

Cultivation – Why Bother?

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There are a number of factors basic to providing a healthy, stress tolerant turf: 1) acceptable environmental conditions, 2) grass(es) adapted to the environmental and use conditions, 3) proper maintenance practices, and 4) reasonable use of the turf. One of the key maintenance practices for sports turfs is cultivation (aerification). The turf manager must determine what kind of cultivation equipment is needed, and when and how often should it be done. But before one can make these decisions an assessment must be made of problems that exist or are likely to develop.

Evaluate turf conditions

A careful review of the site conditions is necessary to determine the best course of action. An effective turf manager must be a keen observer. Several tools are helpful in assessing soil conditions: a soil probe, a cup cutter, a sharp knife, and possibly a shovel. One very effective approach is to take a soil core with a cup cutter. With a sharp knife, cut the core in half. This provides a clear picture of the turf and soil profile to a depth of about 8 inches. Thatch development, soil layers, and rooting patterns will be very evident. Using the knife, one can chip away at various soil depths to determine if any compacted layers are present.

A technique we have utilized effectively to determine which part of the profile that is most limiting for turf is to measure water movement through different layers of soil. Using sections of 4-inch aluminum irrigation pipe cut to appropriate lengths we measured hydraulic conductivity (drainage) through the 0-2, 2-4, 4-6, and 6-8 inch depths. On one green we found the surface layer had the slowest drainage. In another, a compacted layer at 3-4 inches was the most limiting. Knowing this information, one can then determine what kind of aerifier will be needed to address the most significant problem. Without knowing this, the turf manager could be missing the most important problem to be solved.

Observation of the surface will also provide evidence of the need for cultivation. Thin turf or bare soil usually indicate significant compaction. The presence of weedy species such as knotweed, annual

bluegrass, crabgrass, and goosegrass suggest compaction exists. Runoff of rainfall and irrigation is another indicator of compaction.

Evaluation of rooting patterns can help determine if compaction is limiting. In highly compacted soils, rooting will tend to be shallow with few deep roots. This makes the turf susceptible to moisture stress, increasing the need for irrigation frequency. Patch diseases can also contribute to wilting, but will tend to cause patchy wilting in contrast to a general wilting pattern caused by compaction.

The presence of a significant thatch layer is another indication that compaction is serious. Grass roots do not penetrate easily into compacted soil and seem to prefer the less restrictive thatch layer at the surface. Thatch becomes the primary growing medium with high inputs of water and nutrients. This problem is commonly observed when sod is laid on highly compacted subsoils where an irrigation system is routinely used.

Objectives of a cultivation program

Why bother with cultivation, a practice that few people appreciate? Most agronomists suggest cultivation can be used as a tool in: 1) relieving soil compaction, 2) managing thatch, 3) breaking through soil layers, usually in conjunction with topdressing, 4) managing localized dry spots, and 5) renovation or reestablishment. Cultivation will sever some rhizomes and stolons that may result in some rejuvenation of the grass if growing conditions are favorable. Relieving compaction improves rooting and drainage, increases oxygen status of the soil, reduces runoff, and can provide a softer playing surface. A good cultivation program can help reduce runoff, thus it is a positive factor in environmental protection.

Equipment to do the job

This is dependent on the results of the assessment of any problems present. What equipment will provide adequate loosening of the soil or bring enough soil to the surface to achieve the objectives desired? Fortunately, there are many types of equipment from which the turf manager can select. Those which hit

the soil with the highest impact normally give greater loosening of the soil, but the cost of such equipment is usually high. Cheaper units often do not penetrate the soil deeply enough or with enough energy to be very effective. As a tool in thatch control, an aerifier which brings more soil to the surface will be more effective.

On greens and tees, if the objective is to aerify followed by topdressing (to gradually change the soil below the surface), hollow tines that remove soil are most useful. Larger diameter solid tines or a drill aerifier can be used for this purpose but it is more difficult to fill the holes when no turf is removed.

What size (diameter) tines are needed? A minimum of 1/2-inch tines should be used on grounds and fairways. Larger tines are more effective in achieving the desired objectives if they don't cause too much surface disruption.

On putting greens one can use 1/2 to 5/8 inch tines in spring or fall when using cultivation in conjunction with topdressing. Otherwise, 1/4 inch or smaller tines may be desired for less surface disruption during the golfing season.

What spacing of holes is desired? That depends on the diameter of tines used and the severity of the turf or soil problem to be solved. For more severe compaction or thatch problems, larger tines and closer hole spacings are needed.

As a general rule, there should be a hole at least every 3 inches. For sites with serious compaction or thatch problems, even closer spacings could be justified depending on tine diameter and equipment. For small aerifiers with wide tine spacing and/or small diameter tines, it will be necessary to make multiple to many passes. Wide tine spacing and small tine diameter have little effect on a turf. For example, in the table below compare an aerifier which has a 2 inch by 2 inch spacing with one that has a 6 inch by 8 inch spacing. It would

require 12 passes with the latter to achieve the same number of holes as with the 2 inch by 2 inch spacing.

What depth of penetration should the aerifier reach? This depends on the depth of the problem to be addressed. As a minimum, we suggest 2.5-3 inches. For example, if a thatch layer of 1.5 inches exists on a site and the tines reach only to a depth of 2 inches, there will only be 1/2-inch of soil brought to the surface with each tine. Considering the low percentage of area affected (see table) by some aerifiers, it is clear this aerifier will have almost no impact on loosening the soil or diluting the thatch with soil regardless of the number of passes. With larger tines and/or closer tine spacing, the equipment must be heavier to achieve adequate depth of penetration. Heavier aerifiers are usually more expensive and harder to maneuver in tight places. Common sense and careful equipment selection are necessary for flexibility in adapting to varying needs.

Sites that have deep compaction as a result of construction errors pose a special problem. Cultivation equipment is available that can reach to 12 inches or so, but there is not tool that is effective with deep compaction. Fortunately, most turfgrasses do not root deeper than that.

If a soil layer exists causing restricted rooting and drainage, the cultivation equipment should reach through that layer. One can then topdress to fill the aerifier hole which provides some breaking through that restrictive layer.

On thatchy sites (more than 1/2 inch), regular cultivation is one of the most effective cultural practice to follow. Effective thatch control requires a total management program, including proper use of irrigation, dethatching/verticutting, fertilization, and cultivation.

There are now several specialized types of equipment available that offer unique cultivation effects. One of these is high pressure water injection that

Effect of tine diameter and spacing on % of area affected

Tine diameter inch	Percent of area affected tine spacing			
	2" by 2"	2" by 4"	4" by 6"	6" by 8"
1/4	1.2%	0.6	0.2	0.1
3/8	2.8	1.4	0.5	0.2
1/2	4.9	2.5	0.8	0.4
5/8	7.7	3.8	1.3	0.6
3/4	11.0	5.5	1.8	0.9
1	19.6	9.8	3.3	1.6

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utilizes microbursts of water under high pressure. Studies with the Hydroject at Michigan State University and other universities have demonstrated that this equipment can loosen soil with virtually no surface disruption. This is especially useful on putting greens during the growing season. Golfers are seldom aware the greens have been cultivated. In fact, ball roll is improved after this cultivation.

Frequency of cultivation needed

For most lawns, fairways and other grounds, one effective cultivation per year is probably adequate. If the soil is severely compacted, it may be necessary to cultivate 2 or 3 times a year until the condition is improved. For high traffic sites like athletic fields, parks, and greens or tees, 2 or 3 treatments may be needed annually. If there is a significant thatch layer (1 inch or more), 2 or more cultivations may be useful in bringing the thatch under control. When it becomes evident that soil from cultivation is mixed with the thatch so there is no distinct layer of either thatch or soil, the frequency of cultivation can be reduced to annual treatments.

Unfortunately, our research has shown that with continued traffic the positive effects of cultivation disappear with time. As a result, cultivation will be needed regularly on most sites that receive traffic. The degree of compaction, soil conditions, and intensity of use of the turf will determine how frequently cultivation will be needed.

Timing of cultivation

When can cultivation be done? The cultivation process causes some injury to turf by removal of grass and roots with the soil cores as well as by some injury to the roots when loosening the soil occurs. So, it is usually considered best to treat during spring or fall when good growing conditions provide quick turf recovery. However, aerification can be done any time labor, turf use, soil moisture, and growing conditions permit. If the soil is too dry at the time of cul-

tivation, soil strength may be so high the aerifier will not penetrate to an adequate depth into the soil to be effective. If soil is too wet, the equipment may cause more compaction and damage than is corrected by aerification. Fertilization a week or so before cultivation will increase growth rate of the grass for quick recovery and covering of holes on greens.

Cultivation in the late fall (late October) has become a common practice on golf courses. This occurs partly because of golfing tournaments through most of the season when the disruptive effect of cultivation is considered undesirable. Cultivation of any turf in the late fall can leave the soil in a loosened condition so good rooting can occur during the major rooting period of early spring. Golf courses located in areas where winter desiccation is expected should aerify early enough that growth covers the holes before winter begins.

For athletic fields used for fall sports, cultivation should be done in the late fall after the season is completed, provided the soil is not too wet. Otherwise, it should be done the next spring. Summer and early fall cultivation is suggested for sports fields used in the spring. Parks and athletic fields that receive constant use should be cultivated whenever the field use is least and turf recovery can occur.

In the spring one can cultivate at any time even if a preemerge annual grass control chemical has been applied. Research here at M.S.U. and corroborated at other universities has proven cultivation does not affect efficacy of the preemerge application.

Summary

Is cultivation really needed on any given turf? That depends on your assessment of the site conditions. Cultivation should be site specific. Some areas will require intensive cultivation; others may need none. Different equipment may be needed in different areas. Developing a good cultivation program requires regular reassessment of how it is working and making appropriate adjustments as needed.