Ponderings From The Front Nine

IMMOBILITY

By Dr. Frank Rossi
Extension Turfgrass Specialist
Cornell University

Perspective. As a self-confessed lifelong student of science, I must admit I occasionally surprise myself with my pondering. My former by-line known as "Gazing in the Grass" really fit me because I often could be found doing just that. Still, as a student of our discipline, when I look at the turf, my mind is always racing. Most recently, I began to consider the distinct disadvantage that plants face from an evolutionary perspective as a result of their lack of mobility. Simply, plants can't move themselves.

Surely, in a loose sense, reproductive parts of plants such as seeds, rhizomes, and stolons do allow for some species mobility. But once a plant is anchored into a rootzone, unless it is moved by animal (including humans), it's stuck. Here in lies my pondering. Have you ever wondered how plants have evolved within the confines of immobility? Do plants actually communicate with each other? Crazier yet, if plants could move, would the ones you are managing on your course, pick up and leave because of abusive treatment without proper compensation?

The ability to colonize and maintain space could be viewed as the primary function of vegetative growth of a grass plant. What follows then is that a grass plant (or community of plants) is now in position to generate biomass that in turn harvests light energy (sun) and converts it to chemical energy (carbohydrates, etc.). What we see is that a stand of turf looks healthy and becomes dense. What we don't see is an organism in constant communication with adjacent organisms, both above and below ground.

Above-Ground Communication. There is some interesting research that indicates that plants actually "sense" each other. Plants have light sensitive receptors, called phytochromes, that pick up radiation reflected by nearby leaves. This reflectance is processed by the plant and then utilized to determine the growth characteristics to be employed. For example, in a dense planting, where there are many individuals competing for limited resources, plants might reduce tiller production. This is why dense seedings have finer textured plants. Obviously, if plants could move they might venture to an area where there are not so many individuals competing for resources. The management implications in high density plantings, especially with the new upright, high density bentgrasses, are that to support more individuals, we may need to supply more inputs such as water and nutrients.

Below-Ground Communication. The communication below ground could be characterized as "the trading pit at the Chicago Mercantile Exchange". There are many signals being emitted from plants to other organisms, as well as to create a favorable rhizosphere where nutrients are more easily extracted. Again, because plants do not necessarily select where they end up, they are challenged to create a favorable environment for their survival......here and now!

Nutrition. There is a considerable body of literature that describes the regular interaction of plants and the immediate area around their roots, known as the rhizosphere. Specifically, plants excrete a variety of chemicals from their roots with the sole purpose being to create a microenvironment that allows for easy absorption of nutrients. This is accomplished by releasing compounds that alter the pH directly around a root and increases the solubility of an important nutrient. Additionally, a plant can release a chelating agent that can make available a previously unavailable nutrient, like iron.

As turfgrass managers, we are beginning to recognize the importance of this issue by manipulating the rhizosphere pH for management of diseases such as summer patch or take-all patch. Furthermore, there is a body of literature that indicates part of the take-all patch attack includes altering manganese uptake by the plant. Of course, turf managers in Wisconsin are particularly fortunate to have Dr. Kussow currently conducting a study on just this issue—the influence of nutrient management on plant diseases.

Allelopathy. Obviously, one of the greatest challenges for an organism that lacks mobility is competition with other organisms. These other organisms can attack the plant or colonize the area the plant is in, and crowd it out. This is a good description of the approach taken by plants we consider. Therefore, it seems reasonable that plants can influence their immediate environment to effect the growth of another plant as much as they influence their rhizosphere to enhance their own growth.

The scientific term for this influence of one plant's influence on the growth of another plant is allelopathy. This influence can be chemical or physical. In other words, some plants simply shade other plants from light, gain a competitive advantage, and survive while another dies. More complex, and consequently less understood is the concept that a plant releases a chemical (herbicide, growth regulator, etc.) that influences the growth of another species. One of the most famous of these reports is related to black walnut. It was proven that black walnut exudes a chemical (juglone) that acts as an herbicide that prevents the growth of certain plant species around its base.

Historically, this area of research has been controversial. Early researchers typically ground up plant tissue, applied the slurry to a pot full of weeds and recorded weed control. Later it was identified that just about any green plant has high enough concentrations of certain compounds that will influence the growth of another species. Still, there are well documented cases of allelopathy with rye cover cropping system studies conducted at Michigan State University. Interestingly, several years ago, turf researchers investigated the possibility that bentgrass could be allelopathic to annual bluegrass. Currently, there are reports of possible allelopathy of some fescues and ryegrasses on crabgrass infestations. As they say on the X-files, "the truth is out there".

Damping-off. Upon my arrival at Cornell, I began to interact with Dr. Eric Nelson, our Turfgrass Pathologist. In my opinion, most pathologists are in fact microbiologists and in our case in NY, Eric is considered a soil microbial ecologist. In other words, he studies the interaction of microbes and their environment, specifically in a turf system.

Eric has conducted research on seedling damping off problems with turf and other crops. His most recent work, funded by the USGA, discovered that when turfgrass seeds germinate, they take in water and release a sphere of concentrated linoleic acid. It turns out Pythium spp. that cause damping off can "sense" the seed and if they are in this sphere of linoleic acid, spore germination is stimulated and young seedlings are infected. Eric has gone further and identified a microorganism that uses the linoleic acid as a food source. Simply, when you add this microbe to a seedbed, it reduces the sphere of linoleic acid around the seed (called the spermosphere) and the amount of damping off at establishment is reduced.

This information was exciting for me because of the seeding rate research we had just completed at the Noer Facility. If you recall, we found higher damping off infestations associated with increased seeding rates. The seedbed literally becomes a "linoleic acid bath" and since pythium is just about everywhere in the soil, it is no surprise we had these problems. It has been shown that once a plant is infected with pythium, it remains infected and will show symptoms when the plant is stressed. The question follows then that if we keep pythium out at establishment, will we be able to keep our turf pythium-free? Of course, when we had fungicide (Apron) treated seed, we seemed to eliminate the damping off problems.

A few questions remain: 1. does the fungicide prevent pythium infection or just mask symptoms? 2. does the fungicide effect the spermosphere? 3. when we overseed into established turf are we stimulating pythium infections on our established plants? 4. can the micbial innoculant work in high seeding rate situations, not just up north but down south where intense overseeding occurs?

Final Thought. The previous pondering speaks to a guiding principle in my professional life; to try an understand the fundamental processes that occur in our turf systems, above-and below-ground. Next, we should communicate these processes in a way that integrates how we currently are managing the environment. From this should emerge a better appreciation for the impact of our management on the environment—positive or negative.

Once we incorporate this principle into our decision-making process, we are on our way to more sustainable and resource efficient turf management systems.