UT Extension

W161-B

Turfgrass Maintenance Cultivation

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For years, soils have been tilled or cultivated to prepare for planting crops such as corn, cotton and soybeans. As crop plants emerge, the soil is loosened and weeds are controlled by cultivating. Cultivation, as it applies to turfgrass management, refers to mechanical methods of 'selective' tillage. Turfs are selectively cultivated to groom the surface, reduce thatch and relieve soil compaction.

Methods of cultivating turf include coring (core aerification), deep-tine aerification with solid or hollow steel tines, deep-drill aerification, water injection cultivation, vertical mowing, deep vertical mowing, spiking and slicing. Core, deep-tine and deep-drill aerification are more aggressive methods of cultivating turfs than water injection cultivation, vertical mowing, spiking or slicing. Turfs are perforated and holes are visible at the soil surface following core, deep-tine and deep-drill aerification. Vertical mowing and deep vertical mowing create a linear pattern of exposed soil.

Core Aerification

Core aerification involves the use of a machine engineered to penetrate soil, extract cores and place them on the turf surface where they can be mixed with thatch or removed. Technologies have improved since Tom Mascaro developed his aerifier in 1946. Depending on the length and diameter of the hollow tines or spoons selected, today's vertical- and rotary-motion core aerifiers usually pull cores from 3/8 to 3/4 inch in diameter and about 2 to 6 or more inches in length. The aeration pattern or coring grid also varies among machines. Soil or organic matter can be topdressed after core aerifying to improve surface water drainage

Deep-tine Aerification

A major objective of deep-tine aerification is to loosen soils and create aeration channels to a depth well below that of conventional core aerification. Deep-tine aerification may provide the opportunity to relieve compaction that can occur in the soil just below the depth of routine core aerification. It is also used to improve air, water and nutrient movement through layered, poorly drained soils.

Hollow-tine, deep-tine aerification. Deep-tine aerification using hollow tines most often removes much more soil than conventional core aerification. This permits the addition of relatively large amounts of topdressing soil or organic matter to the turfgrass root zone. Hollow tines from 1/2 inch to 1 or more inches in diameter and up to 12 inches in length

may be installed. A steel drag or cocoa mat may be used to break up cores lying on the turf surface after aerifying. These may also be pushed from the turf surface using a squeegee or collected and removed with a mechanized core harvester.

Solid-tine, deep-tine aerification. Long, solid tines up to 16 inches in length and from $^1/_2$ to 1 inch or more in diameter may also be installed on deep-tine aerifiers. Solid tines are often preferred when cultivating heavily compacted clay soils or gravelly soils for the first time. Cultivating with a conventional aerifier before using a deep-tine aerifier with solid tines may prove very beneficial. Aeration channels created by the conventional core aerifier receive some of the soil displaced by deep-tine, solid-tine aerification. This lessens the disruption of the turf surface and fewer turfgrass plants may be lifted from the soil.

Deep-drill Aerification

Although the operating speed of a deep-drill aerifier is usually much slower than that of a core or deep-tine aerifier, the results may be well worth the additional time. As the name implies, soil is lifted to the turf surface by the drilling-action of large, hardened steel aeration bits. Bits from $^1/_2$ to 1 or more inches in diameter and up to 16 inches in length create deep channels and loosen soil as they auger into the turf. Following deep-drill aerification, granulated soil surrounds the top of each aeration channel much like soil castings resulting from earthworm activity in turf. The soil from aeration channels can be mixed with thatch using a drag mat. Dry sand may be added to individual aeration channels during deep-drill aerification, a procedure known as 'drill and fill.'

Water Injection Cultivation

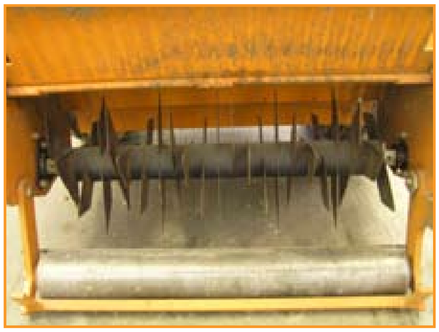
The first commercially available water injection cultivator (HydroJect®) was marketed by The Toro Company, Inc. in the early 1990s. Streams of pressurized-water are directed through small-diameter nozzles penetrating thatch, loosening soil and promoting root growth. Although water injection cultivation is no substitute for coring, it is often used to cultivate stressed turfs during unfavorable weather. This technology has been well-received by many golf course superintendents managing quality creeping bentgrass greens prone to high-temperature stress and wear injury during hot, dry summer months.

Vertical Mowing

Depending on the depth adjustment of a vertical mower, the knives attached to the rapidly spinning, horizontal shaft may be used to relieve 'grain,' dethatch or cultivate turf. For example, grain is reduced when the knives are set to sever aboveground runners (stolons). Thatch is lifted to the turf surface when knives are adjusted to pass through the entire organic layer and lightly strike the soil below. Setting knives to penetrate into soil relieves some surface compaction while mixing thatch and soil. Walk-behind vertical mowers available for lease often have only one depth setting. Dethatching blades last much longer when adjusted to penetrate thatch rather than penetrate soil.

Deep Vertical Mowing / Linear Aeration

Walk-behind machines, often referred to as deep verticutters, have been engineered to carve into soil to a depth of 1 inch or more. Tempered steel



cutting blades from 3/64 to 3/8 inch thick are spaced vertically (e.g., 1 inch on center) on a shaft horizontal to the soil surface. Rows of exposed soil form as these machines move across the turf. Larger, tractor-drawn linear aerators are also available. Linear aeration may expose much more of the soil surface area than core aerification.

Spiking

At first glance, spikers may appear very similar to vertical mowers. Blades, pointed rather than broad and flat, are attached to a horizontal shaft that rotates above the turf surface. However, the spiker blades, unlike vertical mower blades, turn slowly, usually at a rate about equal to that of the implement's wheels. Spiking may stimulate turfgrass shoot and root growth in the immediate vicinity of the shallow holes. Golf greens and tees may be spiked weekly to speed plant recovery from wear injury due to traffic. Small (e.g., ¼-inch diameter and 1½ inches in length), solid-steel tines installed on a vertical-motion core aerifier are used to spike turfs with very little surface disruption.

Slicing

Slicers use V-shaped knives mounted on disks attached to a slowly-rotating steel shaft to produce slightly deeper and longer perforations in the turf than spiking. Heavily trafficked creeping bentgrass, fescue and Kentucky bluegrass turfs may be sliced several times each month in summer, when core, deep-drill or deep-tine aerification would severely injure plants.

A comparison of methods used to selectively cultivate turf.

Cultivation method	Soil penetration (inches)	Spacing between blades or tines (inches)	Relative level of soil loosening	Relative disturbance of the turf surface
Core aerification: conventional and deep-tine, hollow-tine	2 to 12	1 to 8	Minimal to high	Moderate to high
Deep-tine, solid-tine aerification	2 to 16	1 to 8	Minimal	Minimal to moderate
Water injection	4 to 20	3 to 6	Minimal to moderate	Minimal
Spiking	¼ to 12	1 to 2	Minimal	Minimal
Slicing	2 to 8	4 to 12	Minimal to moderate	Minimal

A comparison of the amount of soil exposed and volume displaced by conventional core aerification and linear aeration.

Unit area of turf:	16 in. by 18 in. = 2 ft.^{2}
Coring tines:	3/8-in. dia., 1 3/4 in. long
Aeration pattern:	72 holes, 2 in. on center
Area of soil surface exposed:	72 holes x ¶radius^2 = 72 holes x 3.1416 (3/16-inch)^2 = 72 x 0.11 in.^{2} = 7.92 in.^{2}
Surface area of sides of each aeration channel exposed:	channel circumference x depth = 2¶(radius) x 1 3/4 in. = 2(3.1416)(3/16-in.)(1 3/4 in.) = 2.06 in.^{2}
Total exposed surface area of 72 aeration channels	Total surface area exposed at the base of 72 channels = 7.92 in.^{2} Total surface area exposed on the sides of 72 channels = 72 x 2.06 in.^{2} = 148.32 in.^{2} 7.92 in.^{2} + 148.32 in.^{2} = 156.24 in.^{2}
Volume of each aeration channel:	Volume = ¶(radius^2)(depth) (3.1416)(3/16-in.)^2 x 1 3/4 in. = 0.193 cu. in.
Total volume displaced per 2 ft.^{2}:	72 channels x 0.193 cu. in. per channel = 13.9 cu. in.

Unit area of turf:	16 in. by 18 in. = 2 ft.^{2}
Cutting blades:	1/8-in. blade width, 3/4-in. cutting depth spaced 1-in. on center
Area of soil surface exposed:	1/8-in. x 18 in. cutting distance per blade =2 1/4 in.^{2} per blade 2 1/4 in.^{2} per blade x 15 blades = 33 3/4 in.^{2}
Surface area of sides of each aeration row exposed:	Area = aeration row length x depth 2 sides x 18-in. x 3/4-in. = 27 in.^{2}
Total surface area exposed by each blade:	Total surface area exposed = surface area of 2 sides and bottom of aeration row = 27 in.^{2} + (1/8-in.)(18 in. cutting distance) = 29 1/4 in.^{2}
Total surface area exposed in 15 aeration rows:	15 aeration rows x 29 1/4 in.^{2} = 438 3/4 in.^{2}
Volume of each aeration row:	Volume = width x length x depth = (1/8-in.)(18 in.)(3/4-in.) = 1.69 cu. in.
Total volume displaced:	15 aeration rows x 1.69 cu. in. per aeration row = 25.4 cu. in.

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