Spread Out! Tillers, Rhizomes and Stolons

by Mary Owen

Rhizomes, stolons and tillers are the lateral stems of the turfgrass plant. By their growth an individual turfgrass plant spreads vegetatively, providing for the initiation and development of new turfgrass plants. This sideways or lateral growth thickens a turf and influences its ability to recuperate from wear and other damage. The growth of a network of rhizomes or stolons is crucial to the production of strong sod. The continued development and growth of daughter plants ensures a continuous replacement of plants which naturally senesce and die, or are damaged beyond growth by traffic, wear or other factors. Through the growth of tillers, rhizomes and stolons, turf becomes an interconnected, dynamic community of plants. Let's consider these parts of the turfgrass plant, how they grow, how they function and what factors influence their growth.

The stems

Stems store food reserves needed for growth. The crown is the major storage organ for carbohydrates. The lateral stems, especially the rhizomes and stolons, also are storage areas for those products of photosynthesis, which, when broken down in the plant, provide energy for growth and development.

To understand how lateral stems arise, first understand some things about the crown. The crown itself is a tightly compressed stem. Being a stem, it has nodes, internodes and, at the nodes, it has meristems (growing points). These nodal meristems give rise to buds. These buds are capable of giving rise to new stems: tillers, rhizomes and stolons.

Tillers

Tillers begin to develop only after the grass plant has reached a certain level of maturity. This level may differ by type of grass.

Growing conditions and the level of carbohydrate reserves influence the rate of tillering. When energy status is high, tillers are produced at a greater rate.

When conditions of maturity and energy level are right, a crown nodal bud will begin to develop into a tiller. This new shoot grows upward within the surrounding leaf sheaths and eventually emerges as a new shoot. The new tiller will develop its own leaves and root system, relying less on the parent plant for sustenance as it matures.

When tillers are the only type of lateral stems produced by a grass, the result is a non-creeping growth habit.

Rhizomes

Rhizomes are lateral stems that grow underground. When conditions of plant development and energy status are right, a nodal bud will begin to develop into a rhizome. This new rhizome heads downward a short way, then levels off, growing horizontally and elongating. The rhizome then turns upwards until it reaches a position near the surface. There the presence of light and possibly the change in concentration of CO_2 causes the rhizome to stop elongating and begin the process of forming a new aerial shoot. High nitrogen levels, high temperatures and shortening days can stimulate the terminal growing point of the rhizome to turn upward.

In the presence of light, the leaves at the rhizome tip begin to photosynthesize. New leaves begin to form, and eventually a new crown develops. From the new crown's apical meristem will grow the new shoot, and from its axillary buds at the nodes it will grow tillers, rhizomes and stolons as well as a new root system, eventually functioning essentially on its own.

When a rhizome is cut, the tip turns upward quickly and becomes a new shoot. New shoots also develop from the nodes on each side of the severed stem.

This type of rhizome growth is called determinate, because the growing tip ends in a single plant. Kentucky bluegrass produces strong determinate rhizomes that can bore through dense soils with a circular, penetrating motion.

Bermudagrass produces rhizomes which do not necessarily culminate at a single plant. Each rhizome continues to grow until it is stimulated or physically forced to turn upward, or until the tip is damaged or removed. Even when the tip of the rhizome is intact, new shoots develop readily at the nodes along the stem underground. The result is a denser turf, with many more shoots and more extensive rooting per unit area.

Stolons

Stolons are lateral stems which begin their growth from a crown nodal bud, as does a rhizome, but stay above ground. Like rhizomes, stolons have nodes and buds at the nodes capable of forming new shoots and roots. Because they are above ground,

The thick, white rhizomes in this Kentucky bluegrass sod contrast with the darker, more fibrous roots. A network of rhizomes helps to make this sod strong. Courtesy: Mary Owen

exposed to light, they have the capability of forming new plants (shoots, crown, roots, tillers and lateral stems) wherever a node may contact the ground and form roots. New aerial shoots also may arise at the terminal if the tip of the stolon turns upwards. When the terminal of a stolon is removed during mowing or is damaged, the nodes along that stolon are further stimulated to grow.

The growth and development of lateral stems varies from grass to grass, and may be influenced by a host of factors, including temperature, plant stand competition, light, mowing, fertility and moisture.

Temperature

Cool season grasses tiller most vigorously when air temperatures are between 50 to 60 degrees Fahrenheit. At lower temperatures, Kentucky bluegrass tends to produce more rhizomes than tillers. Low temperatures may cause a more horizontal growth while warmer temperatures may stimulate more upright tillering. Photoperiod, the length of day, in combination with temperature, may influence the rate of tillering as well.

Warm season grasses tend to tiller prolifically at temperatures in the 80 to 90 degree Fahrenheit range.

Plant stand competition

Meeting recommended seeding rates is especially important for grasses that only tiller. These grasses, perennial ryegrass and tall fescue, are not able to fill the spaces between seedling plants as quickly as stoloniferous or rhizomatous grasses. Resist the temptation to use excessive amounts of seed. Turfgrass seedlings can compete with one another like weeds if too many are present, resulting in thin, weak plants.

Light

Both the duration and amount of light may affect the tillering and lateral stem growth of turfgrass.

Most turfgrasses grown for athletic fields, with the exception of bermudagrass, will increase the amount of tillering as the days shorten. The length of light duration also influences the growth habit of some grasses. Kentucky bluegrass tillers, for example, grow more upright when days are long and more prostrate when days are short.

As the amount of light available to the plant decreases, photosynthesis also decreases. With less photosynthesis, there are fewer carbohydrates available for plant growth and development and activity slows in areas of high energy demand, like newly growing stolons, rhizomes and tillers. Therefore, the less light available to the plant, the less lateral stem growth there will be.

Mowing

Close mowing of stoloniferous grasses such as bentgrass, bermudagrass and zoysiagrass increases the amount of tillering and development of stolons. As the tips of stolons are removed by mowing, the stolons are stimulated to branch and to develop new plants at each node.

Mowing too high within the mowing tolerance range for stoloniferous grasses will result in stemmy, puffy turf that is easily scalped. On the other hand, the lateral growth of tillering grasses like perennial ryegrass and tall fescue and of rhizomatous grasses like Kentucky bluegrass is slowed by close mowing.

Frequent mowing removes a small amount of leaf tissue at a time, leaving the maximum leaf residual. This allows the plant to maintain a high level of photosynthesis and production of carbohydrates that will be needed for new leaf tissue and lateral stem growth.

Fertility

Nitrogen nutrition has a profound impact on the development of tillers, rhizomes and stolons. Excessive nitrogen inhibits rhizome and stolon development. Stolons of heavily fertilized grasses may have shorter internodes. Phosphorous deficient turfgrass plants have reduced tillering. Good potassium nutrition increases the development and growth of rhizomes and stolons. With limited fertilizer budgets, schedule applications at periods conducive to tillering and lateral growth.

Moisture

Irrigation timed to provide moisture soon after mowing lessens plant stress and results in more tillers and lateral stems growth. Low moisture levels decrease tillering.

Aeration and cultivation

Cultural practices like core aeration, spiking, verticutting and slicing sever stolons and rhizomes. These practices increase branching of these stems leading to the development of many new shoots and lots of new crowns with buds ready to send out new tillers, stolons and rhizomes.

Tillers, rhizomes and stolons are critical for turfgrass recuperation, for renewal of turfgrass plants from natural senescence and for maintenance of a functional playing surface. Through good cultural practices, a sports field manager will keep the turfgrass plants spreading out to create and maintain a great playing surface.

Mary Owen is extension educator and specialist, University of Massachusetts Turf Program. She has served on the STMA board of directors and currently serves on the Certification and Conference Education Committees.