RELATING TURFGRASS GROWTH AND DISEASE DEVELOPMENT

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The science of turfgrass pathology has been developing rapidly during the past ten year. Our understanding of which microorganisms cause disease in turfgrass has progressed significantly. All the answers are not in hand, but the future is very exciting. Turfgrasses represent a wide range of different plants that have basic genetic differences. Some of the grass plants produce rhizomes and some do not. Some grow only in temperatures above freezing and some can grow or remain green at temperatures below freezing. If we look at a single species of turfgrass plant, we can also see a remarkable ability to adapt. Most cool season grass species are hormonally controlled. That is, they respond to their environment by producing various hormones (growth regulating chemicals). The environment is not the only parameter that plants respond to. They also respond to fertilizers and stress. The growth and performance of a turf can be dramatically affected by both of these. In particular, stress can have both direct and indirect effects on turfgrass. For example, compaction and drought can affect the ability of a grass plant to produce roots, absorb moisture and maintain a thick sward. Indirectly, poor root growth can predispose a plant to attack by pathogens, which is another form of stress. In general, pathogens are considered to have a stressing effect on turfgrass. Some pathogens can only attack grass that is experiencing stress, while others can attack an unstressed plant. In general, however, the attack by pathogens is coordinated with the growth of the grass plant. If we understand how the grass plant grows and how this growth responds to the environment, we will have a better understanding of how and why pathogens will attack that plant.

First, I want to discuss the nature of the grass plant and point out some of the important characteristics concerning its' growth. I will, for the most part, use Kentucky bluegrass as an example. Similarly, comparisons could be made for other cool season and warm season grasses. **What is Turfgrass???** Turfgrass is a perennial population of biannual plants. It is also a dense population of dynamic vegetative plants. What these statements tell us, is that the plants that make up your turf only lives about 12-18 months before they are replaced with new plants or plantlets. This is very important because it means that most of the plants in a turf are young. There are not 100 year old plants in a turf even if the sward has been around for a century. There are thousands of grass plants in a square meter of turf and they grow vegetatitvely. This is very important for two reasons: i) the high density of turf insulates the soil surface and reduces fluctuations in temperture and moisture that would normally occur if the soil were exposed; and ii) the plants being so close together offer a pathogen or insect a very short distance for their next meal. Another point to consider, is that close mowing of turfgrass species has dramatic effect on the root growth and soil-borne turfgrass diseases. It is very important to understand that, in the United States there are about 4 distinct grass climatic regions. The state of Michigan is located in the Northeast region which is characterized by cool, humid conditions. There is also a transitional, climatic zone, but this is not found in your state. Considering bluegrass, if we were to construct a map

of a bluegrass plant it would look like a network of highways and roads. The roads and highways would represent the roots and rhizomes and so on. The fact that the grass plant grows in a connected pattern is important when considering how soil-borne pathogens spread. A very useful model describing the growth of bluegrass is presented in Figure 1. This model breaks down the growth of a bluegrass plant by its' different tissues. With this very brief description of how grass grows, I want to focus your attention on disease development and management in turfgrass ecosystems.

Disease can be thought of as an imbalance in the turfgrass ecology. Generally, when your turf is without disease, all the microorganisms that live in your turf are in biological balance, but occasionally a microorganism will aggressively attack the grass plants and you will see the symptoms of disease on your turf. This represents an imbalanced system. The goal of a **DISEASE MANAGEMENT STRATEGY** is to balance pathogens in the turf. Disease is cosmopolitan and should be managed and not simply eliminated. Remember that disease is caused by microorganisms that live naturally in your turf, and eliminating them would only imbalance your turf and likely result in other problems, including disease.

I have presented a disease management strategy flow chart for you to examine (Figure 2). I will only point out the highlights of each stage in this strategy. Grass requires no management system unless you want it to perform in ways that are unnatural. For example, most of the grass on a golf course is managed, but the grass in a pasture or road side receives the very minimum of management. Unmanaged lawns very seldom develop severe disease. it is necessary, therefore, that the quality and purpose of the turf be decided before the management program is determined. This is mentioned, because it will be the effects of the management program that ultimately will determine how the grass grows and which diseases are likely to be a problem. The selection of the appropriate grass. This is the most important step in minimizing stress and disease. Unfortunately, most superintendents do not have the luxury of choosing the grass varieties that are planted on their course. The growth type, stress tolerance, disease resistance and so on differ among grass genera, species and varieties. Generally, it is the bottom of the plant that should be emphasized. Simply put: you sell the leaves, you manage the roots. The roots and rhizomes of a grass plant are the survival and recovery mechanisms. In the management of the golf course, it is a constant struggle to maintain proper root mass and a quality surface to play on. Too often, the performance of the surface quality is given priority over the roots and rhizomes. However, by understanding when the roots and rhizomes will grow and how to encourage them, you can achieve a balance between leaf quality and root health. Determine the critical stress periods. Each of you should have an understanding of when the periods of critical stress occur for the turfs you manage. When do drought, heat and compaction occur during the growing season? This can be different for each area on the golf course. I have observed many courses where humidity and heat stress were great on one hole, but absent on another, yet both were managed the same. Understand the cultural practices available. The proper use of cultural practices is the second best weapon a golf course superintendent has for reducing disease. In general, turfs that are vigorously growing and have a substantial root and rhizome mass will tolerate more disease and recover faster from stress. Of utmost importance is that you make changes in your cultural management program gradually. Do not shock the turf by abruptly changing the watering, cutting

height, fertilizer and so on. This type of shock can imbalance the turf, allow disease to develop or even kill the grass. The last stage in the management strategy is the application of chemicals for disease control. This should be the last resort. While chemical pesticides are often necessary, the proper attention given to the other management strategies just described should reduce your chemical dependency.

For the remainder of this discussion, I would like to focus on how you can more effectively understand and manage disease, if you think about the growth activities of the grass plant. In Kentucky bluegrass the disease, yellow ring, appears when the turf develops too much thatch too rapidly and both the soil moisture and the temperature are high. The pathogen, which normally does not attack the grass plant, is allowed to grow so rapidly that it colonizes both dead and living tissues in the grass. The solution is to manage the growth rate of the turf to avoid rapid, excessive development of thatch in the mid-summer.

The patch diseases that develop in numerous turfs are very closely associated with the growth and activities of the grass plant. A patch disease is an epidemic in turf; which means that many plants in one area of the turf are affected. There are at least five significant patch diseases that develop in the northeast climatic region. Presently, research has identified some of the pathogens that cause these diseases. More interestingly, is the nature of the development of these fungi on the grass plants. Summer patch and Poa patch (summer patch of P. annua) are two diseases with similar, but not identical developmental patterns. Both diseases are caused by a fungus that grows on the outside of the roots and rhizomes, and can survive in the turf for many years. This means that the fungus can grow along the network of roots and rhizomes "roads." The curious feature about this fungus is that it grows best on the roots and rhizomes when the plant is also growing well. This fungus is so closely associated with the grass plant, that it can only survive if the grass plant survives. In fact, the fungus starts to actively grow on the grass plant in the early spring when the soil temperature is about 18-20 C and the soil is wet. You will realize that this is months before you will see symptoms of either summer patch or Poa patch. By understanding this synchrony between the fungus and the plant, you can appreciate that control of the disease needs to start in early spring or maybe even the previous fall. You can estimate when the fungus will be attacking the grass plant by determining when the roots and rhizomes are growing from Figure 1. The disease take-all patch is caused by another soil-borne fungus, but again requires a living turf plant to grow best. The difference is that this fungus can grow very well on a grass plant when the soil temperature is about 12-15 C and soil moisture is high. This means that just about the time the roots are starting their spring growth, the fungus is also starting.

As we learn more through pathological research, it will be possible to understand the relationship between the growth of the pathogen and that of the plant. To achieve a lasting, disease free turf, a balanced turfgrass ecosystem must be established and maintained.