Water infiltration into soils

How much water is getting to your turf's roots? Water infiltration is a key to healthier turf.

by Don Taylor and C. Frank Williams

■ Water infiltration rate is the rate at which water enters the soil. It is critically important in managing turf.

The water infiltration rate determines how much water from a storm actually gets into the soil, and how much runs off the surface. It determines the rate at which irrigation water can be added, and the length of time irrigation can be continued before water starts to pond and run off.

Due to soil compaction, low water infiltration rates are common on golf greens, athletic fields and some lawns. In fact, most turf areas probably suffer from one or more of the following problems associated with low infiltration rates:

- lowered irrigation efficiency;
- excessive surface water puddling;
- poor playing conditions following rainfall; and
- turf damage from surface water ponding.

Many factors determine the water infiltration rate, including soil type, soil compaction and the presence of thatch or other layers at the surface.

Soil type—Water moves through the pores between soil particles. Generally, larger soil particles result in larger pores; thus, sandy soils with relatively large particles usually have higher infiltration rates than do finer-textured soils such as loams, silt loams and clay loams.

Several factors must be considered in applying this generalization to turf sites:

1) Compacted, sandy soils can have very low infiltration rates. We have measured rates below 0.1 inches/hour on golf greens modified to have 70 to 80 percent sand by weight.

2) Mixing small amounts of sand into fine-textured soil will usually not improve infiltration rates. Research has shown that sand contents must be very high—around 85 percent sand or higher—in soil mixtures to maintain high infiltration rates.

3) Finer-textured soils which are well-aggregated can have reasonably high infiltration rates if the soil structure or aggregation can be preserved. Aggregation of soils high in clay content is stronger and more easily preserved than soils high in silt content. However, soil structure near the surface of any type of soil will be destroyed if subjected to intensive vehicular or foot traffic.

The key is to preserve as much soil structure as possible, regardless of soil type. This can be done by:

1) Keeping vehicular traffic to a minimum and preserving as much soil structure as possible before turf establishment.

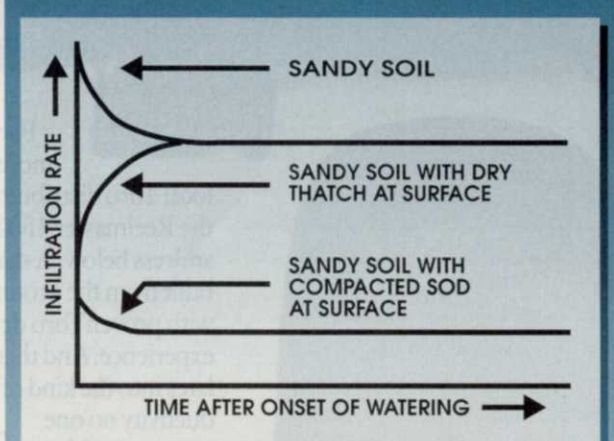
2) Limiting unnecessary traffic on turf, especially when the soil is wet.

3) Maintaining conditions conducive to vigorous root growth, earthworm and micro-organism activity through proper watering, fertilization and aerification practices, and prudent pesticide use.

Soil compaction—The majority of problems with low infiltration rates on turf areas probably result from soil that is compacted before turf establishment. Landscaped sites are often severely compacted inadvertently through construction vehicle traffic. Sometimes the soil is excessively compacted on purpose to establish a smooth, stable surface for sodding.

This type of soil compaction simply must be improved by deep plowing before establishing turf. After establishing turf, options for relieving soil compaction are severely limited.

FIGURE 1
THE WATER INFILTRATION CURVE



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Soil compaction following turf establishment can—and frequently does—occur on golf turf, athletic fields and other heavily used turf areas from concentrated foot traffic. The most common method of alleviating soil compaction on an established turf is through aerification.

Typical aerifiers only go to a limited depth (three to four inches, at most), and disturb a small percentage of the surface. A typical athletic field aerator with 3/4-inch tines taking cores on six-inch centers disturbs only 1.2 percent of the surface with a single pass. A typical golf green aerator with 1/2-inch tines taking cores on two-inch centers disturbs 4.9 percent of the surface. Thus, with most aerifiers, several passes over the turf when soil moisture conditions favor deep tine penetration are required.

The new deep-tine aerifiers can open holes to a depth of 12 inches or more. New water-injection machines can create openings in the soil using water drops under high pressure.

Thatch—The presence of thatch at the soil surface has interesting influences on water infiltration rates.

As long as the thatch layer is relatively un-decomposed, water can flow readily through it, if it is moist. If the thatch is dry, however, it becomes hydrophobic and repels water.

Fig. 1 shows the general response of infiltration rate as time progresses through a storm or irrigation cycle. In normal soils, infiltration rate starts high and decreases as the soil becomes increasingly wet. A dry thatch at the surface causes the initial infiltration rate to be low. Infiltration rate increases as the thatch moistens up.

Maintaining moist conditions in the thatch layer, either through syringing or by a short moistening irrigation prior to a storm or a regular watering, may improve water infiltration into the soil.

Other types of surface layers can severely impact water infiltration rate.

A layer of sod grown on fine soil or peat, once compacted, can severely limit water infiltration. The resulting infiltration curve is represented by the bottom curve in Fig. 1.

Wind-blown soil, particularly silt-sized particles, can plug the pores at the surface of a turf soil and reduce infiltration rates.

Algae growth can create a limiting layer at the soil surface.

Intensive aerification can help break up surface layers regardless of their source, and reduce their impact on water infiltration rates.

Rather than actually measuring infiltration rates (see accompanying article), it seems preferable for turf managers to evaluate the symptoms associated with low water infiltration rates.

One symptom is standing water on the soil surface. Perhaps the simplest method of determining if low infiltration rates are a problem for your turf conditions is to carefully inspect the area during normal irrigation cycles and during substantial storms. If any water collects at the surface during irrigation or if excessive amounts collect during storms typical of your area, then water infiltration rates are too low.

Other symptoms which may be useful in assessing water infiltration rates are evidences of soil compaction—such as hard soil or restricted root systems—shallow depths of soil wetting after irrigation, or distinct soil layering in the rootzone.

What can be done about low water infil-

RING SIZES SHOW DIFFERENT RESULTS

On one golf green where sand topdressing had resulted in several inches of sand over the original gravelly loam topsoil, infiltration rates measured with the small rings averaged 2.0 inches/hour, while the infiltration rate measured with the large rings averaged 0.6 inches/hour. Our opinion the water in the soil was flowing horizontally in the sand layer rather than vertically into the gravelly loam layer.

At one golf green, which had been constructed of 100 percent sand, and where we expected fairly uniform conditions, we measured rates varying from 2.6 to 7.9 inches/hour using the large rings.

—The authors

Measuring infiltration

■ Though many sophisticated methods are used to measure the water infiltration into soil, the only method suitable for routine use by turf managers is to drive a cylinder of two concentric cylinders into the soil. After maintaining a pond of water inside the cylinders for an hour or so, the infiltration rate can be determined by measuring how fast the ponded water in the inner ring drops.

If, for example, the water level drops by 0.2 inches in 15 minutes, the infiltration rate is 0.2 inches divided by 0.25 hours or 0.8 inches per hour.

Typical rings used in agriculture are one foot in diameter or larger. The double ring consists of an inner ring one foot in diameter and an outer ring 20 inches in diameter. Infiltration rings this large are cumbersome and require considerable quantities of water if the infiltration rate is high.

Smaller rings can easily be made. Rings made from a six-inch and an eight-inch turf repairer were used in an experiment to determine their usefulness in assessing water infiltration rates on turf areas. The results were not particularly encouraging and indicated two cautions with using ponded water in rings to measure infiltration rates:

1) Though small rings are easy to use, their results do not always agree with results from large rings. We found this to be particularly true where distinct layers were known to exist in the soil. Measurements from smaller rings are more affected by lateral or horizontal flow than larger rings, and the smaller the ring, the greater the over-estimation of vertical infiltration rate.

2) Infiltration rates into the soil can vary dramatically, even within a small area. Consequently, measurements at several locations on the turf site are essential. A single infiltration measurement to characterize a golf green, athletic field or other turf site may lead to gross errors. Even with several measurements, our opinion is that using water ponded in rings will do no better than give an estimate of infiltration conditions.

—Taylor, Williams

tration rates in turf areas? Most importantly, we need to change our perception about how the soil is treated prior to turf establishment. If everything possible were done to preserve soil structure and minimize soil compaction prior to turf establishment, most of our problems with low infiltration rates would not occur.

Where turf is already present and infiltration rates are low, aerification—and plenty of it—should be the first corrective measure. Once over is not enough; several passes are necessary. Often, adequate turf conditions can be maintained despite compacted soil and low infiltration rates with frequent and intensive aerification.

If regular aerification is insufficient, then more extensive treatments such as deep tine aerification or reconstruction may be required.

Fungicides for pythium on golf course fairways

■ In a test conducted at Penn State University, nine of 15 fungicides tested on pythium blight were providing excellent control eight days after application. By 16 days after application, eight, including three Banol/Subdue mixtures, were still providing control.

One fungicide application was made on July 16th. One day after application, the plots were inoculated with *Pythium aphaniderатum*. They were again inoculated eight days after application.

The tests were conducted at the Valentine Turfgrass Research Center on perennial ryegrass maintained under golf course fairway conditions, which simulated high humidity.

The tests were conducted by P.L. Sanders and M.D. Soika, and reported in "The Keynoter," the publication of the Pennsylvania Turfgrass Council.

See adjacent chart for complete test results.

PYTHIUM BLIGHT CONTROL, POST-TREATMENT RESULTS

Treatment	Formulation	Rate/ 1000 sq ft	Pythium blight severity[1] 8 days post-treatment	Pythium blight severity[1] 16 days post-treatment
FCI 6444	50W	1.47 oz	8.2 a[2]	7.0 b[2]
RO 43-2664	24%E	0.32 fl oz	7.0 ab	9.2 a
FCI 6444	50W	2.9 oz	7.0 ab	8.3 ab
Check	N/A	N/A	6.3 ab	8.2 ab
RO 43-2664	24%E	0.65 fl oz	4.8 bc	9.0 a
RO 43-2664	24%E	1.3 fl oz	3.7 cd	8.7 ab
S 3116	G	6.9 lbs	3.3 cd	2.2 cd
Aliette	80W	4.0 oz		
+ Koban	30W	4.0 oz	1.8 de	3.2 cd
Aliette	80W	4.0 oz	1.2 de	3.0 cd
Subdue	2E	0.5 fl oz	0.7 e	2.8 cd
Subdue	2E	1.0 fl oz	0.7 e	3.3 c
Banol	6S	0.7 fl oz		
+ Subdue	2E	0.5 fl oz	0.7 e	1.5 cd
Banol	6S	1.3 fl oz		
+Subdue	2E	0.5 fl oz	0.7 e	1.3 d
Banol	6S	1.3 fl oz	0.5 e	3.3 c
Banol	6S	1.0 fl oz		
+Subdue	2E	0.5 fl oz	0.3 e	1.3 d
Aliette	80W	8.0 oz	0.0 e	3.0 cd

[1] 0-10 visual rating scale, where 0 = no blight present, 1 = 10% of plot blighted, and 10 = 100% of plot blighted; mean of three replications.

[2] Within columns, means followed by the same letter are not statistically different, using Waller-Duncan K-ration t test.

Source: P.L. Sanders & M.D. Soika, Penn State Univ.

ANT CONTROL RESULTS

Treatment	Rate (lb AI/acre)	Mean number of ant mounds per 144 ft² plot* 15 Aug	23 Aug	30 Aug	6 Sept	13 Sept	26 Sept
019537	2.5 lb/100 ft²	20.7 a	18.0 ab	6.8 bc	8.0 bc	8.5 ab	7.5 ab
Pageant DF	1.0	24.3 a	21.3 a	10.0 ab	19.7 a	18.0 a	13.2 a
XRM-5184	1.0	24.3 a	10.2 bc	4.7 bc	4.2 bc	8.5 ab	7.0 ab
Dursban ME 20	1.0	26.7 a	11.8 b	7.7 bc	6.8 bc	8.8 ab	6.2 ab
Triumph 4E	1.5 oz/1000ft²	24.2 a	4.7 c	3.3 c	1.7 c	2.7 b	3.7 b
Control	....	21.8 a	27.3 a	15.2 a	14.5 ab	19.5 a	8.7 ab

* Means within a column followed by the same letter are not significantly different (P=0.05; DMRT)

Source: Michigan State Univ.

Ant control in turfgrass

■ Triumph 4E was shown to be the best control for ant mounding in a test done by staffers of the Department of Entomology, Michigan State University, in 1990.

At three and four weeks after the August 15th treatment, Triumph 4E had significantly reduced ant mounding in comparison with the control. At one and two weeks after treatment, most insecticide products reduced mounding. None of the products tested was effective five weeks after application.