1999
RUTGERS
Turfgrass Proceedings

THE NEW JERSEY TURFGRASS ASSOCIATION

In Cooperation With

RUTGERS COOPERATIVE EXTENSION
NEW JERSEY AGRICULTURAL EXPERIMENT STATION
RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY
NEW BRUNSWICK

1999 RUTGERS TURFGRASS PROCEEDINGS

of the

New Jersey Turfgrass Expo
December 7-9, 1999
Trump Taj Mahal
Atlantic City, New Jersey

Volume 31
Published July, 2000

The Rutgers Turfgrass Proceedings is published yearly by the Rutgers Center for Turfgrass Science, Rutgers Cooperative Extension, and the New Jersey Agricultural Experiment Station, Cook College, Rutgers University in cooperation with the New Jersey Turfgrass Association. The purpose of this document is to provide a forum for the dissemination of information and the exchange of ideas and knowledge. The proceedings provide turfgrass managers, research scientists, extension specialists, and industry personnel with opportunities to communicate with co-workers. Through this forum, these professionals also reach a more general audience, which includes the public. Articles appearing in these proceedings are divided into two sections.

The first section includes lecture notes of papers presented at the 1999 New Jersey Turfgrass Expo. Publication of the New Jersey Turfgrass Expo Notes provides a readily available source of information covering a wide range of topics. The Expo Notes include technical and popular presentations of importance to the turfgrass industry.

The second section includes research papers containing original research findings and reviews covering selected subjects in turfgrass science. The primary objective of this section is to facilitate the timely dissemination of original turfgrass research for use by the turfgrass industry.

Special thanks are given to those who have submitted papers for this proceedings, to the New Jersey Turfgrass Association for financial assistance, and to those individuals who have provided support to the Rutgers Turf Research Program at Cook College - Rutgers, The State University of New Jersey.

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PRACTICAL TURF PEST MONITORING

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Monitoring is a formalized process of observation that accounts for pest location, severity, and damage to turf. It reveals essential information for making pest management decisions. Effective monitoring results in early pest detection and enables quick action that limits damage. The practice of integrated pest management (IPM) is not possible without some level of monitoring.

Monitoring involves procedures for detecting turf pests such as insects, pathogens, and weeds. Detection methods include sampling techniques and visual observation for damage or symptoms. Monitoring also reveals pest severity, as the knowledge of pest presence is not enough. When possible, pest severity should be considered within the context of turf health. In other words, a given level or population of pest may threaten turf in a weakened state, but not when the turf is healthy. Finally, monitoring should delineate pest troubles to allow for spot treatments.

Successful monitoring systems vary and depend on many factors. They must be compatible, however, with management goals. Generally, high value turf receives the most attention, especially areas with a history of pest damage. For example, golf course putting greens are among the highest value turf areas, so monitoring frequency may be as often as twice a week. On the other hand, turf in parks or cemeteries may be monitored only a few times a year.

Nothing is more important to successful monitoring and IPM practice than the individual who samples, observes, and records pest activity. Such individuals are referred to as scouts and require keen observational skills and knowledge of pest identification and life cycles. The best way to assure the reliability and value of monitoring information is to designate scouting responsibilities to qualified individuals. Scouting may be their sole responsibility, or it may be included among other tasks.

Variables Affecting Monitoring Frequency

- Customer or client expectations
- Value of turf area
- Time of year
- Pest history - key pests
- Site conditions
- Weather conditions
- Cultural considerations
- Turf health

Finally, monitoring systems must include forms for documentation of scouting information such as observation dates, maps to indicate location of findings, ratings of pest presence, location, and severity, cultural practices, pesticide applications, and other pest management inputs.

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MONITORING FOR INSECT PESTS

Various sampling techniques are effective for detecting insect pests of turfgrass (Table 1). Sampling is most useful for early detection and prevention of damage. Often it is useful for diagnosing problems, but sometimes damage and symptoms occur at different times. For example, black turfgrass ataenius damage shows up on golf course fairways in early summer, but often no living stages are present when symptoms are most obvious.

Until pest history is known, it is necessary to monitor for pests most common to the local area. If history is known, monitoring activities should concentrate on key pests that frequently cause damage.

Table 1. Sampling methods for common turfgrass pests.

Pest	Sampling Method	Best Time to Sample	Threshold
Japanese beetle	soil examination	July to August	8 to 10/ft^2
Oriental beetle, European chafer, and others	soil examination	July to August	5 to 7/ft^2
black turfgrass ataenius adults (golf turf only)	visual presence on golf greens or black light traps	April or when redbud blooms	unknown - when present, monitor for grubs beginning in late May
black turfgrass ataenius larvae (golf turf only)	soil examination (golf fairways, greens, and tees)	June: 1st generation August: 2nd generation	30 to 50/ft^2
Hyperodes weevil (annual bluegrass weevil) (golf turf only)	adults in mower basket in late March to April	adults: late March to April larvae: in stems in May	unknown
billbug adults	visual observation, pitfall traps	May to June 280 to 352 GDD base 50 F	presence in pitfall traps or 1/minute walking on adjacent paved areas
billbug larvae	visual observation of stems, crown, and soil	July to August	unknown
chinchbugs	flotation	June to August	25/ft^2
sod webworms, cutworms	disclosing solution	June to August	15 caterpillars/yd^2

The following are sampling techniques for insect pests:

1. *Application of disclosing solutions.* Surface-active insects such as webworms, cutworms, and billbugs can be detected by this method. Mix 2 to 4 tbs of mild dishwashing soap or 1 tbs of 1% pyrethrins into 2 gal of water and apply to one m^2 of turf. Insects will come to the surface within 5 to 10 minutes. Since detergents vary, test solutions on small, inconspicuous areas first to avoid the possibility of turf damage.

2. *Flotation.* Many insects, including chinchbugs and beneficials such as big-eyed bugs, ground beetles, and ants, float when submerged in water. The most commonly used flotation method involves the use of a hollow cylinder inserted into the soil and filled with water. Coffee cans may be used, but are not durable, especially when working on heavy soils. Good cylinders are simple to construct with sheet metal. On well drained, course textured soils, cylinders often fail to hold water. Consider submerging turf samples in either a bucket or plastic container filled with water. Turf samples can be cut with a knife, shovel, or golf course cup cutter. Finally, the simplest method for flotation is to flood the turf. This method is excellent for detecting cutworms on low cut turf such as golf course greens, tees, and fairways. When using flotation techniques for diagnosing damage, sample along the margin of healthy and damaged turf.

3. *Soil examination.* White grubs and other soil-inhabiting insect pests cannot be detected through floatation or disclosing solutions. Soil must be examined to reveal their presence. The traditional sampling method involves cutting a piece of sod on three sides, peeling it back, and carefully examining soil within and below the rootzone. A quicker and less damaging technique involves the use of a golf course cup cutter. These are inserted into turf to a depth of at least 4 inches. Cylindrical cores measuring approximately 1/10 ft^2 are removed and examined for grubs and other pests. As soil and thatch is examined, it is returned to the hole along with the turf. The cup cutter is a fast and efficient sampling tool. Samples should be taken in a grid pattern. Greater sample numbers increase reliability of results, but increase monitoring costs. For large turf areas such as parks or cemeteries, samples may be spaced 50 to 100 ft apart (2 to 4 per 1000 ft^2). For high value turf such as golf course fairways and home lawns, consider closer spacing, especially for turf in sunny or other stress prone sites.

4. *Traps.* Insect activity can be monitored through the use of various trapping techniques. Probably the most useful are pitfall traps which are effective for detecting adult billbugs and many beneficial predators. Traps are constructed with plastic drinking cups and placed flush with the soil surface where insects fall in, but cannot escape.

MONITORING FOR INFECTIOUS DISEASES

Infectious diseases of turfgrass are most often caused by fungi. Often, infectious fungi interact with site stress to increase damage. Disease management begins with timely detection and diagnosis.

Since fungi are microscopic, it is difficult to detect them. While sometimes they are visible, often they are not. Monitoring requires observation for symptoms and a good understanding of the relationship of diseases to environmental conditions and cultural practices.

Early detection of fungal diseases is essential for minimizing damage. Observation frequency should be based on turf disease history or at least an understanding of diseases common in your locality. In addition, monitoring frequency should be relative to environmental conditions. For example, Pythium foliar blight is a highly destructive disease that requires hot, humid conditions. Therefore, it would not make

sense to scout weekly for *Pythium* during cool weather in April. Generally, cool season disease problems require less frequent scouting than hot weather troubles caused by fungi such as *Pythium* or *Rhizoctonia*.

Scouting should be planned as part of scheduled visits to a given turf. Personnel should be trained to observe for disease symptoms. Scouts should at least be able to recognize disease patterns and abnormalities. If they cannot, they should refer it to someone who can.

Turf areas should be monitored by walking across turf and visually scanning the area. Disease problems should be noted on maps and quantified with a numerical rating of severity. Once a disease is detected, it should be monitored for increasing severity and to determine results of management efforts.

The following are general tips for monitoring and field diagnosis:

1. Describe the appearance and location of the symptoms. Do they occur in well-defined patches, or are they uniform throughout the area? Are they confined to a specific location like a low spot, shaded area, or near some physical structure? Next, quantify or rate the severity of damage as a percentage of the area damaged or number of spots or patches in a measured area, (for example, 40 spots/yd^2). Record all information on scouting forms.

2. Mark areas to be used as indicators of disease development. For example, if the number of spots or percentage of damage is increasing it will be evident in indicator areas.

3. Identify the species of turf involved. Do the symptoms occur on one species or on several?

4. Are fungal mycelia present on foliage? When scouting in early morning, mycelia are often visible since humidity is high. Mycelial growth can be induced by placing symptomatic turf samples in a plastic bag. This works well for foliar diseases including pink snow mold, dollar spot, red thread/pink patch, and for blights caused by either *Pythium* or *Rhizoctonia*. Be sure to collect samples along the margin of healthy and diseased turf. Mycelia of the causal agent should develop within 24 hours under favorable temperatures. Longer periods will result in non-pathogenic secondary fungi.

5. Record site and environmental conditions. Is the area well drained? Check for signs of poor drainage. Blackened or mottled soils accompanied by strong odors often indicate poor drainage. Use a soil probe to check rootzone moisture. Is there excessive thatch? Check for presence of arthropod pests. Does the soil appear compacted? For environmental factors, a history of the past week or two is often sufficient. However, for some root and crown diseases like summer patch, infection periods could have occurred a month or more prior to significant disease symptoms. What were the temperatures? How much precipitation has occurred?

6. Record cultural inputs: pesticide applications, irrigation regimes, fertilization program, and cultivation.

If you are not sure of the cause, collect samples for clinical diagnosis Samples should be taken before treating with fungicides and along the border between healthy and diseased plants. Do not expect to recognize all infectious diseases in the field. Characteristic symptoms add to the “body” of information necessary to make a diagnosis, but field symptoms vary and are not always “text book” in appearance. There are too many site, host, and environmental variables that result in unusual symptoms. Always take your time to gather all of the evidence before jumping to conclusions! Never try to impress others by rash and shallow diagnoses. Careful work improves accuracy and ultimately your credibility.

Diagnosis is both an art and a science. Accuracy increases with experience. Many turf managers have neither the time nor the skill to complete the diagnostic process. Help is available from Rutgers Cooperative Extension. Contact your county Agricultural Agent for information on submitting samples to the Rutgers Diagnostic Laboratory. Accurate clinical diagnoses require accurate and extensive information from the field. Turf managers must gather the information indicated above so it can be provided to the diagnostic clinic along with plant samples.

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