AN INDEPENDENT NEWSLETTER FOR TURF MANAGERS

Turf Grass TRENDS

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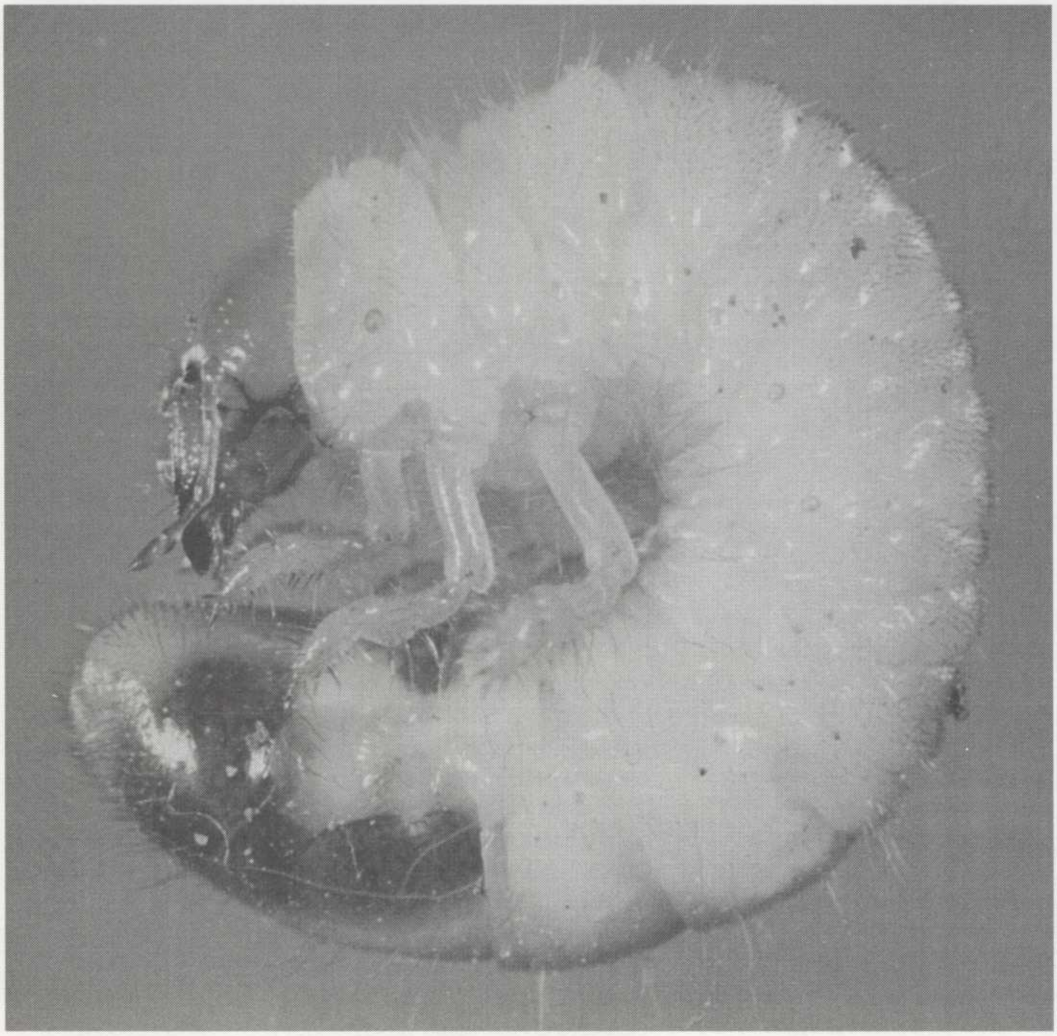

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IN-DEPTH ARTICLES

Cover photo: Japanese beetle grub, about 20 mm in length. Photo provided by Dr. Michael Villani.

Identifying the factors

Predicting grub damage in turf

by Dr. Michael Villani

We undertook a study of 317 lawns in Rochester, New York, in 1990 to gather some of the first large-scale data and formulate protocols that could be used by turfgrass managers to identify sites that harbor grub populations, monitor them and make the appropriate control decisions dictated by what we learned.

Until now, turfgrass managers have been unable make informed decisions prior to applications of potent pesticides (the usual way to deal with the threat of a growing grub population). Until this study, field research could not provide managers with the tools they could use to make informed decisions about controlling this turfgrass pest. Other than the well established, site damage threshold of five to ten grubs per square foot, a threshold that necessitates immediate curative control applications, scant work has been done on providing turfgrass managers with good pest control decision making rules for the control of grubs.

In the Northeast the grubs that threaten turfgrass are from a complex of scarab species:

- Japanese beetle, *Popillia japonica*
- European chafer, *Rhizotrogus majalis*
- Oriental beetle, *Exomala orientalis*

In managed turf sites they have been controlled with one or two applications of an appropriate insecticide, usually on a preventive basis.

These preventive applications have been made by turfgrass managers to prevent the potential for some future unspecified turf damage occurring. They are based on his rough knowledge of grub biology mixed with a very rough estimation of this year's grub populations, but with little regional or site specific information on species or populations.

The field work begins

During the first two weeks of September 1990, in an effort conducted by dozens of people, we sampled 317 residential lawns to establish grub populations and to note site characteristics.

Using a 10-foot grid pattern overlaid on each site, a approximately four-inch (11 cm) round sample was removed from each grid location to a depth of four inches (10 cm) using a golf course putting green cup cutter. Previous work had indicated that these cup cutter samples would provide just as reliable data as the more traditional one foot square samples. They were also easier to handle and caused less damage to the homeowner's lawn. Depending on the size of the residential lawn, from 20 to 180 samples where collected from each site.

Each sample was then examined for the number and species of grubs. Each site was also classified for its characteristics (See Table 1 above.).

We also made a grid map of a typical residential lawn with a representation of the kind of grub population that might have been found and their locations (See figure opposite.).

Table 1

Site characteristics

Characteristics	**Parameters**
Lawn age	less than or more than 20 years old
Amount of Kentucky bluegrass	less than 30%, from 30% to 60%, more than 60%
Slope	level, sloping, low lying
Thatch	less than 1.5 cm, from 1.5 to 2.5 cm, more than 2.5 cm
Soil type	clay, loam, sand
Shading	less than 30%, from 30% to 60%, more than 60%

Only three site characteristics found significant

When the data from the six site characteristics were analyzed statistically, it was found that only three of them were found to be correlated with grub density. They were:

- lawn age
- shade
- Kentucky bluegrass content.

Lawn age

We divided lawns into two groups: less than 20 years old and more than 20 years old. We found the average grub density for the younger lawns ran from 0.6 to 10 per square foot. The average density for the older lawns was between

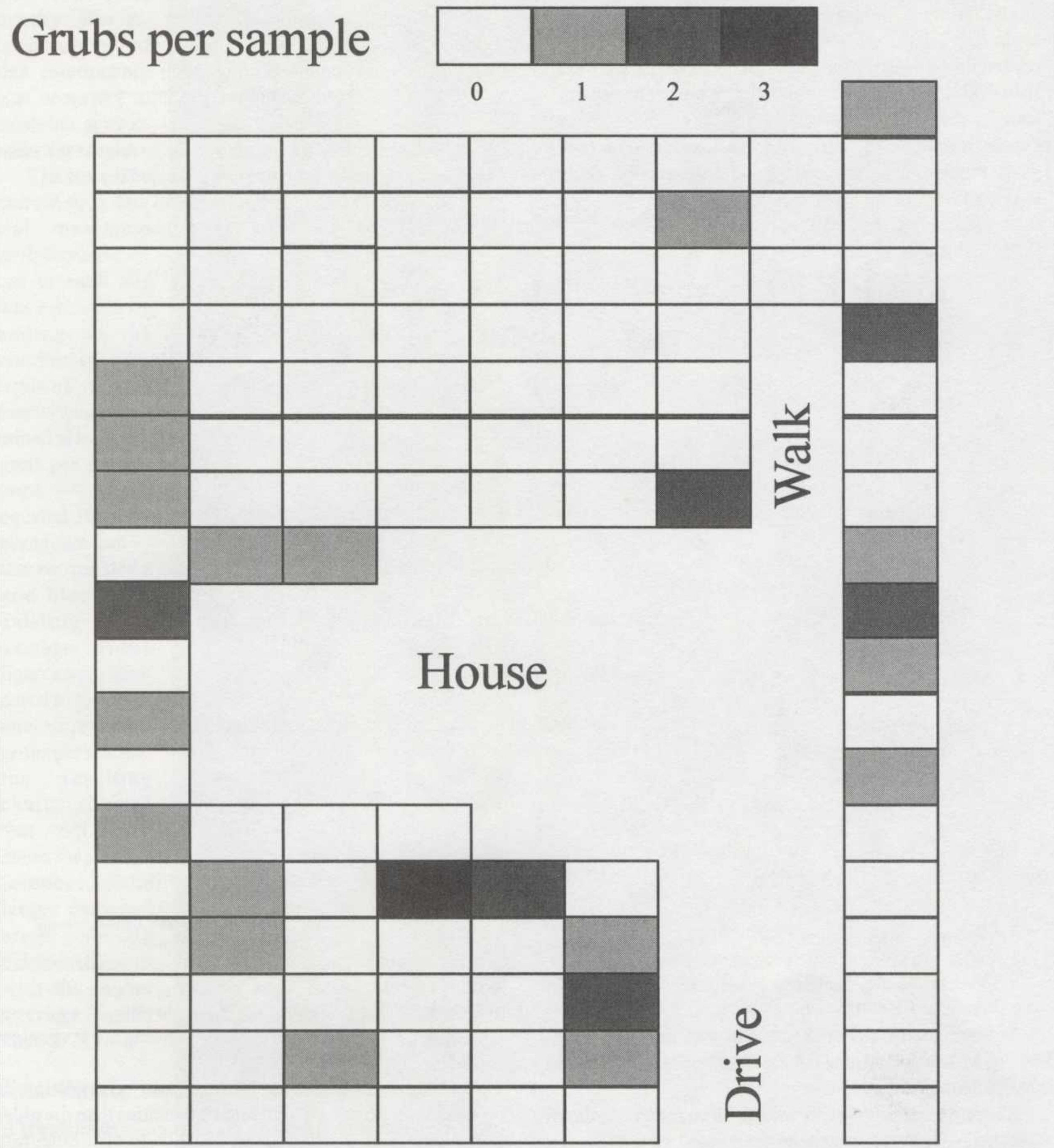


Figure provided by Dr. Michael Villani, Cornell University

Typical house lawn, each block is a 100 square foot area, blank spaces are house, drive and walk.

0.2 grubs and 4 grubs per square foot. We found the European chafer grubs, the ones that predominated in the samples, were 2.5 to 3 times more likely to infest the younger than the older lawns.

Shade

We divided up lawns based on the amount of site shading, less than 30%, from 30% to 60%, or more than 60%. We found the sites with more than 60% shade had the lowest grub density. The from 30% to 60% shaded sites had higher grub densities in five of six categories than the more than 60% shaded sites. But the 30% to 60% sites had lower grub densities than the less than 30% shaded sites in five of six categories.

Species composition

When turfgrass species composition was examined in conjunction with the three categories of shade, sites with

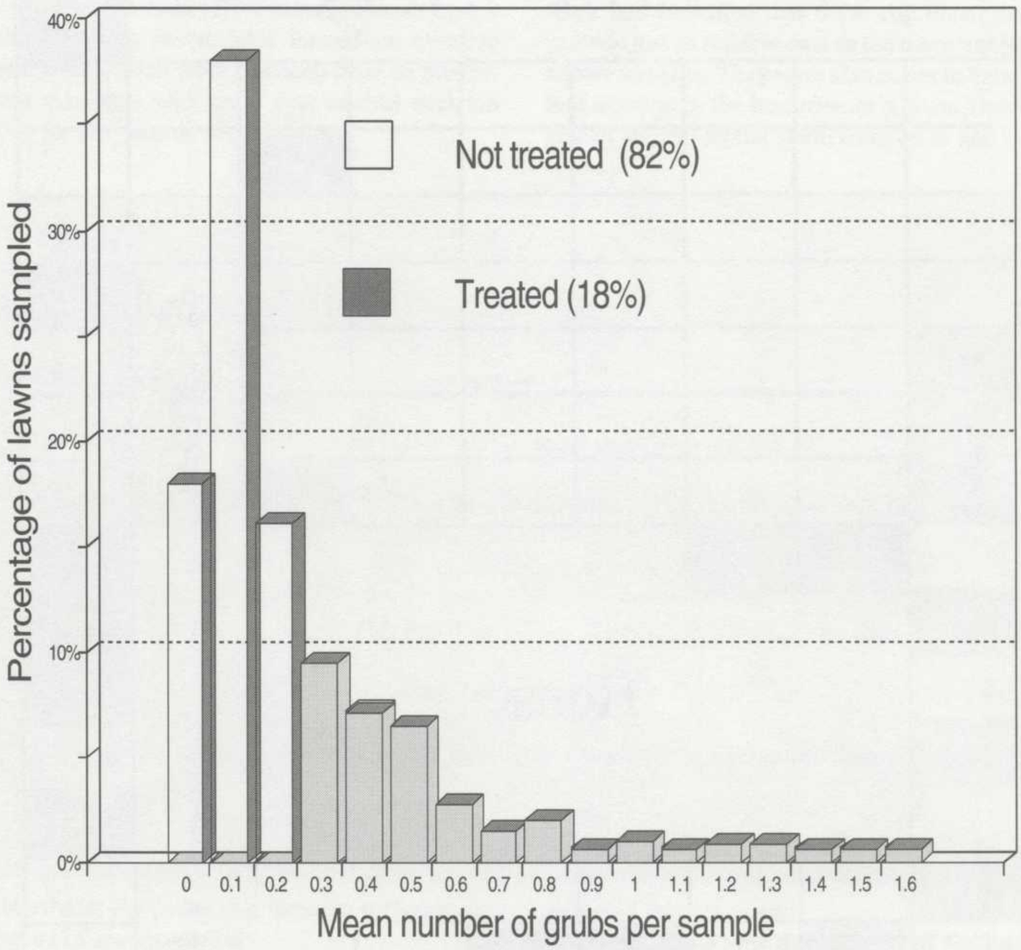


Figure provided by Dr. Michael Villani, Cornell University

This graph shows the percentage of lawns sampled and the number of grubs found, thus providing a treatment threshold.

more than 30% Kentucky bluegrass had higher grub densities in both lawn-age categories. As did those with more than 30% site shading and younger lawns in the from 30% to 60% shading.

The from 30% to 60% bluegrass composition had higher grub densities at both the from 30% to 60% shading and the greater than 30% site shading at both lawn ages.

The more than 30% bluegrass sites and more than 60% bluegrass sites had higher grub densities than the from 30% to 60% bluegrass sites.

A picture begins to appear

When the sites were evaluated so that a set of protocols for turfgrass managers could be made to indicate whether a site is predisposed to high grub infestations, a picture began to appear.

First, sites older than 20 years consistently harbor fewer European chafer grubs than younger lawns.

Second, most sites with high site shading are at very low risk of grub infestation.

Third, all three levels of bluegrass composition at younger sites produced higher grub densities than the older sites when site shading was low. The 30% to 60% bluegrass sites produced the largest number of high grub densities.

Of all the combinations of characteristics, older sites with high shade and low bluegrass content had the lowest grub densities. Younger sites with low shade and high bluegrass content produced the highest grub densities. The difference in grub densities between these two sets of characteristics were as much as 30 times.

Damage and average population density linked

It was necessary to establish a relationship between the size and frequency of observed existing grub damage per site and an overall average per square foot population of grubs, or grub density. The establishment of this relationship was necessary to establish a treatment threshold.

The size of the current or potential maximum grub damaged areas at each site was estimated by adding up the number of contiguous grid blocks which contained at least one grub per sample core — which equaled 10 grubs per square foot — that surrounded a grid block with existing grub damage. These figures were compared to the average number of grubs per site and the resulting chart showed that, with allowances for site differences, the larger damaged areas generally existed at the sites with the higher average grub counts.

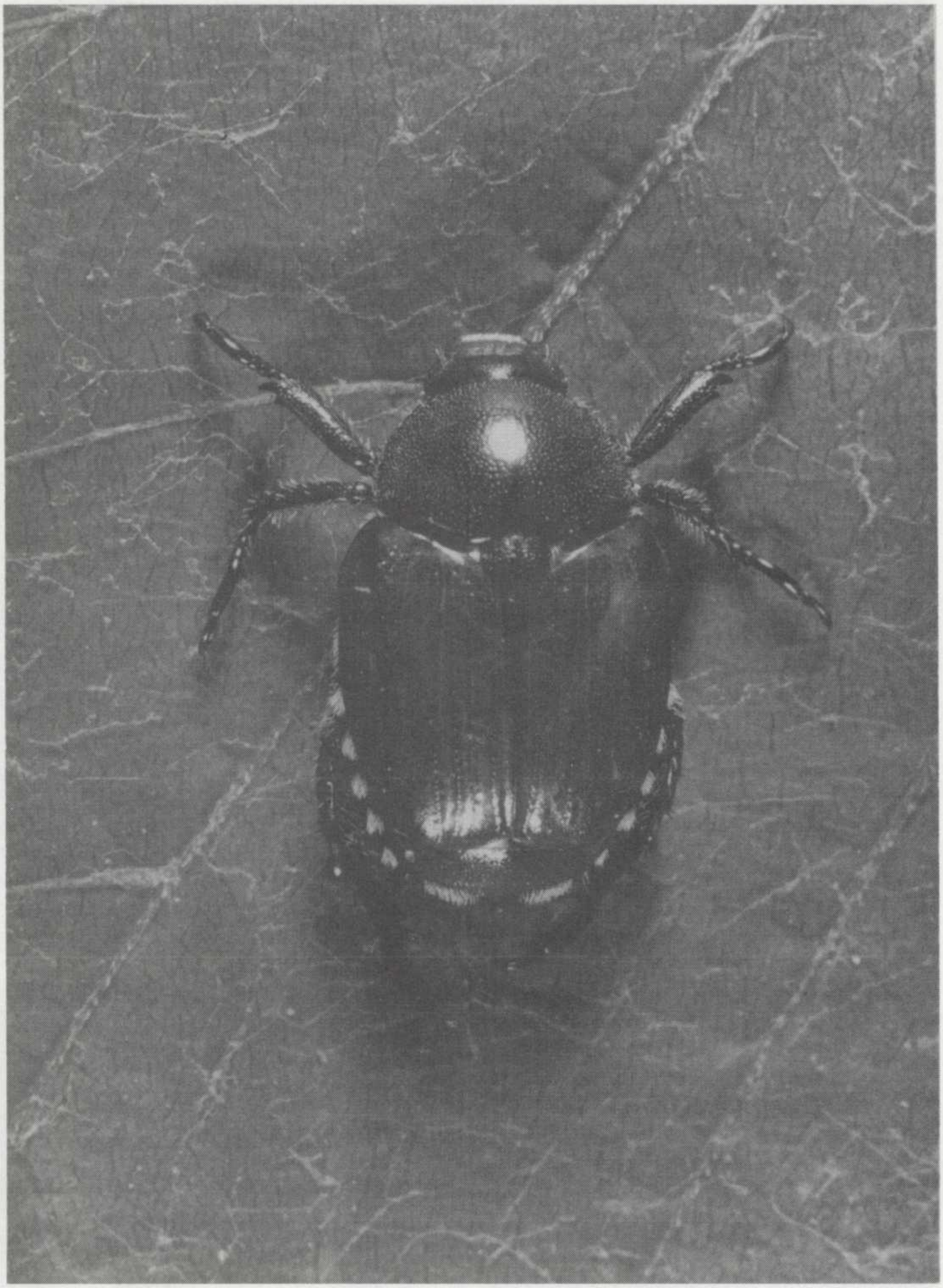


Photo provided by Dr. Michael Villani, Cornell University

An adult Japanese beetle, the final stage in development of this turfgrass pest.

Establishing a treatment threshold

Once the relationship between site grub densities and existing grub site damage was established, it was necessary to establish a range of density values that would trigger a control application.

We showed patch size, as explained above, per site, the actual number of grubs per patch, versus the mean grub density of the whole site on a graph. Both patch size and grub density are expressed on a logarithmic scales (See figure on page 4.).

The number of patches with significant numbers of sample grub counts seems to increase rapidly when mean grub density for the whole site exceeds two to three grubs per square foot. Below that point, the predominant count is one per sample while above that point two or more per sample is in the vast majority. Note that one grub per sample for the areas with existing

Integrated pest management is the future

by Christopher Sann

The Rochester study that Dr. Michael Villani of Cornell University undertook in 1990 represents a milestone in the adaptation of integrated pest management strategies for the turfgrass management industry.

The conclusions and recommendations of this study of grub populations in an urban setting symbolize one of the first steps in the long awaited transition of integrated pest management from an extension service conversation piece into decision-making tools for turfgrass managers.

Most of the work in integrated pest management has been oriented to the research and development of strategies, implementation of demonstration projects and the technical training of those in production agriculture. However, some researchers at Cornell University have been involved in the development of integrated pest management strategies for golf course turf since 1987. The work of these men and women has begun to show some positive results.

1993 golf course work shows results

In 1993, 25 golf courses were involved in the formal integrated pest management turf programs at Cornell and for the second year the participants reduced the number and amount of pesticide applications by more than half, or 54%. Non-integrated pest management golf courses received an average of 212-acre treatments per year, but the integrated pest management group received an average of less than 100-acre treatments per year. The integrated pest management courses ranged from a high of 154-acre treatments per year to a low of 44-acre treatments per year — a reduction in pesticide applications acreage of from 27% to 79% respectively.

These spectacular results were accomplished by the development of specific decision-making tools, such as those that were developed in the Rochester study and then applied in a structured and rigorous way.

This formal integrated pest management monitoring of golf courses has:

- identified a participating high input program golf course as having made at least three unnecessary applications (dicot and monocot herbicides and insect controls).
- found that the application of nematodes produced fair to good control of Japanese beetle grubs in large scale trials, but failed to control Oriental beetle grub populations.
- found that the application of nematodes to control black cutworms at two heavily infested sites produced good control at one site but failed to provide anything more than minimal control at the second.

damage translates into 10 grubs per square foot. At the high end of the existing five to 10 grubs per square foot treatment threshold, and two grubs per sample translates into twice the high end of the treatment threshold. If the suggested all-site treatment threshold is not adhered to, then spot treatments should be made to the areas defined as a patch: any 100 square feet with at least one grub per sample.

Recommended procedures

If confirmed by additional research, this proposed set of decision making protocols will allow turfgrass managers to evaluate individual sites for their potential to harbor damaging grub populations. Once that potential has been established by an analysis of the site characteristics — more than 20 years old, less than 30% shaded, and more than 30% bluegrass content — the study data recommends that the site be sampled for the predominant species present in the region with a minimum of 20 samples selected from random locations in a representative manner for the site and that the samples are taken at least ten feet apart.

If the resulting average grub density exceeds the 0.25 grubs per sample threshold, then the study data recommends that 20 additional samples be taken to confirm the first sampling. If the second sampling grub density confirms the first, then an appropriate insecticide application should be made.

This is the preliminary study

The protocols explained above are at best tentative. They represent only the results of a one year study and present the first attempts at producing protocols.

In order for the 1990 data and analysis be considered to be accurate for more than just that year, we are required to repeat the study to confirm our proposed protocols for grubs. Later this summer, the study will be repeated on a smaller number of lawns in a different area of New York state. As the analysis of the new data is checked against the 1990 data, the proposed protocols may be revised. ■

- identified six of nine surveyed golf courses as requiring no treatment for grubs with two requiring spot treatment and one requiring full course treatment.
- found that the information collected at two participating golf courses produced increased levels of correctly identified and treated disease infestations, correctly identified insect activity as the cause of previously misidentified drought stress, and led to a reduction in the number and quantity of insecticides applied to control grub activity.

Achieving these results will require work

Changing managed turfgrass sites to a formal integrated pest management program, is not as easy as changing the brands of or active ingredient levels of the chemical pesticide arsenal. The dramatic increase in the number of reduced active ingredient pesticides that are currently finding on the market will be helpful in the effort to reduce the overall pesticide load on the environment. But the core of the integrated pest management idea is only to make necessary pesticide applications when scouting reveals that grub populations or damage thresholds have been exceeded.

The argument for integrated pest management, at the conceptual and the practical level, is that integrated pest managed turfgrass can produce turf quality comparable to conventionally managed turf at a dramatically reduced level of inputs. The work of the Cornell researchers has demonstrated this fact.

Change of attitude is required

The successful implementation of integrated pest management strategies at many turf sites will require, at the very least, a change in attitude by many turfgrass managers, if not wholesale changes in many operating procedures. The attitude of turfgrass managers that must change is the idea that control measures, whether chemically based or not, can be instituted without sufficient data. Put bluntly, any turfgrass manager who makes a control decision without a thorough knowledge of all of the environmental, host, and pest data involved, is wasting time and money, and adding to the pressure on an already over-burdened environment.

Once turfgrass managers have made the commitment to the principles of integrated pest management, they must support the establishment of integrated pest management programs in their areas. As the Cornell research has shown, once integrated pest management principles take hold, bottom lines, budgets and the environment will be the better for it.

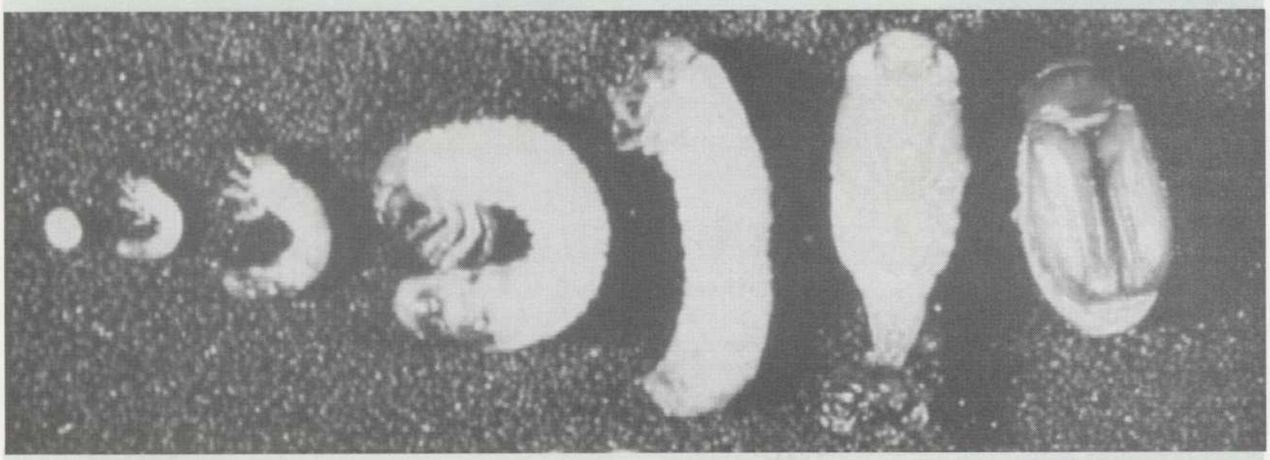


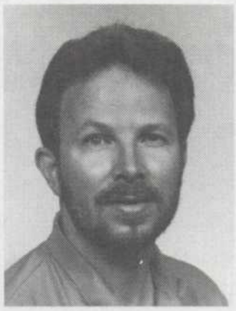
Photo provided by Dr. Michael Villani, Cornell University

10 mm

The life cycle, left to right, of the Japanase beetle.

The disease triangle and the disease cycle

by Dr. Eric B. Nelson



For those of you who have had an introductory course in plant pathology, you might remember learning at least two important concepts: the concept of the disease triangle and the concept of a disease cycle. I would like to refresh your memories about these two important concepts and their applicability to managing turfgrass diseases. In fact, they are perhaps the two most important concepts to know in turfgrass disease management.

The disease triangle

First, let us define plant disease. A plant disease is any disturbance to the normal physiology of the plant brought about by an agent so that the affected plant changes in appearance and/or is less productive than a normal healthy plant of the same variety.

In nearly all turfgrass diseases, the primary disease-causing agent is a fungus. In fact, with the exception of nematode-incited diseases, all of the economically-important turfgrass diseases are caused by fungi.

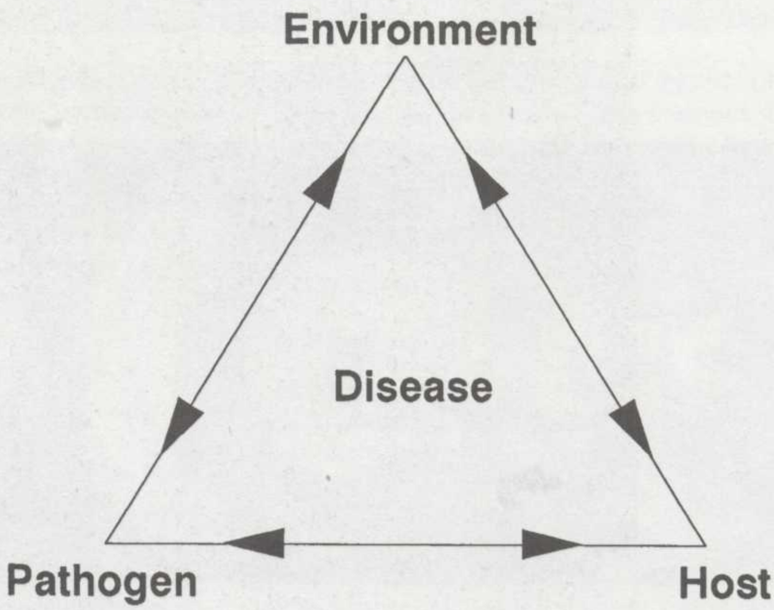
Over the years, pathologists have come to learn that disease development in a plant population is determined primarily by the interactions among three major factors. These are: the presence of a susceptible host plant, the presence of a virulent pathogen, and a favorable physical, chemical, and biological environment.

The interactions among these factors have been traditionally conceptualized in the form of a disease triangle (See figure right).

Conceptually, these interactions dictate that if either the host is less susceptible, the pathogen is less virulent, or the environment is less favorable, diseases will either occur at a reduced level, or they will not occur at all.

Now, how can this concept be applied to turfgrass diseases? There are a few facts about turfgrass diseases to consider. First, for the vast majority of turfgrass germ plasm, there is little or no resistance to turfgrass diseases (obviously there are plenty of specific examples contrary to this statement). Second, since both the turfgrass plants and the pathogens are perennial in nature, infections in turfgrass plants are also perennial. In other words, turfgrass plants are continuously infected with virulent fungal pathogens.

Therefore, the environmental conditions are the overriding factors in determining whether or not a turfgrass disease develops at all. As a result, many control strategies are aimed primarily at alleviating the more favorable environmental conditions favoring disease epidemics. For example, cultural management practices such as fertilization can be manipulated so that the increased or decreased fertility not only creates an environment less favorable for the pathogen, but it helps increase the plants natural abilities to withstand pathogen attack, thus reducing disease development. It should be understood, however, that if environmental conditions favoring disease development are not minimized, other control strategies will not be as effective.



The disease triangle

Figure provided by Dr. Eric B. Nelson, Cornell University

The disease cycle

Another important concept relative to turfgrass disease management is the concept of the disease cycle. A disease cycle is the chain of events involved in the development of a disease, including the stages of development of the pathogen and the effects of the disease on the host plants.

All infectious disease-causing agents go through a disease cycle. A generalized disease cycle is illustrated in the figure below.

If we use fungal pathogens as an example, the over-seasoning stage of most fungal turfgrass pathogens occurs in the winter months when the pathogen persists either in soil, thatch, or in root and crown tissues as a quiescent spore. Snow mold pathogens are the exception to this rule. They over-season during the summer months. When temperature and moisture conditions become favorable, these spores can be transported to adjacent healthy turfgrass plants either by wind, rain, irrigation water, equipment or other means.

Once at the surface of the healthy plant, the spore can then germinate and penetrate the plant tissues. In penetrating tissues, a nutritional relationship is eventually established between the pathogen and the plant. It is at this stage that the plant is considered to be infected. As the pathogen continues to grow between and within cells of the host plant, it can rapidly invade adjacent tissues and organs. It is during this invasive stage that plant symptoms become apparent. Eventually a new batch of spores are produced on and within infected plant tissues. These spores can be again transported to adjacent healthy plants where they initiate secondary disease cycles, or they can over-season in a quiescent state once again.

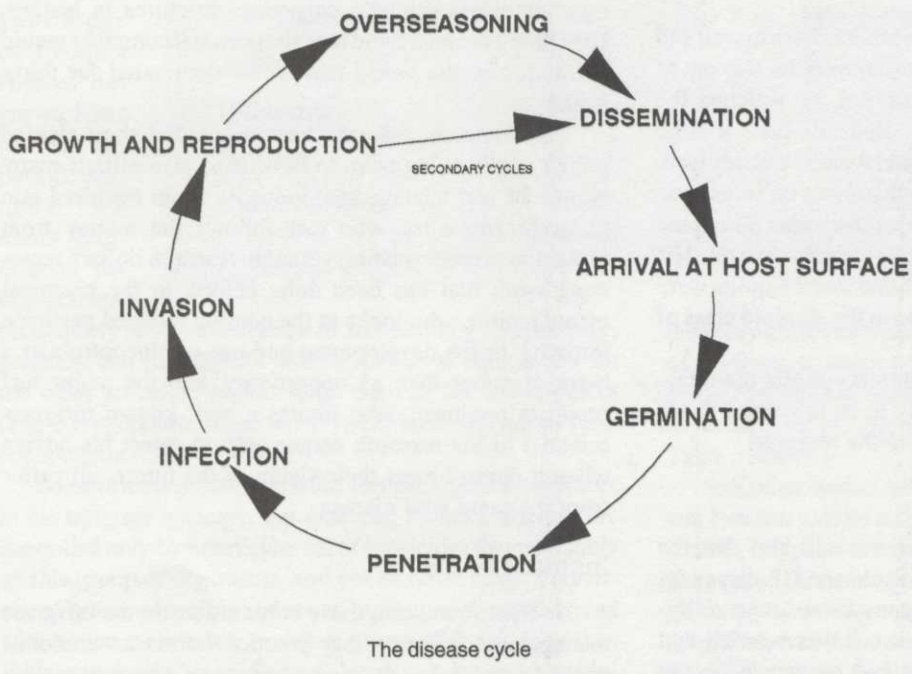
The importance of knowing the disease cycle of various turfgrass diseases is apparent when one considers that each stage in this cycle is required for the next stage. Therefore, if any part of the cycle is interrupted, the disease will not develop.

Turfgrass managers can use this knowledge to develop control strategies. For example, since most fungal pathogens are disseminated by water, simple management of water movement on turfgrass surfaces can minimize losses from certain diseases. Furthermore, water management may reduce the amount of spore germination. Since fungal spores generally require water films in which to germinate, practices that minimize leaf wetness periods will greatly reduce or prevent spores from germinating, thus interrupting the disease cycle. Similarly, most fungicide applications are aimed at preventing spore germination, penetration, and invasion of the fungal pathogen on and in turfgrass plants.

It is clear that, due to the nature of turfgrass ecosystems, environmental conditions are the principal factors driving disease development. Certainly the most effective long-term disease control strategies will be those aimed at minimizing environmental conditions favorable for pathogen germination, spread, penetration, and sporulation. Similarly, environmental conditions that enhance plants' natural abilities to tolerate chronic infections will ultimately be the best approach to disease control.

The concept of the disease triangle and disease cycles are important in understanding what makes diseases develop and how to tackle disease control.

Turfgrass managers will continually be faced with unique and difficult disease control situations. Applying the knowledge of the disease triangle and the disease cycle will enable managers like you to develop logical strategies for minimizing turf losses.■



The disease cycle

Figure provided by Dr. Eric B. Nelson, Cornell University

Making the most of our opportunities

by Christopher Sann

The other day, in one of the few quiet moments that I have, I was reading one of the many magazines that clog my mailbox. I came across a story about porcupines. More specifically, the story was about porcupine quills and an antibiotic present on the outside of these quills.

Why don't porcupines suffer from wounds of their own quills?

The quills of the porcupine are such an effective defense that they can even be a problem to their owners. Yet, the porcupines do not seem to be bothered by self-inflicted wounds.

The author had been wondering about how porcupines managed to deal with this inevitable problem when he got a lesson in wound management. While he was handling a porcupine, he got one of the quills deeply embedded in the flesh on the back of his hand. The quill was so deep and the tip so well barbed that he had two choices — have it removed surgically, with all its associated complications, or wait several days to see if the quill tip would work itself out.

Faced with two unpleasant choices, he chose to wait and see. While he was waiting for the tip to work its way out of the back of his hand (which it did do), he watched the wound for any sign of infection. Had this been a large splinter of wood or a thorn, the wound would certainly have become infected. To his surprise, there was no infection.

His curiosity was piqued. He examined other porcupine quills for the antibiotic that must have been present. His diligence was rewarded when he found that the quills were coated with a very potent antibiotic in the alkaloid class of toxins.

He took his discovery to a pharmaceuticals manufacturer, fully expecting the company to be interested in his discovery. He was not prepared for the response.

Not interested

The pharmaceuticals manufacturer told him that the company was not interested in his discovery. His discovery was not rejected because the company knew about antibiotics on porcupine quills, or because it was worried that alkaloids as a class of chemicals had proven to be too problematic to spend time and money on, or even that the company's research and development budget was stretched to the limits and it would be years before they could even begin to look at this substance as a potential new antibiotic.

The reason the company gave was that the compound was "not complex enough". Read that statement to mean "not patentable".

It did not matter that the author's discovery might have been the beginning of a new class of antibiotics that could help mankind. The pharmaceuticals manufacturer summarily decided that the tail would wag the dog and that maintaining market share was more important than making a new discovery.

The pharmaceuticals manufacturers are not the only group in this country who have mistakenly allowed sales departments to override important advances. Unfortunately, this narrow-minded, short-sighted policy is rampant in this country.

Build a better mouse trap?

The person who coined the phrase "build a better mouse trap and the world will beat a path to your door" wasn't living in this country in the late twentieth century. Corporate America's recent history is replete with the failures of chief executives to understand the foolishness of this policy.

Most recently, the failure of giant IBM to understand this policy has lead to the downfall of one of the largest and most employee-friendly corporate structures in history. IBM failed to understand how the personal computer would revolutionize the world that it had dominated for thirty years.

Unfortunately, this same narrow-minded, short-sighted policy of not being open to new ideas also afflicts many within the turf management industry. From the hired-gun turfgrass specialist, who just follows the money from project to project wasting valuable research dollars recreating work that has been done before, to the chemical manufacturer, who looks at the coming reduced pesticide initiative or the development and use of biocontrols as a betrayal rather than an opportunity, and the major turf products producer, who invites a well known turfgrass scientist to his research center only to reject his advice when it doesn't meet their vision of the future, all suffer from the same fatal disease.

Innovate or die

As IBM found out, those corporations in the turfgrass management industry that practice hubris as a modus operandi and fail to develop a long-term perspective with

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Is *Pythium* really a fungus?

by Dr. Eric B. Nelson

Species of *Pythium* have always been known as some what unusual organisms. Not only are they pathogens of plants, but they are major pathogens of fish and horses as well. Ecologically, they don't quite fit in with other well-known fungal pathogens, and morphologically, genetically, and physiologically, they are quite different from other fungi. As a result, there has been much debate over the years on the precise taxonomic placement of *Pythium* species.

Discovered in 1823

Certainly these organisms look like fungi and behave pretty much like fungi. After all, they have been studied by mycologists for over a century. Yet confusion over this organism has existed from the beginning. *Pythium* was first discovered in 1823 by Nees, but the official date for the establishment of *Pythium* as an official genus was not until 1858 by Pringsheim. As our knowledge of *Pythium* species has grown, it has become apparent that there are many significant peculiarities, particularly with differences in morphology, physiology, genetics, and ecology of *Pythium* species as compared with the other so-called higher fungi such as the ascomycetes (e.g. Pyrenophora "Leaf Spot") and basidiomycetes (e.g. Rhizoctonia " Brown Patch").

Some of these differences with other pathogens are apparent to the turfgrass manager. For example, *Pythium* diseases are controlled only by a particular set of fungicides that work only on this group of organisms, and not on other fungi. Furthermore, *Pythium* species produce swimming spores and spread with water movement; no other group of fungi does this. *Pythium* species cause diseases largely under excessively-wet to water-logged conditions. Few other diseases are problems under these excessively-wet conditions.

Other differences, however, are not so apparent to the turfgrass manager, but are quite obvious to the mycologist or the plant pathologist. These include things such as the chemical composition of *Pythium* cells, the type of propulsion system on the swimming zoospores, and some specific aspects of their reproductive genetics. All of these are quite different from characters found in other fungi.

DNA studies are revealing

Current studies on the phylogeny (i.e. the evolutionary history or relatedness among organisms) of *Pythium* species have revealed some interesting relationships to organisms other than fungi. For example, by comparing the DNA of *Pythium* species with that of higher fungi and some of the green and yellow-green algae, it was discovered that *Pythium* species are more closely related to the algae than they are to the higher fungi. There is now a large body of evidence to support this relationship. As a result, the genus *Pythium* has been moved from the fungal kingdom, Mycetae, and placed into the kingdom Protoctista (See Table 1 above.).

Table 1

Classification of pythium species

Present Scheme	**Classification**	Former Scheme
Eukaryotae	**Superkingdom**	Eukaryonta
Protoctista	**Kingdom**	Mycetae
Oomycota	**Phylum/Division**	Mastigomycotina
Peronosporomycetidae	**Class**	Oomycetes
Pythiales	**Order**	Peronosporales
Pythiaceae	**Family**	Pythiaceae
Pythium	**Genus**	*Pythium*
aphanidermatum	**Species**	*aphanidermatum*

Still other studies have compared the DNA from plants and *Pythium* species and have found striking similarities. In general, it appears that organisms containing certain types of chlorophyll, the main photosynthetic pigment in plants and green algae, are more closely related to *Pythium* than other fungi. This is an interesting fact, since plant pathologists have known for a long time that oospores of *Pythium* and other

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Trucking regulations may apply to turfgrass managers

Turfgrass managers' vehicles may fall under two provisions of U.S. Transportation Department (DOT) regulations. They are the Hazardous Materials regulations (HAZMAT) and Motor Carrier Safety regulations.

Federal regulations require that the transporter comply with the regulations if the product being transported is identified as a DOT regulated product. The Material Safety Data Sheets (MSDS), which are available from either the product supplier or the manufacturer, should identify the product as such. If the MSDS does not identify the product as being DOT regulated, then the transporter should contact the manufacturer for that information. The Code of Federal Regulations (CFR) has a hazardous materials table. Title 49, parts 100 - 180 of the CFR list all of the compliance requirements for transportation of HAZMAT listed products. If the product being transported is not listed as a HAZMAT material, it may still be subject to the requirements of the federal Motor Carrier Safety regulations.

Drug and alcohol rules set

Also, the Federal Highway Administration (FHWA) has finalized the rules for drug and alcohol testing of interstate and intrastate truck drivers with commercial driver's licenses. The rules prohibit the use of any drug, unless prescribed by a doctor, and prohibit on-the-job consumption of alcohol. The rules require that employers must test employees before employing them, after any accident, and when the employer has reasonable suspicion that the employee may be violating the rules. Employers are subject to random record-keeping audits by the FHWA beginning Jan. 1, 1995 for companies with more than 50 employees and by Jan. 1, 1996 for companies with less than 50 employees.

Conditions under which vehicle may be regulated:

- vehicle is self powered or towed
- used to transport people or material
- gross vehicle weight more than 10,000 pounds
- used to transport more than 15 people, including the driver
- used to transport hazardous materials in large enough quantities to require that the vehicle be placarded.

Motor Carrier Safety rules include these categories:

- drivers required to have acommercial driver's license
- driver drug screening, physical exams, etc.
- driver working hour limitations
- safety inspections of vehicles by state and federal transportation agencies
- vehicle noise limitations
- liability insurance requirements
- examination of company records on vehicle safety inspections, repairs, and maintenance
- company policies that delineate HAZMAT rules and requirements.

EPA to place emphasis on enforcement

The Environmental Protection Agency (EPA) has said that it will place greater emphasis and devote more resources to the stricter enforcement of existing environmental laws, such as the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Any environmental law violator would be subject to possible criminal trial with possible heavy fines and jail terms, depending on the severity of the violation.

EPA planned actions:

- consolidate its many different enforcement activities into one
- change the emphasis of prosecutions from companies and to individual violators
- increase the number of EPA enforcement agents from 64 now to 200 by 1996
- train state and local law enforcement officials to recognize environmental crimes
- issue new guidelines to enforcement agents to outline those factors that they should use to determine whether a case should merit criminal investigation
- improve the enforcement agencies' capabilities to target repeat violators by combining the many EPA databases to develop repeat violator's histories and identify those individuals for closer enforcement monitoring
- eliminate the practice of allowing voluntary environmental audits as a means of avoiding prosecution for past environmental violations.

Two examples of increased enforcement

In federal court in Texas, Don Allen Craven, owner of Craven Laboratories, was sentenced to five years in prison and given a $50,000 fine for falsifying pesticide residue test results. The company was put on probation for five years and fined $15.5 million dollars and ordered to pay $3.7 million in restitution to former clients. Additionally, 14 former employees were given either probation, weekend prison terms, or were made to do community service and were issued fines that ranged from $10,000 to $30,000. The EPA said that the employees had systematically falsified lab notebooks and fixed scientific testing equipment to produce erroneous results which were then submitted by the pesticide manufacturer to the EPA in the pesticide registration process.

In Arizona, an aerial pesticide applicator was sentenced to a one year prison term for treating, storing, and disposing of hazardous wastes without a permit. Additionally, Mark Steven Stewart, the applicator and owner of OMNI Applicators, Inc., was ordered to refrain from employment in the application industry for five years. His company was prohibited from operating in the aerial application field for 25 years. Finally, the company's two crop dusting planes were sold to help pay for the estimated $70,000 in clean-up costs resulting from the illegal activities.

TGT's view - The EPA is finally putting some teeth into an enforcement program. Turf managers must be aware they can no longer deal with meeting environmental regulations at a later date. This increased emphasis on compliance indicates that time has run out. The December 1993 issue of Turf Grass Trends *lists many of the agencies that can help turf managers become better informed.* -CS

New federal legislation

Would curtail pesticides even more

Rep. Henry Waxman (D-CA) has introduced a bill entitled "The Pesticide Food Safety Act of 1994", HR 4091, that would amend provisions of the existing Federal Food, Drug and Cosmetics Act (FFDCA), the current law controlling the safety of foods, drugs and cosmetics. The new legislation would "cancel the registration of pesticides determined to be highly hazardous to human health or to be a possible human carcinogen within five years".

Exemptions to this provision for three additional years would be extended if it were shown that cancellation would limit the availability of foods for which no alternative pest management strategies existed. A second provision within the legislation would cancel the registration of any pesticide that was not shown to be "safe" within seven years.

TGT's view: Rep. Waxman, who spearheaded the recent congressional hearings on the addictive nature of cigarettes, has his heart in the right place but this proposal has some huge holes in it. Questions immediately arise:

- *who decides what is the threshold for determining the safety of a pesticide?*
- *is that threshold acute or chronic?*
- *what is the threshold to be, LD 50's oral below 200? 100? or 50?*
- *who does the safety testing and who pays for that testing?*

The EPA is years behind in its basic testing of many of the currently available pesticides that were grandfathered in the original pesticide registration process. What will happen to that timetable if additional human safety requirements are added? -CS

Univ. of Illinois study

More weeds mean lower crop yields

Field studies conducted at the University of Illinois have shown a statistical correlation between weed infestations and crop yields.

Researchers found that one weed per seven square feet in corn plantings reduced crop yields by an average of 10%. Mixed broadleaf weed species infestations produced even greater losses. Broadleaf infestations of as few as 30 weeds per 100 square feet or less than one weed per three square feet reduced corn yields by about 20%. Crop economists estimate that, for every $1.00 spent on weed control materials, yields increased by $2.50.

Integrated pest management

Definition suggested

The National Coalition on Integrated Pest Management (NCIPM), a group of agriculture, horticulture, and environmental groups, is suggesting a standard definition for the term "integrated pest management." It has suggested that the accepted definition should be: "integrated pest management is a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health, or environmental risks."

The group also proposes that the U.S. Agriculture Department establish regional integrated pest management centers and that the job of developing new strategies be delegated to an Agriculture Department deputy administrator. This would give the implementation of the Clinton administration's reduced pesticide initiative through the use of integrated pest management within the Environmental Protection Agency. The NCIPM also recommended the adoption by the Agriculture Department of these seven integrated pest management principles in the development of these new strategies:

- assess plant problems
- develop a management plan
- establish action thresholds
- implement a monitoring procedure
- establish a corrective action
- establish documentation system
- establish an evaluation and verification procedure.

EPA failures

Standards delayed

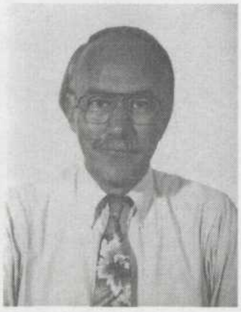
The implementation of most of the federal Worker Protection Standards (WPS) has been delayed from the scheduled date of April 15, 1994 date to January 1, 1995. The delay, signed into law by President Clinton on April 6, was necessitated by the failure of the Environmental Protection Agency (EPA) to interpret the original legislation, promulgate regulations, and distribute the new regulations to field agencies in sufficient time that those subject to the law could get worker protection programs into place. With the exception of certain labeling requirements, all of the other aspects of the original legislation must be in place by the new implementation date.

Although turfgrass management activities are not currently covered by the WPS, the EPA has said that turfgrass managers should make every effort to comply, as the implementation of these standards to turf operations is coming in the near future.

The dog days of August

Seeing grubs and Pythium in a new light

by Juergen Haber



As the dog days of August come upon us we have to worry about a totally different animal: the grub. But now there are more weapons in the arsenal with the completion of an historic first phase study led by Dr. Michael Villani, associate professor, soil insect ecology, New York State Agricultureal Experiment Station, Cornell University.

This second large contribution by Dr. Villani to

Turf Grass Trends, (Effective management of Japanese beetles, July 1992), is the first large-scale survey of grub populations in lawns. To understand the scope of the survey one must be told that the researchers took more than 3,000, four-inch round samples.

Field Editor Christopher Sann follows up Dr. Villani's story by telling us how grubs might be less of a problem by increased use of integrated pest management.

Finally, we follow up Sann's story with news brief that bring more bad news for traditional turf managers: pesticides may be curtailed even more.

And speaking of follow-ups, Science Advisor Dr. Eric B. Nelson finishes last month's discussion of Pythium in this issue. The question of whether Pythium is a fungus bears directly on the way turf managers should treat diseases resulting from Pythium infections.

Finally, we have a correction to make: on page 5, lower right, of the July issue, we ran the wrong photograph. It should have been the following:

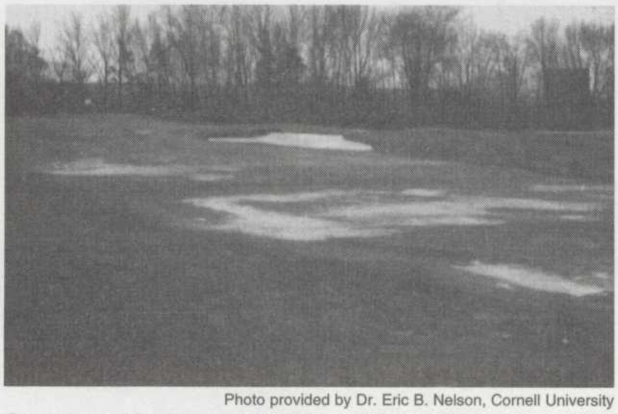


Photo provided by Dr. Eric B. Nelson, Cornell University

Symptoms of Pythium snow rot on a golf course fairway.

***Pythium** continued from page 11*

closely related genera of plant pathogens, require certain wavelengths of light for their spores to germinate optimally.

How does the naming change affect *Pythium* diseases of turfgrasses?

Conventional wisdom and recent experiences with other misidentified pathogens like *Magnaporthae* (Summer Patch) would say that all the *Pythium* species are not really all that different from other fungi or that the *Pythium* species are really just another as yet to be identified "new" branch of the fungal world, waiting to be discovered.

In fact, *Pythium* species are different from the other fungal pathogens. They are as different from these fungal pathogens as fungal pathogens are different from insects. This means that *Pythium* species should be placed into a separate pest category when considering overall control strategies. The control of *Pythium* diseases requires measures unique to this new category, with little or no overlapping strategies with the control of fungal diseases of turf. Interestingly, some of the fungicides that are used for algae control, in particular mancozeb, are also effective *Pythium* fungicides. Perhaps we can learn something about the control of *Pythium* diseases by learning something about the biology and management of algae, and vice versa.

How did *Pythium* evolve?

It is intriguing to note that a number of algal species are parasitic on plants, although none have yet been described on turfgrasses. The most interesting thing about these parasitic algae is that they infect plants by means of zoospores and prolonged culture of these organisms in the laboratory causes them to lose their chlorophyll pigments. Upon losing their pigment, they take on a fungal appearance which very closely resembles that of *Pythium*. Perhaps through evolution or environmentally, *Pythium* was an alga that became a fungus. Or was it a fungus that became an alga? Stay tuned. ■

***Making the most** continued from page 10*

long-term plans will fall by the wayside in the coming 10 to 20 years.

Turfgrass product manufacturers must spend the time and effort to make promising alternative products, strategies, and information available. Turfgrass product suppliers who cling to old product lines and distribution channels, and fail to offer their clients an expanding list of these new "tools", both goods and services, will fade.

As the regulatory pressures grow on turfgrass managers, those manufacturers and suppliers that understand the future and provide answers to future turfgrass management questions will thrive. Those that fail to meet those needs will not survive. ■

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