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Principle of Fall Turf Management

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AGRONOMY NOTES

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PRINCIPLES OF FALL TURF MANAGEMENT

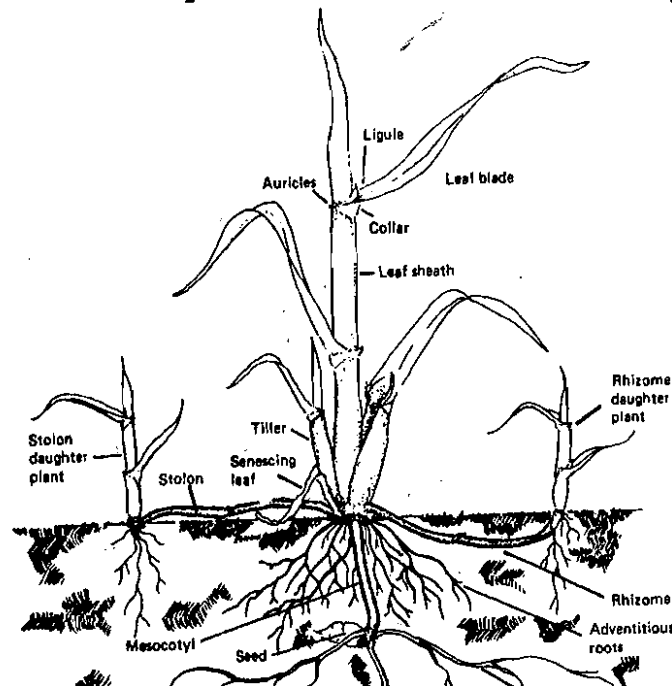
C.T. Dougherty and A.J. Powell, Jr.

Management of cool-season turfgrasses in the fall is mainly directed toward fertilization, broadleaf weed control and mowing. Fertilizer and weed control recommendations are made with great authority because of a good research base. Fall mowing height has not received as much attention, especially since mowing is often considered a curse by the end of a long growing season. In the summer, Kentucky bluegrass and tall fescue turf is mowed high (3-4 inches) to insulate the sward against moisture and temperature stress and to prevent germination of light-sensitive seed of crabgrass and other warm-season annuals. In the fall, however, the mowing height should be lowered progressively.

To understand the importance of mowing height one needs a basic knowledge of the growth of vegetative turfgrasses.

The Tiller

The basic unit of a grass plant is called a tiller (Figure 1).



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Figure 1.—Diagram of a grass plant.

The **vegetative** (non-flowering) tiller usually has 3 or 4 functional leaves - each with a life expectancy of about 3-4 weeks; a tightly rolled bunch of leaf sheaths - called the **pseudostem**; and a growing point enclosed and protected by the pseudostem.

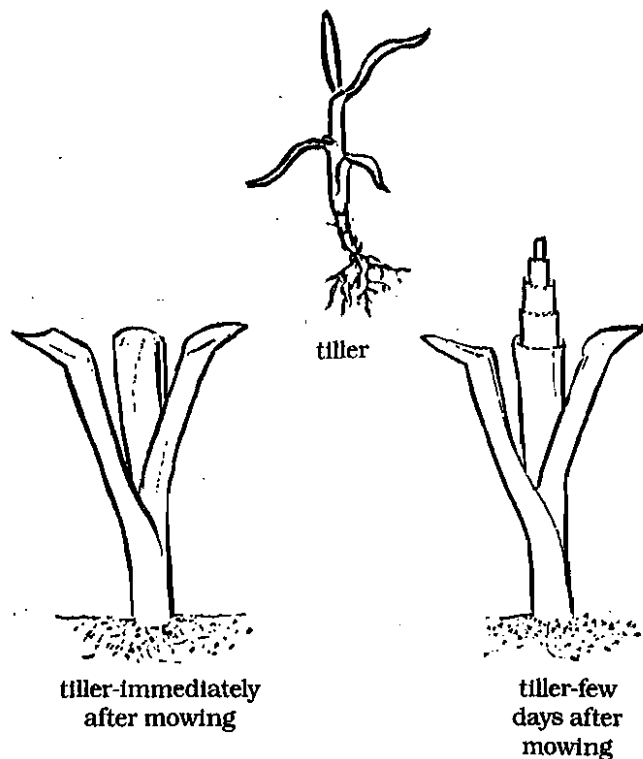


Figure 2.—Grass tiller and pseudostem after mowing.

This growing point surmounts a series of developing nodes separated by unelongated internodes, developing leaves with a tiller bud in each leaf axil, and a rudimentary root system. Tillers are short-lived; most live only a few weeks and the oldest about 18 months. New tillers are produced from buds in the axils (where the leaf is attached to the stem) of leaves in a fashion similar to branches on a tree. Tiller buds may form underground stems (rhizomes; as in Kentucky bluegrass) or aboveground stems (stolons; as in creeping bentgrass) or both rhizomes and stolons as in bermudagrass and zoysia (Figure 1). Tiller stolons and rhizomes are connected for a short while to their parent tiller but by the time you actually see them, they may be independent and have their own fully functional root system.

A tiller remains vegetative, producing a new leaf every 3 or 4 weeks depending on temperature, until it is exposed to a period of low temperatures (below 40° F, i.e. winter) followed by a period of increasing daylength (spring). The change in daylength is detected by a specialized plant pigment called phytochrome that is located within cells at or near the base of the tiller. When these conditions have been met and the tiller has produced at least five or so leaves (i.e. grown out of its juvenile stage) the growing point is converted from leaf production over to flower production (Figure 3).

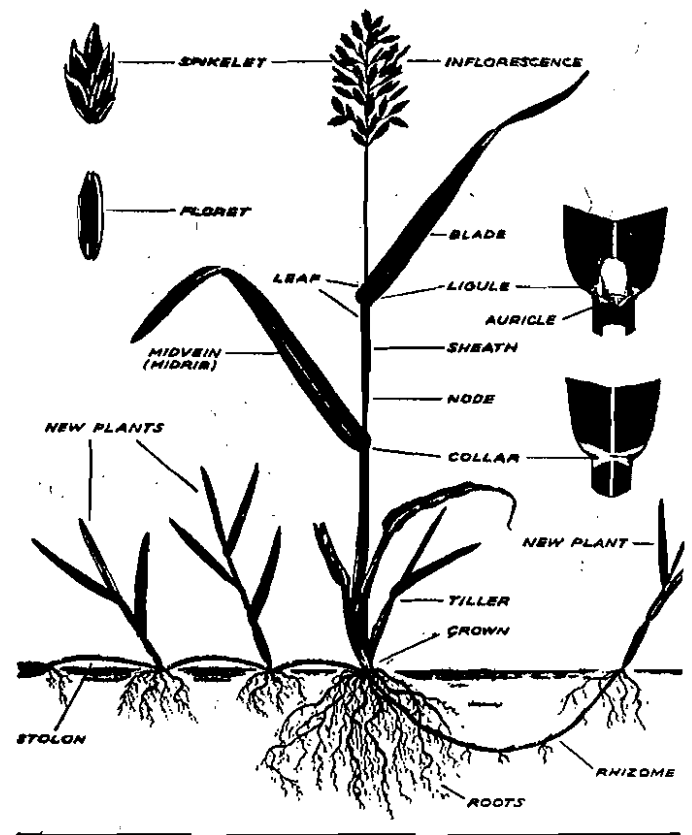


Figure 3. Flowering tiller with elongated internodes

During this flowering stage growth of tiller internodes is stimulated and a stem begins to form. The formation of grass flowers is closely controlled by the length of day; therefore initial flowering occurs about the same week each year. In cool-season grasses such as Kentucky bluegrass this is about the third or fourth week in April. The tillers that make up the turf in spring are mainly the more robust tillers that have overwintered and are programmed to flower. Once the growing point is converted to reproductive growth its destiny is fixed and it will die within a short time after the seed matures. As flowering tillers grow

larger they suppress growth of new tillers and cause death of smaller and weaker tillers. This reaction that ensures reproductive survival is called **apical dominance**.

During flowering tiller populations in a turf are low and turf is very susceptible to stress -- whether environmental or induced by management. The growing point of a flowering tiller is often decapitated by mowing and this causes premature tiller death. Fortunately these dying tillers are unnoticed since many young, non-flowering tillers quickly take their place in the sward. Decapitation of the flowering growing points also destroys apical dominance and the young tiller buds resume growth.

Fall Management

What does this have to do with fall management? Fall management of cool-season turf is designed to generate high populations of small, but robust tillers, strong enough to resist low temperatures, frost, snow and leaf cover, and other hazards of winter. (Excluding the paperboy when he walks on frosted turf).

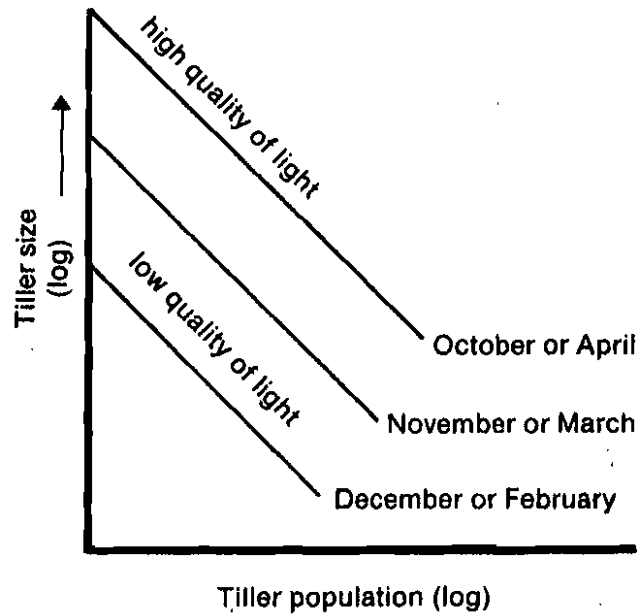
New Fall Growth

In the fall the temperature drops, especially at night, and soil water is replenished by rainfall. Active growth of existing tillers is promoted and a flush of new tillers begin to grow. As the season progresses the increasingly cooler conditions slow top growth but root growth continues in the warmer soil. New plant cells continue to divide, grow and differentiate into functional tissues but they are smaller, have thicker walls and smaller vacuoles (cell cavity). Sugars and proteins accumulate in the cytoplasm and vacuole and act as antifreeze to help prevent formation of ice crystals in the cell. Concurrently, the amount of solar energy reaching the leaf surface declines. As individual tillers grow they occupy more space and absorb more light, but as solar radiation diminishes in intensity and days shorten the turf cannot support all these large tillers. For a stable turf ecosystem either the population of tillers or the size of individual tillers must be reduced.

Unmowed Grass

In reality, both of these events normally occur in unmowed turf. As winter approaches weaker tillers die, (i.e. the turf thins out) and some of the older leaves die prematurely (brown-off). This behavior is entirely predictable by a law of nature known by ecologists as, "the three over two thinning law". This law of nature is based

on the absorption of light (Graph 1).



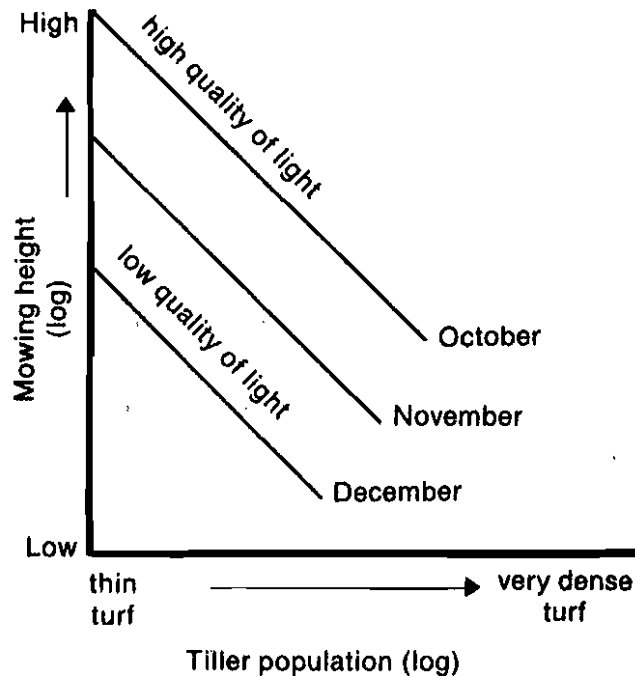
Graph 1.—Size and tiller population that can be supported in the fall or spring.

There is an inverse relationship between tiller size and tiller population. When some tillers grow larger, other weaker tillers must die.

Mowed Turf

In a turf situation lowering the mowing height and mechanically

decreasing tiller size allows more small tillers to survive and stand-thinning is minimized (Graph 2).



Graph 2.—Relationship between mowing height and turf density (populations of tillers).

Mowing frequently and close until growth ceases also removes the tender cells of leaves formed during good growing weather since the leaf tip is the oldest part of a blade. These leaves are comprised of large, thin-walled non-hardy cells and may brown-off at the first hard frost or cold wind.

Many of the responses of turfgrasses to the changing light environment in the fall are mediated by phytochrome, the same plant pigment involved in germination and flowering. As winter approaches the proportion of red light in sunlight increases as the sun's rays are attenuated by travelling through more atmosphere (lower solar elevation). Far-red light, being of longer wavelength, increases even more. The phytochrome detects this shift in spectral composition of light and slows down and eventually stops new tiller production.

Why Mow and Fertilize So Late?

Fall management of turf should maximize populations of winter-hardy tillers. Fall fertilization promotes the production, growth and survival of new tillers. Progressive lowering of the mower blade reduces the size of individual tillers and reduces tiller death, stand-thinning and winter brown-out. Clipping also reduces the leaf area of individual tillers, slows leaf senescence and minimizes brown-out. By mid-December the cool-season turf should be no taller than 1.5-2", and

should have a high population of small tillers composed of small, hardened cells that were formed under low temperatures.

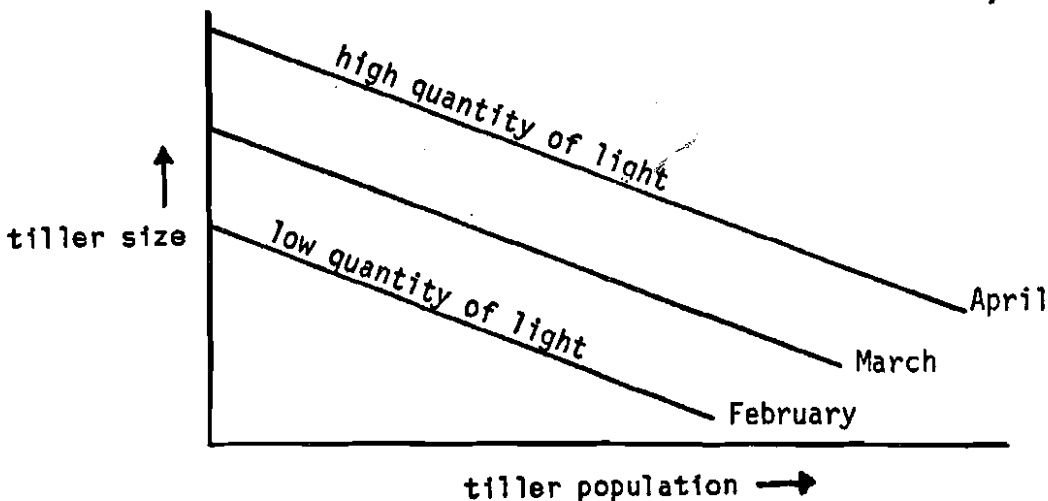
Close-mowing also removes the older tissues comprised of large frost-tender cells that were developed during mild weather. The new hardy (adapted) cells continue to grow, but at a much slower pace. A close-mown turf should resist winter browning and resume growth when conditions are favorable (Graph 2). Cool-season grasses will even grow in mid-January if sunlight strikes living green tissue and temperatures exceed 35-40° F!

What If Turf Is Too Tall?

What are the consequences of allowing turf to enter winter 5-8 inches tall? The "thinning law" would predict considerable stand-thinning coupled with much browning. The thinning law also predicts that unraked leaves or other trash covering the turf will promote stand-thinning and brown-out by reducing the absorption of light. Dead organic residue is most easily trapped in taller turf. This slows down soil warming in spring and spring green-up. Saprohytes are encouraged and turf diseases may become rampant.

Early Spring Management

Rising temperatures and increased sunlight in spring promote new growth. The environment can then support more and larger tillers before thinning occurs (Graph 3).



Graph 3. Theoretical size and or populations of tillers than can be supported during spring.

Nitrogen fertilizer applied the previous fall promotes the development of overwintering tillers and, if enough space and energy is available, it will stimulate an increase in tillering while the growth rate of the

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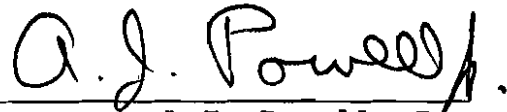
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more robust tillers is still relatively low. If nitrogen is applied during the optimum growth period of spring (approximately 75° F), it causes a flush of top growth at the expense of many of the non-flowering tillers. After flowering and death of the old tillers, the turf quality may decline quite rapidly and the dying tillers may become very unattractive.

From the preceding discussion it is readily apparent that we have an ever-expanding knowledge about the behavior of turfgrasses as influenced by environment and management. It is reassuring to turf researchers to fit principles of ecology and plant physiology to sound turf management practices that have evolved through years of experience.



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