Applied Turfgrass Physiology - Chapter 6 Notes

A. Soil Aerification
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B. Topdressing and Turfgrass Physiology

C. Vertical Mowing and Thatch Management

Learning Objectives: After completing this section, you will be able to:

1. Describe the positive and negative effects of aerification on soil properties.

2. Explain how aerification influences shoot and root growth; turf responses to environmental stresses; and turfgrass pests.

3. Discuss the effects of topdressing and thatch on turfgrass grass growth and physiology.

Application Objective:

With a better understanding of how soil aerification, topdressing, and thatch influence growth of the turfgrass plant, students should be better prepared to employ cultivation practices that improve turf performance.

Cultivation Practices and Turfgrass Physiology

The term cultivation is used differently in turf management than for row crops. A farmer thinks of plowing and discing when he hears “cultivation”; turf managers may think of aerification, topdressing, or vertical mowing practices.

Soil Aerification

Soil Responses to Aerification

There are various types of equipment that can disturb the soil under growing turf. Most familiar are aerifiers, capable of creating some pattern of holes in the soil surface. Those employed include hollow-tine, solid-tine, and water-injection aerifiers. Hollow and solid-tine units come in all shapes and sizes, and many are now capable at punching holes up to 12 inches deep. There is also equipment available that uses large knives to slice into the soil surface or even some that will drill deep holes.

Although aerification is routinely done on sports’ turfs, we know very little about how the plant responds to this cultural practice. In fact, it is likely that responses will vary with the particular soil texture and structure.
Numerous types of soil cultivators are used to improve growing conditions for turf.

Research has shown that turf areas that receive a considerable amount of traffic benefit from cultivation. Turf growing on soil that is not compacted may not benefit, however. Heavily trafficked soils become compacted at the surface, reducing porosity and oxygen available for root growth.

The following changes in soil physical properties can be expected after core aerification:

- An increase in infiltration rate. Opening up a compacted soil surface allows water to enter more readily.
- An increase in oxygen diffusion rate to the depth of cultivation.
- Increase in soil porosity. Soil bulk density is reduced and porosity increases.
- A layer of compaction at the tine/soil interface. Even hollow tine aerifiers can create a “hard pan” at the base and perimeter of tines. Periodically changing aerification depth can help prevent this from becoming an increasing concern.

Core cultivation opens up the soil, allowing for better water and oxygen infiltration.
Shoot and Root Responses to Aerification

When hollow-tine cultivation is used, a portion of the shoots and roots are removed from the stand, after which the plant should respond positively to the improved environment.

Solid-tine and water-injectors do not remove soil; rather, they punch or shoot holes into the soil surface, dispersing soil particles. The following can be expected after the aerification process:

- Potential for a short-term decline in shoot development, for aerification itself is an imposed stress. It is likely that most plants lose part of their root systems. Furthermore, there is some wear injury that results from the aerification process itself. This explains why it is recommended that cultivation be done when the plant is experiencing good growing conditions (i.e., spring and fall for cool-season grasses, summer for warm-season grasses).

- Increased rooting, especially in cultivation holes. This is a response to the increased availability of oxygen, which is essential for root respiration. Soil strength (hardness) is also reduced, which allows for better root penetration into the soil.

- Potential for reduced root growth below the depth of aerification. This may occur after repeated aerification using a machine that operates at the same soil depth.

![Figure 6.3 Turfgrass roots respond to increased oxygen availability by rooting prolifically in aerification holes.](image)

Water Use and Drought Resistance

Improved turf root growth following aerification should result in increased drought resistance, especially on compacted soils in which rooting was restricted. Significant improvements in turf performance may be realized after cultivating sloped areas by encouraging water infiltration.

Open aerification holes will likely cause the turf to dry out more quickly.
Temperature stresses

Cultivation practices should be avoided when the plant is not actively growing or the likelihood of temperature injury is greater.

For example, creeping bentgrass at putting green height may respond negatively to midsummer cultivation. The combined stresses of heat, and disturbance by cultivation, result in turf decline. Less invasive cultivators, such as the hydroject, result in less stress and can be used during summer heat.

Winter injury could be greater if warm-season turfs have open aerification holes going into winter. Holes allow for the infiltration of cold air that could cause lower soil temperatures, and increase potential injury of rhizome-forming grasses such as bermudagrass and zoysiagrass. Similarly, open aerification holes during winter on creeping bentgrass greens could increase the potential for winter desiccation injury.

Aerification should be done at the point in the season that allows time for the turf to recover so that holes are no longer evident as cold temperatures approach.
Shade
Cultivation of shade-grown turf should be done only when it is clear that soil compaction is affecting growth. Plants in shaded areas are tender, succulent, and have low carbohydrate levels. Hence, injury due to the cultivation may be greater, and recovery will be significantly slower.

Interaction with pests

Weeds
Cultivation performed at the time when a particular weed pest is likely to emerge may increase the encroachment of that weed. For example, cultivation in mid-to-late-spring may increase crabgrass levels. Cultivation in fall may facilitate encroachment of annual bluegrass.

Surprisingly, routine core aerification in the spring does not seem to reduce the efficacy of preemergence herbicides that may have been applied earlier.

Diseases
By promoting water infiltration, it is likely that core aerification has the potential to reduce the incidence of numerous diseases that are most pronounced in low, wet areas that drain poorly. These include brown patch, large brown patch, pythium blight, and others.

Researchers evaluating effects of aerification on root-infecting pathogens have found:
- Severe disruption of the surface of bermudagrass (aerification followed by verticutting) reduces spring dead spot symptoms.
- Aerification may reduce summer patch symptoms in Kentucky bluegrass.

Topdressing and Turfgrass Physiology
Topdressing with a sand-based medium is common after aerification, and may be done as frequently as every week. Topdressing can have immediate or delayed effects upon turfgrass performance. For example:
- Abrasive effects of sand can scratch the waxy surface of the leaf (cuticle) causing water loss and visible stress. Avoid dragging sand on creeping bentgrass during the heat of the day. Lighter, more frequent topdressing may eliminate the need to drag the sand in at all.
- Heavy topdressing in fall can help prevent winter desiccation and low temperature injury. Covering crowns will help to retain water and moderate temperature extremes.
- Topdressing encourages thatch breakdown, which may reduce susceptibility to numerous environmental stresses.

Figure 6.6 Aggressive aerification and vertical mowing has been shown to reduce symptoms of spring dead spot on bermudagrass.
Breakdown is thought to be due to an increase in relative humidity in the thatch layer after topdressing, which enhances microbial activity.

- Layering can result, if improper materials are used, and can have negative effects upon soil physical and biological behavior.

**Vertical Mowing and Thatch Management**

Vertical mowing refers to the use of equipment that uses vertically oriented knives to disrupt the turf and/or organic layer lying above the soil surface. It is used to:

- remove excessive organic material (thatch)
- prepare a seedbed
- alter growth of grasses to improve playability

![Figure 6.8](image)

*Figure 6.8 Vertical mowing removes thatch and living shoots and causes a short-term decline in plant growth.*

The severity of the vertical mowing operation depends upon how the vertical blades are attached to the rotating shaft, the spacing between the blades, and the depth at which the knives are set to penetrate the surface.

The power rake, for example, uses closely spaced vertical blades that hang loosely until centrifugal force affects their position around the rotating shaft. This equipment is used for turf renovation, and is capable of severely disturbing the turf surface. The standard verticutter uses rigid knives that are fixed in place, and usually causes less disturbance than the power rake. The groomer also uses fixed knives, and the unit is attached in front of reel mowers. Its purpose is to reduce grain in low-cut turf, and encourage a more upright growth habit.

![Figure 6.9](image)

*Figure 6.9 Thatch formed by sod-forming grasses, such as St. Augustinegrass, can be removed over time by vertical mowing.*
Severity of vertical mowing operations:

- Grooming: Least severe
- Verticutting: Least severe
- Power raking: Most severe

Vertical mowing is routinely used as a mechanical means of controlling, or preventing, thatch. Thatchy turf is susceptible to drought; low and high temperature stresses; and all turfgrass pests. When thatch contains moisture, roots proliferate in it. Therefore, in turf areas with excessive thatch (> 1” deep), a significant root mass is often present above the soil surface. Once thatch dries, and roots have no water available, wilt occurs quickly. Extended periods without water cause death of roots and shoots. Thatch is hydrophobic, and is very difficult to wet again once it dries.

Like roots, crowns become elevated in the thatch layer, predisposing plants to temperature injury. Soil is an excellent buffer for temperature fluctuations, and elevated crowns experience higher and lower temperatures throughout the year than crowns growing at, or just below, the soil surface. Therefore, high and low temperature injury is exacerbated on thatchy sites.

Thatch harbors insects and diseases. Therefore, using vertical mowing to reduce thatch can lead to less problems with these pests. Thatchy turf also experiences decline in quality, which often leads to weed encroachment. Vertical mowing can, therefore, indirectly reduce the potential for weed invasion.