalum has a glossier, more shiny leaf when young than dallisgrass. The dallisgrass leaf has a dull green appearance like crabgrass.



### CONTROL PRACTICES

Dallisgrass, field paspalum, and thin paspalum are some of the more difficult-to-control weeds in turfgrasses. Proven ways to selectively remove this group of paspalums in tolerant turfgrass species include multiple applications of arsonate herbicides in the early spring, or using a two- or three-step program consisting of arsonate and sulfonylurea herbicides.

Characteristic	Type	Description
Seedhead / Flower	raceme	hairy spikelets arranged in 4 rows on 3 - 8 alternate branches on tall (up to 5 feet in unmowed situations) terminal stalks
Vernation Type	rolled	leaves rolled in the bud
Ligule Type	membranous	up to 0.2 in (5 mm) long, sharp pointed to blunt
Growth Season / Life Cycle	perennial weed	
Auricle Type	absent	
Leaf Blade Tip Shape		flat, sharply creased, not hairy or with a few hairs at base, hairs behind ligule, edges smooth or rough

Characteristic	Type	Description
Leaf Blade Width	broad, greater than 0.2 in	0.28 - 0.6 in (7 - 15 mm) wide
Stolon Presence	absent	
Rhizome Presence	present	occasional and very short
Collar Type	continuous	not hairy, often hairy on edges
Sheath Margin	split with overlapping margins	
Sheath Type	flattened	sheath is not densely hairy, often has long hairs near base of plant; slightly creased



## Fescue, Fine

### [*Festuca* spp L.]

Fine fescue species include creeping red, chewings, hard, and sheep fescue. All fine-leaf fescues are bunch-type grasses except creeping red fescue, which is rhizomatous. Fine fescues are some of the most fine-textured turfgrasses available. Due to their superb shade tolerance and ability to recuperate from stresses, fine fescues are often mixed with tall fescue to enhance performance in shady areas.



ligule

Characteristic	Type	Description
Seedhead / Flower	panicle	seedhead is a closed, coarse panicle
Vernation Type	folded	leaves folded in the bud
Ligule Type	membranous	rounded, 0.01 in (0.3 mm) long
Growth Season / Life Cycle	cool-season turf	
Auricle Type	absent	
Leaf Blade Tip Shape	sharp-pointed	bristle-like with whitish cast, deeply ridged on inner surface
Leaf Blade Width		
Stolon Presence	absent	
Rhizome Presence	absent	absent except in creeping red fescue; red fescue rhizomes are slender and short
Collar Type		indistinct, divided in some species, continuous in others
Sheath Margin	open	
Sheath Type	flattened OR round	sheath is smooth or covered with short hairs; red fescue sheath is round; sheath of other species is flattened



## Fescue, Tall

### [*Festuca arundinacea* Schreb.]

Tall fescue is the most widely grown cool-season species in North Carolina. For a cool-season species, tall fescue is tolerant to heat and drought, disease resistant, and persists with minimum care. It has a tendency to clump due to its bunch-type growth habit and may need to be re-seeded each year due to excessive summer stresses. Tall fescue is easily confused with Kentucky bluegrass, annual ryegrass, and perennial ryegrass. However, Kentucky bluegrass



seedhead



rudimentary auricle

has a boat-shaped leaf tip and distinctive light-colored lines on both sides of the midrib. Tall fescue has rolled vernation in the leaf bud and perennial ryegrass has folded vernation. Also, tall fescue has rough leaf blade margins whereas annual and perennial ryegrass have smooth ones. Tall fescue and perennial ryegrass both have non-clasping auricles, whereas annual ryegrass has clasping auricles. The backside of the tall fescue leaf blade is less glossy than that of annual ryegrass.

## CONTROL PRACTICES

Warm-season turfgrass herbicides in the triazine or sulfonyleurea families will control tall fescue.

Characteristic	Type	Description
Seedhead / Flower	panicle	terminal panicle
Vernation Type	rolled	leaves rolled in the bud
Ligule Type	membranous	collar-like, 0.02 in (0.5 mm) or less long, very jagged
Growth Season / Life Cycle	cool-season turf OR perennial weed	
Auricle Type	rudimentary	non-clasping, small, short, hairs on edges
Leaf Blade Tip Shape	sharp-pointed	deeply ridged above, glossy below, prominent midrib below, edges rough
Leaf Blade Width		
Stolon Presence	absent	
Rhizome Presence		occasional and short
Collar Type	divided	may be hairy on edges
Sheath Margin	open	
Sheath Type	round	sheath is smooth



## Foxtail, Green

[*Setaria viridis* (L.) Beauv.]

Green foxtail is a bright green clumping annual weed common in turf and pasture areas. The seedheads are hard to distinguish from those of other foxtails. Yellow foxtail has a smaller seedhead with shorter bristles than green foxtail. In addition, yellow foxtail has hairs on the leaf margins and ligule. Giant foxtail has the largest seedhead of the three and this seedhead droops.



### CONTROL PRACTICES

Green foxtail can be controlled with crabgrass preemergence and postemergence herbicides.

Characteristic	Type	Description
Seedhead / Flower	spike	seedhead a soft spike, oval in shape and long hairs on each seed.
Vernation Type	rolled	leaves rolled in the bud
Ligule Type	fringe of hairs	dense fringe of hairs, 0.03 - 0.04 in (0.8 - 1 mm) long
Growth Season / Life Cycle	summer annual weed	
Auricle Type	absent	
Leaf Blade Tip Shape	sharp-pointed	flat, not hairy, slightly rough
Leaf Blade Width		
Stolon Presence	absent	
Rhizome Presence	absent	
Collar Type	divided	hairy on edges
Sheath Margin	split with overlapping margins	edges hairy
Sheath Type	flattened	sheath is not hairy



## Foxtail, Yellow

[*Setaria glauca* (L.) Beauv.]

Yellow foxtail is a bright green clumping annual or perennial weed common in turf and pasture areas. The seedhead is smaller than green foxtail and has shorter bristles. Giant foxtail has the largest seedhead of the three, and this seedhead droops. In addition, yellow foxtail has hairs on the leaf margins and ligule. Knotroot foxtail is a perennial weed similar in appearance to yellow foxtail, but it has rhizomes.



### CONTROL PRACTICES

Yellow foxtail can be controlled with crabgrass preemergence and postemergence herbicides

Characteristic	Type	Description
Seedhead / Flower	spike	seedhead a coarse spike, several bristles on one seed.
Vernation Type	rolled	leaves rolled in the bud
Ligule Type	fringe of hairs	dense fringe of hairs, 0.04 in (1 mm) long
Growth Season / Life Cycle	summer annual weed OR perennial weed	
Auricle Type	absent	
Leaf Blade Tip Shape	sharp-pointed	long hairs on upper surface
Leaf Blade Width		
Stolon Presence	absent	up to 0.47 in (12 mm) wide
Rhizome Presence	absent	
Collar Type	continuous	
Sheath Margin	split with overlapping margins	edges not hairy
Sheath Type	flattened	sharply creased



## Goosegrass

[*Eleusine indica* (L.) Gaertn.]

Goosegrass is a very troublesome grassy weed in athletic fields, golf greens, tees and fairways, and in other turfgrasses that are mowed short. It germinates when soil temperatures reach 60 to 65°F, which is usually at least two weeks later than crabgrass. It requires moisture and light for germination. Goosegrass has a prostrate growth habit, and is often white in the center with a wagon-wheel like appearance. Unlike crabgrass, it does not root at the nodes. It grows well in compacted soils. Goosegrass



competes very successfully with warm-season and cool-season turfgrasses during summer months and is most competitive in thin, open turfs and turfs subject to intense traffic or use.

### CONTROL PRACTICES

Close mowing and frequent watering enhance goosegrass competition. A severe goosegrass infestation may indicate the need for aeration to alleviate compaction. Preemergence herbicides used for crabgrass control may be used, but they are less effective on goosegrass. Goosegrass may also be controlled by postemergence herbicides.

Characteristic	Type	Description
Seedhead / Flower	raceme	2-6 spikes at the top of stem
Vernation Type	folded	leaves folded in the bud
Ligule Type	membranous	0.02 - 0.04 in (0.6 - 1 mm) long, collar-like, hairy on back, edges sometimes with short hairs
Growth Season / Life Cycle	summer annual weed	

Characteristic	Type	Description
<b>Auricle Type</b>	absent	
<b>Leaf Blade Tip Shape</b>	blunt	sparse long hairs near base above, smooth and sharply creased below, edges may have hairs
<b>Leaf Blade Width</b>	broad, greater than 0.2 in	0.2 - 0.4 in (5 - 10 mm) wide
<b>Stolon Presence</b>	absent	
<b>Rhizome Presence</b>	absent	
<b>Collar Type</b>	continuous	crooked fine hairs on edges
<b>Sheath Margin</b>	split with overlapping margins	sheath is hairy at top, edges may have hairs
<b>Sheath Type</b>	flattened	



## Johnsongrass

**[*Sorghum halepense* (L.) Pers.]**

Johnsongrass is a common weed in turf. It is frequently found on roadsides, but is also found in pastures and disturbed fields. It does not grow well in frequent, close mowing situations. As an adult plant, johnsongrass is characterized by its dense growth habit, with stems that can reach 6 ft in height. The leaf blades are rough, and the prominent white raised midveins that run the length of the leaf are distinctive. The seedhead tends to be purple.

PW



### CONTROL PRACTICES

Johnsongrass can be controlled postemergence with various grass herbicides. Nonselective control may be an option but turf reestablishment will be needed after application.

Characteristic	Type	Description
<b>Seedhead / Flower</b>	panicle	seedhead is often purplish
<b>Vernation Type</b>	rolled	
<b>Ligule Type</b>	membranous	fine hairs
<b>Growth Season / Life Cycle</b>	perennial weed	
<b>Auricle Type</b>	absent	
<b>Leaf Blade Tip Shape</b>	sharp-pointed	
<b>Leaf Blade Width</b>	broad, greater than 0.2 in	0.4 - 1.2 in (10 to 30 mm) wide
<b>Stolon Presence</b>	absent	
<b>Rhizome Presence</b>	present	
<b>Collar Type</b>	continuous	
<b>Sheath Margin</b>	open	
<b>Sheath Type</b>	flattened OR round	round to somewhat flattened



## Nimblewill

**[*Muhlenbergia schreberi* J. F. Gmel.]**

Nimblewill is a dense perennial weed of turfgrass. It is often found at field edges and in forest openings, especially in shaded areas with adequate moisture. Nimblewill grows in a very dense mat, and will root at the nodes. It has very slender, thin leaves, like bermudagrass, but nimblewill has a membranous ligule, and bermudagrass has a hairy ligule.

PW



## CONTROL PRACTICES

Nimblewill may be suppressed with postemergent grass herbicides but limited research has been completed. Spot applications with a nonselective herbicide and reestablishment are the best option.

Characteristic	Type	Description
<b>Seedhead / Flower</b>	panicle	seedhead is a spike-like panicle; each spike contains a single seed with a long awn (bristle)
<b>Vernation Type</b>	rolled	leaves rolled in the bud
<b>Ligule Type</b>	membranous	minute, irregular edge, less than 0.02 in (0.5 mm) long
<b>Growth Season / Life Cycle</b>	perennial weed	
<b>Auricle Type</b>	absent	
<b>Leaf Blade Tip Shape</b>	sharp-pointed	flat, 1-2 in (25 - 50 mm) long, not hairy except for occasional hairs on edges near the base
<b>Leaf Blade Width</b>	narrow, less than 0.1 in	0.08 - 0.1 in (2 - 2.5 mm) wide
<b>Stolon Presence</b>	present	fine
<b>Rhizome Presence</b>	present	
<b>Collar Type</b>	continuous	hairy on edges
<b>Sheath Margin</b>	open	usually a few long hairs on upper edges and near throat
<b>Sheath Type</b>	flattened	sheath is smooth, shorter than internode



## Orchardgrass

**[*Dactylis glomerata* L.]**

Orchardgrass is a common perennial weed of turf, and can be a contaminant in commercial tall fescue seed. The leaves are a characteristic blue-green color, and the seedhead is easy to distinguish from other grasses. In addition, there is a prominent midvein on the underside of the leaves, and the ligule is membranous.



## CONTROL PRACTICES

Warm-season turfgrass herbicides in the triazine or sulfonyleurea families will control orchardgrass.

Characteristic	Type	Description
<b>Seedhead / Flower</b>	panicle	panicle seedhead has stiff branches
<b>Vernation Type</b>	folded	leaves folded in the bud
<b>Ligule Type</b>	membranous	0.12 - 0.4 in (3 - 10 mm) long, collar-like, often with short needle-like projection at the top
<b>Growth Season / Life Cycle</b>	perennial weed	
<b>Auricle Type</b>	absent	
<b>Leaf Blade Tip Shape</b>	sharp-pointed	V-shaped in cross section at base, sharply creased below, deep furrow over midrib, edges rough; lower surface dull, not glossy
<b>Leaf Blade Width</b>	broad, greater than 0.2 in	0.24 - 0.47 in (6 - 12 mm) wide
<b>Stolon Presence</b>	absent	
<b>Rhizome Presence</b>	absent	
<b>Collar Type</b>	divided	distinct, not hairy
<b>Sheath Margin</b>	open	mostly open part way
<b>Sheath Type</b>	flattened	sheath is smooth to somewhat rough; distinctly flattened

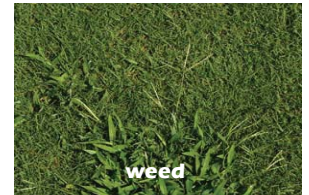
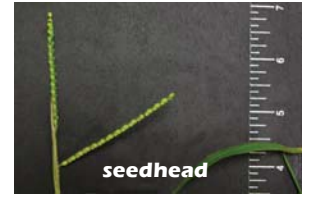




## Paspalum, Thin (Bull)

**[*Paspalum setaceum* Michx.]**

Thin (bull) paspalum is common in sandy soils in disturbed, open areas throughout the coastal plain. Dallisgrass, field paspalum, and thin paspalum closely resemble each other, and thin paspalum is often mistakenly called dallisgrass. Thin paspalum has a glossier, more shiny leaf when young than dallisgrass. The dallisgrass leaf is very similar to crabgrass, which is dull green in appearance.



### CONTROL PRACTICES

Dallisgrass, field paspalum, and thin paspalum are some of the more difficult-to-control weeds in turfgrasses. Proven ways to selectively remove this group of paspalums in tolerant turfgrass species include multiple applications of arsonate herbicides in the early spring, or using a three-step program consisting of arsonate and sulfonyleurea herbicides.

Characteristic	Type	Description
<b>Seedhead / Flower</b>	raceme	1-6 spikelets per stalk
<b>Vernation Type</b>	rolled	
<b>Ligule Type</b>	membranous	small, membranous with fringe of hairs on top
<b>Growth Season / Life Cycle</b>	perennial weed	
<b>Auricle Type</b>	absent	
<b>Leaf Blade Tip Shape</b>	sharp-pointed	hairy to almost smooth, wavy edges
<b>Leaf Blade Width</b>		
<b>Stolon Presence</b>	absent	
<b>Rhizome Presence</b>	present	short
<b>Collar Type</b>	continuous	
<b>Sheath Margin</b>	open	fringe of hair along the margin of the sheath
<b>Sheath Type</b>	flattened	



## Ryegrass, Annual (Italian)

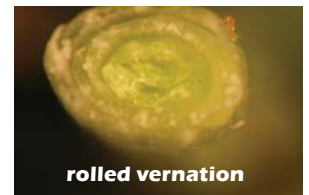
**[*Lolium multiflorum* Lam.]**

Annual ryegrass, also referred to as Italian ryegrass, is a common weed problem in turfgrasses on roadsides in the southeastern United States. It is a bunch-type grass that can be used as a nurse crop for quick cover or for winter overseeding of bermudagrass on low-maintenance athletic fields or golf courses. It does not possess the quality of perennial ryegrass and is not

recommended for sites where high quality turf is desired. However, it is very inexpensive and can be used on low-profile fields, such as school, park or recreation sites, where winter color is desirable. Its seedhead can be confused with that of quackgrass. Annual ryegrass does not have rhizomes, whereas quackgrass does. Annual ryegrass can be easily confused with tall fescue. However, tall fescue has rough leaf blade margins on the lower 1/3 - 1/2 of the leaf whereas annual ryegrass has smooth ones. Tall fescue has non-clasping auricles, whereas annual ryegrass has clasping auricles. The backside of the tall fescue leaf blade is less glossy than that of annual ryegrass.

### CONTROL PRACTICES

Apply preemergence crabgrass herbicides before seed germination in the fall. In dormant bermudagrass it may be controlled with postemergence herbicides in the triazine and sulfonyleurea families. A nonselective herbicide will also provide control in dormant bermudagrass. Resistance to certain postemergence herbicides is a major concern.



Characteristic	Type	Description
<b>Seedhead / Flower</b>	spike	a spike, with spikelets along the main stem
<b>Vernation Type</b>	rolled	leaves rolled in the bud
<b>Ligule Type</b>	membranous	blunt, 0.04 - 0.08 in (1 - 2 mm) long
<b>Growth Season / Life Cycle</b>	cool-season turf OR winter annual weed	
<b>Auricle Type</b>	claw-like	pointed or blunt or claw-like, clasping
<b>Leaf Blade Tip Shape</b>	sharp-pointed	bright green, upper surface dull, deeply ridged, lower surface smooth, glossy and slightly creased, edges smooth
<b>Leaf Blade Width</b>	medium, 0.1 - 0.2 in OR broad, greater than 0.2 in	0.1 - 0.28 in (3 - 7 mm) wide
<b>Stolon Presence</b>	absent	
<b>Rhizome Presence</b>	absent	
<b>Collar Type</b>	continuous	indistinct, not hairy
<b>Sheath Margin</b>	split with overlapping margins	
<b>Sheath Type</b>	round	pinkish at base



## Ryegrass, Perennial

[*Lolium perenne* L.]



claw-like auricles

Perennial ryegrass is a bunch-type grass that is used in mixtures with Kentucky bluegrass or for winter overseeding on sites where high quality and winter color are needed. The texture, color, and density of perennial ryegrass are very similar to those of Kentucky bluegrass. Perennial ryegrass is often utilized for winter overseeding on golf course fairways and teeboxes, athletic fields, and high-profile home lawns. Perennial ryegrass is often confused with tall fescue and Kentucky bluegrass. Kentucky bluegrass has a boat-shaped leaf tip and distinctive light-colored lines on both sides of the midrib. Tall fescue has rough leaf blade margins; perennial ryegrass has smooth ones. Also, tall fescue has rolled vernation in the leaf bud, and perennial ryegrass has folded vernation.

### CONTROL PRACTICES

In the transition zone, especially during cool summers, wet summers, or both, perennial ryegrass can survive the summer and become clumpy. This very attractive turf species becomes a difficult-to-control weed in these conditions. Concentrate on controlling perennial ryegrass before it becomes clumpy. Additionally, sulfonyleurea herbicides offer postemergence control once the ryegrass becomes clumpy.

Characteristic	Type	Description
<b>Seedhead / Flower</b>	spike	a spike, with flattened spikelets along each stem
<b>Vernation Type</b>	folded	leaves folded in the bud
<b>Ligule Type</b>	membranous	collar-like to blunt, may be toothed near top, 0.02 - 0.06 in (0.5 - 1.5 mm) long
<b>Growth Season / Life Cycle</b>	cool-season turf OR perennial weed	
<b>Auricle Type</b>	claw-like	small, soft, claw-like
<b>Leaf Blade Tip Shape</b>	sharp-pointed	bright green, sharply creased, deeply ridged upper surface, lower surface smooth and glossy, edges slightly rough
<b>Leaf Blade Width</b>	narrow, less than 0.1 in OR medium, 0.1 - 0.2 in	0.08 - 0.2 in (2 - 5 mm) wide
<b>Stolon Presence</b>	absent	
<b>Rhizome Presence</b>	absent	
<b>Collar Type</b>	divided	divided by midrib, not hairy, distinct
<b>Sheath Margin</b>		
<b>Sheath Type</b>	flattened	sheath is usually flattened, reddish at base



## Sandbur

[*Cenchrus incertus* M.A. Curtis]

Sandbur can be a very troublesome weed in warm-season turf species. It is easily identified by the seedhead, which is a spike of tiny burs that can hurt when touched. This weed thrives in sandy soils, but can be controlled with certain herbicides when in the seedling stage.



### CONTROL PRACTICES

Sandbur is difficult to control. Partial control can be achieved with preemergence crabgrass herbicides. Postemergence control is achieved with repeat applications of an arsonate herbicide.

Characteristic	Type	Description
Seedhead / Flower	spike	burs that occur all along a spike-like seedhead
Vernation Type	folded	leaves folded in the bud
Ligule Type	fringe of hairs	fringe of hairs 0.04 in (1 mm) long, with 0.08 in (2 mm) long hairs on each side
Growth Season / Life Cycle	summer annual weed OR perennial weed	
Auricle Type	absent	
Leaf Blade Tip Shape	sharp-pointed	thin, flat, usually not hairy
Leaf Blade Width		0.08 - 0.24 in (2 - 6 mm) wide
Stolon Presence	absent	none, but stems decumbent
Rhizome Presence	present	very short
Collar Type	divided	divided by midrib, distinct
Sheath Margin		
Sheath Type	flattened	sheath is usually not hairy



## St. Augustinegrass

[*Stenotaphrum secundatum* (Walt.) Kuntze]

St. Augustinegrass is a warm-season grass with medium density and medium to dark green color. Of all the warm-season grasses, it is the least cold tolerant and has the coarsest leaf texture. St. Augustinegrass grows best in warm, humid areas that are not exposed to long periods of cold weather. In fact, its lack of cold tolerance is the major limiting factor in determining its use in North Carolina. Centipedegrass can often be confused with St. Augustinegrass. However, centipedegrass has alternating



leaves at the nodes whereas St. Augustinegrass has opposite leaves at the nodes. Centipedegrass also has a more pointed, slender leaf blade than St. Augustinegrass. Both leaf blades are V-shaped in cross section, but St. Augustinegrass has a more obvious boat-shaped tip.

Characteristic	Type	Description
Seedhead / Flower	spike	seedhead a thick spike with spikelets imbedded along the sides
Vernation Type	folded	leaves folded in the bud
Ligule Type	fringe of hairs	short fringe of hairs, 0.01 in (0.3 mm) long
Growth Season / Life Cycle	warm-season turf	
Auricle Type	absent	
Leaf Blade Tip Shape	boat-shaped OR blunt	not hairy
Leaf Blade Width	medium, 0.1 - 0.2 in OR broad, greater than 0.2 in	0.16 - 0.4 in (4 - 10 mm) wide
Stolon Presence	present	stout

Characteristic	Type	Description
<b>Rhizome Presence</b>	absent	
<b>Collar Type</b>	continuous	not hairy, constricted
<b>Sheath Margin</b>	open	sheath is slightly hairy along edges and toward top
<b>Sheath Type</b>	flattened	sharply creased, loose

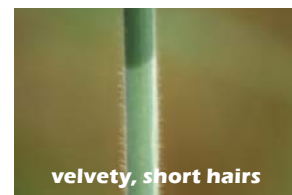


## Velvetgrass

**[*Holcus lanatus* L.]**

Velvetgrass is a clumping perennial weed of turf that can have characteristics of a winter annual in warmer climates. It is found in moist areas in fields, lawns, and roadsides. The stems and leaves are densely hairy and soft to the touch. Velvetgrass was widely used years ago as a forage grass, particularly in tall fescue in the western part of the state. The presence of velvetgrass as a weed now is due to its former widespread use as a forage grass.

PW



velvety, short hairs

### CONTROL PRACTICES

Velvetgrass cannot be selectively controlled in tall fescue. In bermudagrass, it can be controlled in winter with a nonselective herbicide as a dormant bermudagrass spray. A selective herbicide does provide control in zoysia and centipede.

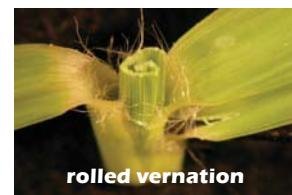
Characteristic	Type	Description
<b>Seedhead / Flower</b>	panicle	seedhead is a soft, purple panicle with soft hairs on each spikelet
<b>Vernation Type</b>	rolled	leaves rolled in the bud
<b>Ligule Type</b>	membranous	up to 0.01 in (0.3 mm) long, rounded
<b>Growth Season / Life Cycle</b>	perennial weed	
<b>Auricle Type</b>	absent	
<b>Leaf Blade Tip Shape</b>	sharp-pointed	dense, velvety, short, hairs above and below, edges with short hairs, sharply creased below
<b>Leaf Blade Width</b>	broad, greater than 0.2 in	0.2 - 0.4 in (5 - 10 mm) wide
<b>Stolon Presence</b>	absent	
<b>Rhizome Presence</b>	absent	
<b>Collar Type</b>	divided	hairy
<b>Sheath Margin</b>	open	
<b>Sheath Type</b>	flattened	sheath has dense, velvety, short hairs



## Zoysiagrass

**[*Zoysia* spp.]**

Zoysiagrass is a warm-season grass that spreads by rhizomes and stolons to produce a very dense, wear-resistant turf. It is best adapted to the piedmont and coastal plain of North Carolina, but some of the more cold tolerant cultivars can be grown in the western part of the state. The three major species of zoysiagrass suitable for turf are Japanese lawngrass (*Z. japonica*), mascarenegrass (*Z. tenuifolia*), and manilagrass (*Z. matrella*). Zoysiagrass can be confused with bermudagrass. Zoysiagrass has hairs standing upright on the leaf blade; bermudagrass does not. Zoysiagrass is also stiff to the touch and offers more resistance to the hand than bermudagrass.



rolled vernation

Characteristic	Type	Description
<b>Seedhead / Flower</b>	spike	seedhead a spikelet, with seeds alternating along head
<b>Vernation Type</b>	rolled	leaves rolled in the bud
<b>Ligule Type</b>	fringe of hairs	short fringe of hairs, 0.008 in (0.2 mm) long

Characteristic	Type	Description
<b>Growth Season / Life Cycle</b>	warm-season turf	
<b>Auricle Type</b>	absent	
<b>Leaf Blade Tip Shape</b>	sharp-pointed	hairy above with at least a few long hairs near base, leaf blade stiff
<b>Leaf Blade Width</b>	narrow, less than 0.1 in OR medium, 0.1 - 0.2 in	0.08 - 0.16 in (2 - 4 mm) wide
<b>Stolon Presence</b>	present	strong
<b>Rhizome Presence</b>	present	
<b>Collar Type</b>	continuous	edges hairy
<b>Sheath Margin</b>	split with overlapping margins	sheath may have tuft of hairs at throat
<b>Sheath Type</b>	flattened OR round	round to slightly flattened

## SEDGES

Sedges are weeds that resemble grasses but unlike grasses, sedges have three-sided or triangular stems. The stem shape can be observed by removing the plant from the soil and cutting the stem in cross section at or slightly above the soil line. It is important to properly distinguish sedges from grasses because management practices are vastly different. In North Carolina, about 10 species of sedges can be found in turfgrasses. Most of these species are perennials and represent some of the more difficult weeds to control. However, a few species (particularly annual sedges) can be easily controlled. In addition, there are several new species of sedges (*Kyllinga* species) that represent new weed problems in turf situations, and are spreading rapidly in many areas. Because many sedges can only be identified by their respective seedheads and because repeated mowing often prevents seedhead development, it may be necessary to remove a sedge from the managed turfgrass area and place it in a pot to allow seedheads to develop.

Many sedge species can be problematic in turf. As a general rule, sedges are more of a problem in warmer climates than cooler climates. Proper identification and an understanding of the biology of sedges are necessary for effective management.

### WEED MANAGEMENT PRACTICES

Sedges thrive in wet or poorly drained soils but can survive in areas that are not wet. Because of frequent irrigation in highly maintained turf, sedges thrive in turfgrass. Sedges often become established in wet areas and spread to other areas that are not properly drained. Therefore, it is important to recognize areas where sedges can become established and prevent spread of these sedge species to other areas of the golf course or landscape. Several recently registered sulfonylurea herbicides effectively control these species, although repeat applications may be required.

**For more information on control of specific weeds, see *Pest Control for Professional Turfgrass Managers*, or the *Decision Aid for Weed Management*, both available on the TurfFiles Web site (<http://www.turffiles.ncsu.edu/>).**

## GENERAL DESCRIPTIONS AND CONTROL PRACTICES

### **W** WEEDS

Weeds by definition are any plant(s) that grow where not intended. Whereas some turfgrass species are classified as both turfgrasses and weeds, all of the sedges listed in this book are considered weeds to any successful turfgrass program. Categorization depends upon several factors including: geographic location, plant species, subspecies, and climate. Sedges included in this book are either summer annual or perennial.

### **A** SUMMER ANNUAL SEDGE WEEDS

Summer annual sedge weeds emerge in the spring or early summer, grow during the summer, and produce seed in mid- to late summer. Midsummer rains frequently encourage germination.

### **P** PERENNIAL SEDGE WEEDS

Perennial sedge weeds are capable of living more than two years. Some of the perennial weed species described in this book are among the most difficult-to-control weeds in turfgrass systems.



## Kyllinga, Green & False Green



**[*Kyllinga brevifolia* Rottb.] & [*Kyllinga gracillima* Miq.]**



These two species are very similar in appearance and both are referred to as green kyllinga. Both species are native to Asia and are spreading rapidly in turfgrasses in the southern United States. Both species are perennials and have well-developed rhizomes. They tend to be shorter growing and have a finer leaf texture than other sedges. These two

species are mat-forming sedges and have been observed to take over turfgrasses in the southeastern United States. The range of these two species is somewhat misleading because they are spreading rapidly. Currently, *K. brevifolia* can be found in North Carolina and states south and west to eastern Texas and Oklahoma. Several specimens have been collected in California. *K. gracillima* has been found in Tennessee, Alabama, Georgia, North Carolina, Virginia, and Pennsylvania north to Connecticut. Because *K. gracillima* is found in cooler climates, it is assumed this species is more cold-tolerant than *K. brevifolia*.

### CONTROL PRACTICES

Kyllingas tend to thrive under close mowing (½ in or less) and are very prolific in areas that are poorly drained or frequently wet. They are very difficult to control once the large mats form. It is believed that spread of these two species may be due to a change in crabgrass control practices in recent years. Preemergence crabgrass herbicides offer no control of these two species, whereas arsonate herbicides have significant activity. Therefore, when the arsonate herbicides were regularly used for crabgrass control, these two sedge species were probably prohibited from becoming established. Current control recommendations include multiple applications of arsonate herbicides in tolerant turfgrasses. Control is also achieved with multiple applications of sulfonylurea herbicides.

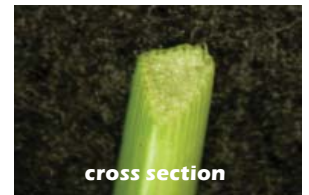
Characteristic	Type	Description
Growth Season	perennial weed	
Seed Arrangement on Spikes	tightly bunched	
Seedhead Spikelet Shape	round	
Tuber Type	none	



## Nutsedge, Purple



**[*Cyperus rotundus* L.]**



Purple nutsedge is a native of India and is widely distributed in temperate and tropical regions of the world and is not as cold-tolerant as yellow nutsedge. In the United States, it can be found in the southeastern part of the country west to the eastern part of Texas and can also be found in parts of California and Arizona. As a result, this weed tends to be more of a problem in warm-season turf. As with yellow nutsedge, purple nutsedge is a perennial that produces tubers on its rhizomes. However,

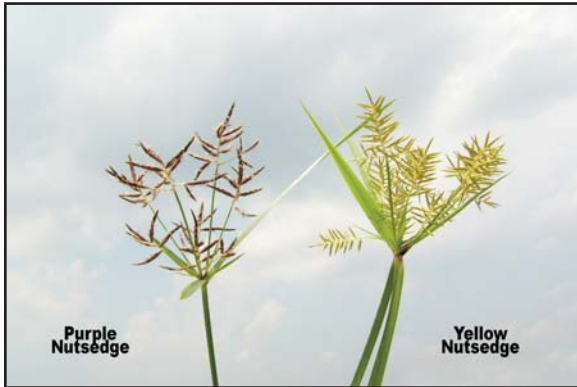
there are several ways the species can be distinguished. Purple nutsedge produces tubers in chains connected by rhizomes, whereas yellow nutsedge only produces tubers at the tips of rhizomes. Purple nutsedge tends to have darker green leaves and produces a characteristic reddish-purple seedhead. The leaf tips of purple nutsedge tend to be more blunt than those of yellow.

### CONTROL PRACTICES

As with yellow nutsedge, control strategies must begin in the spring after maximum shoot emergence but before new tuber production. (In North Carolina, this will be May and June.) This species is much more difficult to control than yellow nutsedge, and effective management requires multiple herbicide applications each year. It will likely take several years to successfully control heavy infestations. Control is best achieved with sulfonylurea herbicides.

Characteristic	Type	Description
Growth Season	perennial weed	

Characteristic	Type	Description
Seed Arrangement on Spikes	loose	seedhead a distinct purple color when compared to yellow nutsedge's yellow seedhead
Seedhead Spikelet Shape	flattened	
Tuber Type	black	black tubers have a bitter (pepper) flavor



## Nutsedge, Yellow

[*Cyperus esculentus* L.]

Yellow nutsedge is a native of North America found throughout the United States and is one of the more cold-tolerant sedge species. Yellow nutsedge is a rapidly spreading perennial that forms brown- to tan-colored tubers at the tips of rhizomes. It gets its name from the yellowish-brown or straw-colored seedhead. This weed can be a severe problem in both warm- and cool-season turf species.

PW



tuber

### CONTROL PRACTICES

Although this weed can be difficult to control, it is much easier to control than other sedge species. Proper identification is important to obtain effective control. Timing of control strategies is also important. Control strategies should begin in the spring after maximum shoot emergence but before new tuber production. Beginning in late June and early July, this weed species starts to add new tubers which will lead to additional weed problems in future years. Control is best achieved with sulfonylurea herbicides.

Characteristic	Type	Description
Growth Season	perennial weed	
Seed Arrangement on Spikes	loose	seedhead a distinct yellow when compared to purple nutsedge's purple hue
Seedhead Spikelet Shape	flattened	
Tuber Type	tan	tan tubers have little taste - might be slightly sweet



## Sedge, Annual

[*Cyperus compressus* L.]

This species is one of the few sedge species that is a true annual. As a result, this sedge is easier to control than many perennial sedges. Annual sedge has a very characteristic flattened seedhead that tends to be relatively large compared to other sedges. Annual sedge tends to have a more "clumpy" appearance than other sedges — particularly when it occurs in low densities. This sedge also tends to emerge later in the spring or summer than most other sedge species.

AW



seedhead

### CONTROL PRACTICES

While several preemergence crabgrass herbicides will partially control this weed, effective control usually involves postemergence applications of various herbicides.

Characteristic	Type	Description
Growth Season	summer annual weed	
Seed Arrangement on Spikes	tightly bunched	seedhead clusters of flat green spikes on stalks
Seedhead Spikelet Shape	flattened	
Tuber Type	none	



## Sedge, Cylindric

**[*Cyperus retrorsus* Chapman]**

Cylindric sedge is an upright perennial weed that can reach heights of 20 inches. It is a very common weed in sandy and moist habitats. The seedhead is comprised of several spikelets. Each spikelet consists of a long stalk with an oblong cluster of seeds perched on the end. The seedheads of both cylindrical sedge and globe sedge are similar but globe sedge seedheads are round, whereas cylindrical sedge seedheads are oblong.

PW



### CONTROL PRACTICES

Effective control is achieved with postemergence applications of sulfonylurea herbicides and also an arsonate tank mix.

Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Seed Arrangement on Spikes</b>	tightly bunched	
<b>Seedhead Spikelet Shape</b>	oblong	seedhead branches at the top of the stem, oblong seedheads are green, and turn dark brown at maturity
<b>Tuber Type</b>	none	



## Sedge, Globe

**[*Cyperus croceus* Vahl.]**

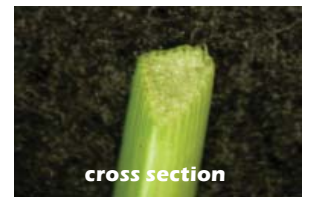
Globe sedge is a perennial that has a rounded or "globe-shaped" seedhead — hence the name. This species is found from Virginia south into Florida and west to Texas, Oklahoma, and Missouri. It is also found in many of the tropical regions of the world. The seedhead is very similar to that of cylindrical sedge.

PW



### CONTROL PRACTICES

As with other perennial sedges, multiple herbicide applications are usually necessary for effective control. Care should be taken to prevent this sedge from producing seedheads because spread of this weed is primarily due to seed dispersal.



Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Seed Arrangement on Spikes</b>	tightly bunched	
<b>Seedhead Spikelet Shape</b>	round	seedhead branches at the top of the stem, and the seeds are arranged in globe-shaped clusters
<b>Tuber Type</b>	none	



# BROADLEAF WEEDS

Broadleaf weeds provide unique control issues in turfgrass. The key to weed control is proper identification. Broadleaf weed characteristics are widely varied, with growth patterns that range from low-growing to upright to vining. Leaves are generally wide, but can also be oblong. Broadleaves almost always have net-like veins, whereas sedges and grasses have parallel venation. Broadleaves can have either round or square stems. In addition, broadleaves generally have showy flowers. Various broadleaf weed leaf shapes include round, oval, linear, kidney, and heart shaped. Leaf edges can be smooth, wavy, serrated, or deeply lobed. Leaves can be simple, pinnately, or palmately compound. Most broadleaf weeds are dicots.

## WEED MANAGEMENT PRACTICES

A dense, vigorous turf maintained year round is the best way to reduce the encroachment of broadleaf weeds. First, select adapted turfgrass cultivars for your area and then properly fertilize, mow, and water to encourage dense growth.

Most of the broadleaf weeds described in this section may be controlled with selective postemergence herbicides if the desired turfgrass has tolerance. When controlling several different weeds, it may be desirable to select a combination product that is a mixture of two, three, or four broadleaf herbicides. Non-selective postemergence herbicides are available for controlling broadleaf weeds in completely dormant bermudagrass or in turf stands where no other control options are available. These sensitive turf stands will require seeding, sprigging, or sodding after application.

**For more information on control of specific weeds, see *Pest Control for Professional Turfgrass Managers, or the Decision Aid for Weed Management, on the TurfFiles Web site (<http://www.TurfFiles.ncsu.edu>)*.**

# GENERAL DESCRIPTIONS AND CONTROL PRACTICES

## WEEDS

Weeds by definition are any plant(s) that grow where not intended. Whereas some turfgrass species are classified as both turfgrasses and weeds, all of the broadleaves listed in this book are considered weeds to any successful turfgrass program. Categorization depends upon several factors including: geographic location, plant species, subspecies, and climate. Broadleaves are generally placed into one or more of the following categories: winter annuals, summer annuals, biennials, or perennials.

## WINTER ANNUAL BROADLEAF WEEDS

Winter annual broadleaf weeds germinate in the fall or winter and grow during any warm weather which may occur in the winter, but otherwise remain somewhat dormant during the winter. They resume growth and produce seed in the spring and die as temperatures increase in late spring and early summer. They quickly invade thin turf areas especially when soil moisture is adequate. Shade may also encourage growth. Many winter annuals have a prostrate growth habit and are not affected by mowing.

## WEED MANAGEMENT PRACTICES

Control all of the winter annual weeds described in this section, except corn speedwell, with selective broadleaf postemergence herbicides if the desired turfgrass has tolerance. When controlling several different weeds, it may be desirable to select a combination product that is a mixture of two or three broadleaf herbicides.

In dormant bermudagrass golf fairways, several herbicides with both preemergence and postemergence activity may be applied to control winter annual broadleaf weeds and annual bluegrass. Non-selective postemergence herbicides are also available for controlling these weeds in completely dormant bermudagrass.

Winter annual broadleaf weeds are preferably sprayed from December through March, depending on turf species, location within the state, temperature, and growing conditions. In warm-season turfgrasses, winter annual broadleaf weeds should be sprayed while the turf is still dormant and before spring greenup occurs. Spray before resumption of spring growth in cool-season turfgrasses. Spraying at these times gives the turf a greater chance of growing into those previously weed-infested areas.

## SUMMER ANNUAL BROADLEAF WEEDS

Summer annual broadleaf weeds emerge in the spring or early summer, grow during the summer, and produce seed in mid- to late summer. Midsummer rains frequently encourage germination.

## WEED MANAGEMENT PRACTICES

Maintain a dense, actively growing turf through proper mowing, fertilizing, and watering practices. Mow at the proper height for your turfgrass. For example, mowing a bluegrass/tall fescue mixture at less than 2 inches will encourage summer annual broadleaf weeds and grassy weeds. Some summer annual weeds, like prostrate spurge, can be effectively controlled with preemergence herbicides that also control crabgrass before the seeds germinate.

Coring and traffic control reduce compaction and encourage desirable turfgrass competition. Spray infested areas with a selective broadleaf postemergence herbicide when weeds are small, usually at the three- to four-leaf stage. It is best to control summer annual broadleaf weeds in late spring or early summer when they are in the early development stage. They are easier to control at that time and both warm-season and cool-season turfgrasses have a greater chance to recover and grow in the areas previously occupied by weeds.

## BW BIENNIAL BROADLEAF WEEDS

Biennial broadleaf turf weeds have a two-year life cycle. They create vegetative structures (leaves, stems, and roots) during the first year, and reproductive structures (flowers and seeds) the second.

## WEED MANAGEMENT PRACTICES

Proper turf maintenance is important for biennial broadleaf weed control. Spray weeds with an appropriate postemergence herbicide in the spring or fall, or both spring and fall, if weeds are actively growing at these times. Select a herbicide according to the weeds to be controlled and the tolerance of the turfgrass. For example, bentgrass and hybrid bermudagrasses are less tolerant to 2,4-D than bluegrass, fescue, and common bermudagrass. Centipedegrass and St. Augustinegrass are also sensitive to products containing 2,4-D. When spraying centipedegrass or St. Augustinegrass, use products formulated for southern grasses as they contain reduced amounts of 2,4-D. You may need to select a product containing two, three, or four broadleaf herbicides if several different weeds are present.

## PW PERENNIAL BROADLEAF WEEDS

Perennial broadleaf turf weeds are capable of living more than two years. They primarily spread by seed produced in the spring or early summer. Many are capable of vegetative reproduction, which makes them difficult to control. For example, ground ivy and white clover have creeping stems that root at the nodes. India mock-strawberry has stolons, and wild garlic has underground bulbs. These perennial broadleaf turfgrass weeds may be considered cool-season perennials. Some actively grow during the summer in the western part of the state (for example, dandelion and plantains), but they are less active in the Piedmont and Coastal Plain. They thrive in weak, thin turf; golf fairways and roughs; home lawns; playfields; and industrial grounds.

## WEED MANAGEMENT PRACTICES

Proper turf maintenance is also the key to perennial broadleaf weed control. Spray weeds with an appropriate postemergence herbicide in March or April depending upon your location. Select the herbicide according to the weeds to be controlled and the tolerance of the turfgrass. For example, bentgrass and hybrid bermudagrasses are less tolerant to 2,4-D than bluegrass, fescue, and common bermudagrass. Centipedegrass and St. Augustinegrass are also sensitive to products containing 2,4-D. When spraying centipedegrass or St. Augustinegrass, use products formulated for southern grasses as they contain reduced amounts of 2,4-D. You may need a product containing two or three broadleaf herbicides if several different weeds are present. Some perennial broadleaf weeds may require a second herbicide application four to six weeks after the first application.



## Betony, Florida

**[*Stachys floridana* Shuttlew. ex Benth.]**

Florida betony is a perennial weed that emerges in the fall and becomes a problem in late winter and spring. It is easily recognized by the very characteristic white tuber that resembles a rattlesnake rattle. This weed also has square stems and produces white to pink flowers in the spring. It is found in the southern United States west to Texas and north to Virginia.

PW



rattlesnake tuber

## CONTROL PRACTICES

Florida betony is a very difficult weed to control. In tolerant warm-season turf, a triazine herbicide may be used in December and again in March. Repeat applications of two-, three-, or four-way broadleaf herbicides will usually provide only partial control.

Characteristic	Type	Description
Growth Season	perennial weed	
Growth Habit	upright	
Leaflet Number	one	
Leaf Margin	serrated/toothed	
Leaf Hairs	none	
Leaf/Leaflet Shape	heart/kidney/spade	
Leaf Width	0.5 - 1 in	
Leaf Venation	palmate	
Leaf Arrangement	opposite	
Root Type	fibrous	very distinctive white rattlesnake tubers
Flower Color	white	

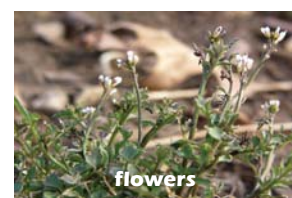


## Bittercress, Hairy

[*Cardamine hirsuta* L.]

Hairy bittercress is a winter or summer annual weed (depending on location). Stems can be 3-9 in long, and the leaves are mostly on the lower portion of the stem in a basal rosette. Leaves are deeply lobed, bearing a few minute hairs at the base of the leaf and occasionally on the upper surface of the leaf. Leaves at the base of the plant are larger than the leaves at the top of the plant. Flowers are borne in dense clusters at the end of branches and are small with four white petals. The fruit, which is a capsule,

develops rapidly at the ends of each branch and is about 3/4 in long and 1/32 in wide.



flowers



seed pods

### CONTROL PRACTICES

Hairy bittercress is easily controlled postemergence in the fall or spring with two-, three-, or four-way broadleaf herbicides.

Characteristic	Type	Description
Growth Season	summer annual weed OR winter annual weed	
Growth Habit	upright OR rosette	
Leaflet Number	four or more	2 - 4 pairs of leaflets arranged alternately
Leaf Margin	lobed	shallowly toothed or with a few lobes
Leaf Hairs	upper/lower surface	
Leaf/Leaflet Shape	heart/kidney/spade	
Leaf Width	<0.5 in OR 0.5 - 1 in	
Leaf Venation	pinnate	
Leaf Arrangement	alternate	
Root Type	fibrous	
Flower Color	white	



## Blackberry

[*Rubus spp.*]

Blackberries are perennial weeds that are often referred to as “brambles.” They have an upright and vining growth habit that can completely take over waste areas when not controlled. Blackberries have prickles on the stems and leaves, and deep taproots that make chemical control difficult. Distinctive berries form in the late summer, turning from red to black in color as the season progresses.

PW



### CONTROL PRACTICES

Blackberry can be controlled with products containing triclopyr. Apply in the spring after greenup.

Characteristic	Type	Description
Growth Season	perennial weed	
Growth Habit	upright OR vining	
Leaflet Number	three	
Leaf Margin	serrated/toothed	
Leaf Hairs	upper/lower surface	leaf hairs are present, along with distinctive thorns on the leaves and stems
Leaf/Leaflet Shape	oval/egg-shaped/elliptical	
Leaf Width	1 - 2 in	
Leaf Venation	pinnate	
Leaf Arrangement	alternate	
Root Type	taproot	
Flower Color	white	



## Burweed, Lawn (Spurweed)

[*Soliva sessilis Ruiz & Pavón*]

Lawn burweed, also known as spurweed, is a very low-growing winter annual weed that closely resembles parsley-piert. It is freely branched and usually does not root at the nodes. The leaves are oppositely arranged and highly divided into little leaf segments. Flowers are small (to 1/4 in), broad, and inconspicuous. The seeds have sharp spines, hence the common name. Lawn burweed is commonly found in turfgrass systems. Infestations are increasing in North Carolina, particularly in the southern coastal plain and piedmont.

AW



### CONTROL PRACTICES

Lawn burweed is controlled postemergence in tolerant warm-season turf with sulfonyleurea and triazine herbicides in fall or spring. Two-, three-, and four-way broadleaf herbicides also provide control.

Characteristic	Type	Description
Growth Season	winter annual weed	
Growth Habit	prostrate, spreading	
Leaflet Number	one	
Leaf Margin	lobed	three-lobed with each lobe again divided into lobes
Leaf Hairs	upper/lower surface	sparsely hairy
Leaf/Leaflet Shape	heart/kidney/spade	
Leaf Width	<0.5 in	
Leaf Venation	palmate	
Leaf Arrangement	opposite	

Characteristic	Type	Description
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Root Type	fibrous	
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Flower Color		inconspicuous
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## Buttercup, Bulbous

[*Ranunculus bulbosus* L.]

Bulbous buttercup is readily found in the piedmont and coastal plain regions of North Carolina.

Vegetative characteristics of bulbous buttercup are similar to hairy buttercup except for the bulb-like swelling at the base of the stem. This swelling is roundish and white, slightly flattened at the top and bottom, and somewhat resembles a small turnip.

Smallflower buttercup is also found in North Carolina. Bulbous buttercup has lobed leaves, whereas most lower leaves of smallflower buttercup are unlobed.



### CONTROL PRACTICES

Bulbous buttercup can be controlled with two-, three-, and four-way broadleaf herbicides in the fall or spring.

Characteristic	Type	Description
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Growth Season	winter annual weed OR perennial weed	
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Growth Habit	upright OR rosette	more prostrate in mowed turf situations
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Leaflet Number	one	
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Leaf Margin	lobed	divided into three lobes
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Leaf Hairs	upper/lower surface	dense hairs on upper surface
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Leaf/Leaflet Shape	oval/egg-shaped/elliptical	
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Leaf Width	0.5 - 1 in OR 1 - 2 in	
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Leaf Venation	palmate	
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Leaf Arrangement	alternate	
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Root Type	bulbous	
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Flower Color	yellow	
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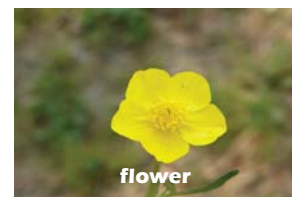


## Buttercup, Hairy

[*Ranunculus sardous* Crantz]

Hairy buttercup is readily found in the piedmont and mountain regions of North Carolina. This buttercup is a hairy plant with erect, hairy stems (single or branching from the base) and a fibrous root system. Vegetative characteristics are similar to those for bulbous buttercup, except hairy buttercup lacks the bulb-like swelling at the base of the stem that is found on bulbous buttercups. Smallflower buttercup is also found in North Carolina, and can be distinguished

from hairy buttercup by the lack of hairs on its leaves. Additionally, hairy buttercup has lobed leaves; most smallflower buttercup lower leaves of are unlobed.



### CONTROL PRACTICES

Same as bulbous buttercup.

Characteristic	Type	Description
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Growth Season	winter annual weed OR perennial weed	
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Growth Habit	upright	
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Leaflet Number	one	
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Characteristic	Type	Description
Leaf Margin	lobed	
Leaf Hairs	upper/lower surface	dense on both upper and lower surface
Leaf/Leaflet Shape	oval/egg-shaped/elliptical	
Leaf Width	1/2 - 1 in OR 1 - 2 in	
Leaf Venation	palmate	
Leaf Arrangement	alternate	
Root Type	fibrous	
Flower Color	yellow	



## Buttercup, Smallflower

**[*Ranunculus abortivus* L.]**

Smallflower buttercup may resemble a wild violet in its early growth, but later produces upright stems that are slender and branch from the base of the plant. Lower leaves are dark green and rounded, while upper leaves are a brighter green and elongated with occasional lobes. Flowers, which appear from April to August, are tiny and yellow with five petals.

**A B P W**



The plant can grow to heights of 6 - 24 in. Smallflower buttercup reproduces by seed, grows in both dry and moist environments, and is commonly found in fields, waste areas, and wooded habitats. It can be distinguished from hairy buttercup by the lack of hairs on its leaves. In addition, hairy and bulbous buttercup have lobed leaves, whereas most of the lower leaves of smallflower buttercup are unlobed.

### CONTROL PRACTICES

Same as bulbous buttercup.

Characteristic	Type	Description
Growth Season	winter annual weed OR biennial weed OR perennial weed	
Growth Habit	upright	
Leaflet Number	one	
Leaf Margin	smooth OR wavy/crinkled	most lower leaves exhibit crinkled leaf margins; upper leaves tend to have smooth margins
Leaf Hairs	none	
Leaf/Leaflet Shape	heart/kidney/spade OR linear/oblong	most of the lower leaves are heart-shaped and unlobed, whereas the upper leaves tend to be elongated and occasionally lobed
Leaf Width		
Leaf Venation	pinnate	
Leaf Arrangement	opposite OR whorled or basal rosette	
Root Type	fibrous	
Flower Color	yellow	

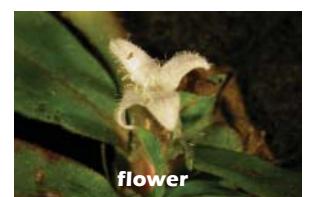


## Buttonweed, Virginia

**[*Diodia virginiana* L.]**

Virginia buttonweed is an herbaceous perennial with prostrate or spreading branches. The stems are longitudinally ridged, especially below the nodes, with hairs along the ridges. The leaves are opposite, lacking petioles, and are rough along the margins. The leaves are slightly thickened, green on the upper surface and light green on the lower surface with both surfaces smooth and slightly folded. The leaves of Virginia buttonweed

**P W**



often take on a mottled-yellow mosaic look. The white flowers sometimes have pink streaks in the center and are borne in the leaf axil. Petals are united into a tube. The fruit, bearing four membranous sepals at the tip, is produced in leaf axils.

## CONTROL PRACTICES

Virginia buttonweed is a difficult-to-control broadleaf weed. Best results have occurred with repeat applications of three-way herbicides. Apply in spring and repeat when regrowth occurs, usually in 4 to 6 weeks.

Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Growth Habit</b>	prostrate, spreading	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	upper/lower surface	
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	
<b>Leaf Width</b>	0.5 - 1 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>	opposite	
<b>Root Type</b>	fibrous	
<b>Flower Color</b>	white	



## Carpetweed

**[Mollugo verticillata L.]**

Carpetweed is a small weed that can cover large patches of ground in a very short time. Although it grows fast, this weed is not particularly competitive in turfgrass. Carpetweed is one of the most common weeds in cultivated areas and thin turf stands. It is a summer annual weed with a prostrate growth habit, smooth stems and leaves, and white flowers in the joints between leaf and stem. Leaves form in round whorls around the stem. Carpetweed flowers from July to September.



## CONTROL PRACTICES

Carpetweed may be controlled with preemergence crabgrass products; triazine herbicides; or postemergence two-, three-, and four-way broadleaf herbicides.

Characteristic	Type	Description
<b>Growth Season</b>	summer annual weed	
<b>Growth Habit</b>	prostrate, spreading	mat-forming, plants root at the nodes, and form round whorls of leaves
<b>Leaflet Number</b>	four or more	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	
<b>Leaf Width</b>	0.5 - 1 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>	whorled or basal rosette	
<b>Root Type</b>	fibrous OR taproot	
<b>Flower Color</b>	white	



## Chickweed, Common

[*Stellaria media* (L.) Vill.]

Common chickweed is a low-spreading winter annual or perennial weed with a weak, shallow root system. The prostrate stems often root at the nodes. Its spreading growth covers adjacent turf, forming extensive, dense patches that seriously impede turf growth. Leaves are opposite, oval, and tapered to a point. Small white flowers are borne in clusters at the end of the stems. Flowers have five deeply notched petals and, though small, the flowers are

quite noticeable. The plant produces numerous seeds, which germinate from late fall through early spring. Common chickweed is similar in growth habit (spreading) and appearance to mouseear chickweed, but mouseear chickweed leaves are covered with soft hairs, and are dark green, whereas common chickweed leaves are less hairy and are light green.



### CONTROL PRACTICES

Chickweed will survive under close mowing, forming dense patches that crowd out desirable turfgrass. This weed quickly invades thin turf areas especially where there is good soil moisture. Shade and frequent watering encourage chickweed growth. Certain preemergence herbicides may be used to control chickweed in areas where reseeding or overseeding of turf is not planned. These are applied in the fall prior to expected germination of chickweed, which is encouraged by cool temperatures and adequate moisture. See page 39 for more information on CONTROL PRACTICES for winter annual weeds.

Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed OR perennial weed	
<b>Growth Habit</b>	prostrate, spreading	mat-forming; young plants are erect
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	upper/lower surface	
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	ovate with pointed tip, broadly elliptical, egg-shaped
<b>Leaf Width</b>	<1/2 in OR 1/2 - 1 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>	opposite	
<b>Root Type</b>	fibrous	
<b>Flower Color</b>	white	

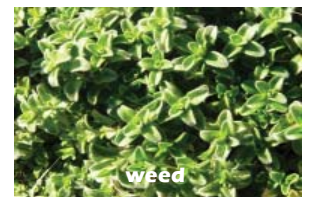


## Chickweed, Mouseear

[*Cerastium vulgatum* L.]

Mouseear chickweed acts as a winter annual in eastern North Carolina and as a perennial in the western part of the state, especially at higher elevations. It has a vigorous prostrate growth habit. Leaves of mouseear chickweed are opposite, oblong, dark green and, in contrast to common chickweed, covered with soft hairs. Hairy stems creep along the

ground and take root at nodes touching the soil. The small, white flowers have five slightly notched petals.



### CONTROL PRACTICES

Same as common chickweed.



Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed OR perennial weed OR biennial weed	
<b>Growth Habit</b>	prostrate, spreading	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	upper/lower surface	very dense, soft hairs on upper surface, hairs on veins on bottom surface
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	oval to elliptical without petiole
<b>Leaf Width</b>	1/2 - 1 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>	opposite	
<b>Root Type</b>	fibrous	
<b>Flower Color</b>	white	

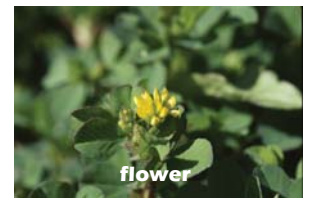
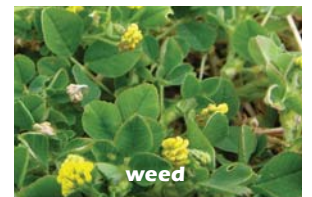


## Clover, Large Hop

**[*Trifolium campestre* Schreb.]**

Large hop clover is a much-branched winter annual or biennial weed. It has a trifoliate leaf similar to white clover. Leaflets have prominent veins, and the terminal leaflet of each leaf is on a short stem. Hop clover has short, hairy, reclining, slender stems, which are somewhat reddish. Flowers are bright yellow with numerous closely associated flowers borne in clusters. Each individual flower produces a single seed. Small hop clover [*T. dubium* Sibthorpe] is very

similar, but with fewer flowers in the cluster. Both clovers grow in disturbed areas.



### CONTROL PRACTICES

Large hop clover can be controlled with products containing two-, three-, and four-way broadleaf herbicides. Clover species are especially susceptible to clopyralid-containing products. Apply in fall or spring.

Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed OR biennial weed	
<b>Growth Habit</b>	prostrate, spreading	
<b>Leaflet Number</b>	three	
<b>Leaf Margin</b>	serrated/toothed	leaflets are toothed from mid-blade to tip
<b>Leaf Hairs</b>	upper/lower surface	
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	leaf is trifoliate; leaflets are elliptical
<b>Leaf Width</b>	<1/2 in OR 1/2 - 1 in	
<b>Leaf Venation</b>	pinnate	prominent veins
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>	fibrous	
<b>Flower Color</b>	yellow	



## Clover, Small Hop

**[*Trifolium dubium* Sibthorpe]**

Small hop clover is a winter annual weed that closely resembles large hop clover. Large hop clover has leaves that are larger and more serrated. Small hop clover is low growing, with prominent yellow flowers that bloom in early summer. Both clovers grow in disturbed areas.



## CONTROL PRACTICES

Same as large hop clover.

Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed	
<b>Growth Habit</b>	prostrate, spreading	
<b>Leaflet Number</b>	three	
<b>Leaf Margin</b>	serrated/toothed	
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	
<b>Leaf Width</b>	<1/2 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>	fibrous	
<b>Flower Color</b>	yellow	



## Clover, White

**[*Trifolium repens* L.]**

White clover is a perennial with creeping stems rooting at some nodes. Leaves with three leaflets (often marked with a white “watermark”) are borne on a long petiole surrounded at the base by a membranous sheath. The flowering heads are borne on long stalks arising from the stems and usually rise above the leaves. The flower cluster may be ½ to 1½ inches in diameter. The petals are white and occasionally tinged with pink.

P W



## CONTROL PRACTICES

White clover may be found under close mowing conditions on golf greens. Maintaining soil phosphorus at medium levels and nitrogen at the proper level for the desired turfgrass reduces the competitive ability of white clover in turf. White clover may be effectively controlled with fall herbicide applications. See page 40 for more information on CONTROL PRACTICES for perennial weeds.

Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Growth Habit</b>	prostrate, spreading	
<b>Leaflet Number</b>	three	usually a white crescent-shaped mark near the base of the upper surface of each leaflet
<b>Leaf Margin</b>	serrated/toothed	slight toothing on leaflet edges
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	
<b>Leaf Width</b>	1/2 - 1 in OR 1 - 2 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>	fibrous	can usually find round nodules on the roots, which fix atmospheric nitrogen for use by plants
<b>Flower Color</b>	white	



## Cudweed

[*Gnaphalium* spp.;  
*Pseudognaphalium* spp.;  
*Gamochaeta* spp. ]

The cudweeds are comprised of many different species that are similar in growth habits and control measures. In general, the cudweeds grow in basal rosettes and the leaves and seedheads are covered in distinct fine, white “wooly” fibers. Some cudweeds only have this hair on the undersides of the leaves, and other cudweeds have this hair on all surfaces.



Cudweeds overwinter as small basal rosettes, but in the spring usually grow an upright stem.

### CONTROL PRACTICES

Cudweed species are biennial plants but are relatively easy to control postemergence with two-, three-, and four-way broadleaf herbicides. Apply in the spring while in rosette stage and before seed stalk formation.

Characteristic	Type	Description
<b>Growth Season</b>	summer annual weed OR winter annual weed OR biennial weed	
<b>Growth Habit</b>	upright OR rosette	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	upper/lower surface	
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	
<b>Leaf Width</b>	1/2 - 1 in OR 1 - 2 in	
<b>Leaf Venation</b>	pinnate	leaf venation is hard to see, but leaves usually look like they have been folded or creased
<b>Leaf Arrangement</b>	whorled or basal rosette	
<b>Root Type</b>	taproot	
<b>Flower Color</b>	white	flower is tanish white, and produces a white fiber



Photo Courtesy of Joe Neal, NCSU

## Dandelion, Carolina False

[*Pyrhopappus carolinianus* (Walt.) DC.]

Carolina false dandelion is a winter annual or biennial weed common in disturbed sites, such as pastures and fields. The hairy leaves are deeply lobed and form a basal rosette with a taproot. The flower stalk can have many branches that end with flowers, unlike common and cat's ear dandelion. The bright yellow flowers appear in the spring and summer.



### CONTROL PRACTICES

Same as common dandelion.

Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed OR biennial weed	
<b>Growth Habit</b>	rosette	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	lobed	deeply lobed
<b>Leaf Hairs</b>		

Characteristic	Type	Description
Leaf/Leaflet Shape	linear/oblong	sharp-pointed
Leaf Width	1/2 - 1 in	
Leaf Venation	pinnate	
Leaf Arrangement	alternate	
Root Type	taproot	
Flower Color	yellow	



## Dandelion, Cat's Ear

[*Hypochoeris radicata* L.]

Cat's ear dandelion is a perennial weed similar to common dandelion. It has a basal rosette of densely hairy leaves with rounded lobes, and a prominent taproot. If broken, leaves and flower stalks emit a milky white sap. Bright yellow flowers are borne on long stems. Common dandelion plants can be distinguished because young leaves do not have hairs, whereas cat's ear dandelion leaves have dense hairs. In addition, the leaves of common dandelion are more deeply notched than those of cat's ear

dandelion. On common dandelion, the leaf notches extend almost to the midrib of each leaf.

PW



### CONTROL PRACTICES

Same as common dandelion.

Characteristic	Type	Description
Growth Season	perennial weed	
Growth Habit	rosette	
Leaflet Number	one	
Leaf Margin	lobed OR serrated/toothed	coarsely toothed; blunt to slightly pointed tips
Leaf Hairs	upper/lower surface	dense
Leaf/Leaflet Shape	oval/egg-shaped/elliptical	
Leaf Width	1/2 - 1 in	
Leaf Venation	pinnate	
Leaf Arrangement	whorled or basal rosette	
Root Type	taproot	
Flower Color	yellow	



## Dandelion, Common

[*Taraxacum officinale* G.H. Weber ex Wiggers]

Dandelion is a perennial weed with a thick taproot. Leaves grow in a rosette and are long, narrow, irregularly lobed, and lance shaped. The lobed tips are opposite each other and pointing toward the crown. Leaves are often purple at the base, and leaves and flower stalks emit a milky white sap when broken. The deep golden yellow flowers are borne on hollow stalks. Blossoms mature into white

puffballs, composed of parachute-like seeds. Common dandelion plants can be distinguished from cat's ear dandelion because young leaves do not have hairs, whereas cat's ear dandelion leaves have dense hairs.

PW



### CONTROL PRACTICES

Dandelion may be effectively controlled with fall herbicide applications. See page 40 for more information on CONTROL PRACTICES for perennial weeds.

Characteristic	Type	Description
Growth Season	perennial weed	
Growth Habit	rosette	
Leaflet Number	one	
Leaf Margin	lobed OR serrated/toothed	irregular border; lobes point back toward base of plant
Leaf Hairs		older leaves may have hairs
Leaf/Leaflet Shape	linear/oblong OR oval/egg-shaped/elliptical	young leaves are oval to spatulate; older leaves are lance-shaped or oblong
Leaf Width	1/2 - 1 in	
Leaf Venation	pinnate	
Leaf Arrangement	whorled or basal rosette	
Root Type	taproot	
Flower Color	yellow	



## Deadnettle, Purple

[*Lamium purpureum* L.]

Purple deadnettle is a common winter annual weed found in North Carolina waste areas. It is similar to henbit in appearance but its upper leaves have short petioles and the lower leaves have long petioles, whereas henbit lacks petioles. Also, the upper leaves have a distinctly red- or purple-tinge. Purple deadnettle and henbit both have distinctive four-sided (square) stems, and flower in early spring.



### CONTROL PRACTICES

Purple deadnettle can be controlled postemergence with repeat applications of two-, three-, or four- way herbicides or with a sulfonyleurea herbicide applied in the spring.

Characteristic	Type	Description
Growth Season	winter annual weed	
Growth Habit	upright OR prostrate, spreading	prostrate, but erect at the tip
Leaflet Number	one	
Leaf Margin	serrated/toothed	
Leaf Hairs	upper/lower surface	
Leaf/Leaflet Shape	heart/kidney/spade	broadly egg-shaped, round; leaves often red- or purple-tinged
Leaf Width	1/2 - 1 in	
Leaf Venation	palmate	
Leaf Arrangement	opposite	
Root Type	fibrous	
Flower Color	blue/purple	



## Dichondra

[*Dichondra carolinensis* Michx.]

Dichondra is a perennial, spreading by slender creeping stems that root at the nodes. It forms mats not over 1½ to 3 in tall. The kidney-shaped to nearly circular leaves grow alternate to each other, sometimes appearing whorled on the stems. The white to greenish small flowers are borne in clusters in the leaf axils below the level of the leaf. Dichondra is cultivated as a ground cover in some states.



## CONTROL PRACTICES

Dichondra is controlled postemergence in the spring with two-, three- and four-way broadleaf herbicides and also with some sulfonyleurea herbicides.

Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Growth Habit</b>	prostrate, spreading	dichondra can creep over a large area, forming a dense mat of vegetation
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	heart/kidney/spade	kidney-shaped to nearly round
<b>Leaf Width</b>	<1/2 in	
<b>Leaf Venation</b>	palmate	
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>	fibrous	roots at the nodes
<b>Flower Color</b>	white	inconspicuous



## Dock, Curly

**[*Rumex crispus* L.]**

Curly dock is a perennial with a thick taproot. Leaves grow at the base of the plant and are lance-shaped with wavy margins. Leaf blades are 6 to 8 inches long and 1 to 2 inches wide. The green leaves may be tinged reddish purple. Curly dock seldom produces seed in maintained turf. When the plants grow unchecked, small greenish flowers are produced in clusters at the top of the main stems. Flowers become reddish-brown at maturity. The shiny reddish-brown triangular seed is surrounded by three sepals.

P W



## CONTROL PRACTICES

Curly dock is controlled postemergence in the fall or spring with two-, three- and four-way broadleaf herbicides.

Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Growth Habit</b>	upright OR rosette	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	wavy/crinkled	
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	linear/oblong	
<b>Leaf Width</b>	1 - 2 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>	taproot	
<b>Flower Color</b>		"flowers" consist of green achenes that turn reddish-brown and dry as the weed matures



## Dollarweed (Pennywort)

**[*Hydrocotyle* spp.]**

This perennial weed is commonly found in very wet areas. Dollarweed can float in water. Plants reproduce from rhizomes, and have leaves that are on long stalks. Solid scalloped leaves are attached to the stalk on the underside and form an inverted "umbrella" shape. Clusters of white flowers form in late summer.

P W



## CONTROL PRACTICES

Dollarweed is a difficult weed to control for an entire growing season. Repeat spring applications of sulfonylurea herbicides in tolerant turf, as well as two-, three-, and four-way broadleaf herbicides, may be used.

Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Growth Habit</b>	prostrate, spreading	leaves on erect long petioles
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	serrated/toothed	scalloped
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	round	
<b>Leaf Width</b>	1 - 2 in OR greater than 2 in	
<b>Leaf Venation</b>	palmate	petiole attaches to center of leaf and veins arise from this point
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>	fibrous	
<b>Flower Color</b>	white	



## Garlic, Wild

**[*Allium vineale* L.]**

Wild garlic is a perennial plant with an odor of garlic, which develops from a basal bulb covered by a membranous coat. At maturity, the bulb is covered with small yellowish bulbs, flattened on one side, which readily split apart. Leaves are hollow and round. The greenish-pink to purplish flowers are borne in clusters at the stem tip and are often mixed among small greenish aerial bulblets.

P W



## CONTROL PRACTICES

Wild garlic can be controlled in the fall, preferably, or spring with a postemergent herbicide plus a nonionic surfactant. Apply for 2 years to get over 90 percent control. Wild garlic is also controlled with various sulfonylurea herbicides.

Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Growth Habit</b>	upright	
<b>Leaflet Number</b>		upright leaves are slender, round, and hollow and resemble grass blades
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	linear/oblong	
<b>Leaf Width</b>	<1/2 in	
<b>Leaf Venation</b>	parallel	
<b>Leaf Arrangement</b>		
<b>Root Type</b>	bulbous	fibrous roots are attached to the bottom of the bulb
<b>Flower Color</b>	blue/purple	



## Geranium, Carolina

**[*Geranium carolinianum* L.]**

Carolina geranium is a winter annual or biennial weed (also called cranesbill because the fruits have a long "cranesbill" beak). The leaves are deeply five- to seven-lobed and each lobe is again lobed and bluntly toothed. The flower is pink to lavender and borne two to several together on stalks from the upper nodes. It blooms mostly in April and May.

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## CONTROL PRACTICES

Two-, three-, and four-way broadleaf herbicides control Carolina geranium in the fall or spring. Sulfonylurea herbicides also give control.

Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed OR biennial weed	
<b>Growth Habit</b>	upright OR rosette	basal rosette of leaves, stems erect
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	lobed OR serrated/toothed	deeply five- to seven-lobed and each lobe is again lobed and bluntly toothed
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	heart/kidney/spade	
<b>Leaf Width</b>	1 - 2 in OR greater than 2 in	
<b>Leaf Venation</b>	palmate	
<b>Leaf Arrangement</b>		usually alternate near base, opposite above
<b>Root Type</b>	taproot	
<b>Flower Color</b>	blue/purple OR white	



## Greenbriar, Roundleaf

**[*Smilax rotundifolia* L.]**

Greenbriar is a perennial woody vine that often climbs other vegetation. The broad heart-shaped leaves are shiny and have parallel venation and smooth margins. The stems have many sharp prickles along their entire length. Greenbriar can form thickets of vegetation in undisturbed sites, as well as in open landscapes and nursery areas.

P W



### CONTROL PRACTICES

Two-, three- or four-way herbicides are not effective on greenbriar. Partial control may be obtained with combinations of triclopyr + 2,4-D or nonselective herbicides.

Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Growth Habit</b>	upright OR vining	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	none	has no hairs, but very prominent thorns and prickles
<b>Leaf/Leaflet Shape</b>	heart/kidney/spade OR oval/egg-shaped/elliptical	
<b>Leaf Width</b>	1 - 2 in OR greater than 2 in	
<b>Leaf Venation</b>	parallel	
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>	fibrous	very "woody"; may also be found with white rhizomes
<b>Flower Color</b>	yellow	yellowish brown



## Henbit

**[*Lamium amplexicaule* L.]**

Henbit is a very common winter annual or biennial weed in turf. Stems grow primarily upright but can root at the lower nodes. It branches freely from the base stems, which are green or purple. Leaves are rounded, coarsely toothed, hairy, and deeply veined. They are opposite on petioles in the lower portion of the stem. The upper leaves are sessile or clasping the stem. Flowers are in whorls in the axils of the upper leaves. Petals are purple and

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fused into a two-lipped tube.

Henbit is similar to purple deadnettle in appearance but its upper leaves do not have petioles, whereas purple deadnettle's do. Purple deadnettle also has upper leaves that are distinctly red- or purple-tinged. Purple deadnettle and henbit both have distinctive four-sided (square) stems, and flower in early spring.



### CONTROL PRACTICES

Henbit is difficult to control. In cool-season turf, fall applications of two-, three- and four-way broadleaf herbicides will provide fair to good control, with control dropping off if spring-applied. In warm-season turf, excellent control is achieved with various sulfonyleurea herbicides applied in fall or early spring.

Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed OR biennial weed	
<b>Growth Habit</b>	prostrate, spreading	stems are prostrate, but erect at the tip, square (four-sided), and often purple-tinged
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	serrated/toothed	bluntly toothed
<b>Leaf Hairs</b>	upper/lower surface	dense on upper surface, along the veins on lower surface
<b>Leaf/Leaflet Shape</b>	heart/kidney/spade	
<b>Leaf Width</b>	1/2 - 1 in OR 1 - 2 in	
<b>Leaf Venation</b>	palmate	
<b>Leaf Arrangement</b>	opposite	
<b>Root Type</b>	fibrous	
<b>Flower Color</b>	blue/purple	



## Ivy, Ground

[*Glechoma hederacea* L.]

Ground ivy is a perennial with creeping stems that root at the node. It forms dense patches and thrives in the sun and shade. The leaves are round, scalloped along the margin, heavily veined and rough on the upper surface. They are borne opposite each other on square-shaped stems. Funnel-shaped blue to violet flowers are found in clusters in leaf axils and occur in the spring. Ground ivy is similar to henbit in some respects but roots at stem nodes whereas henbit does not. Common mallow is also similar but has round stems and alternate leaves.

P W



### CONTROL PRACTICES

Ground ivy grows well in shady, moist areas. Therefore, improving surface drainage, aerating when needed, and watering infrequently will help reduce encroachment of this weed. Repeat applications of two-, three- or four-way herbicides offer fair control.

Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Growth Habit</b>	prostrate, spreading	stems are square (four-sided) and root at the nodes
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	serrated/toothed	scalloped
<b>Leaf Hairs</b>	upper/lower surface	
<b>Leaf/Leaflet Shape</b>	heart/kidney/spade	

Characteristic	Type	Description
<b>Leaf Width</b>		leaves vary in width, from more than 2 in (50 mm) in diameter at the base of the plant to less than 1/2 in (13 mm) for newly emerged leaves
<b>Leaf Venation</b>	palmate	prominent veins
<b>Leaf Arrangement</b>	opposite	
<b>Root Type</b>	fibrous	roots are fibrous, but ground ivy also spreads via creeping stems that root at the node
<b>Flower Color</b>	blue/purple	bluish purple with reddish speckles



## Knawel

**[*Scleranthus annuus* L.]**

Knawel is a winter annual which, when it first germinates, may go unnoticed because of its grasslike features. It is a freely branched plant with spreading stems. Leaves, clasping the stem, are opposite, linear, less than 1 mm wide, and sharp-pointed. The very inconspicuous flowers are clustered in the leaf axils. They are small, green, lacking petals, and somewhat spiny to the touch.



### CONTROL PRACTICES

Knawel is controlled with postemergence two-, three-, and four-way herbicides applied in the fall or spring.

Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed	
<b>Growth Habit</b>	prostrate, spreading	can form low mats or clumps in established turfgrass
<b>Leaflet Number</b>	four or more	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	linear/oblong	
<b>Leaf Width</b>	<1/2 in	
<b>Leaf Venation</b>	parallel	
<b>Leaf Arrangement</b>	opposite	
<b>Root Type</b>	fibrous OR taproot	
<b>Flower Color</b>	green	very inconspicuous green flowers; spiny to the touch when mature.



## Knotweed, Prostrate

**[*Polygonum aviculare* L.]**

Prostrate knotweed is a low-growing annual or perennial weed. Because of its prostrate growth habit, it can survive close mowing. It is a very competitive weed in infertile and compacted soils and often invades turfgrasses along driveways, sidewalks, and beaten paths across lawns. The tough, wiry, slender stems radiate from a central tap root and produce a tough mat-like growth. Leaves are dull, blue-green, oblong in shape, smooth, and alternate with a membrane at the base sheathing the stem.



The tiny white flowers are inconspicuous and are borne at the nodes. This weed germinates with the first warm temperatures in the spring. Newly emerging seedlings are often mistaken for grasses in very early stages of development.

### CONTROL PRACTICES

Knotweed is controlled with postemergence two-, three- and four-way herbicides applied in the spring.

Characteristic	Type	Description
<b>Growth Season</b>	summer annual weed OR perennial weed	
<b>Growth Habit</b>	prostrate, spreading	mat-forming
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	linear/oblong OR oval/egg-shaped/elliptical	
<b>Leaf Width</b>	1/2 - 1 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>	taproot	
<b>Flower Color</b>	white	white to pinkish in color



## Lespedeza, Common

### [*Lespedeza striata* (Thunb.) Schind]

Lespedeza is a dark green, wiry annual with trifoliate leaves. Several wide-spreading prostrate branches come from the slender taproot. It grows close to the ground and seldom is cut by a mower. It is a very common summer weed, choking out thin turf. Hairs grow downward on the stem. Leaves are composed of three leaflets. Stipules are light to reddish brown. Small single flowers arise from the leaf axils on most of the nodes of the main stems and are pink or purple.



## CONTROL PRACTICES

Common lespedeza can be a difficult-to-control weed but it is effectively controlled postemergence in the spring with products containing fluroxypyr or triclopyr. Herbicides containing metsulfuron will also provide good to excellent control.

Characteristic	Type	Description
<b>Growth Season</b>	summer annual weed	
<b>Growth Habit</b>	prostrate, spreading	
<b>Leaflet Number</b>	three	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	leaf margin	may be some along the midveins and margins only
<b>Leaf/Leaflet Shape</b>	linear/oblong OR oval/egg-shaped/elliptical	elliptical to oblong
<b>Leaf Width</b>	<1/2 in OR 1/2 - 1 in	
<b>Leaf Venation</b>	pinnate	prominent midvein on each leaflet, many parallel veins almost perpendicular to the midvein
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>	fibrous	
<b>Flower Color</b>	blue/purple	flowers can range from pink to purple



## Lespedeza, Sericea

**[*Lespedeza cuneata* (Dum.-Cours.) G.Don]**

Sericea lespedeza is a perennial weed that is commonly found in pasture areas. The woody stems grow upright. Individual leaves are oblong in shape, and appear to have been folded. Small white and purple flowers can be found in the axils of the leaves. An important identifying characteristic of sericea lespedeza is the stiff hairs that can be found on the stem.

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### CONTROL PRACTICES

Products containing fluroxypyr or triclopyr provide postemergence sericea lespedeza control when applied in the spring.

Characteristic	Type	Description
Growth Season	perennial weed	
Growth Habit	upright	may reach five feet in height
Leaflet Number	three	
Leaf Margin	smooth	
Leaf Hairs	upper/lower surface	dense
Leaf/Leaflet Shape	linear/oblong	
Leaf Width	1/2 - 1 in	leaflets are 0.5 - 0.75 in (13 - 19 mm) long
Leaf Venation	pinnate	prominent midvein on each leaflet
Leaf Arrangement	alternate	
Root Type	taproot	woody taproot
Flower Color	blue/purple OR white	



## Lettuce, Prickly

**[*Lactuca serriola* L.]**

Prickly lettuce can be a summer annual or biennial. The woody stems of this plant are hollow, and form in the middle of a basal rosette of leaves. Deeply lobed leaves clasp the base of the stem. The leaf shape is distinctive, with the indentation between lobes forming a "C" shape. Leaves are also oriented at an angle to the stem, with spines on the midrib and base of the leaf. Prickly lettuce has yellow flowers, but these can appear to be white from a distance due to the wooly hairs (pappus) on each seed.

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### CONTROL PRACTICES

Prickly lettuce can be controlled postemergence with 3-way herbicide mixtures.

Characteristic	Type	Description
Growth Season	summer annual OR biennial weed	
Growth Habit	upright OR rosette	early in the season it is a basal rosette, and then produces an upright stem later
Leaflet Number	one	
Leaf Margin	lobed	
Leaf Hairs	upper/lower surface OR leaf margin	prickles are found on the midvein on the lower surface of the leaf
Leaf/Leaflet Shape	linear/oblong	long and linear leaves with rounded notches in leaf margin
Leaf Width	1/2 - 1 in OR 1 - 2 in	
Leaf Venation	pinnate	
Leaf Arrangement	alternate	
Root Type	taproot	
Flower Color	yellow	



## Mugwort

**[*Artemisia vulgaris* L.]**

Mugwort is a perennial weed with very distinctive alternate and dissected leaves. The upper leaf surface is bright green and smooth, while the lower leaf surface is light green in color and very hairy. The leaves resemble common chrysanthemums, and also emit an odor when crushed. Mugwort is commonly found in waste areas, flower beds, and lawns. Its strong and persistent rhizomes mean that cultural and chemical control can be difficult.

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### CONTROL PRACTICES

Mugwort is extremely difficult to control. There are no selective postemergence broadleaf herbicides that will control it.

Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Growth Habit</b>	prostrate, spreading	stems round in cross section and hairy
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	lobed	deeply lobed, upper leaf surface dark green, underside of leaf white to gray
<b>Leaf Hairs</b>	upper/lower surface	dense hairs on upper surface, smooth to slightly hairy bottom surface
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	elliptical
<b>Leaf Width</b>	1 - 2 in OR greater than 2 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>	fibrous	
<b>Flower Color</b>		inconspicuous



## Pansy, Field (Johnnyjumpup Violet)

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**[*Viola rafinesquei* Greene]**

Field pansy (Johnnyjumpup violet) is a winter annual with erect, freely branched stems growing ½ to 5 inches tall. The leaves are borne alternately on the stem with prominent dissected stipules (basal appendages). Flowers are borne on prominent stalks from the upper nodes. Flower petals may be white with blue veins or entirely bluish to bluish-violet. They are similar in appearance to a miniature common violet flower.



### CONTROL PRACTICES

Field pansy is a difficult-to-control weed that does not respond very well to two-, three-, and four-way herbicides. However, various sulfonyleurea herbicides do provide good to excellent control in tolerant turf when applied in early spring before flowering.

Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed	
<b>Growth Habit</b>	upright OR prostrate, spreading	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	serrated/toothed	
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	
<b>Leaf Width</b>	1/2 - 1 in OR 1 - 2 in	basal - 0.75 to 1.5" (19 - 38 mm); upper leaves 0.5" (13 mm)
<b>Leaf Venation</b>		

Characteristic	Type	Description
Leaf Arrangement	alternate	
Root Type	fibrous	
Flower Color	blue/purple OR white OR yellow	



## Parsley-piert

**[Alchemilla microcarpa Boiss. and Rent.]**

Parsley-piert is a freely branched winter annual that grows 1 to 3 inches tall. Leaves are alternate and palmately dissected. They may also be described as three-lobed with each lobe again three- to four-lobed. They may be petiolate or sessile with a cone-shaped toothed portion (stipule) at the base that encircles the stem. The inconspicuous flowers are borne in axillary clusters and surrounded by the stipules.



### CONTROL PRACTICES

Parsley-piert is controlled postemergence with two-, three-, and four-way herbicides applied in the fall or spring.

Characteristic	Type	Description
Growth Season	summer annual weed	
Growth Habit	prostrate, spreading	
Leaflet Number		
Leaf Margin	lobed	three-lobed with each lobe again three- to four-lobed
Leaf Hairs	upper/lower surface	
Leaf/Leaflet Shape		
Leaf Width	<1/2 in	
Leaf Venation	palmate	
Leaf Arrangement	alternate	
Root Type	fibrous OR taproot	
Flower Color		inconspicuous green flowers



## Plantain, Blackseed

**[Plantago rugelii Dcne.]**

Blackseed plantain is a fibrous-rooted perennial with smooth lower leaves that are oval to elliptical in shape and purplish at the base of the leaf stalk. Leaf blades are often 1 to 3 inches wide and 3 to 6 inches long. Leaf margins may be wavy with five prominent veins. The rosette of leaves may lie close to the ground, crowding out desirable grasses. Flowers are arranged along more than half of the upright stem. Broadleaf plantain is very similar to blackseed plantain. Blackseed plantain leaves are less waxy than those



of broadleaf plantain and mostly lacking in hairs. The petiole of blackseed plantain is frequently red-tinged at the base, while that of broadleaf plantain is usually not.

### CONTROL PRACTICES

Blackseed plantain can be controlled postemergence with three-way herbicide mixtures.

Characteristic	Type	Description
Growth Season	perennial weed	
Growth Habit	rosette	

Characteristic	Type	Description
Leaflet Number	one	
Leaf Margin	serrated/toothed OR wavy/crinkled	wavy toothed
Leaf Hairs	upper/lower surface	mostly lacking on upper surface, dense on lower surface
Leaf/Leaflet Shape	oval/egg-shaped/elliptical	well-defined petiole, reddish at base
Leaf Width	1 - 2 in OR greater than 2 in	
Leaf Venation	parallel	somewhat parallel
Leaf Arrangement	whorled or basal rosette	dark markings on the leaf surface closest to the stem
Root Type	fibrous OR taproot	many fibrous roots arise from the taproot
Flower Color	white	inconspicuous



## Plantain, Broadleaf

[*Plantago major* L.]

Broadleaf plantain is very similar to blackseed plantain. Blackseed plantain leaves are less waxy than those of broadleaf plantain and mostly lacking in hairs. The petiole of blackseed plantain is frequently red-tinged at the base, while that of broadleaf plantain is usually not.

P W



### CONTROL PRACTICES

Broadleaf plantain is controlled postemergence with two-, three-, and four-way herbicides applied in the fall or spring.

Characteristic	Type	Description
Growth Season	perennial weed	
Growth Habit	rosette	
Leaflet Number	one	
Leaf Margin	smooth OR wavy/crinkled	smooth; sometimes irregularly toothed, wavy
Leaf Hairs	upper/lower surface	short
Leaf/Leaflet Shape	oval/egg-shaped/elliptical	
Leaf Width	1 - 2 in OR greater than 2 in	
Leaf Venation	parallel	somewhat parallel
Leaf Arrangement	whorled or basal rosette	leaves lack dark markings like those of blackseed plantain
Root Type	fibrous OR taproot	many fibrous roots arise from the taproot
Flower Color	white	inconspicuous



## Plantain, Buckhorn

[*Plantago lanceolata* L.]

Buckhorn plantain is a very common fibrous-rooted weed found in poorly managed turfgrasses. The leaves are basal, long, narrow, and pointed with several prominent parallel veins. Flowers are arranged in a dense terminal spike on a long, hairy, leafless stem. As it blooms, the stamens are exerted from the spike.

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### CONTROL PRACTICES

Buckhorn plantain is controlled postemergence with two-, three-, and four-way herbicides applied in the fall or spring.



Characteristic	Type	Description
<b>Growth Season</b>	summer annual weed OR biennial weed OR perennial weed	
<b>Growth Habit</b>	rosette	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	serrated/toothed OR smooth OR wavy/crinkled	may be slightly toothed, often curled
<b>Leaf Hairs</b>	upper/lower surface OR leaf margin	only on the margins of the first leaves, later leaves are sparsely hairy
<b>Leaf/Leaflet Shape</b>	linear/oblong	narrow
<b>Leaf Width</b>	1/2 - 1 in	
<b>Leaf Venation</b>	parallel	prominent
<b>Leaf Arrangement</b>	whorled or basal rosette	
<b>Root Type</b>	fibrous OR taproot	many fibrous roots arise from the taproot
<b>Flower Color</b>	white	inconspicuous



## Ragweed, Common

**[*Ambrosia artemisiifolia* L.]**

Common ragweed is a summer annual weed that emerges early in the spring but can germinate throughout the summer if conditions are desirable. It is often found in cultivated areas, but also occurs in roadsides and landscapes. It prefers heavy soils to sandy soils, and does not tolerate heavy mowing.

The deeply dissected leaves are arranged oppositely when young, and alternately in older parts of the plant. Leaves are hairy on both surfaces. Ragweed produces copious amounts of pollen in the late summer, and often causes allergy problems.



### CONTROL PRACTICES

Common ragweed control is achieved in the spring with postemergence two-, three-, and four-way herbicides and various sulfonyleurea herbicides. Preemergence control is achieved with triazine herbicides.

Characteristic	Type	Description
<b>Growth Season</b>	summer annual weed	
<b>Growth Habit</b>	upright	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	lobed	
<b>Leaf Hairs</b>	upper/lower surface	
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	
<b>Leaf Width</b>	1 - 2 in OR greater than 2 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>		leaves are arranged oppositely when young, and alternately in older plant parts
<b>Root Type</b>	taproot	taproot with many root hairs
<b>Flower Color</b>	green	inconspicuous (very small flower heads)



## Sorrel, Red

**[*Rumex acetosella* L.]**

Red sorrel is a common perennial in pastures, turf and nursery crops. It is found in areas that have low nitrogen levels in the soil and poor drainage. The leaves have a very bitter taste that resembles sour apples, and can be fatal to livestock when eaten in large quantities. The mature leaves of red sorrel have a unique arrowhead shape, and form a rosette.





## CONTROL PRACTICES

Postemergence control of red sorrel can occur with two-, three-, and four-way herbicides, and also herbicides containing metsulfuron applied in the spring.

Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Growth Habit</b>	upright OR rosette	smooth, square (four-sided) stems
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	heart/kidney/spade	arrow-shaped with two basal lobes on most leaves
<b>Leaf Width</b>	1 - 2 in	
<b>Leaf Venation</b>		
<b>Leaf Arrangement</b>	alternate	most leaves develop from a basal rosette
<b>Root Type</b>	taproot	
<b>Flower Color</b>	variable based on sex	yellowish-green (male flowers) or red (female flowers)



## Sowthistle, Spiny

**[*Sonchus asper* (L.) Hill]**

Spiny sowthistle is a summer annual weed with a basal rosette and an upright flowering stem. The leaves are deeply notched and wavy. Spiny sowthistle has yellow flowers that appear in late spring, and the leaves and stems emit a milky latex when crushed. The weed is found in open habitats including waste areas, turf, and roadsides.



leaf arrangement

## CONTROL PRACTICES

Fair to good control can be achieved with two-, three-, and four-way postemergence herbicides.

Characteristic	Type	Description
<b>Growth Season</b>	summer annual weed	
<b>Growth Habit</b>	upright OR rosette	young plant is a basal rosette, older plant is upright
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	lobed	
<b>Leaf Hairs</b>	none	generally, leaves are hairless but have sharp prickles on leaf margins
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	note the clasping lobes at the base of leaves
<b>Leaf Width</b>	1/2 - 1 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>	taproot	
<b>Flower Color</b>	yellow	



## Speedwell, Corn

**[*Veronica arvensis* L.]**

Corn speedwell is a small, weak, low-growing winter annual that thrives in thin open turf and often appears in solid stands. The lower leaves of corn speedwell are rounded and toothed, while the upper leaves are smaller and more pointed. Like the other speedwells, the leaves are both alternate (end of stem) and opposite (base of stem). Corn speedwell is similar in many respects to Persian and ivyleaf speedwell. However, it has the smallest leaves of the three species and is very inconspicuous in comparison to



leaf arrangement

the other speedwells. Ivyleaf speedwell leaves are thicker and less serrated than those of either corn or Persian speedwell. The entire corn speedwell plant is covered with soft, fine hairs. The flowers are small, bright blue with white throats, and nearly stalkless, whereas those of Persian and ivyleaf speedwell have stalks that are longer than 1 mm. The seedpods are heart-shaped in all three species.

## CONTROL PRACTICES

Even though corn speedwell is smaller than either Persian or ivyleaf speedwell, it is more difficult to control since many of the herbicides that are effective against ivyleaf and Persian speedwell do not work well against corn speedwell. For corn speedwell, repeated applications of a three-way combination product at one-half the label rate, applied 10 days apart, provide good control.

Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed	
<b>Growth Habit</b>	prostrate, spreading	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	serrated/toothed	rounded teeth
<b>Leaf Hairs</b>	upper/lower surface	
<b>Leaf/Leaflet Shape</b>	linear/oblong OR oval/egg-shaped/ elliptical OR round	lower leaves egg-shaped or round, upper leaves linear
<b>Leaf Width</b>	1/2 - 1 in	
<b>Leaf Venation</b>	palmate	
<b>Leaf Arrangement</b>	alternate OR opposite	lower leaves opposite, upper leaves alternate
<b>Root Type</b>	fibrous	
<b>Flower Color</b>	blue/purple	



## Speedwell, Ivyleaf

[*Veronica hederifolia* L.]

Ivyleaf speedwell is a common North Carolina winter annual weed found in open fields and grassy areas along roadsides. This low-growing plant creeps along the ground like ivy. It has distinctive 3-5 lobed leaves that are densely hairy. Like the other speedwells, the leaves are both alternate (end of stem) and opposite (base of stem). Ivyleaf speedwell leaves are thicker and less serrated than those of either corn or Persian speedwell. Ivyleaf speedwell flowers in the spring.

The flowers of both ivyleaf and Persian speedwell are blue and are borne on stalks longer than 1 mm, whereas those of corn speedwell are borne on stalks less than 1 mm in length. The seedpods are heart-shaped for all three species.



## CONTROL PRACTICES

Postemergence control of ivyleaf speedwell is achieved with triazine and sulfonyleurea herbicides and also with two-, three-, and four-way broadleaf herbicides when applied in the fall or spring.

Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed	
<b>Growth Habit</b>	prostrate, spreading	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	serrated/toothed	
<b>Leaf Hairs</b>	upper/lower surface	
<b>Leaf/Leaflet Shape</b>	heart/kidney/spade	
<b>Leaf Width</b>		
<b>Leaf Venation</b>	palmate	
<b>Leaf Arrangement</b>	alternate OR opposite	lower leaves opposite, upper leaves alternate
<b>Root Type</b>	fibrous	
<b>Flower Color</b>	blue/purple	

# Speedwell, Persian (Veronica)



## [*Veronica persica* Poir.]



Persian speedwell (also called Veronica speedwell) is a low-growing winter annual weed found in turf, nursery crops, and waste areas. Speedwells can grow in a variety of situations, but are mostly found in shady areas with dry, sandy, or rocky soils. One of the most noticeable characteristics of this and several other speedwell species are the blue flowers. Corn and ivyleaf speedwell are also winter annuals with a



similar leaf shape. Ivyleaf speedwell leaves are thicker and less serrated than those of either corn or Persian speedwell. Like the other speedwells, the leaves are both alternate (end of stem) and opposite (base of stem). In addition, the flowers of corn speedwell are borne on short stalks (less than 1 mm long), whereas those of Persian and ivyleaf speedwell are borne on stalks longer than 1 mm. The seedpods are heart-shaped for all three species.

### CONTROL PRACTICES

Postemergence Persian speedwell control is achieved with triazine and sulfonylurea herbicides and also with two-, three-, and four-way broadleaf herbicides when applied in the fall or spring.

Characteristic	Type	Description
Growth Season	winter annual weed	
Growth Habit	prostrate, spreading	
Leaflet Number	one	
Leaf Margin	serrated/toothed	
Leaf Hairs	upper/lower surface	
Leaf/Leaflet Shape	heart/kidney/spade	
Leaf Width		
Leaf Venation	palmate	
Leaf Arrangement	alternate OR opposite	lower leaves opposite, upper leaves alternate
Root Type	fibrous	
Flower Color	blue/purple	



# Spurge, Spotted (Prostrate)



## [*Chamaesyce maculata* (L.) Small]



Spotted spurge is a summer annual with a taproot; it has an open and prostrate mat-forming growth habit. It branches freely from the base. The reddish or green prostrate stems form a mat-like growth that often chokes out desirable turfgrasses. When the stems are broken, they emit a milky juice. The leaves are opposite and vary in color from a pale reddish-green to a dark green but usually have a conspicuous

maroon blotch. The leaves are smooth or sparsely hairy, toothed especially near the tip with a short petiole. Flowers are very small, pinkish-white, inconspicuous, and borne in the leaf axils. Spotted spurge may flower within three to four weeks after emerging in mid-summer. The fruit, a three-lobed capsule, develops rapidly. Spurge is often found in fields, gardens, turf, and waste areas.

### CONTROL PRACTICES

Spotted spurge is often a sign of nematodes. Spotted spurge can survive close mowing because of its prostrate growth habit. It forms a mat-like growth which often chokes out desirable turfgrasses. The best way to avoid infestations of this weed is to maintain a dense, actively growing turf through proper mowing, fertilizing, and watering practices. Mow at the proper height for your selected adapted turfgrass. Coring and traffic control reduce compaction and encourage desirable turfgrass competition. Control late spring or early summer is easier at this time and turf will have a greater chance of recovering the areas previously occupied by weeds. Two-, three-, or four-way herbicides and herbicides containing metsulfuron offer control of spotted spurge.

Characteristic	Type	Description
<b>Growth Season</b>	summer annual weed	
<b>Growth Habit</b>	prostrate, spreading	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	serrated/toothed	leaf must be closely examined to see serrated edges
<b>Leaf Hairs</b>		hairs not common, but are sometimes present
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	note the purple splotch in the middle of some leaves
<b>Leaf Width</b>	<1/2 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>	opposite	
<b>Root Type</b>	taproot	
<b>Flower Color</b>	red	inconspicuous



## Strawberry, Indian Mock

### [*Duchesnea indica* (Andr.) Focke]

Indian mock strawberry is a perennial, spreading by stolons (runners). It's leaves are alternate and trifoliate. Leaflets are toothed and hairy with long, hairy petioles with leaf-like stipules. Single flowers with five yellow petals are borne on long stalks from the leaf axils. The fruit is red and fleshy and similar in appearance to the commercial strawberry though smaller and tasteless. It is similar in appearance and growth habit to wild strawberry, but it has yellow flowers instead of white and teeth on leaf edges are



rounded rather than sharp-pointed.

### CONTROL PRACTICES

Development of Indian mock strawberry is encouraged by shady, moist areas. Therefore, improving surface drainage, aerating when needed, and watering infrequently will help reduce encroachment of this weed. See page 40 for more information on CONTROL PRACTICES for perennial weeds.

Characteristic	Type	Description
<b>Growth Season</b>	perennial weed	
<b>Growth Habit</b>	prostrate, spreading	
<b>Leaflet Number</b>	three	first few leaves are simple, rest are trifoliates
<b>Leaf Margin</b>	serrated/toothed	roundish teeth
<b>Leaf Hairs</b>	upper/lower surface	dense hairs on upper surface
<b>Leaf/Leaflet Shape</b>	oval/egg-shaped/elliptical	
<b>Leaf Width</b>	1/2 - 1 in OR 1 - 2 in	
<b>Leaf Venation</b>	pinnate	
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>	fibrous	note also the stolons associated with this plant
<b>Flower Color</b>	yellow	

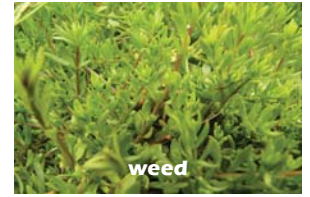


## Toadflax, Oldfield

**[*Nuttallanthus canadensis* (L.) D.A. Sutton]**

Oldfield toadflax is also known as common or blue toadflax. It is a winter annual or biennial weed that is commonly found blooming in the spring in fields and roadsides. Oldfield toadflax is most often found in the piedmont and coastal plain of North Carolina. The plant can flower from early spring (most common) to late fall (less common), depending on growing conditions. The small blue flowers have three lobes

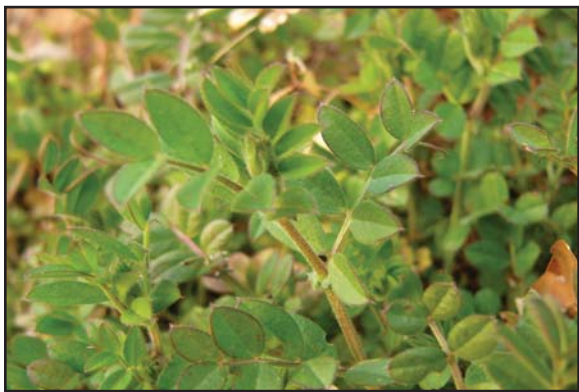
and basal spurs. The leaves are small, bright green, and linear. Small clumps of leaves will form in early spring, and the blue flowers will appear on long green stems shortly thereafter.



### CONTROL PRACTICES

Oldfield toadflax can be controlled postemergence with three-way herbicide mixtures.

Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed OR biennial weed	
<b>Growth Habit</b>	upright	
<b>Leaflet Number</b>	one	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>	none	
<b>Leaf/Leaflet Shape</b>	linear/oblong	
<b>Leaf Width</b>	<1/2 in	
<b>Leaf Venation</b>		
<b>Leaf Arrangement</b>	alternate	
<b>Root Type</b>		
<b>Flower Color</b>	blue/purple	



## Vetch, Common

**[*Vicia sativa* L.]**

Common vetch is a trailing winter annual weed that forms large mats of vegetation. It is common to waste areas and roadsides. The leaves of common vetch are very narrow, alternately arranged, and compound. Tendrils form on the ends of the leaves. Long stems arise from fibrous roots, and flowers are purple. Late in the season after the flowers drop, seed pods form.



Postemergence control of common vetch can occur with two-, three-, and four-way herbicides, with clopyralid-containing products providing excellent control in the fall or spring.

### CONTROL PRACTICES

Characteristic	Type	Description
<b>Growth Season</b>	winter annual weed	
<b>Growth Habit</b>	upright OR vining	
<b>Leaflet Number</b>	four or more	
<b>Leaf Margin</b>	smooth	
<b>Leaf Hairs</b>		may or may not have leaf hairs
<b>Leaf/Leaflet Shape</b>	linear/oblong OR oval/egg-shaped/elliptical	tendrils on ends of older leaves aid in climbing

Characteristic	Type	Description
Leaf Width	1 - 2 in	
Leaf Venation	pinnate	
Leaf Arrangement	alternate	
Root Type	fibrous	
Flower Color	blue/purple	



## Vetch, Hairy

[*Vicia villosa* Roth]

Hairy vetch is a trailing winter annual, biennial, or summer annual weed that forms large mats of vegetation. The leaves are oblong, with 5 to 10 pairs of leaves per leaflet. Purple flowers form in mid to late summer (June - August).

### CONTROL PRACTICES

Same as for common vetch.



Characteristic	Type	Description
Growth Season	summer annual weed OR winter annual weed OR biennial weed	
Growth Habit	vining	vine-like, forms a mat; hairy stems
Leaflet Number	four or more	5 - 10 pairs per leaf
Leaf Margin	smooth	
Leaf Hairs	upper/lower surface	
Leaf/Leaflet Shape	linear/oblong	
Leaf Width	1/2 - 1 in	
Leaf Venation	pinnate	
Leaf Arrangement	alternate	
Root Type	taproot	
Flower Color	blue/purple	



## Violet, Wild

[*Viola* spp.]

Wild violets are winter annual or perennial weeds that often grow in clumps. The plants form rhizomes that support heart-shaped leaves. The flowers of wild violet have five petals and are usually purple, but can also be white or yellow. The flowers usually appear in early spring and summer, and the plants are most often found in shady habitats.

### CONTROL PRACTICES

Wild violets are difficult to control. Repeat applications of two-, three-, and four-way herbicides are needed for extended control. Sulfonyleurea herbicides provide good to excellent control with metsulfuron lasting the longest.



Characteristic	Type	Description
Growth Season	winter annual weed OR perennial weed	
Growth Habit	rosette	
Leaflet Number	one	
Leaf Margin	serrated/toothed	
Leaf Hairs	none	
Leaf/Leaflet Shape	heart/kidney/spade OR linear/oblong	

Characteristic	Type	Description
Leaf Width		1/2 in (13 mm) to more than 2 in (50 mm) wide
Leaf Venation	palmete	
Leaf Arrangement	alternate	
Root Type	fibrous	note also the rhizomes associated with this plant
Flower Color	blue/purple	



## Woodsorrel, Yellow (*Oxalis*)



### [*Oxalis stricta* L.]

Common yellow woodsorrel is an herbaceous perennial supported by a shallow taproot. It sometimes has very short stolons. The plant has a shallow taproot, and hairy stems that are 4 to 10 inches tall. Leaves are alternate and divided into three leaflets. The leaflets are heart-shaped and partly folded. Two to nine flowers are formed together with each being bright yellow with five petals about 3/8 in long. Woodsorrel blooms in early spring (March to April). The fruit is a narrow capsule 1/2 to 1 inches long. The supporting stalk bends just below the capsule.



### CONTROL PRACTICES

Yellow woodsorrel is not easily controlled with two-, three-, and four-way postemergence herbicides. Repeat spring applications are usually needed. Metsulfuron does provide good to excellent postemergence control. Preemergence control is achieved with crabgrass herbicides.

Characteristic	Type	Description
Growth Season	perennial weed	
Growth Habit	upright	upright, but very low-growing plant
Leaflet Number	three	
Leaf Margin	smooth	
Leaf Hairs	none	
Leaf/Leaflet Shape	heart/kidney/spade	partly folded
Leaf Width	1/2 - 1 in	
Leaf Venation	pinnate	
Leaf Arrangement	alternate	
Root Type	fibrous	note the extensive rhizomes associated with this plant
Flower Color	yellow	



## Mosses

### [*Bryum*, *Ceratodon*, *Hypnum*, or *Polytrichum* spp.]

Mosses are branched, thread-like primitive plant lifeforms that create a thick green mat at the soil surface. They are very competitive in cool, moist, shaded locations such as the north side of buildings and wooded areas. Development is favored by low fertility, poorly drained soils, high soil acidity, poor watering practices, soil compaction, or a combination of these factors that adds up to thin, weak turf. Spiking, coring, or raking may be necessary for removal before treatment.



### CONTROL PRACTICES

Silvery thread moss can be controlled or managed with repeat summer applications of carfentrazone plus nonionic surfactant. Fungicides provide some control but need to be applied in warm temperatures (above 80°F) and high spray volumes to be successful.

# Diseases in Turf

BY JIM KERNS AND ART BRUNEAU

Many diseases occur on the different turfgrasses that are grown in North Carolina. In total, there are over 100 diseases that affect turfgrasses. Just like a human illness, each turfgrass disease has its own unique prescription that should be followed for its control. Accurate diagnosis of diseases is, therefore, a critical first step in their management. Fortunately, there are only about 18 diseases that develop in turfgrasses year after year. Learning how to diagnose and manage these most common diseases will prepare you to meet most problems that arise. This chapter emphasizes diagnosis of common turfgrass diseases and cultural practices that help prevent severe damage. Fungicide recommendations are given in other publications, such as *Selection and Application of Fungicides for Turfgrass Disease Control*, *Pest Control for Professional Turf Managers*, and the *North Carolina Agricultural Chemicals Manual*.

Diagnostic services are also available at NC State University. Please refer to page 86 for submission instructions.

Three factors are required for a disease to develop: a susceptible plant, a pathogen, and an environment that is favorable for pathogen growth. Disease will not develop unless all of these factors are present for at least several consecutive days. Because turfgrasses are perennial, the host plant is always present. The pathogens are always present as well, laying dormant in the thatch and soil when they are not causing disease. Therefore, it is the environment that triggers disease development. Weather conditions, management practices, and microclimate are the environmental variables that have the greatest impact on disease development.

Turfgrasses are most susceptible to disease when they are stressed or growing slowly. As a result, the most severe disease problems on cool-season grasses occur during the summer, and most diseases in warm-season grasses develop in the fall and spring. Selecting a turfgrass that is well adapted for the location and intended use will drastically minimize disease problems. Management practices also have a major impact on disease development. Grasses that are healthy and vigorously growing are far more resistant to disease than grass that is poorly managed, and they will also recover more quickly should disease develop.

The vast majority of turfgrass diseases are caused by fungi. Most fungi cause foliar diseases by attacking the leaves of the turfgrass. Others specifically attack the crowns or roots of turfgrass plants, causing crown diseases or root diseases. Most fungi only grow within a specific temperature range and also require ample moisture. Foliar diseases typically develop at night, when the turfgrass leaves are wet from dew, and are, therefore, most strongly influenced by low night temperatures. For example, brown patch may develop when low night temperatures exceed 60°F for several consecutive days. Crown and root diseases are most strongly affected by conditions in the soil, such as soil temperature, soil pH, soil drainage, and soil compaction.

Fungicides can be used to control turfgrass diseases. Fungicide applications may be preventive, if made before symptoms of the disease appear, or curative, if made after symptoms appear. Preventive fungicide programs are recommended for diseases that occur annually, such as brown patch in tall fescue or large patch in the warm-season turfgrasses. Curative fungicide applications are less effective and usually require increased application rates or shorter application intervals. Whenever possible, schedule preventive fungicide applications based on the weather conditions that favor disease development, not based on the calendar.

Fungicides can be grouped into two categories: contact and systemic. Contact fungicides remain on the leaf surface after application, forming a protective barrier to fungal infection on the leaf surface. Contact fungicides protect only the plant parts that are sprayed; therefore, uniform applications are necessary to ensure complete protection of the turf. Contact fungicides must also be re-applied frequently because they are removed from the leaf surface by mowing, precipitation, irrigation, traffic, etc. In contrast, systemic fungicides are absorbed by the plant and translocated. Most systemics are translocated only upward in the plant. Because systemic fungicides are absorbed into the plant, they are longer lasting and are more effective than contacts for curative applications. In general, systemic fungicides have a more limited control spectrum; therefore, a disease must be identified accurately in order to select the best fungicide for its control.

Many systemic fungicides lose effectiveness due to the development of fungicide resistance. Fungicide resistance occurs when fungicides from the same chemical class are applied repeatedly. Repeated applications allow strains of the pathogen that are naturally resistant to the fungicide to build up in the population. When resistant strains become dominant in the population, the fungicide no longer controls the disease, and significant damage may occur when conditions become favorable for disease development. Certain diseases, such as dollar spot and gray leaf spot, develop fungicide resistance very quickly, after as few as 5 consecutive applications of a fungicide. Other diseases, such as brown patch or summer patch, develop resistance much more slowly. To prevent the development of fungicide resistance, (1) use integrated management, including selection of appropriate species and variety, and good cultural management practices; (2) rotate to a different class of fungicides after every application; and (3) tank-mix systemic fungicides with a contact fungicide, which will suppress resistant strains and slow their emergence.



# TURFGRASS DISEASES



**Brown patch of tall fescue.**

## Brown Patch

### PATHOGEN

*Rhizoctonia solani*

### HOSTS

Cool-season turfgrasses; tall fescue is most susceptible

### SYMPTOMS

The symptoms of brown patch vary according to mowing height. In landscape situations, where mowing height is less than 1 inch, brown patch appears as roughly circular patches that are brown, tan, or yellow, ranging from 6 inches to several feet in diameter. The affected leaves typically remain upright, and lesions are evident on the leaves, which are tan in color and irregular in shape with a

dark brown border. When the leaves are wet or humidity is high, small amounts of gray cottony growth, called mycelium, may be seen growing among affected leaves in the turf canopy. In close-cut turfgrasses (1 inch or less), brown patch develops in roughly circular patches, ranging from a few inches to several feet in diameter. Distinct foliar lesions are not visible and mycelium is typically not present, but the brown patches may be surrounded by a black or dark gray ring, called a smoke ring. The smoke ring is evidence of active disease development and is only found when the turfgrass leaves are wet or when humidity is near 100 percent.

### FACTORS AFFECTING DISEASE DEVELOPMENT

Brown patch is most severe during extended periods of hot, humid weather. The disease can begin to develop when night temperatures exceed 60°F, but is most severe when low and high temperatures are above 70°F and 90°F, respectively. Also, leaves must be continuously wet for at least 10 to 12 hours. Poor soil drainage, lack of air movement, shade, cloudy weather, dew, over-watering, and watering in late afternoon favor prolonged leaf wetness and increased disease severity. Brown patch is particularly severe in turf that has been fertilized with excessive nitrogen. Inadequate levels of phosphorus and potassium also contribute to injury from this disease.

### CONTROL

Varieties of tall fescue vary widely in their susceptibility to brown patch. Selection of a tall fescue variety with a high level of brown patch resistance is a critical first step in any management program. There are few differences in brown patch resistance among varieties of bluegrass, ryegrass, or bentgrass.

Do not apply excess nitrogen when conditions favor disease development. In general, cool-season grasses should not receive more than 1 pound of nitrogen per 1,000 square feet at any one time. Avoid applying nitrogen to cool-season grasses in late spring or summer, or use very low rates if necessary. Ensure adequate amounts of potassium and phosphorus by applying these nutrients based on soil test results.

Avoiding prolonged periods of leaf wetness will drastically reduce the severity of brown patch. Leaf wetness can originate from irrigation, dew, or guttation (which is the water that is sometimes exuded from turfgrass leaves during the night). To minimize leaf wetness, do not irrigate daily. Instead, water deeply and infrequently, every 3 to 4 days to a depth of 6 to 8 inches. The timing of irrigation is also critical; it is best to irrigate early in the morning, just before sunrise. This removes large droplets of dew and guttation water from the leaves and speeds drying of the foliage after sunrise. Avoid watering after sunrise or in the late afternoon or evening, as this will increase the duration of leaf wetness.

Proper landscape design and site preparation can help to minimize brown patch problems. Turf surrounded by trees, shrubs, buildings, or other barriers will remain wet for extended periods of time due to reduced air movement and sunlight. Removal or pruning of trees and other barriers will help minimize leaf wetness and discourage brown patch development. In shady areas, plant turfgrass species that are tolerant of low light levels, such as hard fescue or strong creeping red fescue. Good surface and soil drainage will also help reduce the incidence of this disease. Avoid establishing turf in low areas that collect



**Brown patch lesions on tall fescue.**



**Brown patch of creeping bentgrass.**



water or in soil that is heavily compacted. Aerate high-traffic areas each fall to reduce compaction and maintain soil drainage.

In golf course turf, daily removal of morning dew can help reduce brown patch development. This can be accomplished by mowing, dragging a hose, running the irrigation system for a short time, or by whipping the greens with a bamboo or fiberglass pole. Golf course putting greens should be regularly cored and topdressed to maintain soil drainage and aeration.

Fungicides are effective for brown patch control, and can be applied on a preventative or curative basis. Curative applications may not be effective during periods of hot weather because the cool-season grasses are growing slowly and are unable to recover from the damage under these conditions. Consider a preventive fungicide program for tall fescue and creeping bentgrass when conditions favor disease development.



**Damping off of creeping bentgrass seedlings.**

## Damping Off PATHOGEN

*Pythium* and *Rhizoctonia* species

### HOSTS

Turfgrass seedlings, warm- or cool-season grasses

### SYMPTOMS

Damping off may develop before or after the emergence of turfgrass seedlings. Sparse emergence of seedlings and slow establishment occurs when seeds are infected prior to emergence. When the disease develops after emergence, seedlings initially appear flaccid and twisted as if suffering from wilt. The seedlings continue to decline, turning dark in color and greasy in appearance,

and then quickly disintegrate, leaving areas of bare soil. Damping off initially develops in localized spots, but the disease often spreads rapidly to injure large areas. In severe cases, tufts of mycelium may be observed in affected areas when the leaves are wet.

### Factors affecting disease

Turfgrasses are most susceptible to damping off during germination and seedling emergence. After emergence, the turf gradually becomes resistant to the disease as it matures. Damping off is most severe when temperatures or light levels are unfavorable for seedling growth. *Pythium* causes the majority of damping off problems during warm or hot weather, whereas *Rhizoctonia* is more prevalent during cool weather. The disease is encouraged by excessive nitrogen fertility and extended periods of leaf wetness. High seeding rates encourage damping off by producing dense populations of seedlings that mature more slowly and remain wet for extended periods of time.

### CONTROL

Use recommended seeding rates to prevent excessively dense canopies and encourage rapid seedling maturation. Apply a high phosphorous (P) starter fertilizer at the time of seeding to provide 1 pound of P per 1,000 square feet. To encourage rapid germination, water lightly and frequently to keep the seedbed moist, but not saturated. As the seedlings emerge and develop a root system, gradually reduce the irrigation frequency, and ensure that the seedling leaves dry completely in between irrigation cycles. Apply a thin layer of straw or other mulching material to hold in moisture, but do not over-apply as this will retain too much moisture and increase the risk of damping off. A second fertilizer application is typically made around the time of the first mowing, but do not apply more than 0.5 pound of water soluble nitrogen per 1,000 square feet. Do not attempt to establish turfgrasses in low lying, wet areas where damping off is most severe.

Fungicides are available for control of damping off, and may be applied as seed-treatments or directly to the seedbed. If damping off is observed, submit a sample to a diagnostic lab for accurate diagnosis because different fungicides are needed for control of *Pythium* and *Rhizoctonia* species.

Refer to page 86 for instructions for submitting samples to the Plant Disease and Insect Clinic at NC State University.





**Mycelium of the dollar spot fungus on creeping bentgrass leaves.**

## Dollar Spot

### PATHOGEN

*Sclerotinia homoeocarpa*

### HOSTS

All cool- and warm-season turfgrasses

### SYMPTOMS

Dollar spot appears as small spots, approximately the size of a dollar coin, that are bleached-white or light tan. These spots may expand in size up to 6 inches or more in diameter. The affected leaves typically remain upright and have white or light tan lesions with light reddish-brown margins. Leaves are usually girdled by these lesions so that the upper part of the leaves dies slowly on taller cut turf. Distinct lesions are sometimes

not evident on close-cut turfgrasses; instead, the leaves die back from the tip and turn white or light tan. The grass in the spots may be killed to the soil surface if the disease continues to develop, and in time these spots will merge, resulting in large blighted areas. Short, fuzzy white mycelium is often observed on affected turf in the morning when dew is present.

### FACTORS AFFECTING DISEASE DEVELOPMENT

Dollar spot is most common in the spring and fall, when warm, humid days and cool nights lead to heavy dew formation. Dollar spot may develop when night temperatures exceed 50°F and the leaves are wet for 10 to 12 continuous hours. Extended periods of wet, overcast weather can lead to severe dollar spot epidemics on susceptible grasses. The disease can remain active throughout the summer, but typically slows when daytime highs consistently exceed 90°F. Turf that is deficient in nutrients, especially nitrogen, is more prone to dollar spot and also recovers from the damage more slowly than well-fertilized turf. The disease is also encouraged by drought stress, low mowing, excessive thatch accumulation, frequent irrigation, and low air movement. Certain cultivars are very susceptible to dollar spot while others are fairly tolerant.

### CONTROL

Use of resistant cultivars is one of the most effective means of dollar spot management. This is particularly important for creeping bentgrass and Kentucky bluegrass, as cultivars vary widely in their susceptibility to the disease. Base turfgrass selection on regional cultivar trials and University recommendations, and plant blends and mixtures of cool-season grasses whenever possible.

Adequate nitrogen fertilization will help to prevent dollar spot, and will also encourage plants to recover quickly from the disease if it occurs. Select nitrogen sources, rates, and timings based on local University recommendations for your turfgrass species and climate. Use soil test results to apply the recommended amounts of phosphorus, potassium, lime, and micronutrients.

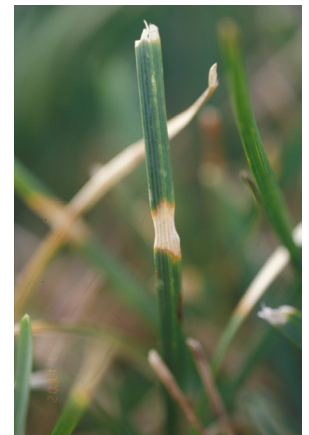
Dollar spot is encouraged by drought stress and leaf wetness. Proper irrigation timing is needed to balance these factors. Irrigate based on the moisture status of the soil, not on a calendar schedule. Use a soil probe to monitor the moisture status of the root zone. Irrigate with sufficient water to wet the entire root zone, and then repeat when the entire root zone is no longer moist. Irrigate early in the morning, before sunrise, to minimize leaf wetness duration. Mowing, dragging, or whipping the turf in the morning to remove dew can help to prevent dollar spot, but these practices can spread the disease if it is actively developing. Improve air movement and reduce humidity by pruning trees, clearing unwanted vegetation, or relocating desirable plants.

Excessive thatch accumulations greatly encourage dollar spot activity. Remove excess thatch by vertical mowing or power raking. Golf course putting greens should be aerified regularly and topdressed with sand to reduce thatch buildup.

Dollar spot is readily spread in leaf tissue or clippings from infected areas. Avoid spreading the disease by washing equipment before entering an uninfected area, by encouraging golfers to clean their shoes between rounds, and by



**Dollar spot of centipede grass.**



**Dollar spot of Kentucky bluegrass.**



**Dollar spot of centipede grass.**

removing and disposing of clippings taken from infected areas.

Many fungicides control dollar spot, but preventative applications are most effective. When applied on a curative basis, fungicides must be applied at high rates and short application intervals. Uniform coverage is important for maximizing effectiveness; even small gaps in coverage may allow dollar spot to develop. Nozzle type, nozzle pressure, and dilution rate have the greatest impact on the uniformity of fungicide applications.

The fungus that causes dollar spot to develops fungicide resistance very quickly. To prevent or delay the onset of fungicide resistance, use integrated management to minimize fungicide use, rotate among fungicide classes after each application, and tank-mix systemic fungicides with a contact fungicide.



## Fairy Ring PATHOGEN

*Basidiomycetes (mushroom and puffball fungi)*

### HOSTS

All cool- and warm-season turfgrasses

### SYMPTOMS

The symptoms of fairy ring appear in patches, rings, or arcs that are initially a few feet in diameter, but expand in size year after year, reaching up to several hundred feet in diameter in old turf stands. The fairy ring fungi are not known to infect or parasitize the turf, but growth of these fungi in the soil can indirectly affect, or even kill, the turfgrass above. Three types of fairy ring symptoms are

observed in turfgrasses. A Type I fairy ring causes the soil and thatch to become hydrophobic, killing the turf in patches, rings, or arcs. In areas affected by a Type I fairy ring, the thatch and soil are extremely dry and repel water. Type II fairy rings appear as rings or arcs of turf that are dark green and growing more quickly than the surrounding turf. In a Type III fairy ring, mushrooms or puffballs are produced in a ring or arc. The type of symptom expressed by a fairy ring may change during the year according to weather conditions. Type III fairy ring symptoms are more prevalent during extended periods of wet weather. Type I and Type II fairy ring symptoms are most common during hot, dry weather in the summer.

## FACTORS AFFECTING DISEASE DEVELOPMENT

Fungi that cause fairy rings are common inhabitants of forested areas. These fungi begin growing on a source of organic matter, such as an old stump, waste lumber, or dead tree roots in the soil. Once established, the turf produces thatch and organic matter, which provides a source of food for continued expansion of the fairy ring. Type I fairy rings are most damaging to turf and are encouraged by drought stress, inadequate irrigation, and infrequent aeration. Type II fairy ring symptoms are a result of the release of nitrogen and other nutrients into the soil as organic matter is degraded by the fairy ring fungi. These symptoms are most evident in turf that is deficient of nutrients, especially nitrogen and iron. Type III fairy rings are encouraged by over-irrigation or poor soil drainage.

## CONTROL

The most effective means for control is to prevent the fairy ring fungi from becoming established in the turf. Remove large pieces of woody material (stumps, waste lumber, and dead tree roots) before turf is planted to prevent the establishment of fairy rings. Landscape contractors should remove this debris around new construction sites before seeding or sodding. Power raking or vertical mowing to remove excessive thatch will help to minimize fairy ring problems. Golf course superintendents should regularly aerify and topdress putting greens to prevent thatch buildup and maintain soil aeration. Avoid extremes in soil moisture (too wet, too dry), apply nitrogen based on local University recommendations, and ensure balanced fertility through regular soil testing.

Once a fairy ring appears, the best management practices depend on the



**Type I fairy ring symptoms on creeping bentgrass.**



**Type II fairy ring symptoms.**  
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**Type III fairy ring symptoms.**  
© by the American Phytopathological Society

type of symptom that is observed. To control a Type I fairy ring, the water-repellent thatch and soil beneath the affected turf must be broken up and re-wet. Hollow-tine aerification, spiking, water-injection, application of soil surfactants, and heavy irrigation are effective strategies for re-wetting this hydrophobic layer. Affected areas should be hand-watered to prevent over-watering of the entire area, which may harm the unaffected turf. Symptoms of a Type II fairy ring can be masked through the application of nitrogen or iron. This will cause the surrounding turf to green-up, making the affected turf less evident. Collect a soil sample for nutrient analysis from the turf immediately surrounding the Type II fairy rings, and correct any nutrient imbalances as recommended. Use caution when applying nitrogen to mask Type II fairy ring symptoms on cool-season grasses during the summer. Too much nitrogen may over-stimulate the grass and lead to the development of more serious diseases.

Drastic methods for control of fairy rings, such as soil fumigation, removal of infested soil, or turf renovation by rototilling and mixing the soil may be effective in the short-term, but the fairy rings usually become re-established over a period of years. Certain fungicides are labeled for control of fairy rings and provide temporary suppression of the disease when drenched into the soil.



Gray leaf spot on St. Augustinegrass.

## Gray Leaf Spot

### PATHOGEN

*Pyricularia grisea*

### HOSTS

St. Augustinegrass, tall fescue, and perennial ryegrass

### SYMPTOMS

Gray leaf spot initially appears on grass leaves as round or oval tan spots that have a dark brown border. When the leaves are wet or humidity is high, the leaf spots turn gray and fuzzy with profuse spore production. In time, the leaf spots expand and girdle the leaf, causing it to die back from the tip. Significant damage to the turf stand may occur as the disease

progresses. In tall fescue and perennial ryegrass, foliar blighting initially occurs in orange to yellow patches 6 to 12 inches in diameter. Like the leaf spots, these patches rapidly coalesce to produce large, irregular areas of damaged turf. The leaves of tall fescue and perennial ryegrass blighted by gray leaf spot are typically matted and greasy in appearance. Because of this symptom, gray leaf spot is often confused with *Pythium* blight in tall fescue and perennial ryegrass. Gray leaf spot does not develop in distinct patches in St. Augustinegrass, but affected leaves may wither and die, causing a brown cast to the stand that is visible from a distance.

## FACTORS AFFECTING DISEASE DEVELOPMENT

Gray leaf spot is most severe in newly established turfgrass stands. The disease is typically most severe in the first year of establishment, but then gradually becomes less damaging as the turf matures. Turfgrass hosts vary widely in their susceptibility to damage from gray leaf spot. Perennial ryegrass is most rapidly affected by the disease, with widespread turf loss occurring in a period of a few days. St. Augustinegrass is most resistant, and rarely sustains significant damage if properly managed. Tall fescue has an intermediate level of resistance to gray leaf spot.

In St. Augustinegrass, gray leaf spot is most active from June through August. In tall fescue and perennial ryegrass, most cases of the disease appear from late July through September. Gray leaf spot may develop when temperatures are between 70 and 95°F, but the fungus also requires at least 14 hours of continuous leaf wetness in order to initiate infection. Any factor that increases the amount of leaf wetness will increase gray leaf spot development. Lush leaf tissue produced by turf that is fertilized with excessive nitrogen is extremely prone to infection by the gray leaf spot pathogen.

## CONTROL

Cultivars of tall fescue and St. Augustinegrass vary considerably in gray leaf spot susceptibility. Refer to local University recommendations for cultivars with gray leaf spot resistance that perform well in your area. Perennial ryegrass cultivars with resistance to gray leaf spot are not currently available, but may be in the near future.

Managing leaf wetness is an effective means for minimizing gray leaf spot in all hosts. Irrigate deeply and infrequently, applying sufficient water to wet the entire root zone and repeating only when the entire root zone is no longer moist. Schedule irrigation early in the morning, before sunrise, and never in the late



Gray leaf spot on tall fescue.



Foliar blighting caused by gray leaf spot in tall fescue.

afternoon or evening. Prune or remove trees, shrubs, or other barriers to increase air movement and sunlight penetration.

Proper mowing practices are most important for gray leaf spot management in St. Augustinegrass. This grass must be mowed frequently during the summer months to remove excess leaf tissue, keep the canopy open and dry, and remove developing gray leaf spot lesions. Removal of clippings reduces spread of the disease when gray leaf spot symptoms are evident. Apply nitrogen and other nutrients as recommended to maintain vigorous foliar growth during the summer months. Excessive shade, in addition to promoting leaf wetness, slows St. Augustinegrass growth and enhances gray leaf spot problems.

Stress of any kind will encourage gray leaf spot development in tall fescue and perennial ryegrass. Proper mowing, fertilization, and irrigation practices will reduce the chances of significant turf loss from this disease. Mow to recommended heights, using the “1/3 rule” (remove top third of leaf) as a guide for mowing frequency. Collect clippings when gray leaf spot is active to reduce further spread of the disease. Do not apply nitrogen to susceptible grasses in late spring or summer. When establishing a new stand of tall fescue or perennial ryegrass, use recommended seeding rates to allow rapid maturation of new seedlings.

Fungicides are available that will effectively control gray leaf spot. Repeat treatments may be necessary if conditions favoring the disease persist.



**Brown blight of perennial ryegrass.**

## Helminthosporium Diseases: Brown Blight, Leaf Spot/ Melting Out, Net Blotch, and Red Leaf Spot



### **PATHOGEN**

*Bipolaris*, *Drechslera*, and *Exserohilum* species (formerly known as *Helminthosporium* species)

### **HOSTS**

1. creeping bentgrass – red leaf spot (*Drechslera erythrospila*)
2. Kentucky bluegrass –leaf spot/melting out (*Drechslera poae*)
3. tall fescue –net blotch (*Drechslera dictyoides*)
4. perennial ryegrass – brown blight (*Drechslera siccans*)
5. Bermudagrass – leaf spot/melting out (*Bipolaris cynodontis*)

### **SYMPTOMS**

These diseases are caused by a group of fungi that produce large, cigar-shaped spores. The symptoms vary slightly from disease to disease, but generally produce round or oval-shaped lesions of varying colors on the turfgrass leaves. The lesions enlarge and girdle the leaves resulting in a light tan or brown turf. On some hosts, the expanded lesions become tan in the center with a dark brown or black border. On Kentucky bluegrass and bermudagrass, these diseases advance from the leaf spot stage to cause a crown rot phase called melting-out. Melting-out is characterized by dark lesions on the sheaths of stunted, spindly shoots and causes death of entire tillers during times of stress. These fungi can also cause seedling blights on newly planted turfgrasses, such as winter overseedings.

### **FACTORS AFFECTING DISEASE DEVELOPMENT**

*Drechslera* and *Bipolaris* species survive in thatch during periods that are unfavorable for disease development. These fungi are most active during periods of cool (60 to 65°F) and wet weather, but some are able to cause disease whenever temperatures are above freezing. Helminthosporium diseases are most severe on turf that is growing slowly due to adverse weather conditions or improper management practices. Shaded areas with little or no air movement result in weak turf and extended periods of leaf wetness that favor disease development and plant infection. Deficient or excessive nitrogen, excessive thatch, extended periods of leaf wetness, drought stress, and low mowing heights are factors that encourage the development of Helminthosporium diseases. These fungi may spread to the crowns and roots and cause melting out, which is most severe during periods of hot weather. Certain cultivars



**Net blotch of tall fescue.**

of turfgrasses are very susceptible to injury from *Helminthosporium* diseases while many of the newly released cultivars have exhibited good resistance.

## CONTROL

Use turfgrass cultivars with resistance to these diseases when available. Use of resistant cultivars is one of the best means of prevention. Select cultivars based on regional trials and University recommendations. Use blends and mixtures of cool-season grasses whenever possible. Fertilize to meet the nutritional needs of the turf but avoid over-stimulation and the development of lush, succulent growth. Do not apply more than one pound of nitrogen per 1,000 square feet in a single application. Avoid continual close mowing of the turf by raising the cutting height whenever possible. Keep the mower blades sharp to prevent open wounds through which the fungus can enter. Reduce extended periods of leaf wetness by watering deeply but infrequently to wet the entire root zone. Do not irrigate just before or after sunrise, and ensure good surface and soil drainage. Remove unwanted vegetation that impedes air movement and prune trees to allow for light penetration. Power rake to remove excessive thatch and reduce the potential for re-infection. Coring and topdressing golf greens on a regular basis will also reduce thatch buildup.

Apply a fungicide that will control these diseases when leaf spot is active and in the early stages of development for best control.



Leaf spot and melting out of Kentucky bluegrass.



Large patch of zoysiagrass.

## Large Patch PATHOGEN

*Rhizoctonia solani*

## HOSTS

All warm-season turfgrasses; centipedegrass and zoysiagrass are most susceptible

## SYMPTOMS

Large patch is a new name for an old disease, brown patch, the same disease that affects cool-season grasses during hot

weather. Other than the fact that they affect different grasses, several important differences between brown patch and large patch necessitated a name change: they occur at different times of the year, produce distinct symptoms, are caused by different strains of the fungus *Rhizoctonia solani*, and require very different control strategies.

Large patch appears in roughly circular patches that are yellow, tan, or straw-brown. The patches are initially 2 to 3 feet in diameter, but can expand in size rapidly to 10 feet or more, hence the name "large patch". Multiple patches may coalesce to encompass even larger areas of turf. When the disease is actively developing, the outer edge of the patches are often red, orange, or bronze. Close examination of individual plants reveals the presence of reddish-brown, oval-shaped lesions on the leaf sheaths. It may be necessary to peel away the older, dead leaves in order to reveal the lesions on the younger leaf sheaths.

## FACTORS AFFECTING DISEASE DEVELOPMENT

The visible symptoms of large patch are most evident during periods of cool, wet weather in the fall and spring. The disease begins to develop when soil temperatures decline to 70°F in the fall, but the symptoms do not necessarily appear at this time. Extended periods of cool, wet weather are required to induce the expression of large patch symptoms. In many cases, symptoms may not become evident until early spring when the warm season grasses are greening up. Large patch is favored by excessive nitrogen in the fall and spring, poor soil drainage, over-irrigation, excessive thatch accumulations,



Large patch lesions on St. Augustinegrass leaf sheaths.



Large patch of centipedegrass.

and low mowing heights. Centipedegrass is most susceptible to large patch, followed by zoysiagrass, and then St. Augustinegrass. Bermudagrass, rarely affected by large patch, recovers very quickly when the disease does occur.

## CONTROL

Do not apply nitrogen to warm-season grasses in the fall and spring. These grasses are growing slowly during this time and do not require a significant amount of this nutrient. In general, nitrogen should not be applied to the warm-season grasses within 6 weeks before dormancy in the fall or within 3 weeks after green-up in the spring. Warm-season grasses vary in their fertility requirements, so refer to local University recommendations for more specific recommendations for timing and rates.

Avoid establishing warm-season grasses in low lying areas that remain saturated for extended periods of time from surface runoff. If this is necessary, install subsurface drainage to remove excess water from the soil. Irrigate only as needed to prevent severe drought stress in the fall and spring. Control traffic patterns to prevent severe compaction, and aerify as needed to maintain soil drainage and aeration. Mow at recommended heights, and power rake or vertical mow as needed to control thatch accumulations.

Fungicides are available for large patch control, but must be applied on a preventative basis. Applications should be initiated in the fall when soil temperatures decline to 70°F, regardless of when symptoms have appeared in the past. One or two well-timed applications provide season-long control of large patch in most situations. Mapping of affected areas in the spring for spot-treatment in the fall can substantially reduce fungicide expenditures.



**Nematode injury on a bermudagrass putting green.**

## Nematodes

### PATHOGEN

Several nematode species, primarily sting (*Belonolaimus* species), stubby-root (*Trichodorus* species) and lance (*Hoplolaimus* species)

### HOSTS

All turfgrasses; especially those grown in sandy soils

### SYMPTOMS

Nematodes are microscopic, worm-like organisms that feed on the roots of all plants, including turfgrasses. They are usually grouped with turfgrass diseases because of their microscopic size. Nematode feeding causes a variety

of symptoms on turfgrass roots, including stunting, clubbing, lack of branching, dieback, and rot. The above-ground symptoms of nematode feeding are slow growth, thinning of the turf, poor response to adequate fertilization and irrigation, rapid wilting during dry weather, and weed invasion. These symptoms typically appear in irregular patterns across the turf stand, not in distinct circular patches. By the time the above-ground symptoms of nematode injury appear, significant damage to the root system has already occurred. A preliminary diagnosis can be made by comparing the root system in core samples from healthy and affected areas. For a definitive diagnosis, submit a soil sample for analysis of nematode populations, since nutritional or other cultural problems may cause similar symptoms. There are about 12 nematode species that are known to damage turfgrasses in North Carolina. Some species are more damaging than others, so each species has a unique threshold, or number of nematodes per volume of soil at which control practices are needed.

## FACTORS AFFECTING DISEASE DEVELOPMENT

Nematodes grow and reproduce best in light, sandy soils. Turfgrasses growing in sand are also less tolerant of root damage, because these soils are low in nutrient and water holding capacity. Soils with significant amounts of silt and clay are not devoid of nematode problems, however, as certain species are able to thrive in these soils. Above-ground symptoms of nematode injury are most prevalent during times of stress or on turf that is under-irrigated or under-fertilized.

Nematodes are able to grow over a wide range of soil temperatures, from 50 to 80°F. Because plant roots are the only source of food for nematodes, their growth closely matches the growth of the turf roots. Nematode populations in warm-season grasses peak in mid-summer, and populations in cool-season grasses peak in the spring and fall. Nematodes are fairly immobile in soil and their spread is mostly through movement of soil and plants by man or the elements.

## CONTROL

Make sure that the problem is due to nematode injury by taking a representative soil sample from the affected area and submitting it to a laboratory for analysis. North Carolina residents should contact their local Cooperative Extension agent for nematode assay boxes and information sheets. Samples, consisting of 12 to 15 soil cores approximately 4 inches deep, should be taken from the edge of the





affected area. The sample must not be allowed to dry or be exposed to extreme heat, otherwise nematodes will be killed and an accurate count cannot be obtained. A separate set of soil samples should also be submitted for chemical analysis to determine if any nutritional deficiencies or imbalances exist.

Selection of well-adapted grasses and proper turfgrass management practices will help to overcome a certain amount of nematode injury. When symptoms from nematode injury appear, apply low rates of fertilizer and irrigation on a frequent basis to compensate for the shallow root system, but do not increase the total amount of fertilizer or water applied to the turf. Good sanitary practices that discourage the physical movement of nematode infested soil and plants will also help. In landscape and utility turf situations, these are the only practical means of nematode management, as nematicides are not registered for use in these areas. Nematicides may be used on golf courses and sod farms when nematode populations exceed threshold values. Nematicides are very toxic to humans and the environment, so label directions should be followed closely if and when they are used.



**Pink snow mold of creeping bentgrass.**  
© by the American Phytopathological Society

## Pink Snow Mold (*Microdochium* Patch)

### PATHOGEN

*Microdochium nivale*

### HOSTS

All cool-season turfgrasses

### SYMPTOMS

Pink snow mold develops during periods of snow cover, with symptoms of the disease becoming evident as the snow melts. The disease appears in roughly circular white or light tan patches from 4 inches to 2 feet in diameter. A ring of salmon or pink-colored growth is present on the outer edge of patches when the disease is actively developing.

The infected leaves within the patches are usually collapsed and matted. Pink snow mold may also develop in the absence of snow cover during periods of cool, wet weather; in these cases, the disease is often referred to as *Microdochium* patch. The symptoms of *Microdochium* patch are slightly different than pink snow mold. The patches are similar to pink snow mold in shape and color, but appear greasy and are surrounded by a dark brown or bronze ring when the disease is actively developing.

### FACTORS AFFECTING DISEASE DEVELOPMENT

Disease activity is most severe when snow falls on unfrozen ground; however, activity can occur without snow cover during cool (less than 60°F) wet weather. Excessive foliar growth and thatch buildup are the most important factors encouraging development of pink snow mold and *Microdochium* patch. Restricted air movement, poor soil drainage, inadequate levels of potassium, and heavy traffic can also enhance the disease. The disease may also develop under tree leaves that remain on the turf for long periods during cold, wet weather.

### CONTROL

Do not apply nitrogen when cold weather is expected or before the first expected prolonged snow cover. Continue mowing in the fall until foliar growth stops completely. These steps will prevent a buildup of lush foliage that is highly prone to pink snow mold or *Microdochium* patch. Apply a high-potassium fertilizer in late fall to increase the cold hardiness of the turf. Improve surface drainage, control traffic patterns, reduce thatch accumulations, and aerify regularly in areas that have been severely affected by the disease in the past. Prune trees and remove unwanted vegetation that impedes air movement. Frequently remove leaves and other debris during autumn and winter from turf that is not covered with snow.

In regions where heavy snow is anticipated, take steps to minimize the duration of snow cover. Erect snow fences or plant landscape plants in strategic locations to prevent excess snow accumulation on highly maintained turf or where snow mold has been a serious problem. Prevent traffic on snow-covered turf, as compacted snow will melt more slowly and increase damage from pink snow mold.

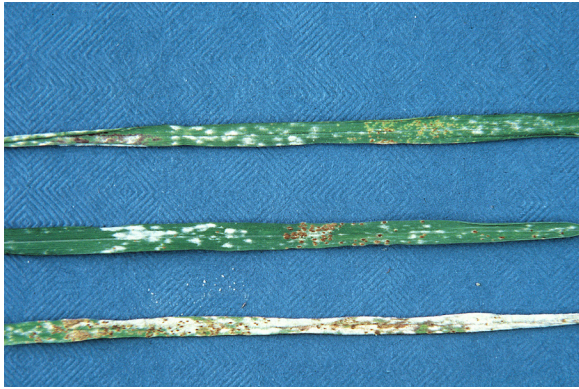
Fungicides are effective for control of pink snow mold and *Microdochium* patch. In the case of pink snow mold, apply fungicides before snow cover to prevent disease development. Mapping and spot-treatment of areas where pink snow



***Microdochium* Patch of creeping bentgrass.**  
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mold is most severe can significantly reduce fungicide expenditures. In regions where snow cover is not a problem, apply fungicides when symptoms of *Microdochium* patch are first observed.



**Powdery mildew on Kentucky bluegrass leaves.**  
© by the American Phytopathological Society

## Powdery Mildew

### PATHOGEN

*Blumeria graminis*

### HOSTS

Kentucky bluegrass, hard fescue, red fescue

### SYMPTOMS

A white or gray powdery growth is evident on infected leaves. Powdery mildew is typically most severe in heavily shaded areas. Heavily infected leaves turn yellow or red and die slowly. If left uncontrolled for several weeks, powdery mildew will significantly reduce turf density and weaken the turf, leaving it more susceptible to other environmental stresses.

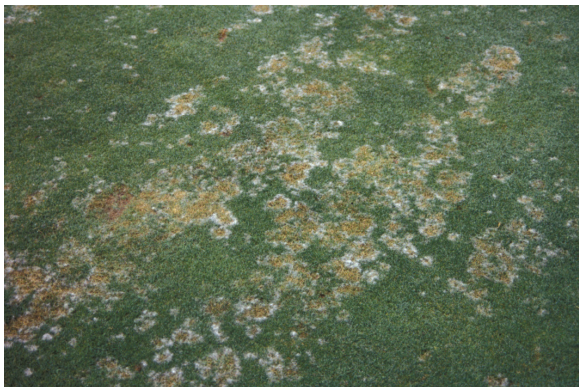


## FACTORS AFFECTING DISEASE DEVELOPMENT

The fungus survives the winter in living plant tissue. Spores are produced in the spring and are spread to healthy tissue by wind. The spores germinate and infect leaves during cool, humid conditions in the spring and fall. Because sunlight inhibits growth of the powdery mildew fungus, turf that is growing in dense shade is most prone to the disease. Unlike most foliar diseases, leaf wetness is not required for development of powdery mildew, but high humidity is necessary.

## CONTROL

Planting shade-tolerant grasses, such as the fine fescues (hard fescue, red fescue), is one of the best means of preventing severe problems with powdery mildew. A mixture of Kentucky bluegrass in combination with tall fescue and a fine fescue is preferred. Turf growing in shade uses less nitrogen, requires less water, and is less tolerant of low mowing. Management practices should be adjusted accordingly for shaded areas. Apply no more than 1 pound of nitrogen per 1,000 square feet at any one time. Maintain mowing height at approximately 3 inches to increase rooting and provide greater leaf surface for photosynthesis. Water deeply but infrequently to a depth of 6 to 8 inches to enhance rooting and reduce leaf wetness. Avoid light, frequent watering and watering just before or after sunrise. Pruning, removal, or careful placement of trees and shrubs to increase light intensity and air movement will help control powdery mildew. Several fungicides can be used to control this disease if necessary.



**Pythium blight of annual bluegrass.**

## Pythium Blight

### PATHOGEN

*Pythium aphanidermatum*

### HOSTS

Cool-season turfgrasses; bluegrasses and ryegrasses are most susceptible

### SYMPTOMS

*Pythium* blight first appears as small, sunken, circular patches up to 1 foot in diameter during hot, humid weather. Leaves within the patches are matted, orange or dark gray, and greasy in appearance. Gray, cottony mycelium may be seen in the infected areas when the leaves are wet or humidity is high.

The disease spreads rapidly along drainage patterns and can be spread by

equipment. This disease can cause severe damage quickly because it spreads rapidly when conditions favor development.

## FACTORS AFFECTING DISEASE DEVELOPMENT

*Pythium* blight may develop when night temperatures exceed 65°F and leaves are continually wet for 12 to 14 hours for several consecutive nights. Daytime temperatures above 85°F also encourage *Pythium* blight development, possibly due to increased stress on the turf. Severe *Pythium* blight epidemics are commonly observed the morning after a late afternoon or early evening thunderstorm in the summer. Excessive soil moisture and succulent foliar growth also favor disease development. Perennial ryegrass and annual bluegrass are most prone to *Pythium* blight and can sustain significant damage in 2 to 3 days when conditions are

favorable. Creeping bentgrass and tall fescue are more resistant to the disease.

## CONTROL

Reduce prolonged leaf wetness by watering deeply before sunrise and on an infrequent basis. Avoid excessive rates of nitrogen to prevent lush, succulent foliar growth. Lush growth is very susceptible to *Pythium* blight when conditions favor disease development. Avoid establishing turf in low-lying areas that will collect water. If necessary, install subsurface drainage to relieve wet soil conditions. Relieve compaction and maintain soil drainage through hollow tine aeration, and topdress golf course putting greens regularly to maintain soil aeration.

Do not mow or irrigate when *Pythium* mycelium is present on the foliage to minimize spread of the pathogen. Collect and promptly dispose of clippings from infected areas and ensure that mowing equipment is washed before going to an uninfected area. Due to the potential for rapid development of this disease, high-value areas and susceptible grasses should be protected with a preventive fungicide program when hot, humid weather is forecast.



**Pythium blight of tall fescue.**



**Red thread of perennial ryegrass.**  
© by the American Phytopathological Society

## Red Thread

### PATHOGEN

*Laetisaria fuciformis*

### HOSTS

All cool-season grasses; perennial ryegrass is most susceptible

### SYMPTOMS

Red thread develops in roughly circular patches from 4 inches to 2 feet in diameter. Affected leaves within these patches are tan or bleached white. From a distance, the patches usually have a reddish appearance, due to the presence of thick, red strands of fungal growth emanating from the affected leaves. These “red threads” spread the fungus to healthy plants, and they survive unfavorable conditions. Small tufts of pink, fuzzy mycelium may also be present in or around

the patches when the leaves are wet or humidity is high. After prolonged periods of disease development, the patches may merge to produce large irregularly shaped areas of damaged turf.

## FACTORS AFFECTING DISEASE DEVELOPMENT

The red thread fungus is able to cause disease at temperatures ranging from 40 to 80°F, but develops most rapidly at approximately 70°F. Red thread affects grass that is growing slowly for any reason: inadequate fertilization, drought stress, cool weather, low light intensity, excessive traffic, or many other pest or environmental stresses. Red thread is most severe in the spring and fall, when extended periods of cool, wet, and overcast weather slow growth of the turf and favor growth of the pathogen. Because of its wide temperature range, red thread can develop at any time of year when a slow-growing host and sufficient leaf wetness are available.

## CONTROL

Fertilize to meet the nutritional needs of the turf and maintain vigorous growth. Submit a soil sample for nutrient analysis regularly, and apply recommended amounts of phosphorus, potassium, and lime. Apply nitrogen based on University recommendations to prevent weak, thin turf; however, avoid overstimulation and the development of lush, succulent turf. Irrigate deeply and infrequently, before sunrise, to prevent prolonged periods of leaf wetness. Prune or remove trees, shrubs, or other barriers to increase air movement and sunlight penetration. Remove clippings from affected areas when the disease is active to reduce spread of the disease, and wash infected clippings from equipment before entering uninfected areas. Fungicides are available for control of red thread, but are usually not necessary if proper cultural practices are implemented.



**Red strands of fungal growth produced by red thread fungus.**

© by the American Phytopathological Society



Rust pustules on tall fescue leaves.

## Rust PATHOGEN

*Puccinia* species

### HOSTS

Kentucky bluegrass, perennial ryegrass, tall fescue, and zoysiagrass

### SYMPTOMS

Early symptoms include small, yellow flecks that develop on the leaves and stems. The flecks expand over time into raised orange or red pustules, that eventually rupture to release powdery masses of yellow, orange, or red spores. Infected plants become yellow and are more susceptible to environmental stress. Heavily infected areas become thin and will exhibit clouds of orange dust (rust spores) when the foliage is disturbed. Rust pustules on infected leaves turn black during the fall in preparation for over-wintering.



## FACTORS AFFECTING DISEASE DEVELOPMENT

The fungus survives the winter in living plant tissue from which new spores are produced in the spring. Spores produced in the spring, summer, and fall are spread by the wind, germinate on the leaves, and infect new tissue. Extended periods of leaf wetness are required for the spores to germinate and for the disease to develop rapidly. Many cycles of spores can be produced during the year. Rust diseases are most severe in turf that is growing slowly due to adverse weather conditions or inadequate management. Low light intensity, inadequate fertilization, drought stress, and infrequent mowing encourage rust development.

## CONTROL

Plant rust resistant turfgrass cultivars whenever possible to reduce potential injury from this disease. Select cultivars based on regional trials and University recommendations. Use blends and mixtures of cool-season grasses whenever possible. Plant shade tolerant grasses and avoid close mowing where shade prevails. Prune trees and remove unwanted undergrowth to improve air movement and reduce prolonged leaf wetness. Mow turf on a regular basis, removing no more than 30 to 40 percent of the foliage in one mowing. Collect and dispose of clippings taken from infected areas to avoid spread of this disease. Fertilize to meet the nutritional needs of the turf. Submit a soil sample for analysis on a regular basis and apply recommended amounts of phosphorus, potassium, and lime. Apply nitrogen based on University recommendations. Water deeply but infrequently to encourage deep rooting and reduce drought stress and extended periods of leaf wetness. Avoid watering the turf before or after sunrise. Several fungicides can be used to control rust diseases.



Slime mold pustules on creeping bentgrass leaves.

## Slime Mold PATHOGEN

*Myxomycetes*

### HOSTS

All turfgrasses

### SYMPTOMS

Many small, round pustules are observed on the turfgrass leaves in small patches. The patches develop very quickly, usually overnight. The pustules may be purple, white, gray, yellow, or orange. The slime mold organisms do not infect the turf or cause direct harm, but they can cause mild yellowing of the leaves due to their shading effect. Slime molds are unsightly but are not considered harmful.



## FACTORS AFFECTING DISEASE DEVELOPMENT

Slime mold spores survive in the soil and thatch. During warm, wet weather the spores germinate and develop into a colorless, slimy mass that grows over the soil and nearby plant parts during wet weather. The pustules observed on turfgrass leaves are reproductive structures that contain numerous spores. Flushes of slime mold growth are often observed after heavy rain storms that were preceded by long periods of dry weather.

## CONTROL

Slime mold pustules typically disappear after 2 to 3 days, therefore, no control practices are needed. If the growth is particularly unsightly, the pustules may be removed by brushing, mowing, or washing the turf. Fungicides are available for slime mold control but should only be used in severe cases.



Spring dead spot in bermudagrass athletic field.

## Spring Dead Spot

### PATHOGEN

Primarily *Ophiosphaerella korrae* in North Carolina, *O. herpotricha*

### HOST

Bermudagrass

### SYMPTOMS

Circular patches of bermudagrass, from 6 inches to several feet in diameter, remain dormant as the turf greens up in the spring. These patches eventually die and collapse to the soil surface. Spring dead spot patches recur in the same spot yearly and increase in size by up to several inches each season. As the patches expand, the centers are sometimes re-established with bermudagrass, resulting

in a ring-like appearance. Recovery of the patches occurs by spread of the bermudagrass from the outside. This process is very slow, taking the entire growing season in severe situations. The spring dead spot patches greatly detract from the uniformity of the playing surface and are frequently invaded by weeds.

### FACTORS AFFECTING DISEASE DEVELOPMENT

Spring dead spot is most evident on intensely managed bermudagrass, such as athletic fields and golf courses. The disease typically takes 3 to 5 years to become established in a new bermudagrass stand. Unlike take-all patch, spring dead spot does not decline in severity as the turf matures. It becomes more severe if left unmanaged.

The spring dead spot fungus attacks the roots, rhizomes, and stolons of bermudagrass during the fall and winter. This causes the affected bermudagrass to be highly susceptible to freezing injury during the winter. As a result, the disease is most severe in the northern range of bermudagrass adaptation and is usually more severe following extremely cold winters.

Spring dead spot is most severe when soil pH is 6.5 or greater. In addition, any factor that restricts bermudagrass root growth or increases its susceptibility to winter injury will also enhance the disease. Excessive nitrogen, potassium deficiencies, poor soil drainage, over-irrigation, excessive thatch accumulation, and soil compaction have been shown to encourage disease development.

### CONTROL

Maintain soil pH between 5.5 and 6.0 to minimize spring dead spot development. Soil pH is best reduced slowly over time through use of an acidifying nitrogen source, such as ammonium sulfate or sulfur coated urea. Fertilize to meet the nutritional needs of the turf, but do not apply excessive rates of nitrogen. Do not apply nitrogen within 6 weeks of winter dormancy, and do not exceed more than 1 pound of nitrogen per 1,000 square feet per application at any time during the growing season. Apply potassium (1 pound  $K_2O$  per 1,000 square feet) and raise the mowing height to 1 or 1.5 inches in late summer to improve the winter hardiness of the bermudagrass. Reduce thatch buildup and relieve soil compaction through aggressive aerification and vertical mowing. Frequent aerification is especially important in high-traffic areas. Golf greens should also be topdressed along with aerification to control thatch accumulation.

Fungicides are available for spring dead spot control, but they must be applied preventatively in the fall. Fenarimol has been the most effective and consistent fungicide for spring dead spot control. Applications are most effective when soil temperatures are between 60 and 80°F. To move the fungicide into the root zone, apply in a high volume of water (5 gallons per 1,000 square feet) or watered in with ¼ inch of irrigation immediately after application. Repeat applications at high label rates may be necessary in severely affected areas. Affected areas should be mapped in the spring for treatment in the fall because fungicide treatment is expensive.

Once the symptoms of spring dead spot appear, the only means of control is to encourage the spread of bermudagrass into the affected patches. Frequent spiking or aerification is recommended to break up the mat of dead turf in



Rotting of bermudagrass roots and stolons caused by spring dead spot.



affected patches. Applying extra nitrogen to encourage recovery is not recommended, as this can enhance the disease in the following year. Dinitroaniline (DNA) herbicides, which are commonly used for preemergent control of annual grasses, can slow the recovery of bermudagrass from spring dead spot injury and should not be used in sites with a history of the disease.



Summer patch of Kentucky bluegrass.

## Summer Patch

### PATHOGEN

*Magnaporthe poae*



### HOSTS

Annual bluegrass, Kentucky bluegrass, fine fescues, creeping bentgrass

### SYMPTOMS

The symptoms of summer patch appear in circular patches or rings, ranging from 6 inches to 3 feet in diameter. Turf within these patches is initially off-colored, prone to wilt, growing poorly, or sunken in the turf stand. Over a period of one to two weeks, the turf continues to decline, turning yellow or straw brown, and eventually collapsing to the soil surface. The outer edge of the

patches may be orange or bronze colored when the disease is actively developing. Affected plants are easily pulled up from the turf, and visual examination reveals that the roots, crowns, and rhizomes are black and rotten. The patches recur in the same spot annually, and expand at a rate of 2 to 4 inches per year. Resistant grasses, such as creeping bentgrass or fescues, or weedy species, are often present in areas damaged by summer patch.

### FACTORS AFFECTING DISEASE DEVELOPMENT

The summer patch fungus begins to attack the roots, stolons, and rhizomes in the spring when soil temperatures reach 65°F. Disease development continues as long as soil temperatures remain between 65 and 80°F. Heat and drought stress during summer induce the expression of summer patch symptoms. In North Carolina, the symptoms typically appear in early to mid-July. Summer patch is most severe when soil pH is 6.5 or greater. In addition, any factor that restricts root growth will also enhance the disease. Lush, succulent growth from excessive nitrogen, potassium deficiencies, poor soil drainage, over-irrigation, excessive thatch accumulation, and soil compaction have been shown to encourage disease development.

### CONTROL

Maintain soil pH between 6.0 and 6.5 to minimize summer patch development. Bluegrasses are less tolerant of low soil pH than other turfgrasses, so use caution when adjusting pH. Soil pH is best reduced slowly over time through use of an acidifying nitrogen source, such as ammonium sulfate or sulfur-coated urea. Avoid excessive nitrogen in the spring and fall, and mow at recommended heights to maximize root growth. Reduce thatch buildup and relieve soil compaction through aggressive aerification, vertical mowing, and topdressing. Frequent aerification is especially important in high traffic areas where the disease is most severe. When summer patch symptoms appear, increase mowing heights and the frequency of irrigation and fertilizer applications to minimize stress and compensate for damage to the root system.

Fungicides are available for summer patch control, but they are most effective when applied on a preventative basis. For best results, fungicide applications should begin in spring when soil temperatures reach 65°F. Two to three applications on 28-day intervals provide excellent summer patch control in most situations. Fungicide applications should be made in a high volume of water (5 gallons per 1,000 square feet) or watered in with ¼ inch of irrigation immediately after application.



Rotting of Kentucky bluegrass roots and crowns caused by summer patch.

© by the American Phytopathological Society



**Take-all patch of creeping bentgrass.**  
© by the American Phytopathological Society

## Take-All Patch

### PATHOGEN

*Gaeumannomyces graminis var. avenae*

### HOST

Creeping bentgrass

### SYMPTOMS

Symptoms of take-all patch initially appear in late spring or early summer as circular patches that are off-colored, growing poorly, or highly prone to wilt. As temperatures increase, turf within the patches becomes thin and turns yellow, orange, or bronze, and eventually collapses to the ground. Other grasses, such as bluegrasses or fescues, are resistant to take-all patch and may be seen growing in the center of the dead patches. Affected tillers are easily pulled up

from the turf, and the roots, stolons, and crowns are dark brown to black. Take-all patch recurs in the same spot yearly, the patches expanding in size several inches per year. The centers of larger patches are sometimes colonized by creeping bentgrass or weedy species, resulting in a ring-like symptom.

### FACTORS AFFECTING DISEASE DEVELOPMENT

The take-all patch fungus begins to infect and kill bentgrass roots in the fall when soil temperatures cool to 60°F and continues during the fall and spring when soil temperatures are between 40 and 60°F. Symptoms are typically not observed until late spring or early summer, when heat and drought cause the affected turf to decline because of its weakened root system.

In North Carolina, take-all patch only occurs at high elevations in the western part of the state. The disease is most severe in newly established turf, typically appearing within a year after establishment. Take-all patch is especially severe in soil that was fumigated prior to establishment or had not been previously established with turf. Severity declines as the turf matures, and may disappear entirely after 5 to 7 years. The disease is also encouraged by cool, wet weather in the fall and spring, followed by hot and dry conditions in the late spring and summer. Soil pH greater than 6.5 and low manganese availability are highly conducive to take-all patch. Any other factor that restricts bentgrass root growth will increase take-all patch problems.

### CONTROL

Where take-all patch occurs, monitor soil pH regularly in newly established creeping bentgrass and maintain it between 5.5 and 6.0. Adjust the pH of irrigation water if necessary to avoid increases in soil pH. Use acidifying sources of nitrogen, such as ammonium sulfate, to reduce soil pH gradually. Do not apply elemental sulfur to creeping bentgrass, as this element can directly injure the turf or initiate black layer formation. If lime is needed to raise soil pH, make several, light applications during the course of a year to prevent a rapid increase in soil pH.

Apply manganese (Mn) at a rate of 2 pounds per acre per year in regions where take-all patch occurs. For best results, make split applications of manganese sulfate (32% Mn) on 4- to 6-week intervals in the fall and spring when soil temperatures are between 40 and 60°F. Monitor soil and tissue levels of manganese regularly to avoid excessive levels of this nutrient.

Creeping bentgrass with a deep, dense root system is far more tolerant of damage from take-all patch. Use all means possible to ensure strong root development in the fall and spring. Avoid excessive nitrogen during these times, which causes excessive foliar growth at the expense of root growth. Control traffic patterns to prevent severe compaction of soils. Avoid establishing turf in low-lying areas that will collect surface runoff. If this is necessary, install subsurface drainage to alleviate the problem. Aerify and topdress regularly to relieve compaction, reduce thatch accumulation, and maintain soil drainage and aeration.

Little can be done to control take-all patch once the symptoms appear, as significant damage has already occurred to the root system. Light, frequent applications of fertilizer and irrigation can help to compensate for the lack of root development. Aerification and reseedling of dead patches should aid in recovery. Re-sodding or plugging patches on golf greens may be practical. Fungicides are effective for take-all patch, but must be applied preventatively in the fall. Initiate applications in the fall when soil temperatures decline to 60°F, and repeat on 4-week intervals. Two to three applications in the fall provide excellent take-all patch control in most situations. Applications should be made in a high volume of water (5 gallons per 1,000 square feet) or watered in with 1/8 to 1/4 inch of water immediately after application.



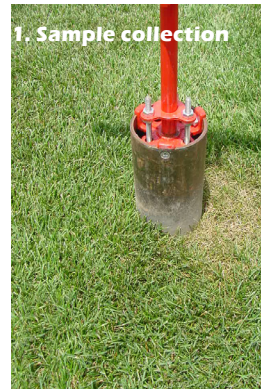
# HOW TO SUBMIT TURF SAMPLES FOR DISEASE DIAGNOSIS

Diagnostic services are available to turfgrass managers through the Plant Disease and Insect Clinic at North Carolina State University. The clinic is recognized nationally for its outstanding services and internet-based system for sample reporting and distance diagnosis.

Dr. Jim Kerns coordinates the turfgrass diagnostic services and conducts all disease diagnosis on turf samples. Extension specialists from Entomology and Crop Science are consulted when insect, weed, or management-related problems are encountered. This team approach ensures that you receive an accurate diagnosis and reliable recommendations for solving the problem.

## INSTRUCTIONS

1. Download and print the Sample Submission Form from the Plant Disease and Insect Clinic Web site at: <http://turfpatholgy.plantpath.ncsu.edu/files/2014/03/2015-Turf-Form.pdf>
2. To diagnose turfgrass problems, we need at least a 6-by 6-inch piece of the turf, including the root system and soil. If using a golf course cup cutter, please send at least 2 plugs.
3. Collect samples from the border between healthy and diseased turf, so that 2/3 of the sample is diseased and 1/3 is healthy.
4. Wrap the soil and roots in aluminum foil to keep the soil from shaking loose during transit. DO NOT store or transport the samples in plastic bags. Instead, place the samples in a cardboard box, and stuff it with newspaper or other packing material to hold the samples in place.
5. Please fill out the sample submission form completely, and describe the symptoms you are observing as accurately as possible. All of the information requested on the form is needed to make an accurate diagnosis.
6. Send the sample and submission form to the Plant Disease and Insect Clinic by overnight mail or state courier using the following address:



### ADDRESS

Plant Disease and Insect Clinic  
Campus Box 7211  
100 Derieux Place  
North Carolina State University  
Raleigh, NC 27695-7211

### STATE COURIER ADDRESS

Plant Disease and Insect Clinic  
Campus Box 7211 NCSU  
Raleigh, NC  
STATE COURIER: 53-61-21

## HOW TO SUBMIT DIGITAL IMAGES

We now accept digital images along with physical samples. Pictures of the symptoms from a distance of 6 feet or more are very useful for diagnosis of disease and insect problems. Close-up pictures, from a distance of less than 2 feet, are usually not helpful. Digital images can be sent to the Plant Disease and Insect Clinic by direct upload at the following website:

<http://turfpatholgy.plantpath.ncsu.edu>

For further assistance, please see instructions on the website under 'Turf Diagnostics Lab.'

Please do not send images as e-mail attachments.



# Insect Pests on Turf

BY RICK BRANDENBURG

Many insects and small animals live in or on turf. Some damage turfgrasses by feeding on or sucking sap from the roots and leaves and, to a lesser extent, stems. Others damage turfgrasses by making burrows in the soil that disturb roots. Insects may reduce stands by killing plants, reduce turfgrass quality, or make plants more susceptible to other pests. Some also transmit plant pathogens. If turfgrass areas have stunted, distorted growth, browning or yellowing leaves, or dead areas, you should confirm the presence of insects before an insecticide is applied. Similar symptoms may be caused by diseases, nematodes, poor soil conditions, or other factors.

The potential for insect damage to turf varies greatly due to many factors, such as fertility, irrigation, height of cut, age of turfgrass, climate, food availability, plant response, natural enemies (parasites, predators, and pathogens), and use of the area. Some turfgrasses tolerate insect attack better than others and grow well in spite of insects. Others may be severely damaged by the same number of insects.

Fortunately, only a few pests cause problems that require control measures in any one year. Therefore, it is impossible to give a clearcut guide to the number of insects that must be present to cause damage for each situation. From experience we know that certain insects must be controlled at the first sign of presence because they will likely increase in numbers and cause considerable damage. With other pests, pest buildup can be detected by frequent examination of the turf. Use insecticides only if the injury gets progressively worse. Heavy infestations of cutworms, fall armyworms, or sod webworms may be tolerated on fairways, industrial areas, home lawns, and parks with few ill effects, whereas only a few in number severely damage golf greens.



## SOIL INSECTS

The major soil-inhabiting insects in North Carolina are the grubs (larvae of many species of beetles, such as the Japanese beetle, green June beetle, Asiatic garden beetle, northern masked chafer, southern masked chafer, and billbug), ants, mole crickets, and scale insects, such as ground pearls.

Soil insects are difficult to detect and can only be found by close examination of the roots, stems, and crowns of plants along with soil from around the turfgrass. This usually requires a shovel or spade to dig up the turf and soil. Moles, voles, birds, and skunks feed on grubs and, in the process, tear up the turf as they search for them, often causing extensive damage.

### CONTROL PRACTICES

If an economic threshold of grubs exists, there are several alternatives to conventional insecticide use. The spores of *Bacillus popilliae*, milky spore disease, for control of Japanese beetle larvae have been around for years. Treatment with milky spore disease is expensive, very slow, and should only be directed against Japanese beetle grubs. However, once the spores are distributed, the treatment will provide some control for years. Unfortunately, there are no data to support the effectiveness of milky spore, and the availability of quality product has been sporadic in recent years. New products, such as various species of entomogenous nematodes that are currently available and a new strain of *Bacillus thuringiensis* that is effective against white grubs, have provided and will provide future opportunities for alternative management options. Timing and application techniques are critical with these control options.

Insecticides must be distributed evenly to obtain good insect control. They may be applied as coarse sprays or granules. Because effective control depends upon contact between the insect and the insecticide, irrigate the treated area immediately after application. With sprays, irrigate before spray deposits dry. Granules should be applied when the grass is dry. Then apply at least ½ inch of water as soon as possible. Irrigation is important because some insecticides have a strong affinity for organic matter, and some of the material binds to the thatch and becomes ineffective unless sufficient water is used to move the material through the thatch. Some insecticides are virtually impossible to move through the thatch, and as a general rule, thatch significantly hinders attempts to manage soil insect pests. Recent research has demonstrated that pretreatment irrigation is usually beneficial as it adds moisture to the organic matter and aids movement of the pesticide to the target site and also helps move the soil pests closer to the surface.



Photo Courtesy of Brian Royals

## White Grubs

[Family Scarabaeidae]



White grubs are the larvae of several kinds of scarab beetles. The Japanese beetle larva is the most important species in North Carolina. Other common species are the green June beetle, northern and southern masked chafers, and the black turfgrass ataenius. All have creamy, blunted bodies with yellow to brown heads and brownish hind parts and visible legs (except billbugs).

Mature grubs vary from ¼ to 1½ inches in length depending on the species. White grubs usually lie in a curled or C-shaped position. All of the important species in North Carolina have a 1 year life cycle and spend about 10 months in the ground. In mild weather they are 1 to 3 inches below the surface; in winter they go deeper into the soil.

All species of grubs other than the green June beetle and billbug larvae burrow around and feed on grass roots about 1 to 2 inches below the surface. Heavy infestations destroy the root system and cause the area to become “spongy.” The turf can often be rolled back like a carpet. Damage is most apparent in April and May or September and October when grubs are actively feeding. All species of turfgrasses are affected, but injury is more severe on bluegrass and bentgrass. Moles, voles, skunks, and birds feed on grubs and often severely damage turf areas while searching for them.

The green June beetle grub feeds mainly on decaying vegetative matter. Grass is smothered by mounds of dirt as a result of burrowing. They also uproot seedlings. Sometimes in the fall or after a heavy rain, green June beetle larvae come out of the soil and crawl on the surface of the ground. They have the unusual habit of crawling on their backs. This pest seems to be on the increase throughout North Carolina and the southeastern United States. Billbugs (not a true white grub) feed on stems, crowns, and rhizomes. They severely weaken the turf and deposit a sawdust-like frass. Adult beetles usually appear from mid-May to mid-June depending on the species and weather conditions. They are usually active from 4 to 6 weeks, during which time eggs are laid for succeeding generations.

### CONTROL PRACTICES

To detect white grubs, take 1-square-foot areas from several locations and examine the soil and roots in the top 3 to 4 inches. If an average of five or more grubs is found per square foot, apply an insecticide for control. The condition of the turf, its value, use, and damage caused by birds and mammals may alter thresholds.

Control of white grubs can be difficult, and there will probably always be some level of activity in the soil following treatment. Insecticides are most effective if applied when grubs are small, actively feeding, and soil temperatures are warm (August and September). It is important to remember that some grubs have different life cycles. Billbugs and black turfgrass ataenius have more than one generation per year. Understanding their development and targeting control toward the most susceptible stages are critical.



Photo Courtesy of Rick Brandenburg

## Mole Crickets

[Scapteriscus species]



Mole crickets are light-brown crickets about 1½ inches long with short, stout forelegs and shovel-like feet. They feed at night on the roots of grass, and their burrowing also uproots seedlings and causes soil to dry out quickly. One mole cricket can travel and damage several yards of a newly seeded area or a golf green in a single night. On golf greens, the raised tunnels made by mole crickets are skimmed off by the mower, damaging not only the grass but also the equipment. Two species are responsible for much of the damage in the southeastern United States. The tawny mole cricket is the most destructive since it feeds almost entirely on the roots of grass; the southern mole cricket that feeds less on grass roots acts more as a predator.

Mole crickets generally overwinter as nymphs or adults deep in the soil, but may come to the surface and do some feeding even during the winter months. They become active in March and feed aggressively until they mate and lay eggs in late spring. Each female lays 35 to 50 eggs, which hatch in 10 to 40 days depending on temperature. This egg hatch usually begins in mid-June in North Carolina and continues into July. There is only one generation per year.

## CONTROL PRACTICES

Mole crickets are most effectively controlled soon after they hatch. As mentioned above, this usually occurs in North Carolina about mid-June to early July and a little earlier in more southern areas. The smaller nymphs are more susceptible to treatments and, at that time of year, have not caused serious damage. Under severe insect pressure, even the best timed treatment may not be sufficient to prevent undesirable damage. Continued monitoring of the area is required, and followup treatments should be applied as necessary to those areas still infested, using contact insecticides or poisoned baits.

To detect small mole crickets, use a soapy water flush (2 teaspoons of liquid dishwashing detergent in 2 gallons of water poured over a square yard area). On established turf, spray or granular applications can be used as long as they are thoroughly watered into the grass. Such treatments will be most effective if they are applied when night temperatures are at least 60°F. Baits can also be effective in August or September but provide little residual activity. For specific chemical controls, consult the Cooperative Extension recommendations. Effective management of mole crickets requires a complete management plan and a commitment to follow through.



Fire ant infestation of North Carolina.

## Ants

### [Family Formicidae]

There are a number of different kinds of ants that build nests in the ground on golf courses. They are particularly troublesome when nests are built around the fringes or on golf greens and tees or in fairways. Ant hills and mounds often smother the surrounding grass. Ants also destroy roots of grass near mounds, eat grass seeds, and complicate mowing operations. Some ants bite people and animals — fire ants and harvester ants are especially vicious. Some people are allergic to imported fire ant bites. Other ants are simply a nuisance.



## CONTROL PRACTICES

Ants may be controlled by treating individual mounds with insecticidal drenches or granules. If ant hills are numerous, a broadcast treatment of the entire area may be needed. Fire ant management is more complicated and requires a complete plan if many mounds are present over a large area.



Photo Courtesy of J.R. Baker, NCSU

## Bees and Wasps

### [Family Andrenidae, Vespidae, Scoliidae, and Sphecidae]

There are several species of bees and wasps that occasionally damage turfgrass by digging up the soil, making holes, or forming mounds. Some of these are solitary ground nesting bees, cicada killer wasps, Scoliids, yellow jackets, and bumblebees. Most are present from June to October.



## CONTROL PRACTICES

Yellow jackets, bumblebees, and cicada killer wasps will sting if molested. This makes control of these pests important. Spot treatment or broadcast application of recommended insecticides will usually control these insects. The solitary bees, such as the Colletid or Andrenid bees, are not aggressive, but often occur in

large numbers in the spring, building nests in areas where the turf is thin. One effective management strategy for many of these bees and wasps is to maintain a thick, lush stand of turf as well as to replenish mulch to keep to a minimum the bare soil areas where the insects prefer to build nests.



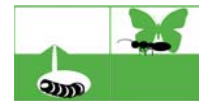
Photo Courtesy of Terry Thormin



Photo Courtesy of Rick Brandenburg

## SCALE INSECTS

**(both soil and surface)**



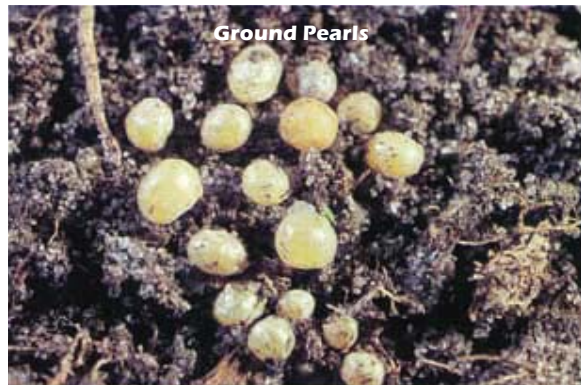
Scale insects suck the juice from grasses — some feed on the crown of the plants and above-ground parts and others feed on the roots. The grass becomes yellow and then brown, and finally dies. Damage is usually more severe in dry periods than in wet. Several kinds of scales damage turfgrass in the South. The most important species of scales in North Carolina are bermudagrass scale and ground peals.

### Bermudagrass Scale

**[*Odonaspis ruthae*]**



The adults are about 1/16 inch long, oval, and covered with a white, hard secretion. This insect infests bermudagrass and is especially active in shady areas. It kills the grass and leaves bare brown patches.



Ground Pearls

Photo Courtesy of D.J. Shetlar

### Ground Pearls

**[*Margarodes species, Eumargarodes species*]**

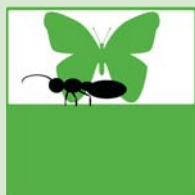


The female adult secretes a white, waxy sac in which it places about 100 pinkish-white eggs. Slender nymphs hatch and feed on the fine grass roots. The nymphs cover themselves with hard globular shells that look like tiny pearls. These are called ground pearls. They are about 1/8 inch in diameter.

Ground pearls cause serious damage to centipedegrass and St. Augustinegrass and, to a lesser degree, bermudagrass. The grass turns brown in the summer; it dies in the fall and leaves irregular dead spots.

#### CONTROL PRACTICES

Practice good management. Irrigate regularly during dry periods. Control with insecticides is not currently effective.



## SURFACE-FEEDING INSECTS

Several insect pests, the foliar feeders, feed on turfgrasses at or above the soil surface. One group chews the sides of blades or chews entire plants off at the crown. Examples are armyworms, cutworms, and sod webworms.

Another group of insects damages turfgrasses by sucking fluids from the grass plants. Examples are leafhoppers, spittlebugs, and chinch bugs.

Surface-feeding insects hide in grass, and burrow into thatch and debris above the soil. This often makes them difficult to locate. The presence of foliar feeders such as sod webworms, armyworms, and cutworms can be verified by mixing one tablespoon of 1 or 2 percent pyrethrum in a gallon of water and applying it to 1 square yard of turf. The soapy water flush mentioned in the "Mole Crickets" section can be substituted if pyrethrum is unavailable. These mixtures irritate the insects and force them to crawl to the surface within 5 to 10 minutes. This technique is not effective for soil insects other than mole crickets.

To detect chinch bugs, remove both ends of an empty can and push one end 2 to 3 inches into the turf where chinch bugs are suspected. Fill the can with water and wait a few minutes. If chinch bugs are present, they will float to the surface.

#### CONTROL PRACTICES

Surface-feeding insects are usually less difficult to control than those in the soil. However, with the exception of control measures for the chinch bug, insecticides should be applied as a spray with little or no irrigation or rainfall within 24 hours. Insecticides should not be applied unless the insect, damage, or both have been confirmed. As a general rule, it is important not to mow and remove clippings for two or three days after treating for surface-feeding insects. Several products are available that offer alternatives to conventional insecticides for surface pests. These include numerous entomogenous nematode products, several *Bacillus thuringiensis* (*Bt*) products, azadirachtin (neem seed extract), and the lower-use-rate synthetic pyrethroids.



Fall Armyworm

## Armyworm

[*Pseudaletia unipuncta*]

## Fall Armyworm

[*Spodoptera frugiperda*]

The fall armyworm is a sporadic but serious pest of turfgrasses in North Carolina. When numerous, this insect will devour grasses down to the ground, causing circular bare areas. The fall armyworm is 1½ inches long and greenish with blackish stripes along each side and down the center of the back. It has a distinct inverted “Y” on the head.



Photo Courtesy of Bart Drees, Texas A&M University

The fall armyworm does not overwinter in North Carolina, but egg-laying armyworm moths migrate northward from Florida and the Gulf Coast areas throughout the spring and summer and begin to arrive in North Carolina in June. Damaging larval populations usually occur from midsummer to late fall. Some years the fall armyworm is a serious pest of turfgrasses in North Carolina, usually following cool, wet springs which seem to reduce the effectiveness of naturally occurring parasites. Each female lays about 1,000 eggs in masses of 50 or more. Fall armyworms feed any time of day or night, but they are most active early in the morning or late in the evening. When abundant, fall armyworms eat all available food and move in mass to adjoining areas. The larvae feed two to three weeks and a generation takes about five to six weeks. Several generations occur each year. The fall armyworm is a common pest of newly seeded stands of cool-season turf in the fall and often attacks overseeded areas of warm-season grass as the ryegrass establishes. The true armyworm is similar in appearance but lacks the inverted “Y.” It is found less frequently in turf but is a potential pest. Larval populations usually occur earlier in the spring and summer.

### CONTROL PRACTICES

Armyworms attack most common turfgrasses grown in North Carolina. Chemical control is needed if natural enemies do not keep infestations below the economic threshold of 1 per square foot on general turf or 1 per square yard on golf greens. If possible, do not mow turf and remove clippings for several days after treating for any of the caterpillar pests.



Bronze Cutworm

Photo by Marlin E. Rice

## Black Cutworm

[*Agrotis ipsilon*]

## Granulate Cutworm

[*Feltia subterranea*]

## Variegated Cutworm

[*Peridroma saucia*]

Cutworms are the larvae of several species of night-flying moths. The most common species attacking turfgrass in North Carolina is the black cutworm. The variegated cutworm and granulate cutworm also are occasional pests. Each cutworm differs slightly from the others in details of habits and appearance, but life histories are generally similar. Cutworms are fat, smooth, dull-colored caterpillars from 1½ to 2 inches long when full grown. Adults and larvae hide during the day but may become active on cloudy days. Cutworms overwinter in the soil either as pupae or mature larvae. In the early spring, the hibernating larvae pupate and adults appear by mid-March. Females lay eggs singly or in clusters. Eggs hatch in 3 to 5 days, and larvae develop in 3 to 4 weeks. Some have as many as four generations per year in North Carolina.



Cutworms feed on leaves or cut off the grass near the soil. They are major pests of bentgrass golf greens and often migrate onto greens from surrounding areas. The grass is often eaten to ground level around aerifier holes or holes made by the cutworms. Cutworms are seldom numerous enough to damage tees, fairways, roughs, lawns, or other turfgrass areas. Damage to turf from cutworms can occur from March to November in North Carolina.

## CONTROL PRACTICES

To detect cutworms, closely examine for damage and worms late in the afternoon or use the flush method described under “Surface-feeding Insects.” Apply a recommended insecticide if damage is noted and one or more cutworms is present per square foot of general turf. On golf greens, treatment should be applied when one cutworm is present per square yard. Control is generally more effective if insecticides are applied in the late afternoon.

## Sod Webworms

### [Family Pyralidae]



Sod webworms are the larvae of the buff-colored lawn moth. The larvae are from 1/2- to 3/4-inch long when full grown. They have dark heads and most are hairy with two dark spots on each body segment. The adults are small, whitish moths that fold their wings closely about the body when at rest. They hide in shrubbery or other sheltered spots during the day. Females fly over the grass in the early evening and scatter eggs on the grass. Moth flights may occur from May to October. The worms live in a protective silken web and work only at night. As larvae grow, they build silk-lined tubes close to the surface of the soil.

Several different species of sod webworms infest turf in North Carolina. They attack bentgrass, bluegrass, fescue, hybrid bermudagrass, and other grasses. Larvae cut off grass blades just above the thatch line, pull them into their tunnels, and eat them. Irregular brown spots are the first signs of damage. A heavy infestation will destroy large areas of grass. Most sod webworms complete two to three generations per year in North Carolina, with approximately six weeks elapsing from egg laying to adult emergence.

A burrowing sod webworm (*Acrolophus* sp.) occasionally attacks golf greens and lawns in North Carolina. This larva makes a hole about the size of a pencil as much as a foot or more deep that is silk lined. The larva comes to the surface to feed. Damage is usually more prevalent on tall fescues in very dry weather.

## CONTROL PRACTICES

If five or more sod webworms or two or more burrowing sod webworms are found in a square foot area, chemical control is recommended.

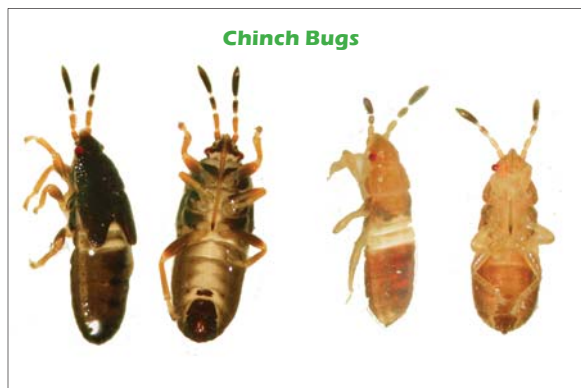


Photo Courtesy of the CENTERE

## Chinch Bugs

### [Blissus species]



At least two species of chinch bugs are pests of turf in North Carolina. The hairy chinch bug damages fescues and bluegrasses in the mountains. The southern chinch bug is a serious pest of St. Augustinegrass in the eastern part of the state. The latter also attacks centipedegrass and, to a lesser extent, bermudagrass.

Adult chinch bugs are about 1/6 inch long; they are black with white markings. Young nymphs are about half the size of a pinhead; they are bright red with a white band across the back. The full-grown nymph is black and has a white spot on the back between the wing pads.

Most damage is done by the nymphs, which feed for two to six weeks depending on weather conditions. Yellowish spots appear and then rapidly turn brown and die. Damage occurs in scattered patches.

## CONTROL PRACTICES

Chinch bugs are serious pests on St. Augustinegrass, and controls are often needed. However, chemical controls are seldom needed on other turfgrasses unless 25 or more chinch bugs are present per square foot. Insecticides need not be watered in (unless stated on the insecticide label) because chinch bugs are found in the upper thatch area. Frequent irrigation is often an effective control of chinch bugs because it helps induce a fungal disease of this pest. Several resistant cultivars have been released.

## Leafhoppers and Spittlebugs

### [Family Cicadellidae and Cercopidae]



Many species of leafhoppers (small wedge-shaped insects) suck the sap from leaves and stems of grass. Symptoms include a bleaching or drying out of the grass. New fairways, golf greens, lawns, and other turf areas may be seriously damaged so that

reseeding or resprigging is necessary. However, established lawns may also be damaged.

Spittlebugs attack clovers and grasses. They suck juices from leaves and stems, especially spittlebugs in areas with dense growth and heavy mats of thatch. The spittlebug nymphs live within a mass of white froth or “spittle” is found on the plants. These insects are often controlled when thatch is removed. Some adults may attack ornamentals while the nymph stage attacks turf. The twolined spittlebug nymphs frequently feed on centipede while the adults are pests of hollies.

## CONTROL PRACTICES

Control measures are seldom necessary but may be required on newly established turf.

## Bermudagrass Mite

### [*Eriophyes cynodoniensis*]



The bermudagrass mite is now found throughout the South. It feeds only on bermudagrass and is a very small, wormlike, white mite about 1/100 inch long. They can only be seen with a good-quality hand lens. However, the damage is easily recognized. First, the grass has yellow tips and then shortened internode and leaves, which produces a rosetted or tufted appearance referred to as “witch’s broom.” Infested areas may die, and damage is most severe during hot, dry conditions. These mites are most active during late spring and summer. They spend all of their lives under the leaf sheath.

## CONTROL PRACTICES

Bermudagrass mites can be controlled with chemical insecticides, but repeated applications may be necessary. Good management through fertilization and irrigation can help the grass outgrow the mite damage. Resistant cultivars are available.

PERIODS OF INSECT ACTIVITY & TREATMENT TIMING CHART FOR NORTH CAROLINA													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
<b>ANTS</b>			[Insect Present]										
<b>FALL ARMYWORM</b>						[Insect Present]							
<b>BEEES &amp; WASPS</b>			[Insect Present]										
<b>CHINCH BUGS</b>						[Insect Present]							
<b>CUTWORMS</b>			[Insect Present]										
<b>WHITE GRUBS</b> <small>Green June Beetle, Japanese Beetle, Asiatic Garden Beetle</small>			[Insect Present]				[Insect Present]			[Insect Present]			
<b>MOLE CRICKETS</b>	[Insect Present]				[Insect Present]								[Insect Present]
<b>SOD WEBWORMS</b>					[Insect Present]								
<b>SPITTLE BUGS &amp; LEAFHOPPERS</b>				[Insect Present]									

[Dark Green Bar] = Insect Present

[Light Green Bar] = Periods when control most likely needed and most effective.

**NOTE:** Periods of activity will vary up to three weeks from the mountains to the coast.

# Soil Samples

BY ART BRUNEAU AND CHARLES PEACOCK

A soil test report shows the results of tests for soil pH, acidity, and cation exchange capacity (a measure of nutrient holding capacity), as well as plant available phosphorus, potassium, calcium, magnesium, sulfur, sodium, and micro-nutrient levels. Measures of salinity and sodium levels may also be requested. The report also includes suggested lime and fertilizer treatments for the turf being maintained. Please note that soil tests do not measure nitrogen. The suggested nitrogen rate is a general recommendation for the grass you specify on the information sheet submitted with a soil sample. Information on N rates for specific grass types and the appropriate timing of nitrogen application is provided with the report in an enclosed brochure called Note 4: Lawns, Gardens, and Ornamentals.

A good soil sample accurately represents the area being tested. If the parts of the area differ in previous fertilizer practices, soil texture, terrain, drainage, or date of establishment, take separate samples. A single sample may be all that is necessary for home and commercial lawns, provided the area is relatively uniform. If you are taking only one sample, be sure not to sample an area with an obvious trouble spot, such as poor color or growth. Sample these trouble spots separately. Areas with different use, such as a front yard versus a backyard, may also need to be sampled separately. Golf course superintendents should sample each green, fairway, and tee if they have not done so in the last three years. (Follow-up sampling may only require sampling every third or fourth green, tee, or fairway to determine trends, provided previous testing results show similarity between the areas.) To decrease variability resulting from temperature and biological activity, always take samples around the same time of year.

Most newly planted areas should be tested annually during the establishment phase. Established grasses should be sampled every three to four years, depending on the type of turf being grown and the amount of nitrogen applied. Higher nitrogen rates require more frequent liming to sustain optimum growth. Greens, for example, receive more nitrogen and higher traffic than roughs, and should be tested more frequently. Soil test boxes, instructions, and information sheets can be obtained by contacting your county Extension agent located at your county Extension center. You will need to obtain a separate mailing carton for each area you intend to sample. Remember to include all the necessary information requested on the information sheet. This will help to ensure proper interpretation of the results and correct lime and fertilization suggestions. Some points to keep mind when obtaining a soil sample follow.

- 1 It may take several weeks before you receive your soil test report, so plan to submit your sample far enough in advance. This is especially critical for areas to be limed and fertilized before establishing a new turf area.
- 2 Make sure the sampling equipment and plastic containers used to sample and collect and mix the soil are clean and free of contaminants like old fertilizer granules. Remove any soil from the equipment between samples. **DO NOT USE METAL BUCKETS.**
- 3 Sample to a uniform depth — preferably 4 inches for established turf. (For establishment, sample to the depth you will be able to incorporate lime and fertilizers — usually 6 to 8 inches.)
- 4 Take 15 to 20 soil cores from each area being tested using a 1-inch soil probe and thoroughly mix them in a plastic container or paper bag. Metal buckets contain micronutrients that may affect results.
- 5 Do not sample immediately after the area has been fertilized. Wait a minimum of three to four weeks before sampling.
- 6 Submit samples to a reputable laboratory for testing and interpretation. North Carolina residents should submit their samples to

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# Glossary

## **Active Ingredient**

The chemical in a pesticide that controls the target pest.

## **Adjuvant**

Chemical added to a pesticide formulation or tank mix to improve mixing, application or activity of a herbicide. Spray adjuvant examples include fertilizers, surfactants, methylated seed oils and crop oil concentrates.

## **Aerifying**

Removal of soil cores from a turf with hollow tines or spoons.

## **Alternate**

Leaves appear singly at each node as in prostrate knotweed.

## **Annual**

A plant starting from seed and completing its life cycle in the same growing season.

## **Auricle**

A claw-like appendage projecting from the collar of the leaf.

## **Basal**

Arising from the base of the stem.

## **Biennial**

A plant starting from seed and requiring two years to complete its life cycle.

## **Blade**

The flat portion of the grass leaf above the sheath.

## **Blend, Seed**

A combination of two or more cultivars of the same species, e.g., Rebel and Falcon tall fescue.

## **Broadcast**

Uniform application to an entire area.

## **Broadleaf**

Plants with flattened leaves; dicots, i.e., plants that possess two seedling leaves.

## **Bud Leaf**

First emerged leaf of a grass plant.

## **Bunchgrass, Bunch Type Growth**

Plant development in the absence of rhizome and stolon production; a non-spreading grass.

## **Capsule**

A dry type of fruit that contains seed.

## **Carrier**

An inert material added to an active ingredient to prepare a

formulation of a pesticide.

## **Collar**

A narrow band marking the place where the blade and sheath of a grass leaf join.

- divided--collar divided by the midrib
- continuous--collar not divided by the midrib

## **Control**

Keeping pests at tolerated levels.

## **Cool-Season Grasses**

Turf species that have optimum growth at temperatures between 60 and 75°F.

## **Coring**

See aerifying.

## **Corm**

A short, thickened, upright underground stem.

## **Creeping Growth Habit**

Plant development at or near the soil surface that results in lateral spreading by rhizomes and/or stolons.

## **Crop Seed**

Any seed grown for profit, often including undesirable grassy weeds, e.g., orchardgrass.

## **Crown**

That portion of the grass plant which includes the stem apex, unelongated internodes, and lower nodes from which secondary roots begin.

## **Culm**

A stem of a grass plant.

## **Cultivar**

A cultivated variety of a species, e.g., K-31, Rebel, etc.

## **Cultivation**

In turf, the working of the soil without the destruction of the turf.

## **Decumbent**

Lying flat with apex tip growing upward.

## **Emulsion**

One liquid suspended in another, e.g., oil in water.

## **Dicot**

A plant having two seed leaves or cotyledons. Generally refers to broadleaf plants.

## **Dormancy**

Resting stage through which the plant or ripe seeds usually pass and during which nearly all manifestations of life come to an almost complete standstill.

### **Eradication**

Total removal of a pest.

### **Flowable**

A suspension consisting of finely ground, insoluble active ingredients in solid form mixed with a liquid and inert ingredients.

### **Fumigant, Soil**

A volatile material that vaporizes and destroys pests, e.g., methyl bromide.

### **Fungi**

A major group of microorganisms commonly known as molds, mushrooms, and mildews; some cause disease.

### **Fungicide**

A pesticide used to kill fungi.

### **Herbaceous**

Refers to plants with non-woody stems that normally die back to the ground in the winter.

### **Herbicide**

A pesticide used to kill weeds.

### **Herbicide, Arsonate**

This class of herbicides pose very little concern as far as toxicity to humans. Their mode of action is not well understood. The arsonates are also very water soluble. Arsonates include DSMA, MSMA (Bueno 6, MSMA Turf), and CMA.

### **Herbicide, Contact**

Herbicide that injures only those portions of the plant with which it comes into contact.

### **Herbicide, Dinitroaniline (DNA)**

A class of herbicides that includes some of the most important soil-applied herbicides in turf. These herbicides are formulated as liquids, wettable dispersible granules, and granules. Herbicides in this class are mostly used to control crabgrass and goosegrass seedlings, as well as some small-seeded broadleaves. DNA herbicides are root inhibitors, and their primary mode of action is inhibition of mitosis. Examples include prodiamine (Barricade), benefin (Balan), pendimethalin (Pendulum, Pre-M, Weedgrass Control), and oryzalin (Surflan).

### **Herbicide, Non-selective**

Herbicide that kills or injures all plants. Some plant species may exhibit more tolerance than others. Examples include glyphosate (Roundup, Touchdown Pro), and glufosinate (Finale).

### **Herbicide, Plant Growth Regulator (PGR)**

This class of herbicides is used on more land area worldwide than any other herbicide group. The mode of action is not well understood, but in general they interfere with plant metabolism

and transport. In turf, they are 2,4-D, 2,4-DB, clopyralid (Lontrel), triclopyr (Turflon Ester), dicamba (Banvel).

### **Herbicide, Postemergence (POST)**

Herbicide that needs to be applied after weeds emerge in order to be effective.

### **Herbicide, Preemergence (PRE)**

Herbicide that needs to be applied prior to weed emergence in order to be effective. Can be applied before or after turf establishment. Rainfall or irrigation is often needed to move the chemical into the top few inches of the soil for best activity.

### **Herbicide, Selective**

Herbicide that kills/injures some plants without harming others.

### **Herbicide, Sulfonylurea (SU)**

A class of herbicides with high levels of activity at low application rates. In general, the SU herbicides are used to control annual bluegrass and perennial ryegrass during bermudagrass spring transition, as well as certain broadleaf weeds. Some members of this herbicide family also provide control of nutsedge and kyllinga species, and also dallisgrass when used with MSMA. The mode of action for this class is inhibition of the ALS enzyme that is used in biosynthesis. These chemicals are rapidly translocated, and resistance can become an issue. Examples include sulfosulfuron (Certainty), metsulfuron (Manor), trifloxysulfuron (Monument), foramsulfuron (Revolver), and rimsulfuron (TranXit GTA).

### **Herbicide, Systemic**

Herbicide that is taken up through contact with the leaves or through the soil (via contact with the roots) and is moved throughout the plant to kill the whole plant.

### **Herbicide, Triazine**

A class of herbicides which has inhibition of photosynthesis as the main mode of action. They are readily absorbed by both the roots and foliage of plants. This class of herbicides has tight restrictions due to concerns about atrazine leaching into groundwater. Triazines include atrazine (Purge, AAtrex), simazine (Princep, Regal Wynstar), and metribuzin (Sencor 75 Turf).

### **Herbicide, Two-, Three-, or Four-Way Broadleaf**

A combination product which is a mixture of either two, three, or four broadleaf herbicides that should be used when several different weed species present in the area being treated. Examples include Chaser 2 Amine (2,4-D amine + triclopyr), Trimec Classic (2,4-D amine, + mecoprop + dicamba), Escalade (2,4-D amine + fluroxypyr + dicamba), and Speed Zone (2,4-D ester + mecoprop + dicamba + carfentrazone).

### **Hybrid**

The progeny resulting from a cross of individuals differing in one or more heritable characters.

### **Inflorescence**

The flowering portion of a plant.

- Insect**  
Members of the animal kingdom; all mature insects have six legs and three body segments.
- Insecticide**  
A pesticide used to kill insects.
- Larva**  
A stage in the development of certain insects; caterpillars (butterfly larva) or grubs (beetle larva).
- LD<sub>50</sub>**  
A lethal dose for 50 percent of the test animals.
- Lesion**  
A localized area of diseased tissue.
- Ligule**  
A thin projection from the top of the leaf sheath in grasses; it may be a fringe of hairs, membranous, or absent.
- Lobe**  
Any rounded portion of a leaf.
- Mixture, Seed**  
A combination of two or more species; e.g., Kentucky bluegrass and perennial ryegrass.
- Monocot**  
A plant having one seed leaf or cotyledon.
- Mycelium**  
A cobweb-like growth of fungal tissue.
- Nematicide**  
A pesticide used to kill nematodes.
- Nematode**  
A microscopic, worm-like organism.
- Nitrogen, Quick Release**  
Readily available sources of nitrogen that exhibit fast turf greening, short residual, and high burn potential, e.g., ammonium nitrate.
- Nitrogen, Slow Release**  
Slowly available sources of nitrogen that exhibit slow turf green-up, long residual, and low burn potential, e.g., IBDU, Urea formaldehyde.
- Node**  
A joint where leaves, roots, branches, or stems arise.
- Nymph**  
A stage in the development of certain insects where the young resemble the adult in form, eat the same food, and reside in the same environment.
- Opposite**  
Leaves appear in pairs at each node along the stem.
- Palmate**  
Leaflets attached to the petiole as fingers are on a hand.
- Panicle**  
Seedhead in which the side branches are attached to the main axis with a stalk. May form a triangular shape.
- Parallel**  
Leaf veins begin at the base of the leaf and run lengthwise along the whole leaf.
- Parts Per Million (PPM)**  
The number of parts by weight or volume of a constituent in 1,000,000 parts of the final mixture, by weight or volume.
- Pathogen**  
The causal agent of disease.
- Perennial Plant**  
A plant that may or may not start from seed, may or may not produce seed, and lives more than two years.
- Phytotoxic**  
Poisonous to plants.
- Pinnate**  
Leaflets arranged along the sides of a common axis; feather-like.
- PSI**  
Pounds per square inch.
- Prophyll**  
The first leaf of a branch off the main axis; a sheath-like structure.
- Prostrate**  
Low growing; hugging the ground.
- Puffiness**  
A spongy, irregular surface.
- Raceme**  
Seedhead in which more than one slender spike is attached along the end of the stem. Individual spikes can be attached at one point or along the top of the stem in an alternate fashion.
- Raking, Power**  
Removal of debris with rapidly rotating vertical tines or brush.
- Rhizome**  
An underground creeping stem which can produce roots and shoots at each node.
- Rosette**  
A cluster of leaves radiating out from a central axis.
- Scalping**  
Excessive removal of turf leaves by close mowing. Results in a brown, stubby appearance.

**Sclerotia**

Seed-like, compact masses of fungal tissue that allow fungi to survive unfavorable conditions.

**Seed, Certified**

A seed lot inspected to meet minimum standards and to ensure trueness to type for a given cultivar.

**Semiarid Turfgrass**

Turfgrasses adapted to grow in semiarid regions without irrigation, such as buffalograss, gramagrass, and wheatgrasses.

**Sepals**

The floral organs found at the base of the flower; usually green and somewhat leaflike.

**Sessile**

Directly attached without a stem or stalk.

**Sheath**

The basal portion of the leaf surrounding the grass stem. In grass plants, it is usually split with overlapping edges.

**Site or Mode of Action**

The way that a pesticide works to kill an organism.

**Slicing**

Penetration of turf in a vertical plane by series of solid flat tines.

**Solution**

Physically uniform mixture of two or more liquids.

**Spike**

Seedhead in which the side branches are attached to the main axis without a stalk.

**Spiking**

Penetration of turf in a vertical plane by series of solid round tines.

**Spore**

A microscopic seed-like reproductive unit that can germinate and give rise to more fungi.

**Spreader**

An ingredient that helps pesticides come in closer contact to the plant surface.

**Sprig**

A stolon or rhizome used to establish a turf.

**Stamen**

The male part of a flower that produces the pollen.

**Sterilant, Soil**

Any chemical applied to the soil that prevents growth of plants for a long time.

**Sticker**

An ingredient that helps pesticides stick to plants.

**Stipule**

Appendage at the base of a leaf.

**Stolon**

An above-ground creeping stem that can produce roots and shoots at each node.

**Surfactant**

Several classes of chemicals that reduce the interfacial tension between water and plant material or other liquids. Classes of surfactants include wetting agents, spreaders, and stickers. Types of surfactants include anionic, cationic, and nonionic. The most common type of surfactant used in herbicide applications is nonionic.

**Symptom**

The visual characteristics associated with a given disease.

**Thatch**

A tightly intermingled layer of undecomposed roots, stems, and shoots located between the soil surface and the green vegetation of the turf grass.

**Throat**

The region between the sheath and blade on the ligule side of the leaf.

**Tiller**

A grass plant shoot arising in the axes of leaves in the unelongated portion of the stem.

**Tolerance, Turf**

Ability of a turf species to withstand application of a pesticide (herbicide) at the normal dosage without being killed or injured. Specific tolerance may be associated with an anatomical or physiological characteristic in the plant.

**Topdressing**

A sand or prepared soil mix applied to the turf to help smooth the surface, enhance establishment, and reduce thatch buildup.

**Toxicity**

A term used to define a product's hazard potential.

**Trifoliate**

Leaf consisting of three leaflets, e.g., clover.

**Tuber**

An underground stem modified for food storage that is attached to the root system as found in yellow nutsedge. See example image p. 37.

**Turf**

A covering of mowed vegetation, usually a grass.

**Turfgrass**

A species or cultivar of grass, usually of spreading habit, which is maintained as a mowed turf.

**Vernation**

An arrangement of the youngest leaf in the bud shoot; rolled or folded.

**Venation, leaf**

Appearance of veins in the leaves. Leaf venation can be defined as pinnate, palmate, or parallel.

**Volatile**

Likely to vaporize.

**Warm-Season Grasses**

Turf that has its optimum growth at temperatures between 80 and 95°F.

**Weed**

A plant growing where it is not wanted.

**Wetting Agent**

A chemical that aids in liquid-to-surface contact.

**Whorl**

Three or more flowers, branches, or leaves located at one node.

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