

Molecular Biology for Turf: Will It Help Our Industry?

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Most of you, myself included, finished your formal education before the advent of molecular biology. This does not mean we are old, it means that we have not attended college in the past twenty years. During these past twenty years, the science of molecular biology has grown at a tremendous rate. It is an exciting field that will affect the way we produce food and fiber, grow ornamentals, maintain our health, and manage turf. How fast these things happen is a combination of interest, money, and time. Before I get to that, let me tell you what it is and how it works.

Molecular biology is the study of molecules that are important to life. This includes all life: plant and animal. You and I can remember biology, the study of life. We were taught that the unit of life is the cell, and that it has parts like the cell wall, nucleus, cytoplasm, and so on. We learned that cells form tissues like roots, leaves and stems, and these combine to form organisms, like turfgrass. All this is still true, but in the past fifty years, scientists have focused a lot of energy and thought on what happens inside the cells to make them work. Preceding molecular biology was the science of physiology, which studies how reactions take place in cells. For example, enzymes are proteins that bring about reactions. One reaction you might have heard of is lactose intolerance. This condition occurs when a human cannot tolerate the sugar

lactose. The reason for this intolerance, stomach ache, is the lack of production of the enzyme lactase. Lactase breaks down lactose. This is a physiological reaction in humans. There are millions of such reactions going on in every cell: plant and animal. Molecular biology seeks to understand how the enzymes are produced and what controls their formation. It is as simple as that. Science has



discovered that enzymes are the machines that bring about all biochemical reactions in cells. They further discovered that DNA controls enzymes!

Molecular biology is the study of how DNA controls the formation of enzymes, which allow the cell to live!

If we can understand molecular biology, we can understand life. With such an understanding, we can manage life to insure that it meets our needs. Now it might sound like we are messing around with the very essence of our existence, which God created, and we

are. But there are safeguards that exist in the cells of life that will prevent us from making any big mistakes. It is important to understand that the cell and its DNA have been around for millions of years. They have co-evolved; and through that long process, they have been challenged and stressed over and over, yet they continue to live.

What can molecular biology do for you?

Before you turn the page, let me briefly describe what molecular biology can do for the turf industry and how it could affect you! We are all aware of *Poa annua*, and a lot of us would like to get rid of it from our greens. There are many ways to approach this: a stronger more aggressive bentgrass, a better *Poa annua* that could replace bentgrass, selective pathogens that kill only *Poa annua*, selective herbicides, or herbicide-resistant bentgrasses. In each case, to bring about these changes, the DNA of *Poa annua* or the bentgrass must be changed.

One way to change DNA is through the breeding of plants. Breeding is a form of DNA manipulation, but you work with the whole plant, not inside a cell. Breeding is still an active and productive science, but it has limitations and can be slow and expensive. Molecular biology is another approach, now being adapted by many breeders as a means to focus and speed up the process of changing plants. For example, let's say that you want to produce a bentgrass with resistance to the herbicide glyphosate (RoundUp). Very simply, what

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you would like to find is an enzyme (remember them?) that would destroy the toxicity of glyphosate. If you have this enzyme (and it does exist!), then you could put it into bentgrass. This glyphosate-resistant bentgrass could be sprayed with RoundUp, and it would not die. I guess that you can picture the management program for golf course superintendents. Just think of what that would do to the sale and use of herbicides! You could kill all your broadleaf and grassy weeds with one chemical!

Now, before you call me and ask where you can buy this, let me tell you why you cannot buy this. Look up an inch or so, and you will see the words, "put it into bentgrass." Saying this is easy; doing this is not! It takes a lot of time, people and money to achieve this, but it can be done. It

has been done for soybeans and corn, and is on the market. How is it done? There are a number of ways to take a piece of DNA and put it into a living cell without

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killing the cell. But even before you can do that, you have to find the little piece of DNA that is responsible for the enzyme which destroys the glyphosate. This is where molecular biology comes

into the picture. Molecular biology explores DNA and how it works. This is what I have been learning to do for the past year.

Controlling a weed is child's play compared to controlling a disease!

Controlling a weed in turf is a relatively straightforward process, and I believe that within the next five to ten years, the turf industry will have molecular controls for weeds. But more on that in a moment.

As you know, I am not a weed scientist, but a plant pathologist. Controlling a weed is child's play compared to controlling a disease! It is my ambition to develop molecular tools to control disease. Diseases are difficult because they are caused by an organism, usually a fungus, that attacks the turf over time. Weeds do not attack turf directly, and

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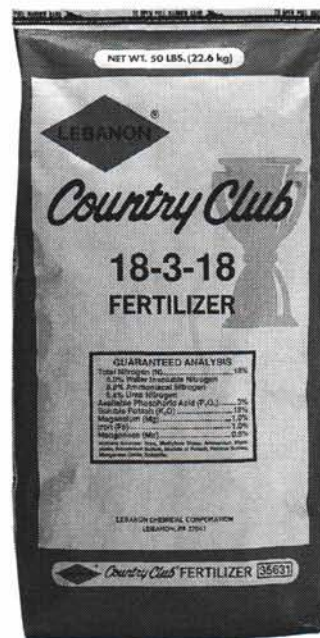
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even insects attack turf for only short periods of time while they feed. Because diseases are a process, i.e., they develop over time, it is more difficult to stop them with a single action, like a fungicide or a single enzyme. As a plant pathologist, I continue to search for that specific moment in time when a plant can kill or be killed by a pathogen, but it is a very rare event in nature.

Another important realization about disease is that it is necessary for our existence. If plants, including turf, do not die, rot and give new life, we will all die. So do we want to eliminate disease, or just manage it? I am trying to learn molecular ways to manage disease.

How can diseases be managed with molecular biology?

Let me explain one approach that I am working on. Take-all patch is a very difficult and destructive disease of bentgrass. There are no highly resistant bentgrass varieties available to you. I

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believe the reason is that there is no single enzyme which determines whether a plant will stop the pathogen or be killed. I have been studying this disease for over

twenty years. Recently, I have begun an investigation of particular enzymes that could help us manage the pathogen that causes take-all patch. This work is being done cooperatively with Professor Joan Henson at Montana State University. (Most of my "friends" thought I was fishing out there! Shame on you!) We believe that the point of decision (kill or be killed) for the plant occurs inside the plant, not on the outside. We further believe that if a plant can stop the fungal DNA from encoding or producing a single enzyme, then it could resist death caused by the fungus.

Yes, it is complicated, but after we sort it out, it means that we could do two things at once. First, the pathogen will not be able to kill the bentgrass; and secondly, the plant will not be able to stop or kill the fungus. The result is management, i.e., the necessary

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process of living and dying has not been interrupted by man, just manipulated.


What is the delay in achieving better turf management through molecular biology?

Earlier, I told you the practical application of molecular biology for the turf industry is a function of interest, money and time. The interest is there. There are scientists, such as myself, working in this area, and there are commercial companies that are interested, too.

Interest, however, is not sufficient to achieve advancements

that will improve your ability to manage turf. It takes money to support the research necessary to achieve significant results. This money is difficult to come by for turf scientists. Turf is not considered an essential commodity in the eyes of the USDA or other government funding agencies. State support is insufficient for sustained, meaningful programs. It costs about \$75,000 per year for a simple research program to operate, and at this level of support, results will be slow in coming. Commercial companies are slowly realizing the future potential of molecular means of improving turf, but there are many roadblocks. For example, the regulations for distributing genetically (DNA) engineered

plants are growing in complexity. Questions concerning the impacts of releasing "unnatural" plants into the environment are being addressed. Another obstacle is the competitive nature of the commerce. Companies like Scotts and Monsanto are starting to emerge as the controlling entities of molecular turf advancements, but their interest in advancing turf science is tainted by their concern with proprietary rights and profit. The end result is that molecular advancement of turf will happen, and I feel it will be very beneficial to you, but it will take time to develop.

If you have any questions or comments, I am always glad to hear from you! 

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