Improving Water Conservation Through Fairway and Rough Cultivation

Improving water infiltration provides significant benefits to a water conservation program.

BY PATRICK O´BRIEN

Water is precious. Every drop counts. Tremendous effort, expense, and sophisticated technology are used to move water from its source to the turf, but sometimes water does not want to stay where it is applied. Oftentimes water may run off the intended site to an adjacent area that may not need additional water. This can result in areas that are alternately too wet or too dry, both of which conditions are stressful to the turf, the superintendent, and the water budget.

The focus of this article is minimizing water runoff on the golf course. The causes of runoff will be reviewed, and an economical solution using solid-tine aeration or deep slicing will be introduced.

Irrigation water for golf courses is under close scrutiny. Large acreage areas like fairways and roughs often use the most water from golf course irrigation sources.

Irrigation technology today allows for very precise application rates and accuracy when irrigating fairway and rough areas.

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Golf cart tires can cause significant soil compaction in fairways and roughs.

WHY WATER RUNS OFF COMPACTED SOILS

Soil compaction is an enemy of water conservation programs and impairs soil structure. Runoff occurs on compacted sites when soil macropores (small channels in the soil) become sealed. Without proper water infiltration, compacted soils in fairways and roughs often remain dry even after irrigation or rain events. The dry soil conditions caused by compaction-diminished infiltration rates can increase turfgrass stress, and additional irrigation water targeting the dry, compacted sites is likely to run off into non-target areas. Furthermore, turfgrasses grown on compacted soils have shallower roots, placing the turfgrass under additional stress.

CULTIVATION IS THE ANSWER

Routine cultivation of compacted fairway and rough soils creates temporary macropore channels that promote water infiltration and percolation during rain and irrigation events. In other words, cultivation helps restore soil structure.

Cultivation channels benefit turfgrass root systems in two ways. First, soil oxygen levels increase. Oxygen is required for respiration, the plant process that takes place in the roots and converts stored food reserves into energy for growth. Second, cultivation channels help reestablish soil structure and promote deeper roots. Turfgrass plants with deep root systems have an increased tolerance to dry conditions and typically require less irrigation.

Using soil cultivation to foster deeper, more viable rooting and improve infiltration rates is essential for efficient water use during natural rainfall events. Promoting a healthy root system and maximizing the amount of rainwater that can be effectively captured and stored by the soil will reduce the need for additional irrigation.

WHERE SHOULD CULTIVATION START? FAIRWAYS AND ROUGHS

According to the Golf Course Superintendents Association of America, an average 18-hole golf course comprises 150 acres, approximately 100 of which are maintained as turfgrass. Typically, the 100 acres of maintained turfgrass are predominately comprised of roughs and fairways, each constituting approximately 51 acres and 30 acres, respectively. Combined, roughs and fairways comprise 81 percent of the total maintained turfgrass areas at the average 18-hole facility. Due to the large acreage of maintained roughs and fairways — coupled with the cost, labor, and time associated with cultivation — focusing cultivation efforts to address soil compaction in key areas where

water runoff occurs is a good strategy for most courses to improve water-use efficiency and conserve water.

CULTIVATION FREQUENCY — HOW OFTEN?

Cultivation frequency varies depending on soil properties, irrigation water quality, and the amount of traffic. Generally, sandy soils tend to require less cultivation than clay or silt soils. Additionally, the use of irrigation water high in salts, sodium, and bicarbonates will necessitate additional cultivation due to the negative impact dissolved solids can have on soil structure and turf quality. Furthermore, high-traffic areas — especially where cart traffic is concentrated — are prone to soil compaction and will require extra cultivation. The regeneration of temporary, functioning macropores through cultivation is particularly important whenever soil macropores become sealed, especially those within the surface 1-3 inches of the soil.

Additional consideration must be given to the duration of cultivation channels and how long new macropores stay open. Numerous factors influence how long a cultivation treatment remains effective:

- Silt and clay soils are the most prone to compact again.
- Heavier or more frequent traffic causes quicker hole closure.
- Traffic when moisture is at or above field capacity causes more compaction.
- Significant quantities of sodium in the soil deflocculate soil structure.
- The larger the diameter of the cultivation hole, the longer it will last. As a broad rule of thumb, a 5/8-inch diameter hole lasts about 5-8 weeks; a 1/4-inch diameter hole lasts about 1-3 weeks.
- Generally, less cultivation is required at sites with regular sand-topdressing programs, especially when the sand is backfilled into cultivation holes. Sand-filled cultivation holes create macropore channels that are less prone to dispersal and sealing than clay- or silt-based soils. The effective duration of sand-filled cultivation channels can be lengthened when combined with a proper sand-topdressing program that dilutes organic matter accumulation.

The presence of functional macropore channels due to cultivation programs is especially important before and during maximum root-growth periods for turfgrasses and should be taken into account when scheduling cultivations. Keep in mind that cultivation hardpans can sometimes develop within the upper rootzone and may necessitate deep-tine aeration or slicing, especially before heavy rainfall to avoid runoff that may occur and cause saturated soil conditions in low-lying areas.

Finally, cultivation and the subsequent creation of macropores can assist with soil-flushing programs, especially if the irrigation water being

The heavy-duty slicer is an excellent tool to quickly alleviate water runoff issues associated with compacted soils. The slicing blades penetrate 6-8 inches into the rootzone and cause minimal surface disruption.

used is relatively high in sodium. Salt-affected sites require good internal drainage to promote the movement of salts and sodium away from the upper rootzone.

CULTIVATION EQUIPMENT FOR FAIRWAYS AND ROUGHS

There are basically two cultivation options for fairways and roughs: hollow tine or solid tine/slicing. Hollow-tine aeration brings soil cores to the surface that are generally broken up and dragged back into the turf canopy. In addition to creating macropores for the purpose of reducing runoff, hollow-tine aeration reduces thatch and creates channels for sand topdressing.

Hollow-tine aeration may require closing a course for several days to aerate and clean up the debris from soil cores. Depending on the intended results, hollow-tine aeration has its place in golf course maintenance, but there may be better options if simply decreasing soil compaction and water runoff is the primary function.

Solid-tine aeration and slicing reduce water runoff with minimal disruption. The Verti-drain, Soil Reliever, AERA-vator, and Aerway slicer are a few examples of these machines that, depending on the type of machine and soil characteristics, use either solid tines or slicing blades to penetrate 3-16 inches into the soil. USGA-funded research has supported field observations that the Aerway slicer improved Tifway bermudagrass rooting by 50 to 120 percent over a two-year trial (Wieko et al. 1993).

Solid-tine aeration and slicing also fracture the soil, thereby improving soil structure. Furthermore, solid-tine aeration and slicing cause minimal surface disruption, allowing golfers to play immediately following cultivation. The solid-tine and slicing machines are best used when the soil is relatively dry to achieve maximum soil fracturing. Due to the efficiency and minimal surface disruption caused by slicing blades, this option is easy to fit into most fairway and rough scheduling programs during the growing season. Remember, spot cultivation is a valuable option in areas prone to soil compaction and runoff.

Hollow-tine aeration of fairways and roughs remains the "gold standard" to relieve soil compaction issues. Debris cleanup makes this a tedious process.

Solid-tine aeration provides relief from soil compaction in a quick and efficient manner with minimal disturbance.

WHAT CAN I EXPECT TO SEE THE FIRST YEAR?

Initiating a fairway- and rough-cultivation program using any of the methods previously mentioned will provide immediate results and help reduce water use. Soil cultivation provides an immediate increase in macropore space and instantly improves water infiltration, oxygen diffusion, and rooting channels.

CONCLUSION

Developing a golf course water-conservation program has many facets, but a key component of reducing water use is to make sure water, whether rainfall or irrigation, moves down into the soil profile and not across the surface. Regular cultivation programs as reviewed in this article will help conserve water by reducing runoff.

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