GROWTH AND DEVELOPMENT

In the last issue of the ITU, I began a series on basic concepts in turfgrass science. The first article in this series covered the germination of the seed and the early stage of seedling growth. In this issue, I will continue to describe the growth and development of the turfgrass plant.

For the purposes of this presentation, consider the newly emerged seedling to be made up of two parts, the root system and the shoot system. The root system shortly after germination is composed of the primary or seminal root system. This root system is active for only a few weeks and is composed of only a few roots. Approximately two weeks after germination, the seminal roots start to decay and the plant starts to develop what is called the adventitious root system. The adventitious root system is so named because it does not arise from root tissue but rather from stem tissue. The adventitious roots, located at the base of the shoot, serve the plants needs for the rest of the plant's life. This system is characterized by extensive branching and is very fibrous in nature. One researcher, who examined the root system of Kentucky bluegrass, found that in one cubic inch of soil there were 2,000 roots with 1,000,000 root hairs. The cominbed length of all the roots was 4,000 feet and the surface area of the roots amounted to 65 square inches.

Turfgrass species have either an annual or perennial root system. This means that some species regenerate almost their entire root system every year while others, with a perennial root system, retain a portion of their roots on a year-to-year basis. All roots have a limited life span; the perennial vs. annual designation refers to the time period over which the roots are regenerated. Perennial ryegrass has an annual root system while Kentucky bluegrass has a perennial root system. Research done in Texas has shown that bermudagrass has an annual root system and that when the plants are greening up in the spring, there are very few roots to support the new top growth. The tops actually start growing before there is an adequate root system.

As would be expected, there are many factors that affect the extent of rooting of a turfgrass plant. The environmental factors that affect rooting include the soil temperature and pH, the oxygen status of the soil, the fertility level of the soil and the presence of salts. Also important are the cultural practices that are imposed on the plants including mowing height and nitrogen fertilization. The root system is less extensive when turf is mowed very close or when high levels of nitrogen are applied.

There is a facility at Ohio State University to study the rooting of turfgrass plants. This facility, called a rhizotron, is composed of an underground room housing root observation boxes. The boxes are filled with sand and plants are seeded or sodded at the surface of the box which is flush with the surrounding area. Because the room is underground, the roots can be observed while they are exposed to natural growing conditions. The Ohio State research has shown that the major root growth period for perennial ryegrass, tall fescue, creeping bentgrass, and Kentucky bluegrass was during mid-March to the end of April. Interestingly, the root growth of annual bluegrass was severly reduced at the beginning of April. This reduction corresponded with the period of seedhead formation. The researchers suggested that the food supply normally going for root growth was diverted to produce the annual bluegrass seedhead. Comparison of several turfgrass species revealed that, on April 15, perennial ryegrass had the deepest root system at 13 inches followed by tall fescue at 10.6 inches, creeping bentgrass and Kentucky bluegrass and 6.3 inches, and annual bluegrass at 3.5 inches. As expected, the root growth rate declined during the summer and increased again in the fall. The growth rate in the fall was less than that for the spring.

The shoot system of a turfgrass plant is termed a compound shoot system since it is made up of a single repeating unit called the phytomer. The phytomer consists of the leaf blade and sheath and a bud at the base of the leaf sheath. Furthermore, the shoot of a grass plant does not have elongated internodes so that the phytomers are stacked on top of each other. By holding a turfgrass plant in your hand and peeling back the leaves one can get the concept of the phytomer and the compound shoot system. The leaves that are pulled off will consist of the blade and sheath, the bud located at the base of the sheath will either not be visible or will have developed into a tiller, rhizhome or stolon. A good way to understand the growth of the shoot system is to visualize a collapsable telescope that is made up of a series of concentric rings where the eyepiece is the innermost and smallest ring. The youngest leaf of a turfgrass plant can be compared to the eyepiece of the telescope. The oldest leaf of a turfgrass plant corresponds to the outermost section of the telescope. As a new leaf begins to grow, it emerges from the leaf sheath of the next oldest leaf. The growth of the leaf is due to meristems located at the base of the leaf blade and leaf sheath; these meristems are called intercalary meristems (a meristem is an area of the plant where new cells are produced by division of older cells, intercalary meristems are meristems located away from the apical meristem or pirmary growing point of the plant). The ability of a turfgrass plant to withstand mowing is because their apical meristem is removed during the mowing process. The leaf of a turfgrass plant cannot grow indefinitely, once it has reached full expansion, it will stop growing and will remain below the mowing height. The newest growth is always removed during mowing.

As was stated earlier, the phytomer or building block of the shoot is composed of the leaf blade and sheath and a bud at the base of the leaf sheath. This bud can either remain dormant or develop into a intravaginal or extravaginal tiller. The terms intravaginal or extravaginal refer to whether the new tiller remains inside the leaf sheath of the previous leaf (intravaginal, sometimes referred to bunch-type growth habit) or penetrates the leaf sheath and developes into a stolon or rhizome (extravaginal, sometimes referred to stoloniferous or rhizomatous growth habit). All turfgrass species have intravaginal tilling while some species have extravaginal tilling in addition. Perennial ryegrasses has only intravaginal tilling while Kentucky bluegrass has intravaginal tilling and extravaginal tilling in the form of rhizomes. Extravaginal tilling can sometimes be seen on plants that do not normally have this type of tilling in a turf situation. For example, I have seen rhizomes on tall fescue space-planted in a breeder's nursery.

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