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report on
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LEAF SMUTS OF TURFGRASSES

Stripe smut, caused by the fungus *Ustilago striiformis*, and flag smut, caused by *Urocystis agropyri*, are two leaf or foliar smuts widely distributed in the world and destructive to many turfgrass species. Smut fungi weaken the grass host making the plant easy to kill when under severe stress. Plants infected with flag smut are killed more readily than are plants infected with stripe smut. Flag smut is often more prevalent in early spring, while stripe smut generally predominates in late spring and early autumn. These smut fungi grow systemically throughout a grass plant, and both smut fungi may infect the same grass plant at the same time and even the same leaf. Once infected, a plant remains so for life. Infected plants are often weakened and invaded by other organisms.

Leaf smuts, together with high temperatures and drought, cause grass plants to exhibit stunted growth, a brown to blackish brown appearance, a general decline, and early death. Dead patches of grass often appear in heavily infected turf during midsummer; weed invasion soon follows (Figure 1).

Figure 1. Severe stripe smut in Kentucky bluegrass.

The stripe and flag smut fungi infect about 100 species of turf and forage grasses, both cultivated and wild (Table 1). A number of highly specialized varieties and pathogenic races of these fungi are restricted to certain cultivars and species of grass. The diseases occur most commonly on annual bluegrass and Kentucky bluegrass (especially on the cultivars Delta, Geronimo, Merion, Newport, Park, Rugby, and Windsor). Creeping bentgrass, colonial bentgrass, redtop, fescues, common timothy, several wild-ryes and wheatgrasses, orchardgrass, perennial or English ryegrass, and quackgrass are also commonly infected. Leaf smuts are favored in locations having excess thatch, frequent irrigations or rains during spring and summer, turf that is 3 years or more old, a pH below 6.0, and where susceptible grass cultivars are grown.

SYMPTOMS

Due to the killing of individual plants and the distinct upright growth of infected plants, the turf, in an overall view, appears clumpy and patchy. Smutted plants are most noticeable during cool weather in the spring and autumn, appearing pale green to slightly yellow or brown, stunted, and more upright than healthy plants. Single plants, or irregular patches up to one foot or more in diameter may be affected.

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Short to long, narrow, and yellow-green streaks (sori) develop between the veins in infected leaves and leaf sheaths. These streaks soon become silvery to dull gray and extend the entire length of the leaf blade and sheath (Figure 2). The grass epidermis covering the streaks soon ruptures, exposing blackish brown, dusty masses of smut spores (teliospores). After dispersal of the spores, the leaves soon split and shred into ribbons, turn brown, curl from the tip downward, turn light brown and die. In addition, leaves of infected bluegrass and bentgrass plants tend to remain stiff and erect rather than lax and spreading. The symptoms are usually most evident in middle to late spring and autumn, when temperatures average 50° to 65°F (10° to 18°C). Affected plants do not tiller as profusely or produce as many rhizomes or stolons as healthy plants, nor do they develop as extensive a root system.

Figure 2. Dark streaks in Kentucky bluegrass due to leaf smut infection (courtesy D.H. Scott).

Smutted plants are often difficult to find during hot, dry weather because a large percentage of such plants often die during summer droughts (Figure 1). Both smut fungi decrease leaf turgor and water potentials of infected plants under drought stress. Once infected, grass plants will rarely, if ever, recover unless properly treated with a **systemic** fungicide.

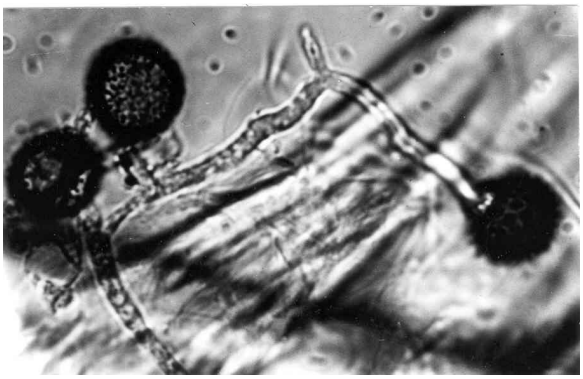

Figure 3. Three stripe smut spores germinating in drop of water (C.F. Hodges).

Under close mowing, both smut fungi produce identical symptoms. Positive diagnosis can be made only through a microscopic examination of the teliospores produced by the smut fungus. The spores of *Ustilago striiformis* are single cells, round to elliptical in shape and covered with prominent spines (Figure 3). The spores of *Urocystis agropyri* are smooth and roundish and are composed of one to four, dark reddish brown, fertile cells (teliospores) surrounded by several smaller, empty, or sterile cells (Figure 4) forming a spore ball.

DISEASE CYCLE

The stripe and flag smut fungi overwinter and oversummer as dormant mycelium in the meristematic tissue of crowns and nodes of infected plants and as dormant teliospores in or on grass debris, living plants, and soil. The teliospores are carried to the thatch and soil by many agents, including wind, rain, shoes, mowing, watering, raking, dethatching, coring, and other turf maintenance practices. Spores may also be transported on the seed. These teliospores may lie dormant in soil for up to 3 years (4 years on stored seed) before they germinate.

When suitable conditions occur in the spring and autumn, a teliospore germinates to produce mycelium on which minute spores (sporidia) may be borne, although this is apparently rare on certain grasses, such as Kentucky bluegrass and creeping bentgrass. Each sporidium then germinates and forms a germ tube. When the germ tubes of opposite mating types fuse (conjugate), an infection hypha forms that penetrates

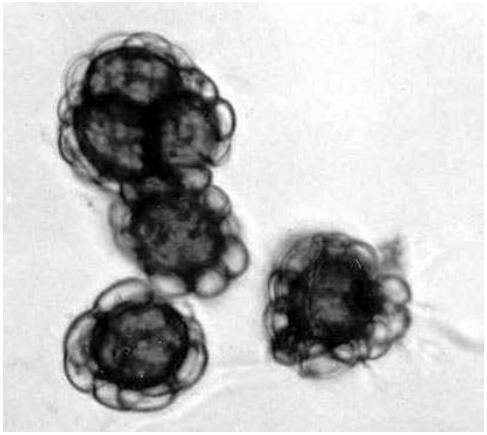

Figure 4. Four spores of flag smut fungus (Urocystis agropyri). (C.F. Hodges)

susceptible host tissue directly. Invasion may occur through the coleoptile of seedling plants and actively growing (meristematic) tissues produced by the lateral or auxiliary buds on the crowns, rhizomes, and stolons of older plants that come into contact with germinating spores. Once inside the grass plant, smut hyphae develop systemically in the direction of plant growth, with new leaves, tillers, rhizomes, and stolons becoming infected as they form. The mycelium continues to grow within developing tissues.

Teliospore formation begins with thick, tangled mats of mycelium within infected grass tissues. The mycelium then breaks up to form masses of blackish brown, greasy teliospores that are released when the host tissues rupture, shred, and die.

Smutted plants in new turfgrass areas are uncommon, indicating limited infection of seedling plants from soil- or seedborne teliospores. The large number of diseased grass plants in turf areas more than 3 years old is probably caused by the invasion of lateral buds and the growth of smut fungi from perennially infected crowns. Once infected, watering and high fertility, which stimulate plant growth during droughts, create conditions that favor the buildup of leaf smuts. Such practices keep the systemically infected grass plants from dying during hot, dry weather.

CONTROL

1. Grow a blend of several cultivars that generally show resistance to leaf smuts and other major diseases. Bluegrass and bentgrass cultivars apparently differ greatly in their resistance to leaf smuts. Because numerous races of the two smut fungi exist, it is difficult to predict the relative resistance or susceptibility of a cultivar in any given location. Kentucky bluegrass cultivars showing good resistance to one or both leaf smuts include A-34 (Bensun), Adelphi, America, Baron, Brunswick, Cheri, Eclipse, Enmundi, Glade, Majestic, Midnight, Monopoly, Nugget, Parade, Plush, Rugby, Sydsport, Touchdown, and Victa (see Table 2). Kentucky bluegrass cultivars rated as susceptible to very susceptible include Galaxy, Geronimo, Merion, Park, Pennstar, Ruby, and Windsor.

   Stripe smut has been reported to infect the following creeping bentgrass cultivars: Arlington, Cohansey, Congressional, Evansville, Old Orchard, Penncross, Penneagle, Pennlu, Seaside, Toronto, and Washington. The races of the stripe smut fungus that attack Kentucky bluegrass do **not** infect creeping bentgrass.

2. Sow **only** seed that is not surface contaminated with teliospores and is treated with a captan- or thiram-containing fungicide, or start with disease-free sod, sprigs, or plugs of a resistant cultivar. During hot weather, the smut fungi become dormant in bentgrass stolons and the healthy-appearing stolons continue to grow. When cooler weather returns in the autumn, the smut fungus resumes growth and symptoms reappear in the stolons.

3. Remove thatch in early spring or late summer when it has accumulated to 1/2 inch. Use a "vertical mower," "power rake," "aerifier," or similar equipment. These machines can be rented at many garden supply and tool rental stores.

4. Avoid frequent light irrigations during spring and summer. During summer or early fall droughts, water established turf thoroughly early in the day so the grass can dry before dusk. Water infrequently and deeply, moistening the soil at each watering to a depth of 6 inches or more.

5. Apply nitrogen-containing fertilizers sparingly during the summer months (no more than 1/2 lb of nitrogen per 1000 sq ft per month).

6. Renovate and overseed infected turf with a blend or mixture of relatively resistant cultivars (Table 2).

7. Where practical, remove the clippings when smutted leaves are evident.

8. Yearly treatment with a systemic fungicide is expensive, but it checks the pathogen(s). Fungicides that are suggested for the control of leaf smuts are given in the current edition of University of Illinois Urban Pest Control Management Guide. Two applications of a systemic fungicide are needed in late fall with the second application 14 to 21 days later just before winter dormancy occurs. Apply the fungicide at the recommended rate per 1000 sq ft in 5 to 10 gal of water. Immediately after each treatment, drench the fungicide into the soil, applying the equivalent of an inch of water (600 gal per 1000 sq ft) to make sure that the fungicide moves down into the root zone. The manufacturer's directions should be followed carefully. Use the lower fungicide rates in **preventive** programs, higher rates in **curative** programs. Only one of the fungicides listed in the management guide need be used. Fungicide use and restrictions are subject to change without notice. Always read and follow the current package label instructions and precautions.

Carefully follow the manufacturer’s directions on the container label. Use one of the fungicides listed in the current edition of Illinois Commercial Landscape Turfgrass Pest Management Handbook. The only two fungicides that control both summer patch and necrotic ring spot are Banner and Rubigan.

(Mention of a trade name or proprietary product does not constitute warranty of the product and does not imply approval of this material to the exclusion of comparable products that may be equally suitable).

Table 1. Some Turf, Forage and Wild Grasses Reported to be Susceptible to One or More Physiologic Varieties and Races of Stripe Smut (*Ustilago striiformis*), Flag Smut (*Urocystis agropyri*), or Both

GRASSES SUSCEPTIBLE TO BOTH STRIPE AND FLAG SMUT

X *Agrohordeum macounii = Elymus macounii*
quackgrass or couchgrass (*Agropyron repens*)
beardless or bluebunch wheatgrass (*A. spicatum = A. inerme*)
bearded couch or slender wheatgrass (*A. trachycaulum*)
cheatgrass (*A.* sp.)
browntop or colonial bentgrass (*Agrostis capillaris = A. tenuis*)
creeping bentgrass (*A. stolonifera = A. alba, A. palustris*)
alpine foxtail (*Alopecurus alpinus*)
fringe brome (*Bromus ciliatus*)
awnless or smooth brome (*B. inermis = B. pumpellianus*)
bluejoint (*Calamagrostis canadensis*)
orchardgrass or cock's-foot (*Dactylis glomerata*)
Canada wild-rye (*Elymus canadensis = E. wiegandii*)
blue wild-rye (*E. glaucus*)
western wheatgrass (*E. smithii = Elytrigia smithii, Agropyron occidentale, A. smithii, A. spicatum* var. *molle*)
beardless wild-rye (*E. triticoides*)
Virginia wild-rye (*E. virginicus = E. striatus*)
bluebunch or Idaho fescue (*Festuca idahoensis*)
foxtail or squirrel-tail barley (*Hordeum jubatum*)
June grass (*Koeleria nitida = K. cristata*)
Leucopoa kingii = Festuca kingii
alpine cat's or alpine timothy (*Phleum alpinum*)
common timothy (*Phleum pratense*)
bulbous bluegrass (*Poa bulbosa*)
Canby bluegrass (*P. canbyi*)
Kentucky bluegrass (*P. pratensis*)
Sandberg bluegrass (*P. sandbergii, P. secunda*)
Sitanion jubatum
spike trisetum (*Trisetum spicatum*)

GRASSES SUSCEPTIBLE ONLY TO STRIPE SMUT

fairway crested wheatgrass (*Agropyron cristatum*)
thick-spike wheatgrass (*A. dasystachyum*)
Agrostis castellana
spike redtop (*A. exarata*)
redtop (*A. gigantea*)
A. humilis
A. hyemalis
A. microphylla
autumn or brown bentgrass (*A. perennans*)
Ross redtop (*A. rossae*)
rough bentgrass (*A. scabra = A. geminata*)
European beachgrass (*Ammophila arenaria*)
American beachgrass (*A. breviligulata*)
broom-sedge (*Andropogon virginicus*)
vernalgrass (*Anthoxanthum* sp.)
Arctagrostis latifolia
oatgrass (*Arrhenatherum* sp.)
Avena pubescens
American sloughgrass (*Beckmannia syzigachne*)
quaking-grass (*Briza* sp.)
plains reedgrass (*Calamagrostis montanensis*)
C. pickeringii

Scribner reedgrass (*C. scribneri*)
timber oatgrass (*Danthonia intermedia*)
mountain hairgrass (*Deschampsis atropurpurea*)
tufted hairgrass (*D. caespitosa*)
Elymus semicostatus subsp. *Striatus = Agropyron striatum*
Siberian wild-rye (*E. Sibiricus*)
Elymus semicostatus subsp. *Striatus = Agropyron striatum*
Siberian wild-rye (*E. Sibiricus*)
nodding fescue (*Festuca obtusa*)
western fescue (*F. occidentalis*)
sheep fescue (*F. ovina = F. brachyphylla, F. ovina* var. *brachyphylla*)
English bluegrass or meadow fescue (*F. pratensis = F. latior*)
Thurber fescue (*F. thurberi*)
sweetgrass (*Hierochloe* sp.)
velvetgrass or Yorkshire-fog (*Holcus lanatus = Notholcus anatus*)
bottlebrush (*Hystrix patula = Elymus hystrix*)
Chinese wild-rice or false wheatgrass (*Leymus chinensis = Elymus chinensis, E. pseudoagropyrum*)
English or perennial ryegrass (*Lolium perenne*)
purple oniongrass (*Melica spectabilis*)
muhly (*Muhlenbergia* sp.)
reed canarygrass (*Phalaris arundinacea*)
alpine bluegrass (*Poa alpina*)
annual bluegrass (*P. annua*)
arctic bluegrass (*P. arctica*)
Chapman bluegrass (*P. chapmaniana*)
Canada bluegrass (*P. compressa*)
P. curtifolia
alkali bluegrass (*P. juncifolia*)
P. longifolia
Nevada bluegrass (*P. nevadensis*)
fowl or roughstalk bluegrass (*P. palustris = P. serotina*)
P. reflexa
roughstalk bluegrass (*P. trivialis*)
Nuttall alkaligrass (*Puccinellia nuttalliana*)
Sesleria sp.
squirreltail (*Sitanion hystrix = Elymus elymoides*)

GRASSES SUSCEPTIBLE ONLY TO FLAG SMUT

goatgrass (*Aeglilops* sp.)
Baker wheatgrass (*Agropyron bakeri*)
bearded wheatgrass (*A. X subsecundum* var. *andinum*)
thin grass (*Agrostis diegoensis*)
beardgrass (*Andropogon* sp.)
oatgrass (*Arrhenatherum* sp.)
California or mountain brome (*Bromus carinatus = B. aleutensis*)
hairgrass (*Deschampsia* sp.)
Elymus aristatus
basin or giant wild-rye (*E. cinereus = E. condensatus*)
American dunegrass (*E. mollis*)
E. riparius
E. scabrus = Agropyron scabrum
Elytrigia sp.
chewings or red fescue (*Festuca rubra = F. rubra* subsp. *rubra, F. rubra* var. *lanuginosa, F. rubra* var. *prolifera*)
fowl mannagrass (*Glyceria striata = G. nervata*)
Hierochloe sp.
Hordeum brachyantherum = H. boreale
ryegrass (*Lolium* sp.)
California melic (*Melica imperfecta*)
big bluegrass (*Poa ampla*)
Wheeler bluegrass (*P. nervosa = P. wheeleri*)
bread or common wheat (*Triticum aestivum = T. sativum, T. vulgare, T. timopheevii*)

Table 2. Modern Kentucky Bluegrass Cultivars Adapted to Illinois and Reported to be Moderately to Highly Resistant (R)[a] to one or More Diseases

Kentucky Bluegrass Cultivars	"Helminthosporium" diseases	Leaf smuts	Leaf and stem rust	Necrotic ring spot	Dollar spot	Typhula blight	Septoria leaf spot	Red thread
America	R	R	R	R	R	(b)		
Bensun (A-34)	R	R	R		R			
Adelphi	R	R	R	R	R	R	R	R
Baron		R		R		R	R	R
Brunswick	R	R	R	R	R			
Cheri	R	R		R		R	R	
Eclipse	R	R		R	R			R
Enmundi	R	R	R	R			R	R
Glade		R	R	R		R		
Majestic	R	R	R	R	R	R	R	R
Midnight	R	R	R	R	R			R
Monopoly	R	R	R	R		R	R	R
Nugget	R	R	R			R	R	R
Parade	R	R	R	R	R	R	R	
Plush	R	R	R		R		R	R
Rugby	R		R	R	R			
Sydsport	R	R	R	R		R	R	
Touchdown	R	R		R			R	R
Victa	R	R	R	R			R	R

a A resistant (R) rating does not mean that a particular cultivar will be resistant in all locations every year. Due to the presence of physiological races or strains of the various fungi that cause these diseases, a cultivar may be susceptible in one locality and highly resistant in another. This is especially true of powdery mildew and is the reason we omitted this disease from our ratings.

b A blank under a given disease does not necessarily indicate susceptibility. In some cases it means that no data are available on which to evaluate the relative susceptibility or resistance to a particular disease.