H1553 (Revised)

Home Lawn

Problems and Solutions for North Dakota

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NDSU EXTENSION SERVICE
North Dakota State University, Fargo, ND

Revised and reprinted March 2015

While an attractive lawn can complement an equally attractive landscaping with trees and shrubs, one that is unkempt and weedy will be a major distraction. Indeed, a good looking lawn is as important to the total landscape picture as a shined pair of dress shoes is to formal attire. The two just naturally go together.

In response to the many inquiries about home lawn care and problems, the intent of this NDSU Extension publication is to assist the homeowner first in identifying these problems and, secondly, providing advice on actions they can take to solve these problems. Our initial emphasis will be to adjust or modify cultural practices to minimize or, in some cases, eliminate the pest. We also provide options for chemical use in case the problem has not been solved.

Each author has contributed to this publication based on his or her expertise: Alan Zuk on typical diseases observed on home lawns, Janet Knodel on insect problems; and Ron Smith in dealing with distractive weeds.

In surveying the retail market, we noted the wide availability of combination products, with herbicides and fertilizer being the most common. While this appeals to our American desire for convenience, our research has found that such combinations are not as effective in taking care of the problem, and the homeowner is better off using the pesticide (in this case, the herbicide) separately from the fertilizer application to obtain better control.

We encourage the North Dakota homeowner to be a wise shopper: Ask if using any pesticide is needed to correct the problem. If so, the homeowner should use the least toxic material according to label directions. Blanket applications of most pesticides, including fungicides, insecticides or herbicides, on an annual basis are not recommended in any instance for reasons of environmental concerns.

Weed Problems in Lawns

Nothing is more distracting in an otherwise attractive lawnscape than the presence of weeds, both broadleaf and grassy types. Broadleaf weeds, with dandelions as a conspicuous example, cause homeowners to expend money and effort to bring them under control. More than being a visual nuisance, they can compete with the desired turfgrass plants for space, light, water and nutrients. Even if the homeowner is committed to a low-maintenance or low-input lawn, some form of weed control should be implemented if for no other reason than to be considerate of your neighbors.

The first point to understand is that weeds, both the grassy and broadleaf types, are opportunistic plants that will fill any space not covered with turfgrass. Consequently, the final objective in moving toward a low weed count in a lawn would be to have dense, well-maintained turfgrass.

Some weeds are easy to control with a pre-emergence herbicide; others will require repeat applications. What you never should do is what we term "revenge spraying," which is overapplying the herbicide in an attempt to kill the weeds faster. Most herbicides are as effective as they can be when applied according to label directions. An example of following the label is to make sure the weed leaf surface is moist when applying granular herbicides.

Below is a list of common weeds, which once established, may require more than a single herbicide application to be controlled effectively.

Broadleaf Weeds

Dandelion. (Alan Zuk, NDSU)

Dandelion, *Taraxacum officinale*

This is a deeply taprooted perennial. The distinct yellow flowers in May make them a favorite target of homeowners. The flowers are followed by parachute-type seeds that children (as well as Mother Nature) distribute indiscriminately. When not in flower, dandelions are not as conspicuous but still can be identified easily by the milky sap in the leaves when they are broken. While digging dandelions out is possible, essentially the entire root system needs to be extracted or any significant fragment will form a new plant. Control is most effective with herbicide application in the fall and in maintaining a dense turf canopy.

Prostrate knotweed. (Courtesy of Anne Streich, University of Nebraska)

Prostrate Knotweed, *Polygonum aviculare*

This is a low-growing annual that usually is found where soil compaction exists. It is one of the first weeds to germinate in the spring, just as soon as the frost has left the surface of the soil. Close mowing will not eliminate it, but when caught early enough while the plants are still young, it is easy to control. Mid to late-summer attempts at controlling this weed, especially reducing seed production and future infestations, usually fail. To correct without chemical use, initiate a practice of core aeration and continue the practice annually, especially if the areas are going to be compacted continually from foot or vehicular traffic.

Wild violet. (Courtesy of Anne Streich, University of Nebraska)

Wild Violets, *Viola* spp.

A cool-season perennial, this plant will make itself known via the heart-shaped leaves that have a waxy surface and reproduce via bulbs and seeds. The lavender violet flowers look nice in a flower bed, but when spreading in a lawn, this plant is a source of annoying distraction. Few herbicides effectively control wild violet; consequently, proper timing of the herbicide application is very important to maximizing control.

Field bindweed. (Courtesy of Anne Streich, University of Nebraska)

Field Bindweed, *Convolvulus arvensis*

The slender stems on this aggressive, deep-rooted perennial make it difficult to control in both lawns and surrounding ornamental plants. Spade-shaped leaves have pointed basal lobes. Field bindweed is immediately recognizable when the white to light pink morning glory-type flower is produced. The extensive root system and numerous viable seeds that are produced make this species difficult to control, especially in high-traffic or compacted areas.

Ground ivy. (Ron Smith, NDSU)

Ground Ivy, *Glechoma hederacea*

It also is known as “Creeping Charlie.” The plant has square stems with opposite leaves, spreads via runners, roots at every leaf node, and will thrive in both sun and shade. The flowers often are missed by the homeowner, but when present, are lavender, trumpet-shaped and first appear in early spring. This particular weed is a good scavenger of available soil nitrogen, definitely making it a worthy turfgrass competitor.

Black medic. (Courtesy of Anne Streich, University of Nebraska)

Black Medic, *Medicago lupulina*

This, along with **white clover,** *Trifolium repens* L., is a member of the legume family, giving both the ability to mine nitrogen from the air as well as the soil. Black medic produces foliage similar to that of white clover, being trifoliate in form. Black medic distinguishes itself with vivid yellow flowers and hairy stems leading up to the leaves. While the flowers of **white clover** are attractive to bees, those of the black medic are much less so. **Black medic** is a winter or summer annual that disperses seed every year, with a strong taproot, making it difficult to remove by hand pulling. While **white clover** is a perennial and will root along spreading stems, black medic does not root at the nodes. Both are tolerant to 2,4-D so herbicide mixtures should be used.

Oxalis. (Courtesy of Anne Streich, University of Nebraska)

Oxalis (also known as **Yellow Woodsorrel**), *Oxalis stricta*

It often is confused with clover and black medic in leaf form. They differ significantly when viewed side by side in that the oxalis has distinctly heart-shaped leaflets that are always a lighter or yellowish green. This is a unique weed in that it has both annual and perennial forms; the flower and capsule (fruiting structure) are what warrant special comment. The flower is yellow and tubular, and when the capsule matures, it expels the seed, doing so with great momentum, scattering the seed like birdshot in multiple directions several feet away. It is a curse to have in greenhouse environments and can go from being insignificant to a real headache if not controlled early in detection.

Broadleaved plantain. (Ron Smith, NDSU)

Broadleaved Plantain, *Plantago major*

A common problem in compacted lawn areas, this is second only to dandelions for ease of identification. The broadly dark green, parallel-veined leaves make it easy to spot in any lawn. In contrast to the common dandelion, which has an extensive taproot, the plantain has fibrous roots and a rattail-like seed head that is not nearly as obvious as the yellow flowers of the dandelion. Reducing compaction via cultural practices will limit the presence of this weed. Plantain is easily dug or controlled with herbicides.

Bull thistle. (Rod Lym, NDSU)

Bull thistle, *Cirsium vulgare*

Bull thistle is a biennial that forms a conspicuous rosette the first year. Leaves are covered with sharp spines and dense hairs. The plant has a deep taproot, so it doesn't spread by rhizomes like Canada thistle. The rosette stage is the easiest to control either with herbicides or by digging to cut the taproot below the crown.

Canada thistle, *Cirsium arvense*

Canada thistle is a colonizing plant that spreads specialized creeping roots and can take over an area of the lawn quickly if control measures are not instituted early and frequently enough. This perennial has leaf edges that are crinkly and covered with sharp spines.

Canada thistle and Canada thistle rosette. (Rod Lym, NDSU)

Annual Sowthistle, *Sonchus oleraceus*

This annual is in a class by itself. It has smooth stems and emits a milky sap when broken. The flower resembles a dandelion, and the root system is a taproot. This sowthistle reproduces by wind-blown seed. The leaves are alternate, and while spiny, they are not as rigid or sharp as bull or Canada thistle.

Perennial Sowthistle, *Sonchus arvensis*

This is an invasive perennial that is similar in appearance to the annual. It differs in the ecological threat it poses. It spreads vegetatively as well as with windborne seeds. Each tiny piece of root can grow a new plant. The roots are deeply penetrating and colonizing. Multiple methods of control are employed: cutting and pulling, or spraying with glyphosate or a selective broadleaf herbicide.

Perennial sowthistle. (Rod Lym, NDSU)

Perennial Grassy Weeds

Grassy weeds pose a particular problem in lawns if they are perennials. Attempts at control can become expensive and require much effort with few satisfactory results. In many cases, the homeowner might be better off simply learning to tolerate their presence and managing the lawn to favor the full development of the desired turfgrass. Some of the more common perennial grassy weeds encountered in North Dakota lawns are:

Tall fescue. (Courtesy of University of Illinois Extension)

Tall Fescue, *Festuca arundinacea*

Both a weed and a desirable lawn grass when planted properly and with the correct cultivar selection, tall fescue is considered a utility grass that often is used along roadsides for its tolerance to abuse. Its coarse, bunch-type habit of growth often shows up from purchasing low-quality seed mixes at a "bargain" price. It is identified by its sharp-pointed leaves, very small ligule and auricles, and stem bases that are often reddish. Although chemicals exist for selective control in lawns, the homeowner is better off either digging out the clumps with a shovel and sodding or reseeding that area. Using chemicals to control perennial grassy weeds in the lawn often leads to collateral damage that is not pleasing to the homeowner.

Creeping bentgrass. (Courtesy of Purdue University Extension)

Creeping Bentgrass, *Agrostis stolonifera*

Another desirable grass on golf courses, it can be an annoying weed in the home lawn. The seed being very small (more than 5 million seeds/pound), it easily can become wind-borne or carried on golfing equipment to the home lawn environment. It becomes obvious in a typical higher-mowed bluegrass turf by spreading in circular patches with its stoloniferous growth over the top of the desired grass. Like tall fescue, if just a few clumps occur in the home lawn, the homeowner is better off simply digging out the offending patches and either sodding or seeding the open area immediately.

Foxtail barley. (Ron Smith, NDSU)

Foxtail barley, *Hordeum jubatum*

This is a perennial that often is found in continuously moist and recently disturbed sites with a high pH, restricted soil drainage, and waste areas and fields. It is among the first grasses to establish after disturbance and rapidly invades areas exposed by a receding water table. It often is a "holdover" in newly constructed residential areas that previously were abandoned fields.

Quackgrass with rhizomes. (Ron Smith, NDSU)

Quackgrass, *Agropyron repens*; [*Elytrigia repens*]

Quackgrass is a major headache for homeowners desiring a "perfect" lawn. It has an extensive rhizomatous (underground) system that spreads quickly once established. Digging does little good unless **100 percent of the rhizome is removed**, which is almost impossible to do. Mowing high (more than 3 inches) will help reduce the presence of this pest in the lawn.

Annual Grassy Weeds

Unlike their perennial cousins, these pests are relatively easy to control with chemicals and good management practices.

Annual bluegrass with seed heads at the edge of a golf green. (Ron Smith, NDSU)

Annual Bluegrass, *Poa annua*

This bluegrass is the bane of the fussy home lawn owner. It sets conspicuous seed heads, is apple green, and will go to seed and die out when hot, dry weather arrives. It will be conspicuous in the cool, moist weeks of spring and fall. Upon close examination, the plant will have a conspicuous, membranous ligule; folded bud; and boat-shaped leaf tip.

Barnyard grass with spreading base of plant, and distinctive seedheads (right). (Ron Smith, NDSU)

Barnyardgrass, *Echinochloa crusgalli*

Like all annual weeds, this one will show up in open, water-stressed and compacted areas. It usually is one of the first weeds that new homeowners encounter when seeding a new lawn. This weed will lie flat and is fan-shaped when under mowing pressure and typically will have a purple-tinged sheath near the base of the plant. The plants lack a ligule.

Crabgrass with distinctive seed heads.
(Courtesy of Anne Streich, University of Nebraska)

Crabgrass, *Digitaria* spp.

In contrast to the cool-season quackgrass that shows obvious growth in the early spring before the desirable turf has a chance to green up, crabgrass is a warm-season annual that starts to germinate at about the same time common lilacs are starting to bloom in the area. One plant potentially has 10,000 seeds, which can result in a high seedling population getting established in bare areas. This grass is easily controlled with a pre-emergence herbicide and cultural practices.

Fall panicum. (Ron Smith, NDSU)

Fall Panicum, *Panicum maximum*

Like crabgrass, this pest is most conspicuous in late summer or early fall with a display of coarse seed heads. In contrast to the crabgrass, which has a long, membranous ligule, panicum has a ligule that is a fringe of hairs.

Foxtail.
(Ron Smith, NDSU)

Foxtail.
(Courtesy of Anne Streich, University of Nebraska)

Foxtails, *Setaria* spp.

Three foxtails are common in our area: green foxtail, yellow foxtail and foxtail barley. The seed heads on all three are conspicuous and a give-away to their identity. Foxtails produce up to 10,000 seeds per plant and have the added headache of being viable in the soil for up to 20 years. The green and yellow foxtails are annual species.

Sandbur. (Courtesy of Anne Streich, University of Nebraska)

Sandbur, *Cenchrus* spp.

Common in open, sandy soils and where the rainfall is typically low during the growing season, this weed will provide a lasting memory if one should step on one of the burs in bare feet. While the flat leaf blades are sandpapery to the touch, the presence of the sharp burs certainly will confirm it.

General Nonchemical Control of Lawn Weeds

Before jumping into the arsenal of chemicals that are on the market for weed control in home lawns, try some common-sense cultural practices that will promote weed control:

- **Mow high.** Set the mower height at 3 inches or more by measuring from the bottom edge of the mower deck to a flat, solid surface.
- **Postpone dethatching and power raking until the grass is growing actively and weed seed germination would be at a minimum.** The biggest mistake the homeowner makes is to try to get a jump on the season and employ these tactics to "clean up the yard" from winter debris while the grass still is dormant. This opens the crown canopy to sunlight, exposing otherwise dormant weed seed and creating a setting that results in unwanted weed seed germination.
- **Avoid fertilization when the grass is dormant.** Companies are anxious to move their product as early in the spring as possible, so retailers will have "spring fertilizer sales" in March. If the price is right, make the purchase, but hold onto it until you have mowed your lawn at least three times. Spring fertilization is most effective sometime in May, or around Memorial Day.
- **Hold off irrigating the lawn as long as possible coming into the spring.** As the grass comes out of dormancy, the root system becomes increasingly active and will develop in soil that is warm and moist and has good drainage. Watering too soon will encourage shallow root development. When the irrigation is turned on, water deeply and infrequently. Don't follow municipality recommendations of EOD (every other day) watering. Water when the grass needs it, just before wilting.
- **Follow a rational fertilization program.** Decide what you want your turfgrass to look like. High fertilization rates require greater irrigation frequency, predispose the turfgrass to disease problems and will result in soft, succulent growth that could exhaust the turfgrass from excessive top growth. This also would necessitate greater mowing frequency. If fertilization is going to be just once a year, then make it in the late summer-early fall, when it will do the most good. For a little better looking grass, follow up the fall application with one in the late spring. Most lawns will look very satisfactory with two timely applications of a complete turfgrass fertilizer.

Using Herbicides to Control Weeds

Basically, chemical weed control involves using two classes of herbicides: pre-emergence and postemergence. Pre-emergence herbicides work by preventing emergence of weed seeds. The herbicide is applied and watered into the soil, where a chemical barrier will keep the weed seedlings from emerging. Most of the pre-emergence herbicides on the market are for summer annuals such as the ones mentioned in this publication. This would necessitate the application being made in the spring at least two weeks before germination of the weeds.

Since crabgrass, as well as most annual grassy weeds, germinate when the lilacs are starting to bloom, the application of the pre-emergent herbicide would need to be made at the time the forsythia in the area are coming into flower, or about two weeks before the lilacs flower.

Most herbicides that are labeled for controlling crabgrass as a pre-emergent herbicide will control all the other annual weeds in this publication except for annual bluegrass. Only one herbicide in the pre-emergence category will allow the desired grass seed to germinate when it is applied: **Tupersan** (siduron). It is incorporated into the soil at the time of seeding bluegrass, fescue and perennial ryegrass without harm. It should be worked into the soil because it tends to break down in sunlight. Hydro-mulching will help block some of the sunlight that might cause degradation.

For annual bluegrass, the homeowner is better off just accepting this minor pest in the lawn than attempting to bring it under control. Most chemical control measures will work up to a point, but because of the prolific and repeated seed production from this very genetically diverse bluegrass (36 variants so far), the impact of this bluegrass can be minimized with regular high mowing and bagging the clippings where the seed heads are evident.

Herbicide chemical formulations are changing constantly in response to new regulations and laws pertaining to their use. Chemical companies continually rename their formulations to catch the customer's eye at the retail level. Check the label for the chemicals in it and their concentration. Popular "weed and feed" products will have a lower concentration of the active ingredient (AI) than a product that is formulated only as a herbicide. Research has shown that the herbicide concentration in these combination herbicide and fertilizer products is insufficient at giving good control of the target weeds. You are better off locating the weeds in the lawn and applying the appropriate herbicide in a liquid solution.

"Crabgrass Killer" certainly will be an eye catcher for anyone desiring to kill this prolific weed. When you look on the label, you find the AI in the product is called **pendimethalin**, one of the oldest and most common AIs on the market for pre-emergence for grassy weed control. If you shop a little, you might find other trade name products on the market such as **Pre-M, Halts** or something as unimaginative as **Weed Grass Control**. At this point, the homeowner would be wise to check the concentration of the AI, the price and the square foot area the package will cover.

Other popular products on the market are **Trimec** and **Super-Trimec**. What is the difference? Both are combination products that contain three active ingredients that research has found creates a synergistic effect in controlling the target weeds. **Trimec** is formulated with 2,4-D, or (2,4-dichlorophenoxyacetic acid), MCPP (methylchlorophoxypropionic acid) and dicamba (3,6-dichloro-2-methoxybenzoic acid). This product is very capable of killing a wide spectrum of broadleaf weeds in the lawn when properly applied. **Super Trimec** simply replaces one of the AIs (MCPP) with 2,4-DP, which is a sister chemical to 2,4-D but works faster and in cooler weather than the Trimec formulation.

Trimec Plus is another well-known product. Its formulation has been altered with the addition of an arsonate compound, which will give a broad spectrum of control of both broadleaf and grassy leaves.

It also carries a "Warning" signal word, to which homeowners should be alert. "Caution," "Warning" and "Danger" are the three signal words that appear on pesticide labels, none of which should be taken lightly. They serve to alert the applicator to the precautions (found on the label) that are needed to apply the product safely, so it neither harms the applicator nor the environment.

A look at these formulations indicates that a review of the available herbicides obviously would be outside the purview of this publication. Such a review would be temporary at best because formulations of such products continually change. We simply will say that if you have a weed in your lawn, a herbicide of some formulation is available to kill it.

Turfgrass Diseases

Most homeowners desire a beautiful lawn, and many spend hours or even a significant amount of money to achieve that goal. No matter how much effort one puts into managing a beautiful, vigorous lawn, turfgrass diseases are something that all homeowners will have to cope with at some point. No single turf species or cultivar is resistant to all grass diseases. However, planting resistant turfgrass cultivars is a wise policy and will reduce the odds of encountering a disease problem.

Thatch. (Courtesy of Derek Settle, Chicago District Golf Association)

Most turfgrass diseases occur because of improper cultural practices, such as watering improperly, applying too much fertilizer or not enough, mowing too low or high, using pesticides that impede soil macro- and microorganisms, and allowing thatch to accumulate.

By the time the signs (visible expression of the pathogen) and symptoms (visible expression of a disease) of a turf disease are noticeable, trying to achieve effective chemical control usually is too late. Many fungicides are safe for homeowners to use if label directions are followed. However, most are not available for use by homeowners because the general population lacks the ability to diagnose turfgrass diseases properly. Furthermore, some products are very hazardous to people or pets that come into contact with them during or after application. Also, some fungicides are extremely expensive and may require specialized application equipment. Therefore, we recommend that fungicides be applied preventatively by a professional applicator. By hiring a professional applicator, a homeowner can avoid purchasing too much product, which must be stored safely and properly.

Contact your local county Extension office for proper chemical and nonchemical disease control options.

Gray snow mold mycelium. (Alan Zuk, NDSU)

Gray snow mold sclerotia. (Alan Zuk, NDSU)

The following are cultural methods to prevent gray snow mold:

Autumn

- Improve soil aeration.
- Keep mowing grass as long as it is growing. Tall grass will mat down under snow.
- Do not fertilize within six weeks of dormancy.
  - Late N applications will promote lush growth.
  - Late growth will interfere with winter hardiness.
- Rake leaves in the fall.
  - A layer of leaves will contribute to matting down and moisture buildup.

Spring

- If practical, shovel the snow off susceptible areas.
- Spread something dark (humate) on the snow surface to promote melting.
- Rake lawns to air out the turf and promote drying.

Gray snow mold, *Typhula* spp.

Gray snow mold is a common cold-weather disease that can affect all cool-season turfgrass in North Dakota. It typically attacks turfgrass leaves but can kill the crown during a severe outbreak. Loss of the meristematic tissue (turfgrass crown) will cause plant death. It develops during winter under snow cover at temperatures just above freezing, usually requiring 30-plus days for development.

After the snow melts from an infected area, light tan patches ranging from 2 inches to 2 feet are present in the lawn. Patches also may coalesce under snow cover to produce a larger infected area. The disease cannot advance once snow cover recedes. The patches often are covered by a white, cottony growth called mycelium. Thirty days of snow cover can result in a light outbreak. Sixty days of snow cover typically results in a moderate outbreak and 90-plus days of snow cover can cause a severe outbreak. If the crown is killed, the turf must be re-established.

Fungi survive warm weather as resting structures called sclerotia, which are black *(T. ishikariensis)* or reddish brown *(T. incarnata)* structures visible to the naked eye. They may resemble black pepper sprinkled over leaves and ground litter or they may grow as large as a pin head either on or embedded in the grass leaves.

A preventative fungicide treatment applied right before permanent snow cover occurs usually is very effective in preventing gray snow mold infection. Contact your county Extension specialist for recommended chemical control options.

Chemical control options: Instrata (chlorothalonil, fludioxonil and propiconazole), Bayleton (triadimefon), Prostar (flutolanil) and Medallion (fludioxanil).

Susceptible Turfgrass Species:

Moderate Susceptibility
Kentucky bluegrass
Perennial ryegrass
Fine fescues
Tall fescue

Severe Susceptibility
Annual bluegrass
Bentgrass

Pink snow mold.
(Courtesy of Derek Settle, Chicago District Golf Association)

Pink snow mold.
(Courtesy of Derek Settle, Chicago District Golf Association)

Pink snow mold, *Microdochium nivale*

Pink snow mold is a cold-weather disease that affects all cool-season turfgrasses. It develops under snow cover at temperatures ranging from 30 to 60 F. Unlike gray snow mold, the disease still can proliferate after snowmelt as long as conditions remain cool and wet. The fungi produce dead, matted, tan, circular patches ranging from 3 inches to 2 feet in diameter. However, the circular pattern may not be as distinct in taller mown grass. The mycelium produces a pink cast in the infected areas during wet conditions, often with a darker pink to red perimeter. Another difference between pink and gray snow mold is that pink snow mold does not produce black sclerotia in the infected areas.

A preventative fungicide treatment applied right before permanent snow cover occurs usually is very effective in preventing pink snow mold infection. Contact your county Extension specialist for recommended chemical control options.

Chemical control options: Instrata (chlorothalonil, fludioxonil and propiconazole), Insignia (pyraclostrobin), Compass (trifloxystrobin) Ferti-lome Halt Systemic Spray (thiophanate methyl), Banner Maxx (propiconazole) and Medallion (fludioxanil).

Cultural methods to prevent pink snow mold are the same as those listed under gray snow mold.

Susceptible Turfgrass Species:

Moderate Susceptibility
Kentucky bluegrass
Fine fescues
Tall fescue

Severe Susceptibility
Annual bluegrass
Perennial ryegrass
Bentgrass

Stripe smut.
(Courtesy of Derek Settle, Kansas State University Department of Plant Pathology)

Stripe smut, *Ustilago striiformis*

Stripe smut is a cool-weather disease that primarily affects bluegrass and bentgrass. It is most active in temperatures ranging from 45 to 60 F. Lawns exhibit poor growth and often are patchy, uneven and thin. Leaves on infected plants develop yellowish-green, elongated streaks that eventually turn gray, then finally black. The leaf breaks along the black stripes, causing the leaf to tatter and release spores. The

tips of the tattered strips curl downward, causing the leaves to turn brown and die. Severe infections may kill the entire plant.

Chemical control options: Banner Maxx (propiconazole), Bayleton WP25 (tridiamefon) and Fungo Flo (thiophanate methyl).

Cultural methods to prevent stripe smut: Avoid frequent light irrigation in the afternoon and evening. Control seldom is required because the disease is rarely severe. Apply nitrogen to infected areas, along with deep watering early in the day to stimulate growth and aid recovery.

Leaf spot phase.
(Courtesy of Derek Settle, Chicago District Golf Association)

Leaf spot and melting out, *Drechslera* spp.

Leaf spot and melting out are caused by *Drechslera* spp., a cool-weather disease that affects most grasses. It is most active in temperatures ranging from 45 to 60 F. Once a serious problem primarily on Kentucky bluegrass lawns that caused thinning and eventually large-scale loss of turf, it now is considered only a nuisance in most cases because of the availability of resistant cultivars. The symptoms appear in the form of small, purplish elliptical spots on grass blades after green-up in early spring. The center of the spot soon fades to tan with a purplish border. When the air temperature reaches 85 F or higher, the fungi can spread to the crown and other lower portions of the plant, causing severe stress or death as a result of crown, rhizome or root rot; this phase of the disease is called “melting out.” Melting out also can develop into a serious problem in early summer during periods of prolonged leaf wetness or if improper cultural practices are used.

Melting out phase. (Courtesy of Derek Settle, Kansas State University Department of Plant Pathology)

Leaf spot may reappear in the fall but usually with less impact.

Leaf spot and melting out caused by *Bipolaris* spp. are similar to leaf spot symptoms caused by *Drechslera* spp., but they usually attack turfgrass in midsummer during hot weather.

Chemical control options: Banner Maxx (propiconazole), Daconil Ultrex (chlorothalonil) and Eagle (myclobutanil).

Cultural methods to prevent leaf spot and melting out: Avoid high nitrogen fertility, avoid low mowing heights, mow with sharp blades, water deeply and infrequently to prevent drought stress, avoid prolonged

leaf wetness, renovate with improved cultivars and apply preventative fungicide treatments.

New Kentucky bluegrass cultivars, some with moderate to high levels of leaf spot and melting out resistance, are released every year. Contact your county Extension office for a list of resistant cultivars. Avoid planting susceptible cultivars such as 'Park,' 'South Dakota Common' and 'Kenblue.'

Red thread (mycelium in front of thumbnail).
(Courtesy of Derek Settle, Chicago District Golf Association)

Red thread injury to turf.
(Courtesy of Derek Settle, Chicago District Golf Association)

Red thread, *Laetisaria fuciformis*

Red thread affects most cool-season turfgrasses during temperatures ranging from 40 to 75 F. Signs of the fungus are pinkish to red threadlike hyphae (cottony or hair-like filamentous structures produced by fungi that infect and digest plant tissue [plural – mycelium]) that grow on the grass blade and sheaths. The hyphae, which can be spread by foot traffic and mowing, often are seen protruding from the leaf tip, often giving infected areas a pinkish hue. Symptoms of the disease are tan grass blades that are dispersed throughout the lawn. The disease also can form scorched-like patches ranging from 4 to 8 inches in diameter. Patches also can coalesce to form larger infection sites. Red thread does not affect roots, so turf rarely is killed by the disease and will recover after favorable fungal growth conditions subside.

Chemical control options: Banner Maxx (propiconazole), Daconil Ultrex (chlorothalonil), Eagle (myclobutanil) and Prostar 50WP (flutolanil).

Cultural methods to prevent red thread: Provide adequate nitrogen fertility, maintain a soil pH of 6.5 to 7, water deeply and infrequently, avoid prolonged leaf wetness by watering in the morning and prevent thatch buildup.

New turfgrass cultivars, some with moderate to high levels of red thread resistance, are released every year. The following cultivars offer good red thread resistance:

Kentucky bluegrass	**Fine leaf fescue**
Ascot	Biljart
Classic	Bighorn
Dawn	Reliant
Eclipse	SR 3000
Princeton	Waldina
Trenton	

Contact your county Extension office for more information regarding resistant cultivars.

Brown patch. (Courtesy of Derek Settle, Chicago District Golf Association)

Brown patch leaf lesions.
(Courtesy of Derek Settle, Chicago District Golf Association)

Dollar spot. (Courtesy of Derek Settle, Chicago District Golf Association)

Brown patch, *Rhizochtonia solani*

Brown patch is a common patch disease that affects several cool-season grasses in North Dakota, primarily tall fescue. Symptoms can appear quickly in warm, humid weather, primarily when nighttime temperatures exceed 70 F during heavy dew formation. During favorable conditions, fungal resting spores in the thatch begin to grow and rapidly damage the susceptible turf. Symptoms may appear as circular brown patches ranging from inches to several feet in diameter or as large blighted areas that lack a distinct pattern. The circular patches often are bordered by a brown band referred to as a smoke ring. Irregular, tan lesions with a brown border usually are visible on individual grass leaves. Mycelium often are visible between grass blades in infected areas in the morning, especially in the presence of dew. Brown patch rarely kills the turfgrass crown, which allows the turf to recover after favorable disease development conditions subside.

In addition to favorable weather conditions, brown patch development can be promoted by improper cultural practices such as over fertilization, excessive leaf wetness caused by watering lawns during the early evening hours and by allowing thatch to accumulate.

Chemical control options: Heritage (azoxystrobin), Compass (trifloxystrobin), Bayleton (triadimefon) and Prostar (flutolanyl).

Cultural methods to prevent brown patch: Do not over apply nitrogen fertilizer, avoid prolonged leaf wetness by providing irrigation deeply and infrequently in the morning or early afternoon, and prevent thatch buildup.

Dollar spot, *Sclerotinia homeocarpa*

Dollar spot can infect most turfgrasses, including Kentucky bluegrass and creeping bentgrass putting greens. Although the disease can develop under any growing conditions, it primarily attacks nitrogen-deficient turf when daytime air temperatures reach 59 to 86 F, followed by cool evenings and heavy dew.

Infected turf produces bleached white spots about the size of a dime, which can increase to the size of a silver dollar and eventually coalesce to produce large patches. Cottony mycelium often are visible

Dollar spot leaf lesions. (Courtesy of Derek Settle, Kansas State University Department of Plant Pathology)

on infected turf in the morning, especially if dew is present. Leaf constriction approximately half way up the blade and a bleached hourglass-like spot with a black or red margin are noticeable with the naked eye. The fungus lies dormant in thatch and soil until environmental conditions are right, then it infects the turfgrass if adequate leaf moisture is present. Primarily a foliar disease, the fungus produces a toxin that can kill the crown of the plant and even the roots during a severe infection. Many fungicides are available that are effective in preventing or curing dollar spot. However, infections on residential lawns are rarely severe enough to warrant chemical control.

Professional turfgrass managers should consult with their county Extension specialist for advice on the most effective fungicides available.

Chemical control options: Banner Maxx (propiconazole), Daconil Ultrex (chlorothalonil), Eagle (myclobutanil) and Bayleton 25WP (triadimefon).

Cultural methods to prevent dollar spot: Provide adequate nitrogen fertility, water deeply and infrequently, avoid prolonged leaf wetness by watering in the morning, prevent thatch buildup and use resistant turfgrass cultivars.

Summer patch. (Alan Zuk, NDSU)

Summer patch, *Magnaporthe poae*

Summer patch is a soil-borne fungus that affects all cool-season turfgrasses, especially creeping red fescue and bluegrasses. However, it rarely infects bentgrasses and ryegrasses. Immature turfgrass cannot provide fungal colonies with enough root tissue to survive. Therefore, the pathogen typically attacks mature turfgrasses that are two years old or older. Symptoms of summer patch are very similar to those of necrotic ring spot and may have to be diagnosed by a professional for proper identification. The fungus colonizes turf roots in midspring and slowly attacks healthy root tissue. Turfgrass decline appears during the heat of summer because the roots no longer can function properly and the plant eventually dies. The infected turfgrass forms a 2- to 12-inch crescent, doughnut or ring-shaped dead patch with a green center. Patches may reach 36 inches in diameter or even coalesce to resemble large-scale grub damage. The frog eye appearance is caused by the outward growth of the fungus. Since the fungus is soil-borne, it cannot be eradicated; outbreaks can occur in the same area annually or after remaining dormant for several years. The pathogen favors poorly drained soil and can be spread by foot, mower or vehicular traffic.

Chemical control options: Banner Maxx (propiconazole), Cleary's 3336 (thiophanate methyl) and Heritage (azoxystrobin).

Cultural methods to prevent summer patch: Avoid high soil pH, aerate to provide soil drainage, prevent thatch buildup, provide air circulation to the turfgrass canopy, avoid summer stress of turfgrass, raise mowing height to encourage deeper rooting, apply quick-release nitrogen fertilizer to declining turf, apply a contact fungicide for preventative control and use resistant turfgrass cultivars.

Pythium blight.
(Courtesy of Derek Settle, Chicago District Golf Association)

Pythium blight spread by flowing surface water.
(Courtesy of Jack Fry, Kansas State University Department of Horticulture, Forestry and Recreation Resources)

Fairy ring. (Courtesy of Derek Settle, Kansas State University Department of Plant Pathology)

Pythium blight, *Pythium* spp.

Pythium blight can be caused by a host of fungal pathogens belonging to the *Pythium* genus. All turfgrasses, especially cool-season species such as creeping bentgrass, rough and annual bluegrass, and perennial ryegrass, are susceptible. Foliar blighting occurs when daytime temperatures reach 86 to 95 F and the average nighttime temperature reaches 68 F with a relative humidity of 90 percent or higher for 14 hours or more. Root and crown infections are initiated by slightly cooler temperatures and wet soil. The disease usually starts near poorly drained areas or in low areas with limited air circulation. Large areas of turf can by killed quickly. The disease can be spread by heavy rain; mowers; and foot, cart and vehicular traffic.

Patches ranging from 1 to 6 inches can appear suddenly in hot, humid weather and can coalesce rapidly. Infected leaves have a straw-colored lesion that lacks a margin. Infected areas are accompanied by white cottony mycelium, which are visible especially in morning dew. Leaves appear to be water-soaked and feel oily when rubbed between the fingers, hence the name “greasy spot.”

Chemical control options: Banol 66.5 L (propamocarb), Subdue 2E (metalaxyl) and Aliette WDG (aluminum phosphonate).

Cultural methods to prevent pythium blight: Aerate to provide soil drainage; avoid turf cultivation until infected areas have recovered; avoid excessive leaf wetness by providing irrigation in the morning; prevent thatch buildup; raise mowing height to encourage deeper rooting; avoid mowing in infected areas during moist, hot weather; prune trees to provide good air circulation to the turfgrass canopy; avoid summer stress of turfgrass; apply a slow-release nitrogen fertilizer; apply a contact fungicide for preventative control; use fungicide treated seed; and use resistant turfgrass cultivars.

Fairy Ring

Fairy rings are caused by several species of fungi collectively referred to as *basidiomycetes*. They are soil- and thatch-borne fungi that form rings or arcs of dark green or dead grass. These rings can range in size from 2 inches to several yards in diameter. Fairy rings can be classified into three types. Type I fairy

Fairy ring. (Courtesy of Derek Settle, Kansas State University Department of Plant Pathology)

Fairy ring. (Courtesy of Derek Settle, Kansas State University Department of Plant Pathology)

rings have a band of dead grass and a band(s) of dark green grass. Type II fairy rings lack the band of dead grass, and Type III fairy rings consist of a ring of toadstools or puffballs that may be accompanied by a dark green ring. The lush green growth, called the zone of stimulation, is caused by the release of nutrients (primarily nitrogen) from the activity of the fungus decomposing organic matter in the soil, such as dead tree roots, buried construction material or excessive thatch. The ring of dead or dormant turfgrass plants, the zone of inhibition, is a result of the water-resistant (hydrophobic) properties of the fungal mycelia. As the fungus grows in the thatch and soil, it prevents water from penetrating and reaching the plant roots. The result is plant dormancy or death. The majority of the fungal mycelia can be found below the fairy ring symptoms. As you move toward the center of the ring, the fungus is absent, resulting in a return to the normal appearance of the turfgrass plants and the characteristic ring symptom of this disease. The bands of lush growth often are visible throughout the growing season and may persist in the same location for many years as long as a food source remains. Fairy ring damage is the most severe in dry, nutrient-poor areas and can be exacerbated by excess thatch.

Chemical control options: Heritage (Azoxystrobin), Insignia (pyraclostrobin) and (ProStar 70WP) (flutolanyl).

Cultural methods to prevent fairy ring: Do not bury organic matter such as lumber and construction material, water and fertilize appropriately to mask symptoms, and balance rates of thatch accumulation and decomposition to decrease nutrients available to the fungus. Fungicides and wetting agents may offer limited control. Soil replacement is also an option. This can be quite labor-intensive and requires the removal of a 20-inch-wide by 8- to 30-inch-deep band of soil, followed by replacement with sterile soil and reseeding or sodding. Mushrooms and puffballs may be raked up and discarded. Be sure to wear gloves if handling the fruiting structures to prevent skin contact with toxins such as alkaloids that are produced by some mushrooms and puffballs. Controlling weeds in zones of dead and dormant grass also may be important.

Powdery mildew. (Sam Markell, NDSU)

Powdery mildew, *Erysiphe graminis*

Powdery mildew resembles powder or flour on the upper side of ornamental and turfgrass leaves. The disease typically occurs during periods of high humidity, air temperatures around 65 F, poor airflow and shade. The disease rarely warrants chemical control, but a severe outbreak can kill turfgrass, especially a newly established lawn.

Chemical control options: Banner Maxx (propiconazole), Bayleton (triadimefon), Eagle (myclobutanil), Cleary 3336F, (thiophanate methyl) and Fungo Flo 4.5F (thiophanate methyl).

Cultural methods to prevent powdery mildew: Improve airflow and sunlight by selectively pruning trees and shrubs, avoid excessive leaf wetness, fertilize with nitrogen to allow the turfgrass to outgrow the disease and plant resistant cultivars.

Rust. (Courtesy of Derek Settle, Chicago District Golf Association)

Rust, *Puccinia* spp.

Rust affects all turfgrasses grown in North Dakota, especially Kentucky bluegrass and perennial ryegrass, which often is included in seed mixtures for quick cover. The disease typically occurs in late summer during extended wet periods accompanied by air temperatures ranging from 68 to 86 F. Nutrient-deficient grass, grass grown in shade or turf managed under other forms of stress are very susceptible to infection. Symptoms include yellow spots on the leaves, which cause the lawn to look off-color. The spots develop into pustules that produce copper-colored fungal spores that easily adhere to shoes, clothing and skin as one passes through an infected area. Although rust typically subsides when dry weather returns and rarely warrants chemical control, a severe infection can cause grass blades to wither and die.

Chemical control options: Heritage (Azoxystrobin), Daconil Ultrex (chlorothalonil), Medallion (fludioxanil and Banner Maxx (propiconazole).

Cultural methods to prevent rust: Avoid excessive leaf wetness by providing irrigation in the morning, improve airflow and sunlight by selectively pruning trees and shrubs, provide adequate nitrogen fertilization and avoid plant stress.

Rust. (Courtesy of Derek Settle, Chicago District Golf Association)

Slime mold. (Courtesy of Derek Settle, Kansas State University Department of Plant Pathology)

Slime mold. (Courtesy of Derek Settle, Chicago District Golf Association)

Slime mold, *Physarum cinereum* and *Mucilago spongiosa*

Slime mold can affect all turfgrasses but is not considered a destructive disease. Slime mold is a primitive organism (prokaryote) that uses the grass blade for support as it feeds on bacteria, fungi and organic matter such as thatch. The spores typically spread from thatch to the leaf during heavy rain. Although the black and white reproductive structures, called sporangia, often form an unsightly mass on grass leaves in patches as large as 1 foot in diameter, they do not harm the host turfgrass unless the entire blade is covered and its ability to photosynthesize is reduced; such conditions can cause leaf yellowing.

Noticeable masses appear in cool, humid weather and break apart when hot, dry weather returns. Mechanical removal of the fruiting structures can be achieved with a rake, broom or strong stream of water from a garden hose. Chemical control is not warranted.

Chemical control options: Not necessary, but Fore (mancozeb) will provide effective control if coverage is heavy enough to block sunlight from leaves.

Cultural methods to prevent slime mold: Prevent thatch accumulation from exceeding 1/2 inch.

Turfgrass Insects

Turfgrass insects can be extremely destructive to residential lawns. Most turfgrass insects rely on thatch for shelter, cover or a secondary source of food as they feed on grass leaves or roots. Therefore, the best preventative control measures are to employ proper cultural practices in managing your lawn, which includes thatch control. See NDSU Extension publication H-1170 for proper thatch control practices. One should not resort to chemical control upon first detection of an insect in the lawn. Threshold numbers are available for each turfgrass insect that indicate the number of insects per unit area that would cause noticeable damage. Threshold numbers should be considered before applying insecticides. Many insect populations can be held below their threshold number by using proper turfgrass cultural methods, especially avoiding thatch accumulation.

Sampling is a good way to estimate the number of insects present in a given area to determine whether chemical control is needed. The following are reliable sampling methods that are effective in determining pest populations of turfgrass insects commonly found in North Dakota:

Flotation sampling — Cut both ends out of a metal cylinder such as a coffee can. Pound it 3 to 4 inches into the ground in a damaged area and fill it with water. Small insects will float to the top quickly. Estimate the number of insects per square foot based on the number present in the area covered by the can.

Irritant sampling — Mow the grass in the damaged area. Then mix 2 tablespoons of liquid dishwashing detergent in 2 gallons of water and pour the entire batch over 1 square yard. Any larvae present in the canopy should come to the surface in a few minutes.

Soil sampling — Cut a square foot of turf on three sides, undercutting 2 to 3 inches deep with a sharp, flat-edge shovel. Roll the sod back and count the number of grubs in the sampling area. Crumble some of the soil from the root zone to expose more grubs. After counting, level the soil and roll the sod back into place. Be sure to provide water for several days to promote re-establishment. Roots should recover quickly if the sample was cut deeply enough.

Contact your local county Extension office for other sampling methods and proper chemical and nonchemical insect control options. A partial list of insecticides for control of lawn insect pests is provided in Table 1.

Armyworm adult. (Gerald Fauske, NDSU)

Armyworm larvae. (Gerald Fauske, NDSU)

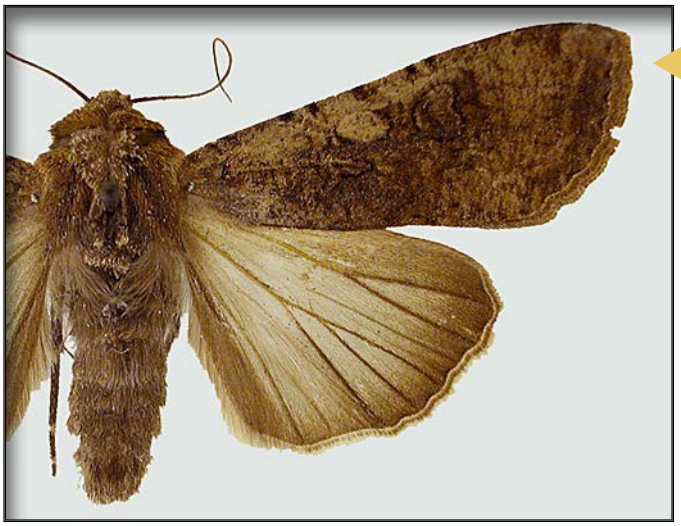
Armyworm, *Mythimna unipuncta*

Armyworms migrate into North Dakota but are unpredictable as to when they will arrive. Larvae strip turfgrass vegetation as they feed in large groups. The destruction they leave in their wake and the short time it took can be quite alarming to most homeowners.

Adult moths overwinter in the pupal stage in southern Florida and southern Texas. After warm weather arrives, moths migrate northward to all states east of the Rocky Mountains, often blown in on strong southerly winds during the summer months. Adult moths are buff-colored and have a 1.5-inch wingspan with a diagnostic white spot on each wing. After arriving, adults mate and females lay a cluster of 25 to 200 eggs on any type of vegetation, then cover the mass with a layer of grayish scales. After the eggs hatch in one to two days, armyworm larvae begin stripping turfgrass foliage, primarily during dusk and morning hours. Therefore, a healthy lawn may appear to be defoliated overnight if the infestation is severe. Young larvae are green and approximately 1/16 inch long. Mature larvae are brown to grayish or green and 1.5 inches long, and have a distinctive netlike pattern on the head and a dark stripe along each side of the body, with a lighter orange stripe below the dark ones. If the larvae stop feeding or are chemically controlled before they feed on the crown tissue, the turf likely will recover. However, if the turfgrass was in a stressed state before armyworm feeding began, a lawn may be lost even if the crown tissue is left intact.

Sampling method: Irritant sampling

Threshold number: five larvae per square yard



Variegated cutworm adult. (Gerald Fauske, NDSU)

Cutworms

Several cutworm species, such as the variegated cutworm *(Peridroma saucia)*, black cutworm *(Agrotis ipsilon)* and bronze cutworm *(Nephelodes minians)*, defoliate turfgrass in North Dakota. Mature cutworm larvae range from 1 to 2 inches long and can range from brown to black to gray and may be spotted or striped, depending on the species. Cutworm larvae are nocturnal and feed on the lower stems of tender flowers and vegetable bedding plants, but when those food sources are not available, they begin to feed on turfgrass leaves. Adults are brownish to grayish moths with a small, black daggerlike marking on each wing. Adults are nocturnal and do not damage

Variegated cutworm larva. (Gerald Fauske, NDSU)

turfgrass. Once the warm weather of spring arrives, adults begin feeding on flower nectar. Females then attach eggs to the tips of grass blades. As morning light appears, larvae burrow into the soil or hide under foliage to avoid detection throughout the day. Damage is more noticeable in short grass compared with grass mowed high. Defoliated areas may range in size from that of your little finger to large patches several feet wide. Cutworm larvae may kill turfgrass if they feed low enough to injure or destroy the crowns. If insecticidal control is necessary, the optimal application time is late evening because larvae actively feed after dark.

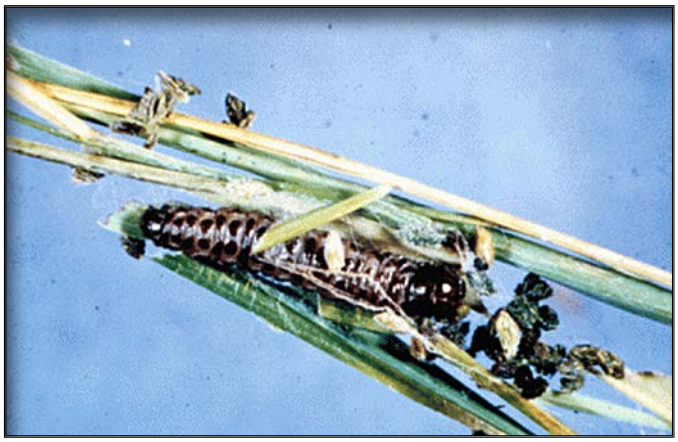
Sampling method: Irritant sampling

Threshold number: five larvae per square yard

Sod webworm

Sod webworm adult. (Courtesy of Jessica Lawrence, Eurofins Agrosciences Services, www.bugwood.org)

More than 40 species of sod webworms can be found in eastern North Dakota. The first signs of sod webworm activity are moths flying in an up-and-down pattern over the turf canopy during the twilight hours. The dull-colored moth ranges from 0.5 to 0.75 inch long, and has a snoutlike projection rather than a typical proboscis and wings that fold over the body when closed, giving it a wedge-shaped appearance.



Sod webworm larvae. (Courtesy of Ward Upham, Kansas State University Department of Horticulture, Forestry and Recreation Resources)

Damage is caused by larvae, which feed on leaves at night beginning in mid to late summer. The larvae range from green to gray to brown, and are from 0.75 to 1 inch long, with a brown head and spots that run the length of the body. Evidence of larval activity includes baseball-sized dead patches in the lawn with silken tunnels at ground level. The webbed tunnels are littered with grass, leaves and excrement that resembles green pellets. Damage may go unnoticed if the lawn is healthy and actively growing but tends to be more evident during hot weather later in the summer. The best control is achieved when insecticides are sprayed in the evening because larvae are more likely to ingest the insecticide since they feed shortly after dark. Insecticides should be applied when adult moth flight activity is observed and larvae reach the threshold level. Endophyte-enhanced turfgrasses such as perennial ryegrass, tall fescue and fine fescue contain fungal endophytes that generally are resistant to sod webworm attacks.

Sampling method: Irritant sampling

Threshold number: four to six larvae per 4 square feet

Western chinch bug adult. (Patrick Beauzay, NDSU Department of Entomology)

Western chinch bug nymph. (Patrick Beauzay, NDSU Department of Entomology)

Western chinch bug, *Blissus occiduus*

The western or buffalograss chinch bug primarily feeds on buffalograss and zoysiagrass but also can damage other warm- and cool-season turfgrasses in North Dakota. Nymphs and adults cause turf damage by sucking fluids from the grass stems with their piercing/ sucking mouth parts. Adult females are approximately 1/8 inch long by 1/16 inch wide, while adult males are smaller. They range from gray to black or brown with white wings. Adults overwinter at the bases of the turfgrass host and in the adjacent thatch layer. They re-emerge in the spring when the air temperature reaches the upper 60s and begin to mate when temperatures reach the 70s. Eggs are laid in the thatch near the base of the crown. Nymphs begin feeding on turfgrass immediately after hatching and continue to do so through the adult stage. Damaged turf first appears as small, yellow patches that often coalesce to cover the entire lawn. Severely damaged turf can die, especially if it is in a state of stress during the infestation.

Sampling method: Flotation or irritant sampling

Threshold number: 15 to 20 insects per square foot

White grubs

White grubs are the larvae of May and June beetles or masked chafers. Larvae of billbugs are similar in appearance to white grubs but lack legs and develop into a weevil as an adult. All of these species do extensive damage to turfgrass by feeding on the roots. Larval feeding begins in late spring in North Dakota, but damage usually is not noticed until the summer months. Predicting peak damage is difficult because timing varies among species and seasonal weather trends. Signs of grub damage begin as small, irregular dead patches several inches wide. If control measures are not taken, the damaged areas can expand to several feet or yards in diameter. A simple way to diagnose grub damage is the “tug test.” Grasp a handful of damaged turf and pull; if the turf comes up in large pieces without resistance, the damage likely was caused by white grubs severing roots from the turf as they feed in the thatch layer or just below the soil surface. Diseased turf, although dead or damaged, will provide resistance during the “tug test” because the roots still are intact.

Skunks and moles often cause secondary damage to grub-infested turf by digging and tunneling for larvae just below the soil surface. Mole tunnels and skunk diggings may indicate a white grub problem.

Systemic insecticides provide effective control if applied approximately one month before the heaviest feeding occurs. Contact or stomach insecticides can be used as a rescue treatment, but neither chemical control measure will revive dead or severely damaged turf.

May/June beetle adult. (Courtesy of Ward Upham, Kansas State University Department of Horticulture, Forestry and Recreation Resources)

May/June beetle larvae.
(Courtesy of Steven Katovich, USDA Forest Service, www.bugwood.org)

An effective nonchemical control measure is to avoid thatch accumulation and maintain a vigorous lawn. Also, avoid permanent night lights in or near the turf area. They attract adult beetles, which often lay eggs at night in turf adjacent to illuminated areas.

Biopesticides have not provided reliable control of white grubs. Milky disease spores *(Bacillus popilliae)* are not effective against white grubs of May beetles, June beetles or masked chafers. Beneficial parasitic nematodes are effective for white grub control only when soil moisture is adequate. However, efficacy often is unreliable compared with conventional insecticides.

Sampling method: Soil pest sampling for larvae of May and June beetles and masked chafer beetle, and irritant sampling for billbug adults

May and June beetles, *Phyllophaga.* spp.

The May and June beetle have a three-year life cycle ending with the emergence of adult beetles in late May or early June; hence the names May or June beetles. Adults are tan to brown, ranging from 0.5 to 1 inch long and 0.25 to 0.33 inch wide, with a smooth, hard exoskeleton. Adults mate shortly after emerging from the soil. Females lay eggs 3 to 7 inches below the soil surface. The eggs hatch in three to four weeks and produce white C-shaped larvae approximately 1 inch long when mature with six legs behind the head. With the aid of a hand lens, two rows of whiskers can be seen among the rasters near the anal slit of the grub. After hatching, the larvae dig upward to feed on turfgrass roots for the rest of the summer. Feeding may cause the turfgrass to wilt, thin or even die in small to large patches. As fall approaches, the larvae migrate downward below the frost line to hibernate for the winter. They move upward again after spring arrives to resume feeding. The most extensive turfgrass damage is caused by the second-year larvae. As fall approaches, the larvae move down below the frost line once again. They resume feeding for a short time during the third spring before pupation into the adult stage begins. Adults emerge from the soil the following spring to mate and complete their three-year lifecycle. Adults do not damage turfgrass; after emergence, they mate and feed on ornamental foliage for a short time, then die.

Threshold number: three to four larvae per square foot

Masked chafer adult. (Courtesy of M. Reding and B. Anderson, U.S. Department of Agriculture – Agricultural Research Service, www.bugwood.org)

Masked chafer larva. (Courtesy of M. Reding and B. Anderson, U.S. Department of Agriculture – Agricultural Research Service, www.bugwood.org)

Northern masked chafer,

Cyclocephala borealis

Masked chafers have one generation per year. The northern masked chafer is native to North Dakota, and like the May/June beetles, causes extensive damage to turfgrass by feeding on the roots during the larval stage. Larvae look similar to those of the May/June beetle except that the body is shorter and thinner, and has a scattered raster pattern lacking the two lines of whiskers on the hind end, which are present on the May/June beetle. Adults are smaller than the May/June beetles, measuring 0.5 inch long and 0.25 inch wide and have a brown, masklike patch across the front of the face. In late June, females lay their eggs on the soil surface. After hatching, the grubs feed on grass roots until late summer. By September, the grubs are in the third instar of development and do the most destructive damage to the turf. At this time, they move deeper into the soil to begin hibernating in the larval or pupal stage. Adult chafers emerge from the soil in June to mate, then die shortly afterward because, unlike the May/June beetles, adult chafers do not feed.

Threshold number: eight to nine larvae per square foot

White grub raster patterns

May/June beetle larvae raster pattern.
(Courtesy of University of Nebraska, Department of Entomology)

Masked chafer beetle larvae raster pattern.
(Courtesy of University of Nebraska, Department of Entomology)

Billbug beetle adult. (Courtesy of Joseph Berger, www.bugwood.org)

Billbug larvae. (Courtesy of Ward Upham, Kansas State University Department of Horticulture, Forestry and Recreation Resources)

Bluegrass billbug, *Sphenophorous parvulus*

The bluegrass billbug damages bluegrass and fescue lawns during the larval stage. Billbug larvae are not a true white grub. Nonetheless, they can do extensive damage by feeding on stems, crowns and shallow roots. The legless larvae are white, stubby and humpbacked; have a brown head; and are approximately 0.25 to 0.5 inch long when mature. The adult is a small, dark brown to black weevil approximately 0.25 inch long with a long curved snout and often are seen walking across concrete sidewalks and driveways adjacent to infested areas. Females lay their eggs in May in holes that they chew into stems and crown tissue. After hatching, the larvae tunnel through the lower plant parts as they feed, and even may migrate down to shallow roots. Small patches of damaged or dead grass appear in midsummer and may coalesce into larger dead patches. If billbugs are suspected, look for hollowed stems and yellowish sawdustlike frass at the bases of plants. Dead turf pulls up easily because of the lack of root resistance. Larvae stop feeding in midsummer to tunnel into the soil to pupate into the adult stage. If the weather is conducive, a second partial generation may occur that ranges from September to October. Adult weevils of the second generation overwinter under leaves that accumulate in shrubs, tall grass and against buildings.

Threshold number: six to eight larvae per square foot

Note: Mention of any trade names does not imply endorsement of one product over another nor discrimination against any product by the North Dakota State University Extension Service or the authors.

Table 1. Partial list of insecticides available to homeowners for control of insect pests of lawns.

Active Ingredient Insecticide Class	Trade Name(s)	Armyworms	Cutworms	Sod webworms	Western chinch bugs	White grubs: May and June beetles	White grubs: Masked chafers	Bluegrass billbugs
acephate Organophosphate	Orthene	X	X	X	X			
Bacillus thuringiensis (Bt) Bacterial insecticide	Dipel			X				
bifenthrin Pyrethroid	Talstar	X	X	X	X			X
cyfluthrin Pyrethroid	Tempo Ultra GC	X	X	X				
carbaryl Carbamate	Sevin SL			X				
deltamethrin Pyrethroid	Deltagard			X				
halofenozide Moulting disruptor (ecdysone agonist)	Mach 2 1.5 G Grub-B-Gon	X	X	X				X
imidacloprid Neonicotinoid	Merit 0.5 G Merit 2F Grub-Ex Bayer Advanced Season-long Grub Control					X	X	
lambda-cyhalothrin Pyrethroid	Scimitar	X	X	X				X
trichlorfon Organophosphate	Dylox Bayer Advanced 24-hour Grub Control (for white grubs rescue control only)	X	X	X	X	X	X	X

Note: Mention of any trade names does not imply endorsement of one product over another nor discrimination against any product not mentioned by the North Dakota State University Extension Service or the authors.

Additional References

Bambara, S. 2003. Fall armyworms in lawns. Ornamentals and Turf. Dept. of Entomology Insect Note. North Carolina State University Cooperative Extension. www.ces.ncsu.edu/depts/ent/notes/O&T/lawn/note128/note128.html

Braxendale, F.P., and R. Gaussoin. 1997. Turfgrass management for the northern great plains. EC97-1557. University of Nebraska Cooperative Extension.

Capinera, J. 1999. Fall armyworm. University of Florida Institute of Food and Agricultural Sciences, Dept. of Entomology and Nematology. http://entnemdept.ufl.edu/creatures/field/fall_armyworm.htm

Heller, P. 2007. Sod webworms in home lawns. Penn State University. College of Agricultural Sciences. Dept of Entomology. http://ento.psu.edu/extension/factsheets/sod-webworms-lawns

Kennelly, M. 2007. Rhizoctonia brown patch on fescue. Kansas State University. Dept. of Plant Pathology. www.ksre.ksu.edu/Search.aspx?q=brown%20patch

Kennelly, M. 2008. Fairy rings in turfgrass. EP155. Kansas State University. Dept. of Plant Pathology. www.ksre.ksu.edu/Search.aspx?q=fairy%20ring

Kennelly, M. 2009. Slime Molds in the Lawn and Landscape. Kansas State University. Dept. of Plant Pathology. www.ksre.ksu.edu/Search.aspx?q=slime%20mold

Latin, R. 2007. Turfgrass disease profiles - Gray snow mold. BP-101-W. University of Purdue Cooperative Extension. www.extension.purdue.edu/extmedia/BP/BP-101-W.pdf

Mulrooney, B. 2004. Fungicide recommendations for turfgrass. University of Delaware, College of Agricultural and Natural and Resources, Cooperative Extension.

Obasa, K., and M. Kennelly. 2010. Rust Diseases of Turfgrasses. Kansas State University. Dept. of Plant Pathology. www.ksre.ksu.edu/Search.aspx?q=rust

Oklahoma State University Dept. of Entomology and Plant Pathology-Armyworm. www.ento.okstate.edu/ddd/insects/armyworm.htm

Sod Webworm. 1999. University of Rhode Island Landscape Horticulture Program. GreenShare Factsheets. www.uri.edu/ce/factsheets/sheets/sodwebworm.html

Upham, W. 2009. Leaf spot and melting out. Kansas State University. Dept. of Horticulture, Forestry and Recreation Resources. www.ksre.ksu.edu/Search.aspx?q=melting%20out

Upham, W. 2009. Powdery mildew of turf. Kansas State University. Dept. of Horticulture, Forestry and Recreation Resources. www.ksre.ksu.edu/Search.aspx?q=powdery%20mildew

Upham, W. 2009. Summer patch. Fairy rings in turfgrass. Kansas State University. Dept. of Horticulture, Forestry and Recreation Resources. www.ksre.ksu.edu/Search.aspx?q=summer%20patch

Western or Buffalograss Chinch Bug. Syngenta Turfgrass Encyclopedia. www3.hcs.ohio-state.edu/turfwiki/index.php/Western_or_Buffalograss_Chinch_Bug









Acknowledgements

The authors extend their gratitude to the following individuals for their contributions to this publication:

Jared LeBoldus
Marcia McMullen
Jeff Stachler
Rich Zollinger

For more information on this and other topics, see www.ag.ndsu.edu

2M-8-11, 3M-5-12, 2M-3-15