Physiological Response of Grasses to Mowing

Lawns and sports fields are mown for aesthetic reasons. Grasses that are properly mowed form a dense, uniform, and visually appealing turf. Sports fields are also mown to accommodate play of activities such as, football, golf, tennis and, here in the USA, American football and baseball. Grasses are clipped to provide a uniform surface for ball roll and bounce, as well as for movement of athletes.

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However, mowing is a destructive process that wounds grass plants, altering plant growth and development, and increasing susceptibility to other stresses. It is essential, therefore, that appropriate mowing practices are developed to ensure plant health and vigor. In this article, we will discuss physiological and morphological responses of grasses to mowing practices, like height-of-cut, mowing frequency, and mower maintenance that should be considered when developing a mowing programme.

PHYSIOLOGICAL AND MORPHOLOGICAL RESPONSES OF GRASSES TO MOWING

Plants harvest energy from the sun in a process known as photosynthesis. The net result of photosynthesis is manufacture of carbohydrates that are analogous to food in humans. Carbohydrates can be broken down to provide energy for processes involved in the growth and development of the plant. Plants store carbohydrate reserves when production exceeds requirements of the plant, much like humans store fat when food intake exceeds needs. These carbohydrate reserves are used to provide energy for metabolic processes at night or for use during periods of stress.

Mowing removes leaf tissue that grasses use to acquire solar energy, effectively lowering the rate of photosynthesis and limiting the ability of the plant to synthesize carbohydrates. Re-growth and initiation of new leaf tissue after mowing is necessary to develop the photosynthetic leaf area required for production of carbohydrates. Grasses often increase leaf and shoot density below the height-of-cut to re-establish leaf surface area. Plants rely on carbohydrate reserves to provide energy and raw materials required to redevelop leaf and shoot tissue.

Redistribution of carbohydrate reserves for shoot re-growth occurs at the expense of root formation. In general, root growth decreases as mowing height decreases. Kentucky bluegrass (Poa pratensis L.) clipped weekly at 6.2 and 2.5cm developed 41 and 76 per cent less root mass, respectively, than non-mown controls two to four weeks after the first mowing. Researchers also observed shorter total root length of creeping bentgrass (Agrostis stolonifera L.) mown at 3mm compared with grasses mown at 4mm. They also noticed a reduction of root mass in creeping bentgrass mowed at 3.2mm compared to turf clipped at 4.0 or 4.8mm.

MOWING PRACTICES THAT AFFECT GRASS GROWTH AND DEVELOPMENT

The height at which grasses can be maintained differs among species. Growth habit by and large dictates the height at which grasses can be clipped. It is not uncommon for creeping bentgrass and hybrid bermudagrass (Cynodon dactylon [L.] Pers. x C. transvaalensis Burt-Davy) to be mown as low as 2.5-3mm. Lateral stems, or stolons, formed by these grasses result in a dense turf canopy, even at low mowing heights.

A dense turf canopy ensures that the rate of photosynthesis will be sufficient to supply carbohydrates to the shoots and roots. Grass species with an upright growth habit do not tolerate low mowing heights as readily as stolon-forming grasses. Kentucky bluegrass and tall fescue (Festuca arundinacea Screb.) are examples of grasses that develop an upright growth habit. Low mowing heights reduce the number of tillers formed in grasses with this growth habit, limiting the ability of the plant to increase leaf density below the height-of-cut.

This diminishes the photosynthetic capacity of the plant and its ability to provide carbohydrates for shoot and root growth. Annual bluegrass (Poa annua L.) and perennial ryegrass (Lolium perenne L.), bunch-type grasses with upright growth habits, are notable exceptions. Annual bluegrass is often observed in golf course greens mown at heights of 2.5mm, whereas perennial ryegrass can be maintained at 6 to 6.5mm under favorable conditions.

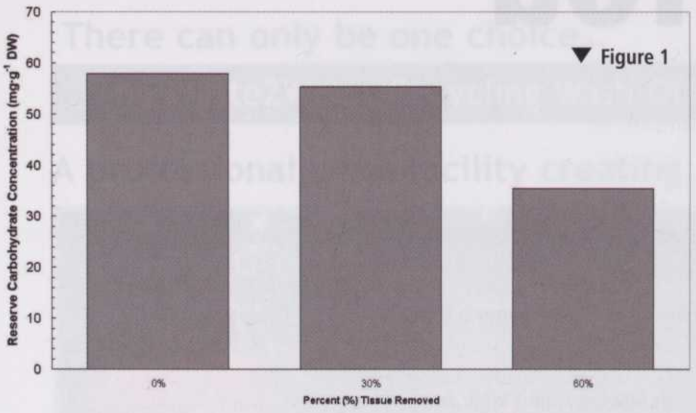
MOWING HEIGHT

Recommended mowing heights have been developed that best meet the agronomic needs of grasses. In general, Kentucky bluegrass and tall fescue are clipped at the highest mowing heights, whereas perennial ryegrass and fine fescues (Festuca spp.) may be mowed at lower heights. You are advised to consult turf experts in your region to determine mowing heights pertinent for your geographical area and environment.

Sports play, however, often dictates that grasses be mown lower than recommended. In these instances, special attention must be given to water, fertility, pest, and pathogen management because at lowered mowing heights the ability of the plant to tolerate stress is reduced. Disease severity often increases in grass mowed at lower than recommended heights lower during warm, summer months. Lower mowing heights are also associated with increased infestation of weeds, like crabgrass and annual bluegrass.

Mark Howieson and Nick Christians, of Iowa State University, take a scientific look at mowing

▼ Figure 1



FREQUENCY OF CUT

Growth rate and mowing height dictate the frequency that grasses should be clipped. No more than 30 - 40 per cent of leaf tissue should be removed in a single mowing during periods of active growth. For example, if the desired mowing height is 5cm, grasses should be clipped when they reach 7cm. Similarly, mowing height should be gradually reduced to allow grasses to increase shoot and leaf density below the height-of-cut.

In a study performed at Iowa State University, 'L-93' creeping bentgrass maintained at 1.25cm was not mown or mowed at heights of 0.88 and 0.50cm to remove approximately 0, 30, and 60 per cent, respectively, of leaf tissue. Carbohydrates were extracted from leaf tissue collected 36 hours after mowing and were analyzed by using high performance liquid chromatography. Grasses mowed at 0.50cm had 36 per cent less reserve carbohydrates than grasses that were mowed at 0.88cm (see Figure 1). Excessive tissue removal also reduced visual quality (see Figure 2).

The results of this study demonstrate the importance of proper mowing frequency. Severe defoliation limits the availability of carbohydrates for shoot and root growth and development.

MOWER MAINTENANCE

Regular mower maintenance is essential to achieve the best possible quality of cut. Dulled mower blades tear and fray leaf blades, resulting in brown and ragged leaf tips that reduce the visual quality of the turf. Moreover, grasses mown with dull mowers are subjected to more stress than grasses mown with sharp mowers. Rotary mower blades should routinely be inspected and sharpened by using a file or bench grinder as necessary to produce as clean a cut as possible.

Several methods of sharpening reel-type mowers exist, including single-blade grinding, spin-grinding, carbide-milling, back-lapping, and facing of the front face of the bedknife. The decision on which method, or combination of methods, to use often depends on economic, labour and time factors, as well as desired cutting quality and personal preference.

There is no set standard regarding how often reel-type mowers should be sharpened. That depends on several factors, such as the area of turf to be mowed, the regularity of cutting, the species of grass being cut, the method used to sharpen the mower, and the adjustment of the reel to the bedknife. A goal of a research project at Iowa State University is to develop general guidelines to determine how frequently reel-type mowers should be sharpened. Several mowers will be sharpened by using different sharpening techniques and will be used to mow a known area of turf each week. Measurements of leaf blade tissue damage, carbohydrate concentration, photosynthetic yield, and cutting surface geometry will be used to quantify mower sharpness over time.

CURRENT RESEARCH PROJECTS

The goals of our current research projects are to identify physiological mechanisms that allow creeping bentgrass to tolerate close and frequent mowing. In addition, we would like to identify wound responses that may contribute to overlap marking, the unsightly groove that develops between successive passes of walk-behind mowers, or among the overlap area of reels in multiple reel, or gang, mowers. Primary areas of interest include carbohydrate metabolism and activities of antioxidant enzymes.

As mentioned previously, carbohydrates play an important role in regeneration of shoot and leaf tissue after mowing. Carbohydrate concentrations are altered in response to common mowing practices, like mower sharpness and mowing frequency. Preliminary results indicate that grasses that are mowed with dull mowers contain less carbohydrate reserves than grasses mowed with sharp mowers.

Grasses maintained on sports fields often are double-cut, or mowed twice in different directions, to create a more uniform playing surface. This practice is especially prevalent on golf course greens. Results from our research, however, have demonstrated that grasses that are double-cut have less carbohydrate reserves than grasses that are mowed once, or single-cut. Reduced carbohydrates levels observed in double-cut grasses may contribute to the severity of overlap marking.

In response to wounding, plants generate reactive oxygen species that kill plant cells. Plants produce several antioxidant enzymes that breakdown and detoxify reactive oxygen species to limit tissue damage. The activities of antioxidant enzymes may be an indicator of the severity of mowing stress.

▼ Figure 2

SUMMARY

Development of a practical mowing programme that balances agronomic requirements with sports play demands is important to produce dense, uniform and visually appealing turf. When possible, clip grasses within recommended mowing height ranges. If grasses must be mowed at heights lower than recommended, careful attention should be paid to water, fertility and pest management because grasses will be less tolerant of environmental stresses.

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