13 LAWN CARE WITHOUT PESTICIDES

The key to maintaining a lawn without pesticides is to understand the relationship between an organism and its environment. The key organism in a lawn, of course, is the grass and the relationship is known as ecology. The environment, which includes soil, light, temperature, moisture, and humans, is dynamic and intimately linked. Lawn care practices generally have many effects on the environment beyond those on the grass plant. For example, a lawn mowed very short not only weakens the plant but also results in increased light contacting the soil, thereby increasing soil temperature and promoting weed invasion.

Managing a healthy lawn that is less reliant on energy-intensive inputs and more competitive against pests requires a thorough understanding of the biology of grass plants, the physical and chemical aspects of soils, biology of the pests, and human expectations. Simply, care should be intimately linked to quality expectations to management practices that are based on the growth of cool-season lawn grasses.

Important ecological concepts at work in a lawn include (1) *adaptation:* selecting for plants that are adapted to an environment (e.g., temperature, moisture, traffic, mowing height) to make them more successful in competing for resources and help maintain a dense, healthy lawn; (2) *competition:* managing well-adapted plants in a healthy state so they will be more competitive against pests such as weeds; (3) *avoidance of open space:* making sure plants are properly managed and healthy so they will seek to develop a dense canopy and resist severe disturbance from pests and traffic. As plants suffer from poor adaptation, improper care, or excessive traffic, open space is created where other plants can invade to compete for resources.

Growth and Development of Lawn Grass

Lawn care without pesticides requires the selection of a species that is well adapted to the prevailing environmental conditions. Adaptation of lawn grasses in the northern United States from Maine to Virginia west to Iowa and Minnesota is determined by temperature, specifically low temperature. Traveling farther west into the Great Plains, moisture becomes a second limiting factor determining species adaptation.

Cool-season grasses produce optimal shoot growth between 67° and 75° F and optimal root growth from 55° to 65° F. This suggests that cool-season grasses grow best in spring and fall conditions and are less adapted to the warm, dry summer months. Root growth is most active in spring before significant shoot growth, then as temperatures warm, root growth is limited. In fact, substantial root loss can occur at temperatures above 85° F. As the soil cools in late summer, active root growth resumes in early fall with little competition from shoot growth for energy.

During summer months, as conditions for active cool-season grass growth decline (reducing competitiveness), populations of warm-season grassy weeds such as crabgrass (*Digitaria* spp.) become more competitive. In essence, the crabgrass plants, which grow actively at high temperatures, are more able to gather resources and persist. Therefore, proper selection of well-adapted lawn grasses to meet quality and use expectations, as well as prevailing environmental conditions, will be more able to compete with undesirable species throughout the growing season.

Selecting Lawn Grasses

Important cool-season lawn grass species include Kentucky bluegrass, perennial ryegrass, tall fescue, and the fine-leaf fescues. Other cool-season grasses found in lawns include roughstalk bluegrass and creeping bentgrass. In addition to temperature, the grasses differ in adaptation to soil fertility, moisture, and pH, as well as mowing, traffic, and pest tolerance. Visually, grasses differ in leaf width (texture), growth habit (bunch-type, rhizomatous, stoloniferous), density, and color. This variability exists between and within each species, which partially explains the increased number of cultivars available for each species.

Kentucky bluegrass (*Poa pratensis*) is the predominant high-quality lawn grass for northern climates. It is a well-adapted, perennial species that produces rhizomes (underground lateral stems) that enhance the species' ability to form a sod and recover from traffic injury. Kentucky bluegrass is most successful in sunny, well-drained, fertile sites that are fertilized regularly, although it will require 45 to 90 days to establish a dense lawn. Improved varieties will require supplemental irrigation to avoid summer dormancy associated with warm, dry conditions. Older, common varieties, however, have been successful with no irrigation in northern climates. The major pest problems associated with Kentucky bluegrass include fungal diseases such as leafspot, dollar spot, and necrotic ringspot, as well as major surface and root feeding insects such as billbugs and white grubs.

Perennial ryegrass is considered a bunch-type grass that does not produce lateral growth in the form of rhizomes and stolons. Rather, it spreads from the base with tillers. This makes ryegrass plants less competitive in a lawn under regular traffic that injures the plant and leaves open spaces. In addition, weeds in soil would also be able to fill the open spaces before the ryegrass filled in, unless more ryegrass seed was distributed on the soil. Ryegrass will germinate from seed in two to four days and will provide a uniform lawn within two weeks. Therefore, regular seeding of the lawn is vital to maintaining a dense stand of bunch-type grasses such as perennial ryegrass and tall fescue.

Perennial ryegrass is most successful in sunny, well-drained, fertile sites receiving regular care. The major pest

problems associated with perennial ryegrass include fungal diseases such as red thread, rust, brown patch, and Pythium blight. Over the past several years, gray leafspot has become a damaging disease of perennial ryegrass, to which there is little to no natural resistance. Ryegrass breeders have developed varieties that contain endophytic fungi (fungi that live in association with the grass plant in the leaf sheath, referred to as endophytes). The endophytes produce chemicals that deter surface-feeding insects such as chinch bugs and sod webworm but have no effect on white grubs or other subsurface feeders.

The fine-leaf fescues are comprised of a group of lawn grasses that includes creeping red fescue (*Festuca rubra*), chewings fescue (*Festuca rubra* var. *commutata*), hard fescue (*Festuca longifolia*), and sheep fescue (*Festuca ovina*). The fine-leaf fescues are characterized by medium to dark green color, narrow needle-like leaves, primarily bunch-type growth (except for creeping red, which can produce rhizomes), and are exceptionally slow growing, requiring little or no supplemental fertilizer.

The fine-leaf fescues are well adapted to infertile, acidic soils and are most tolerant of shaded conditions as compared to other cool-season grasses. As a group the fescues are not tolerant of traffic because the leaves cannot withstand the abrasion of wear; moreover, similar to ryegrass, they do not fill in open spaces as a result of bunch-type growth. The slow-growing nature of the fine fescues allows for improved shade tolerance in places where less light is available for growth.

The fine fescues have few major pest problems; under wet conditions, however, they can be attacked by red thread and leaf spot. Similar to the ryegrasses, certain fescue cultivars have endophytes to repel surface-feeding insects but are susceptible to white grub infestations.

Turf-type tall fescue (*Festuca arundinacea*) is a bunch-type grass with substantially wider leaves as compared to the fine leaf fescues. It is an exceptionally deep rooted grass, a trait that affords significant ability to persist under drought conditions. It is tolerant of the abrasion of wear, but because it lacks rhizome and stolon growth it will require regular seeding to be competitive in a heavily trafficked lawn.

Tall fescue is susceptible to brown patch, Pythium, and like the ryegrasses has suffered in recent years from rust infestations. Proper nitrogen fertilization is vital for avoiding and managing these pest problems. Tall fescue is most successful when established from seed in early August, several weeks before establishing other cool-season grasses, because it is less winter hardy in the seedling stage. In addition, while generally not recommended, spring establishment can be successful when soils warm and seed rate is increased slightly to compete with weed growth.

Establishing and Renovating a Lawn

A healthy soil grows healthy, competitive plants. Although healthy plants should be the goal of any lawn care program, a program that strives to use a low-input approach requires consistent and vigilant plant health care. The foundation of plant health care is the enhancement and improvement of the soil, which is most effectively accomplished during the establishment of a new turf area or before renovation. This is the first step in an integrated pest management (IPM) program.

IPM is a method of pest management that uses a variety of options to maximize plant health. This approach indicates the importance of site assessment and modification, then selecting the right grass species, followed by proper culture. Proper implementation of these practices will assist in maximizing plant health because of the stable foundation from establishment through maintenance. Where this approach is not followed, pesticides often become the primary component of a management system.

The timing of establishing a new turf area generally coincides with a period of desirable soil temperatures (between 55° and 65° F for the cool-season grasses with adequate precipitation available). For most areas of the cool humid region these conditions are generally available in the late summer and early fall (mid-August to late-September). The farther north in the region, the earlier in the summer the conditions will be available. One of the ecological principles behind this timing is competition from weed infestations, especially annual grassy and broadleaf weeds because their seeds are germinating at this time. The competition from weeds often results in a less than desirable stand of turf.

Primary Cultural Practices

Once the lawn has become established and actively growing, cultural practices must be employed to maximize plant health. In essence a healthy plant is more able than an unhealthy one to compete against weeds and other pests that may infest the stand. Ecologically, lawn care involves striving for what nature would not otherwise select, i.e., a monoculture. Therefore, cultural practices must be properly timed and executed to minimize disruption to the population balance in favor of the lawn grasses while preserving environmental quality.

Mowing

The single most common and time-consuming practice in lawn care is mowing. Still, mowing is probably the most poorly understood of all the cultural maintenance practices, especially the impact of close mowing on plant health. Simply, the lower the height of cut, the less root system available to extract water and nutrients from the soil and the high level of maintenance required to maintain acceptable quality.

The lawn should be mowed so that no more than one-third of the leaf tissue is removed with each mowing. For example, a low-maintenance lawn

that is maintained at 3 inches should be mowed when it reaches 4.5 inches. Grass clippings should be left on the lawn, as long as there are no clumps, and have been shown to contribute to the nutrient pool in the soil after three to five years. In addition, leaving clippings on the lawn reduces the chance that they can blow onto paved surfaces and then wash into storm drains where they can contribute to reduction in surface water quality from the phosphorus contained in the tissue.

As mowing height increases, soil surface temperature is reduced as the canopy shades the soil. In fact, several studies have demonstrated a significant reduction in weed infestations as a result of mowing heights that were shown to cool the soil and restrict germination of summer annual grasses such as crabgrass (*Digitaria* spp.)

Of all the cultural practices, the removal of leaf tissue by mowing can be the most severe if not done properly. Therefore, the four keys to a healthy mowing program are to (1) mow the lawn at 3 inches or higher to promote deep rooting and cool the soil surface, both of which discourage weed problems, (2) never remove more than one-third of the leaf blade at each mowing so as to minimize physiological shock and maintain health, (3) maintain a sharp cutting blade to reduce tearing and minimize water loss, especially on perennial ryegrass, and (4) return clippings to the lawn to take advantage of the nutrient cycling offered by the clippings.

Fertilizing

Proper nutrient management is as vital for maintaining healthy plants as humans eating a balanced diet. The more a person eats the wrong foods and not enough of the right foods, the greater the chance of not being healthy, especially if the person is experiencing stress or exposed to germs. Likewise, to maintain healthy plants a balanced amount of nutrients must be available.

The soil test provides a basis for the fertilizing program. For example, the soil test will indicate if supplemental applications of P and K will be required. If soil tests indicate adequate levels of these nutrients, there is little evidence that suggests fertilizing with them will provide a benefit. Yet, especially with phosphorus, there can be a significant detrimental effect if fertilizer is deposited on paved surfaces or applied and not watered in properly.

The primary nutrient for the growth of healthy turf is nitrogen. Nitrogen is vital for several important physiological aspects of plant growth, especially shoot and root growth. However, improper timing of nitrogen fertilizer can result in excessive shoot growth at the expense of root growth. This is typical with early spring applications of soluble nitrogen fertilizers.

Research has shown that early spring nitrogen does not enhance green-up as compared to nitrogen applied in late fall. In addition, when the soil warms (the actual cause of spring green-up) and water-soluble nitrogen is available, the plant produces top growth at the expense of root growth. Thus, plants fertilized in early spring are more stressed going into hot, dry summers because their roots have grown less.

Spring fertilization will occasionally be necessary to promote increased density following turf loss from winter injury. In addition, lawns that have not received late fall fertilizer will benefit from early spring fertilization as the soil warms above 55° F. This increased density from an ecological perspective will enhance grass competition for space before emergence of summer annual and perennial weeds.

A fertilizer program for the cool-season grasses should be focused on the fall months. Essentially, 50 to 75 percent of all nitrogen should be applied between August and November. At this time, shoot growth is declining and root growth increasing as temperatures cool but days remain long. Never apply fertilizer to frozen soil because this will increase the likelihood for runoff.

Lawns grown on mostly sandy soils should use a high percentage of slow-release nitrogen to minimize the potential for leaching past the root zone. Research has demonstrated that on most soils, with some silt and clay, leaching of nitrogen is extremely rare.

Regarding the human dimension, lawns whose owners have high visual quality expectations and are exposed to limited traffic will need less nitrogen than those receiving large amounts of traffic. From a species perspective, Kentucky bluegrass lawns have a higher nitrogen requirement than the fine-leaf fescues. If the correct amount of nutrition is not supplied to the bluegrass, it will be less competitive against weeds and other pests. Comparatively, if too much nitrogen is supplied to the fine-leaf fescues, which have a slow growth rate, they will produce lush, weak growth susceptible to pest injury.

Watering

Most lawns do not receive supplemental watering, and fortunately the northern climates rarely require additional water except for a few months in the summer. The lack of supplemental watering does not mean that it is impossible to maintain a healthy turf, only that to do so will require careful management before entering a stress period without precipitation.

Proper watering of lawn areas is vital for maintaining plant health during stressful periods. The most important rule to remember is to attempt to apply what the plant and soil would have lost to evapotranspiration (ET), approximately one inch of water per week and at a rate that matches how the water will infiltrate the soil.

The best time to apply supplemental watering is early in the morning. At this time evaporation rates are low, which improves efficiency. In addition, it is important to try to minimize the length of time grass blades are wet to reduce potential for fungi to cause disease.

It is normal for cool-season grasses to experience summer dormancy asso-

ciated with lack of moisture. Studies have shown that one inch of water over a three-week period is all that is required to avoid desiccation. Under all but the most severe conditions, it is better to avoid lawn watering especially if application devices are not precise. Inadequate (too much or too little) water can weaken the plants, making them more susceptible to pest problems and less likely to recover when cool, moist conditions return.

Problem Solving

Managing a lawn without pesticides includes attempting to solve existing problems that may be a result of poor growing conditions or excessive use of an area that results in reduced lawn health.

Weeds

A lawn with significant weed infestations can detract from visual appearance but often poses no functional or environmental problem. Weeds are best managed from an ecological perspective through prevention rather than control. The most effective strategy employs a multifaceted approach: understand the biology of the weeds; properly evaluate site conditions to determine if they are conducive to poor lawn growth; and focus on maintaining a dense, healthy lawn. Simply, a chronic weed infestation means that something is awry with the lawn care practices that reduces the competitive ability of the plants. Increased fertility will improve turf density and competitive ability, but if weeds invade, hand pulling remains the only viable control option.

Diseases

Most lawn diseases are caused by fungi. The fungal pathogens (those that infect grasses) live mostly as saprophytes (feed on dead or decaying organic matter) until environmental conditions become favorable for infection (the fungi become parasites).

Most lawn diseases occur when the grasses are experiencing stress and are in a weakened condition, which usually coincides with environmental conditions that are conducive to pathogen growth. Once the infection process is initiated, chemical control is rarely effective and not recommended under lawn conditions.

Insects

Insects are abundant in nature and make up a substantial portion of all the forms of life on this planet. In fact, the lawn environment sustains high populations of insects. Few, however, cause damage.

Grass plants have a substantial ability to tolerate insect feeding. The principles of an IPM program are based on the population threshold of the insect, beyond which significant injury will occur. For white grubs, an actively growing lawn will often experience feeding pressure in early spring from European chafer and be able to tolerate between 10 to 15 grubs per square foot of lawn. In late August through October, Japanese beetle larvae will surface to feed on grass roots and should be monitored to determine if control strategy is required. Observing the population dynamics throughout a season is fundamental to developing a healthy lawn care program.

Surface feeder damage occurs on lawns from June through August. Proper inspection of the periphery of the damaged area is accomplished using a disclosing solution made with soapy water applied as a drench that causes the insects to float to the surface.

In addition, endophytes associated with perennial ryegrass, fine leaf, and tall fescues have been shown to provide resistance to surface-feeding insects. The insects are deterred from feeding by the presence of a chemical in the leaf sheath as a result of the association between the endophyte and the plant.

Insect Management

Three basic types of insects feed on lawn grasses. The *surface feeders* include chinch bugs and sod webworms. *Billbugs* feed in turfgrass stems and crowns. *Root-feeding insects* include several white grub species (larvae of certain scarab beetles such as the Japanese beetle) and the European Chafer.

As with diseases and weeds, a properly maintained lawn is more tolerant of insects than a neglected or improperly maintained lawn. For example, a lawn that is watered and fertilized may tolerate 10 to 15 grubs per square foot with no visible damage. But the same number of grubs may devastate a weak, poorly maintained lawn.

Monitoring: Homeowners can check for grubs in their lawns by cutting three sides of a square-foot area with a shovel and peeling back the sod layer. The white, C-shaped grubs will be apparent on the soil surface of the underside of the sod mat. Several areas of the lawn should be checked and grub levels compared with thresholds listed in Table 15. Inspect lawns in mid- to late August in upstate New York and late July or early August in downstate and Long Island, New York.

In recent years, plant breeders have been working on varieties of lawn grasses that have insect resistance. They have introduced into the grass plant a fungus called an endophyte, which produces a chemical that is toxic to insects. Perennial ryegrass cultivars with insect resistance include AllStar, Repell, Citation II, Dasher II, Pennant, Pinnacle, and Saturn. Fine fescues infected with the endophyte include Jamestown II and SR 3000. Unfortunately, the toxin does not move to the underground plant parts. Thus insect resistance is limited to surface- and stem-feeding insects such as sod webworm, chinch bug, and billbugs.

White grubs are the most damaging insects on home lawns in New York. There are actually five species of beetles in New York whose larvae feed on turfgrasses. In upstate New York the European chafer and the Japanese beetle cause the most damage. On Long Island we also commonly see grubs of the Asiatic garden beetle and Oriental

beetle and Japanese beetle. Currently, one biological insecticide milky spore is labeled for turf, and nematodes may also be used.

Milky spore is a naturally occurring bacterial parasite that infects Japanese beetle grubs but is not effective on other white grub species. Each grub species is infected with its own strain of milky disease. Naturally occurring milky disease is found in most soils that will infect each of the scarab species. We find infected grubs when conditions are stressful for the grubs, that is high population, lack of food, crowding, etc. Population may crash after several years due to natural milky disease buildup. Commercial milky disease product will only infect Japanese beetle. Milky spore products on the market do not survive and spread very well. Grubs and moist, warm soil (>70° F) are needed for sufficient disease development. When soil temperatures reach 70° F or above is usually when adults are present, or eggs are present. These temperatures seldom occur for very long when grubs are active. Thus they have been, at best, marginally effective in New York. Supplies of milky spore have been limited over the last several years because of difficulty in producing sufficient quantities of a high-quality product.

Parasitic nematodes (microscopic worms) are also available to control insects, including grubs. Results with nematodes have been inconsistent without irrigation, but with sufficient moisture applied they are a viable choice for soil insect control on lawns. Homeowners should choose the nematode product that is targeted to the insect pest causing problems and should follow label directions carefully. Active, living nematodes and sufficient soil moisture are essential for success. Homeowners who do nothing may have to renovate their lawns when heavy grub infestations occur. Nematodes might prevent this.

Integrated Pest Management (IPM)

Integrated pest management integrates many factors into a pest management program. IPM is not, by definition, a pesticide-free program, but a homeowner may choose an IPM program that avoids the use of some or all insecticides. Proper culture, pest monitoring, sanitation (such as thatch control), and proper timing and selection of pesticides are all a part of an IPM program. Ultimately, if a pesticide is used, it will be used much more efficiently than in a preventive program.

Home lawn IPM incorporates all the cultural practices discussed in this chapter. Following such a program greatly reduces reliance on pesticides. But there may come a time when a weed or insect population reaches an unacceptable or damaging threshold and use of a pesticide may be justified. Then IPM depends on the proper identification of the pest and selection of the pesticide that will effectively manage the pest with minimal hazard to the environment.

Tables 15 and 16 give cultural guidelines. Pesticide guidelines are found in Part II, Tables 17 and 18.

Summary

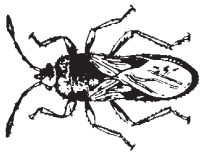
The importance of efficient use of natural resources combined with preserving environmental quality demands a more holistic approach to managing the lawn environment. It is no longer possible to expect technology, in the form of energy-intensive inputs, to provide solutions to managing a dynamic biological environment such as a lawn. Therefore, the time is right to approach lawn care from the perspective that all parts are intimately linked and that the alteration of one component will ultimately influence the performance of another.

The ecologically based approach embraces the human dimension as well as the biological aspects of lawn care. This begins with selection of adapted plants that can be competitive while meeting quality and use expectations, then timely and proper cultural management to maintain plant health, and pest management based on the ecology of the organism employing control programs that minimize environmental impact. The result is likely to be a more satisfied lawn care provider and a lawn that provides the environmental benefits that improve the quality of life.

Table 15. Turf pests

Pest	*Cultural Management*
INSECTS	
Ants	May nest in turfgrass areas, causing mounds. Although many ants are beneficial as predators and recyclers and are useful in cleaning up the environment, mounds are undesirable in lawn areas. Frequent disturbance may cause ants to move.
Bluegrass billbug	Scattered brown spots lead to destruction of entire lawn. Check for infestations by looking for adult billbugs walking on driveways and sidewalks on warm days in early June or when soil temperature reaches about 65° F. Endophytic grasses have shown resistance to billbug damage. Parasitic nematodes may be useful for controlling grubs, billbugs, sod webworms, and cutworms. Commercial nematode products tested have been inconsistent, especially for grub control. They may be useful for spot treatments in late June–early August, especially when turf is under water stress. Apply in evening or early morning as directed by supplier.

Table 15. Turf pests *(continued)*

Pest	*Cultural Management*
Chinch bugs  **Hairy chinch bug**	Adults are black with white wings folded over body, $^{1}/_{5}$ inch in length. Nymphs are red to orange, early stages with white band across back. Damage leaves copper-colored area on lawn; closely resembles sunscald or drought injury. Chinch bugs injure grasses by puncturing stems and sucking out plant juices. They do best in thatchy lawns. In severe infestation the grass is killed and only cover and other nongrass weeds remain. Chinch bugs are more of a problem in warmer temperatures in late June through September. Monitor for chinch bugs in June. Check outer margin of injured area by getting down on hands and knees, parting grass, and looking carefully for nymphs and adults; or try a flotation method: (a) water small areas heavily, cover with white cloth; within a short time bugs crawl up grass blades and hang onto cloth; or (b) use large can with both ends open, drive it into soil a few inches and fill with water. Adults and nymphs should float to surface within 5 to 7 minutes. If 15–20 nymphs are present per square foot you may want to consider treatment or may be able to reduce damage by keeping lawns watered.
Digger wasps	See Table 6, Annoying pests outside the home—Wasps and hornets.
Grubs (Japanese beetle, oriental beetle, Asiatic garden beetle, European chafer*, northern masked chafer)  **White grub**	General wilting and thinning of turf stand. Grubs, the larvae of scarab beetles, feed on grass roots within 1 in. of soil surface, cutting them off and killing grass plants. Before treatment, ask: (1) Is damage definitely caused by grubs? (2) Are grubs still present? (3) What species is causing the damage? (4) What is best time to treat for grubs? (Treat when grubs are young and actively feeding close to the soil surface: mid-August to late September in upstate New York; early August to mid-September in southeastern New York.) (5) Are there enough grubs to warrant treatment? (Rule of thumb: if there are more than eight grubs per square foot, soil should be treated.) (6) Are alternatives to synthetic soil insecticides available? (see Japanese beetle, below). Parasitic nematodes may be useful for controlling grubs, billbugs, sod webworms, and cutworms. Commer-cial nematode products tested have been inconsistent, especially for grub control. They may be useful for spot treatments or to control black vine weevil larvae in ornamentals. Apply in evening as directed on label. *The European chafer may be the most serious pest of home lawns and low-maintenance turf. Feeding occurs from August to November and again in late April to June. Damage is most severe under drought conditions. Adults emerge from mid-June to early July in New York State. They fly on warm evenings at dusk to tall objects in a landscape. They make a sound like a swarm of bees. After mating, they deposit eggs in soil.
Japanese beetle	Japanese beetles are considered the number one turf pest in much of New England and the mid-Atlantic states. Use milky disease (a bacterium) spore powder: grubs must be present to spread and maintain the disease. Moist, warm soil (>70° F) is necessary for sufficient disease development to be of value. The powder is useful on large, marginal, or low-value turf areas; it is not effective against other grubs. Trapping adults is not recommended. Although large numbers of beetles may be caught, they have little effect on population levels. If used, keep traps as far away as possible from valued trees and shrubs. Traps contain a sex lure and a feeding lure and may be useful in monitoring activity. See Grubs.
Oriental beetles	This is one of the most damaging grub species on Long Island, New York, along with the Japanese beetle. Because adults are much less conspicuous than Japanese beetles they are often overlooked. Many times adult Japanese beetles are flying but the grub infestation is oriental beetles (OB). OB grubs are not susceptible to commercial milky disease and will not be attracted to Japanese beetle traps. Because oriental beetles oviposit slightly before Japanese beetles, treatment for grubs on Long Island should be slightly ahead of the rest of the state—the last week in July to mid-August would be ideal, but several weeks later would not cause major problems. Maintain healthy turf, use adequate lime, fertilization, and irrigation. Entomopathogenic nematodes may be helpful.

continued

Table 15. Turf pests *(continued)*

Pest	*Cultural Management*
Sod webworms and cutworms	Young larvae (caterpillars) chew tender leaves and stems. Larger larvae may cut off grass blades and consume them. Adult moths deposit eggs at night as they fly over turfgrass areas. Determine presence of webworm and cutworm by mixing 1 to 2 Tbsp. of liquid dishwashing detergent in 1 gal. water and drenching lawn in selected spots. Insects will surface in 5 to 10 minutes. Larvae often hide in burrows in soil or thatch, coming out at night to feed. Endophyte-enhanced turfgrass can suppress cutworm activity. Entomopathogenic nematodes have been used for black cutworm on golf course greens.
Moles	Moles feed on grubs, earthworms, and other invertebrates. Traps are effective when carefully set. Look at improving draining in the area. Moles often inhabit the wettest portions of lawns because this is where earthworms are found.

FPO-Sod webworm

Sod webworm

Table 16. Turf Diseases

Plant	*Description and Occurrence*	*Cultural Management*
Anthracnose	Spots are vague or variable in shape. Leaf ends are often tan or brown, giving turf a brownish cast. This disease is most common on turf that is not growing rapidly. Spring through fall.	Maintain adequate nitrogen fertility, but avoid excess nitrogen in spring. Avoid drought and water early.
Brown Patch (Rhizoctonia blight)	Brown patches a few inches to several feet in diameter. Bare spots may occur where turf is killed. Most common in summer during hot, humid weather.	Avoid excess nitrogen and escess water. Water early in the day. Use of some organic fertilizers may reduce disease severity.
Dollar Spot	Bleached leaf spots with brown borders, often extending across entire leaf blade. Often in small silver-dollar sized patches at first, but may then spread over the lawn. June through September.	Assure adequate fertility. Avoid watering frequently or in late afternoon or evening. Use of some organic fertilizers may reduce disease severity. Resistant bluegrasses include Adelphi, America, Aquila, Bonnieblue, Eclipse, Majestic, Midnight, Parade, Park, Touchdown, Vantage, and Victa.
Fairy rings and toadstools	Arcs or rings of fast-growing, dark-green grass that often surrounds a ring of thin or dead grass where mushrooms may grow. Rings vary in size.	Mask symptoms with good fertility, watering, and mowing programs. Rake down or pick and discard mushrooms.

FPO-Fairy rings

Fairy ring in a lawn

Table 16. Turf Diseases (*continued*)

Plant	*Description and Occurrence*	*Cultural Management*
Fungal leaf spots and blights  FPO-Fungal leaf spots **Leaf spots on grass blades and melting-out infections on crowns**	Oblong brown leaf spots with dark red, brown, or purple borders. Overall yellowish cast to turf; generally does not occur in distinct patches. If severe, leaves shrivel and entire plants discolor and die. Spring through fall.	Avoid high-nitrogen nutrition in early spring. Water early in the day. Renovate lawn. Resistant bluegrasses include BonnieBlue, Challenger, Eclipse, Fylking, Midnight, Nassau, Parade, and Touchdown. Avoid systemic fungicides.
Gray snow mold (Typhula blight)  **FPO** **Gray snow mold on lawn** **Gray snow mold on a lawn**	Bleached, tan, small or large patches covered with white-gray, fluffy mycelial growth. Tiny, yet visible, red or brown spherical fungal sclerotia embedded in infected leaves. Rarely kills grass plants. December to March.	Rake matted grass in spring. Baron Kentucky bluegrass is resistant. Worsened by cool, wet autumn or spring and by deep compacted snow over unfrozen soil. Fertilize to prevent lush turf going into winter.
Necrotic ringspot and summer patch (formerly Fusarium blight syndrome)  **Summer patch "frog-eyes" & patches** **Summer patch "frog-eyes" and patches**	Irregularly shaped, bleached leaves or dying leaf ends. Irregular crescents or circles of dying grass with or without a small patch of healthy grass in the center. April to November.	Remove excess thatch. Avoid high-nitrogen nutrition, excessive watering, and drought stress. Avoid soil pH below 6.2 and drought stress. Resistant bluegrasses include Adelphi, America, Aspen, Columbia, Eclipse, Glade, Midnight, Mystic, Nassau, Parade, Ram I, Sydsport, Touchdown, Vantage, and Windsor. Mix perennial ryegrass seed with bluegrass seed when overseeding.

Table 16. Turf Diseases

Plant	*Description and Occurrence*	*Cultural Management*
Pink snow mold (Gerlachia patch)	Bleached brown, small or large patches covered with pinkish fluffy mycelium. No sclerotia. Can rot crowns and kill grass plants. Autumn to spring.	Avoid nitrogen application in late fall. Remove thatch. Rake matted grass in spring. Resistant bluegrasses include Adelphi, Birka, Bonnieblue, Bristol, and Touchdown. Worsened by cool wet autumn or spring and by snow over unfrozen soil. Snow is not necessary for disease to develop.
Powdery mildew	White, powdery growth on leaves, which appear frosted. Usually found in shady areas. Infected leaves become yellow and then die. July to October.	Reduce shading and avoid excess nitrogen. Plant shade-tolerant varieties. Resistant bluegrasses include A-34, Bristol, Eclipse, Glade, Nugget, and Touchdown.
Pythium blight	Diseased patches often follow shapes of wettest areas. Plants that are killed feel slimy or greasy in early morning. Most common during hot weather on poorly drained sites.	Avoid excess nitrogen and excess water. Do not mow wet grass. Renovate lawn.
Pythium root and crown rot	Small or large areas of lawn appear thinned, off-color, and slow growing. A general decline. Year round.	Avoid excess water and frequent use of systemic fungicides. The use of some organic fertilizers will reduce disease severity.
Red thread	Pink to red threadlike fungus strands grow from ends of leaves. Entire leaves eventually die and turn brown. Irregularly shaped patches. June to July.	Maintain adequate fertility and avoid nitrogen deficiency. Resistant bluegrasses include A-34, Adelphi, Birka, Bonnieblue, Challenger, Monopoly, Nassau, and Touchdown. The use of some organic fertilizers will reduce disease severity.
Rust	Small orange spots occur on leaf blades; later grass develops a reddish discoloration and affected plants shrivel and die. July to September.	Avoid nitrogen deficiency and drought. Resistant bluegrasses include Fylking, Park, and Sydsport. Avoid systemic fungicides
Slime mold	White, yellow, bluish, or dark gray fungus fruiting structures appear on the lawn. Patches of grass become dull gray but do not die. Late summer.	Rake or wash slime mold off leaves. Do not use fungicides.

Pink snow mold on a lawn

continued

Table 16. Turf Diseases

Plant	*Description and Occurrence*	*Cultural Management*
Smuts	Leaf blades become yellowish with gray or black stripes. Later the leaf turns brown, dies, and shreds into ribbons. Generally does not occur in distinct patches. May and October.	Avoid nitrogen application in late fall. Remove thatch. Rake matted grass in spring. Resistant bluegrasses include Adelphi, Birka, Bonnieblue, Bristol, and Touchdown. Worsened by cool wet autumn or spring and by snow over unfrozen soil. Snow is not necessary for disease to develop.

Further Reading

Lamboy, J., and M. Villani. 1998. *All About White Grubs*. NYS IPM Program, Ithaca N.Y. 2 pp.

Nelson, E. B. 1992. *Biological Control of Turfgrass Diseases*. Cornell Cooperative Extension Information Bulletin 220, Ithaca, N.Y. 12 pp.

Smiley, R. W. 1992. *Compendium of Turfgrass Diseases*. American Phytopathological Society, St. Paul, Minn. 98 pp.

Smiley, R. W., and M. C. Fowler. 1985. *Turfgrass Disease List and Identification Key for New York State*. Cornell Cooperative Extension Miscellaneous Bulletin 127, Ithaca, N.Y. 4 pp.

Tashiro, H. 1987. *Turfgrass Insects of the United States and Canada*. Cornell University Press, Ithaca, N.Y. 391 pp.

Thurn, M. C., N. W. Hummel, E. B. Nelson, and M. G. Villani. 1995 (rev.) *Home Lawns: Varieties and Pest Control Guide*. Cornell Cooperative Extension, Ithaca, N.Y. 8 pp.

Thurn, M. C., N. W. Hummel, and A. M. Petrovic. 1994. *Home Lawns: Establishment and Maintenance*. Cornell Cooperative Extension Infor-mation Bulletin 185, Ithaca, N.Y. 46 pp.