FACTORS LIMITING GROWTH OF TURF GRASSES

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IF SOMEONE were to ask you to talk on this subject, what would you say? If they asked you to list, in order of their importance, the five most important factors that limit the growth of grass, what would you write? I'm wondering how many of us would agree. Most of us probably would include dry weather, lack of fertilizer, diseases and insects in our list. Someone, remembering that Bermudagrass stops growing in the fall and grows little, if any, all winter, might include cold weather. Others might list light or air, or something else. I have an idea, however, that we would come nearer agreeing on our list than on the relative importance of the factors listed. Actually, the order of importance probably would be changed a dozen times as you walked over any one of the golf courses you represent.

In order to discover the factors that limit the growth of grass in any one location, one must know what makes grass grow. He also must understand the Law of the Minimum and how it works. Suppose we consider the Law of the Minimum first. More than 100 years ago a German scientist by the name of Justin Von Liebig made a very significant observation. Said he, "The amount of plant growth is regulated by the factor present in the minimum amount and rises or falls accordingly as this is increased or decreased in amount." This statement soon became known as the Law of the Minimum.

Let me illustrate it like this. I'm sure everyone has seen grass stop growing during an extended drought. Water, obviously, was the minimum factor limiting the growth. The Law of the Minimum says to get more growth, water must be added, and the amount of growth will be proportional to the amount of water added until something else becomes the limiting factor. As long as water is the limiting factor, increasing the fertilizer, light, air, will increase the growth of the grass very little, if any. Most of us have had enough experience with grass to understand and agree with this statement. It may be more difficult, however, to see how light, air, temperature or any one of the other growth factors can also be limiting factors.

The Needs of Grass

Now, let's try to answer the question, "What makes grass grow?" Grass is very much like you and me. In order to live and grow, it must have water, a favorable temperature, and food. Anyone who has undertaken to grow grass knows how important water and favorable temperatures are. Very few people who grow grass realize that it requires the same kind of food that we require in order to live and grow.

Most of this food would be classed as sugars and starches which furnishes the energy to keep the plant alive and to make it grow. The process of converting these sugars and starches to energy is called "respiration." The following chemical formula indicates how it works:

$C_6H_{12}O_6 + 6O_2 \xrightarrow[\text{of enzymes}]{\text{in the presence}} \text{gives } 6CO_2 + 6H_2O + \text{energy for life and growth}$

Sugar — Oxygen — Carbon dioxide — Water

This process must go on in every plant cell if those cells are to remain alive. You will notice that oxygen, which is in the air, is necessary for this process to go on. You have heard a great deal in the past few years of the importance of getting air into the soil in order to develop good roots. Without the air, this process called "respiration" could not take place and the cells in the grass roots would die for lack of energy.

Perhaps the greatest difference between green plants and you and me is that we have to buy our food at the store, whereas they can manufacture their own, provided they have the following things:

1. Water
2. Favorable Temperature
3. Air (Carbon dioxide and oxygen)
4. Fertilizer elements
   a. Nitrogen
   b. Phosphorus
   c. Potash
   d. Calcium
   e. Magnesium
   f. Sulphur
   g. Minor elements or trace elements
5. Light

This food manufacturing process is called "photosynthesis" and is sometimes described with the following chemical formula:

$6H_2O + CO_2 \xrightarrow{\text{in chloroplasts in the light}} C_6H_{12}O_6 + 6O_2$

Water — Carbon dioxide — Sugar — Oxygen

This process actually takes place in tiny little green bodies called "chloroplasts" that can be found in the leaves of green plants. In other words, green leaves are the factory that manufactures the food required to keep the green plant alive.

The Limiting Factors

Many probably are beginning to wonder "What does this have to do with growing grass on golf courses? What are those limiting factors and how do they work?" Many people fail to realize that the size and condition of the factory (the leaves that manufacture the food) may often be the principal factor limiting grass growth on a golf course.

It is quite obvious that the amount of food that will be manufactured will depend upon the size of the factory, as well as the supply of the things listed above. The closer the grass is mowed, the smaller becomes the factory and the less food that can be manufactured. As we have indicated before, some of the food manufactured by the plant must be used every moment of the day and night to keep plant cells alive. If there is any left over, it either will be used to make the plant grow or will be stored in storage organs, such as seed or rhizomes. Close and frequent mowing, such as we practice on golf greens, reduces the size of the factory to the extent that very little food is manufactured for growth. If the grass is scalped, as it may be on the edge of the greens when the mowers are careless, the factory becomes so small that it is unable to make enough food to keep the plant alive and eventually it dies, leaving bare spots in these scalped areas.

Two South Africans, Weinmann and

COMING EVENTS

1955

Sept. 7-8:
Penn State Field Days, Pennsylvania State University, State College, Pa. Prof. H. B. Musser.

Sept. 15:
Lawn and Turfgrass Field Day, Ohio Agricultural Experiment Station, Wooster, Ohio. Dr. R. R. Davis.

Sept. 19-20:
Fall Field Day, Purdue University, Lafayette, Ind. Dr. William H. Daniel.

Sept. 23-24:
Edmonton Turfgrass Conference, University of Alberta, Edmonton, Alberta, Canada. Prof. R. H. Knowles.

Sept. 27-28:
Northwest Turfgrass Conference, Pullman, Wash. Prof. A. G. Law.

Sept. 30-Oct. 1:
Utah Turfgrass Conference, Utah Copper Golf Course, Magna, Utah. J. W. Richardson.

Oct. 3-4:
Rocky Mountain Turfgrass Conference, Colorado A. & M. College, Fort Collins, Colo. Prof. George A. Beach.

Oct. 6-7:
New Mexico Turfgrass Conference, New Mexico College of Agriculture and Mechanic Arts, State College, N. M. Clarence E. Watson.

Oct. 19-21:
Central Plains Turfgrass Conference, Kansas State College, Manhattan, Kan. Chester Mendenhall.

Dec. 7-9:
Oklahoma Turfgrass Conference, Oklahoma A. & M. College, Stillwater, Okla. Dr. Wayne W. Huffine.

Dec. 12-14:
Texas Turfgrass Conference, Texas A. & M. College, College Station, Tex. Dr. Ethan C. Holt.

1956

Feb. 5-10:
Golf Course Superintendents 27th National Turfgrass Conference and Show, Long Beach, Cal. Agar M. Brown.

Feb. 20-23:
Penn State Turf Conference, Pennsylvania State University, State College, Pa. Prof. H. B. Musser.

Goldsmith, ran a very interesting experiment demonstrating this point. They cut all the tops of the Bermudagrass once a week for 25 weeks. When they began their experiment they had a ton of starch and sugar per acre stored in the roots and rhizomes of their Bermuda. After scalping the grass once a week for 25 weeks they found only 57 pounds of sugar and starch per acre. By that time, most of the grass was dead. It would not have lived that long had it not been able to use the starch and sugar that had been stored in the roots and rhizomes when the experiment began.

Many plant diseases destroy a part, or all, of the grass food factory. No food can be manufactured in those portions of a leaf that have been killed by disease. The leafspots that kill some of our grasses actually kill them by first destroying the food factory and the grasses starve to death after that.

Worms Destroy Factory

Insects, such as the army worm, limit the growth of grass by consuming the leaves and destroying the factory. The sucking insects, like the chinch bug and the scale insects, injure the grass by sucking the freshly manufactured food out of the plant sap. As a result, many of the cells in the plant, particularly those in the roots, are undernourished and under severe attack and may die. Cutworms, webworms and their kind limit growth and often kill the plant by separating the nutrient-gathering roots from the food-manufacturing tops. Without water and nutrients, the tops die and without the energy-supplying food manufactured in the leaves, the roots die. Fortunately, there are good insecticides that will control most of these insects. The wide-awake superintendent who knows his insects and insecticides, who spots them early, and properly applies the right insecticide can grow excellent turf in spite of the insects.

Most golf courses have some shaded places on greens or tees where the grass is very thin or has died out completely. Usually, these areas are shaded only a part of the day. Why does Bermuda and other grasses die out in those areas? The answer is simple enough. The factory is not large enough to make enough food with the limited amount of light to keep the grass alive and growing. The same grass in the same amount of shade, cut at a height of 1½ to 2 inches, lives and makes some growth because the factory is large enough to manufacture the food requirements, even though the amount of light is not sufficient to permit the factory to work to full capacity.

Judging from the questions we have received during the past few years, the greatest problem facing greenkeepers in the South is the problem of the transition from ryegrass to Bermudagrass greens in the spring. Most greenkeepers give little thought to this problem until the ryegrass begins to die out. Then if the Bermudagrass fails to start off fast (as it very often does) they begin to put on fertilizer and do everything possible to try to bring it along. Very few of them realize that they should have prepared for the transition the previous summer and fall. The amount of protein, sugar, and starch stored in the rhizomes of Bermudagrass determines how fast Bermuda will start off and grow, once temperatures become warm enough to make it grow. These proteins, starches and sugars must be manufactured and stored in the late summer and fall if they are to be available to push the grass off in a hurry during the transition in the spring. Perhaps you are wondering what you can do to increase the amount of food stored in these rhizomes in late summer and fall. The first thing that you should do is to make the factory as large as possible. That means raising the height of cut as much as you can. A satisfactory playing surface must, of course, be maintained, but raising the height of cut from 3/16 to 4/16 inch need not interfere too much with play and it certainly will help the Bermudagrass to manufacture more food to store for spring growth.

The next thing that you can do is to keep the factory working by making sure that it has all the things it needs. This means supplying it with all the fertilizer that is needed for good growth, enough water to keep it growing and plenty of light, if possible. The South Africans referred to above demonstrated the importance of this principle in the following experiment: They applied five pounds of actual nitrogen per 1,000 square feet on Bermudagrass and found at the end of the year that there were 1,600 pounds per acre of sugar and starch in the roots and rhizomes. When they applied no nitrogen, they found only 700 pounds per acre of sugar and starch in the roots and rhizomes. Controlling diseases will also help to keep the factory working. The easiest way to do this is to plant disease-resistant grasses.

Only a few of the fundamental processes that "make grass grow" have been mentioned. I believe if you know "how" grass grows and "why" it grows you will be able to do a better job planning and carrying out a good turf management program. There is no substitute for the judgment that a superintendent must use as he nurses the grass on a golf course.

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