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How do sand-soil-compost rootzones work for athletic fields?

DURING THE PAST 20 YEARS, the sports turf industry has experienced significant growth due to increased demand for quality playing fields. During this time there was movement away from natural soil fields to more sand-based fields in an effort to reduce challenges of overuse. One challenge for turf managers working sand-based fields though is that surface stability can sometimes be lacking.

With sports such as football, extreme shearing and torque can be placed on turfgrass plants both at and below the surface. These forces are also exerted on the rootzone. When sand is moist, it is relatively stable, though it is a media lacking cohesion. Therefore, increases in surface instability can be linked to sand.

Selection of materials to formulate the appropriate rootzone medium is one of the most important factors influencing field performance. In a desire to achieve an ideal rootzone, more research is needed on rootzones that incorporate sand, soil, and organic amendments in varying ratios to determine a standard mix. One objective would be the comparison of selected soil- and sand-based root one mixtures for their response to surface traction, surface hardness, infiltration and turf appearance. Work conducted at the University of Missouri Turfgrass Research Center earlier this decade in Columbia, studied sand-soil rootzones that combined both laboratory analysis and field investigations.

>> Table 1. Description of the treatments for the experiment along with organic matter content.

Treatment Name	Volume Ratio[1]	Rootzone Components	Organic Matter Content (%)
SandP10	90/10	Sand/Peat[2]	0.5
SandSoil10	90/10	Sand/Soil[3]	0.2
SandSoil15	85/15	Sand/Soil	0.33
SandSoil20	80/20	Sand/Soil	0.36
SandSoil30	70/30	Sand/Soil	0.40
Soil	100	Soil	0.21
SandSoil20C5	75/20/5	Sand/Soil/Compost[4]	0.70
SandC15	85/15	Sand/Compost	1.10
Sand	100	Sand	0.10

[1]Incorporated on a volume to volume basis.
[2]Sphagnum peat moss.
[3]Mexico silt loam, A horizon material (28.3% sand, 53.5% silt, 18.2% clay).
[4]Fine grade, sterilized steer manure.

>> Table 2. Physical properties of the rootzone mixes at initiation of the experiment.

Treatment	Bulk Density	Saturated Hydraulic Conductivity	Total Porosity	Air-filled Porosity	Capillary Porosity[1]
	g/cm^3	in/hr	% (v/v)	% (v/v)	% (v/v)
SandP10	1.58	17.06	40.38	22.25	18.13
SandSoil10	1.61	9.19	39.25	24.73	14.52
SandSoil15	1.59	6.78	40.00	26.55	13.45
SandSoil20	1.63	4.70	38.49	24.47	14.02
SandSoil30	1.66	3.68	37.36	24.26	13.10
Soil	1.18	0.07	55.47	17.79	37.68
SandSoil20C5	1.60	5.35	39.62	22.46	17.16
SandC15	1.52	12.88	42.64	21.60	21.04
Sand	1.62	15.70	38.87	27.26	11.61

[1]Capillary porosity is determined from water retention at -12 inches water potential.

Rootzone treatments

Rootzone treatments selected for the study are listed in Table 1, which included sand + organic amendments, soil, sand + soil and sand-only rootzones. The sand used for the sand-based rootzone treatments met the USGA standard recommendations for particle size distribution. The Soil rootzone treatment consisted of 100% topsoil removed from near the study site, since silt loam topsoil is very common throughout the Midwestern US. Sand/soil mixes ranged from 10% to 30% soil by volume and are referred to as SandSoil10, SandSoil15, SandSoil20, and SandSoil30 treatments. Three additional sand-based treatments included compost (fine grade, sterilized steer manure) or peat: SandSoil20C5 (20% soil, 5% compost), SandC15 (15% compost), and SandP10 (10% peat). The nine rootzones were mixed off-site and trucked into place on a laser graded sub-base. Each plot was 10x10-feet and measured 6 inches in depth. Plots were sodded using a blend of Abbey, Viva, Buckingham, and Ascot varieties of Kentucky bluegrass.

Laboratory analyses were conducted to determine physical characteristics of the rootzone treatments and included saturated hydraulic conductivity, bulk density, and rootzone water retention. Total porosity was calculated using bulk density, capillary porosity was determined from water retention, and air-filled porosity was calculated as the difference between total and capillary porosity.

Field measurements included turfgrass quality (scale of 1 to 9, where 1=dead or dormant, 9=ideal), shock attenuation measurements (with a 5 lb portable Clegg Impact Tester), surface traction measurements (using a shear unit developed by Canaway and Bell), and infiltration (using double ring infiltrometers).

Sand-soil rootzones maintain adequate performance characteristics after 2 years that allow for safe, playable fields

Physical property results of the rootzone mixes are shown in Table 2. The treatment effects on saturated hydraulic conductivity were most pronounced ranging from 0.07 to 17 inches/hour. The lowest values were for the Soil treatment and the highest for the SandP10 and Sand treatments, which were expected. Evaluating the logarithm of saturated hydraulic conductivity versus the amount of silt plus clay in the rootzone mix (Sand, SandSoil10, SandSoil15, SandSoil20, SandSoil30 and Soil treatments) provided a linear relationship (coefficient of determination of 0.998). This illustrates the effect that additions of silt plus clay have on reducing the relative transport of water through the rootzone. Results from this study are similar to those reported by Jason Henderson in 2005 while at Michigan State. Henderson indicated that only mixes with less than 10% silt plus clay produced acceptable drainage levels (6 to 8 in/hr) which was the case for the SandSoil10 treatment (7.4% silt + clay) and the SandSoil15 treatment (11.0% silt + clay).

Rootzone hardness

Mean shock attenuation (Gmax values, dimensionless unit) had few differences in 2000. The SandSoil20 and SandSoil20C5 treatments had significantly higher shock attenuation readings on the initial collection date (late summer, 2000); the Sand treatment had the lowest value. One year after establishment, SandSoil15, SandSoil20, SandSoil30, Soil, SandSoil20C5, SandC15, and Sand treatments had higher Gmax values. SandSoil15, SandSoil20, SandSoil30, Soil, SandSoil20C5, and SandC15 also had higher Gmax values in early fall of 2001; these treatments all had greater than 15% fine particles. Although treatments did show differences in 2001, most treatments were still within acceptable ranges (60-80 Gmax). Treatments in the study that never reached 80 Gmax included the SandP10, SandSoil10, and SandC15. SandSoil15, SandSoil20, SandSoil20C5, and Sand treatments exceeded 80 Gmax on only one of the six sampling dates. The SandSoil30 and Soil treatments exceeded 80 Gmax on two of the six sampling dates. In 2000, the average Gmax value for all treatments increased from about 50 to 60 from late summer to fall. In 2001, the average Gmax value exceeded 80 one year after establishment.

In fall of 2000, significantly higher shear values were measured for the SandSoil15, SandSoil20, and SandSoil30 treatments relative to the Sand treatment. Surface traction improved throughout the study. Traction readings increased over the length of the study for all treatments and were within acceptable ranges even though significant differences among treatments were not observed on three of five sampling dates. Our study found a range of 27.3 lbf•ft (Sand - fall, 2000) to 47.9 lbf•ft (SandSoil30 - fall, 2001). An additional observation occurred with the dense turfgrass cover of this study; the shear instrument sheared the grass plants and thatch layer but not the roots or rooting material, giving inconclusive readings of overall system traction. Lack of simulated traffic and a dense turf cover were factors that contributed to limited measurable differences among treatments.

Water infiltration rates

The Soil treatment had the lowest infiltration rates for the three sampling dates ranging from 75 to 233 times lower than the next lowest treatment. This result was expected, due to the smaller pore sizes of the silt loam soil used in this study compared to the other treatments. Evaluating the logarithm of infiltration rate for the three sampling dates versus the amount of silt plus clay in the rootzone mix (Sand, SandSoil10, SandSoil15, SandSoil20, SandSoil30 and Soil treatments) provided a linear relationship (coefficient of determination of 0.963). This illustrates the effect that additions of silt plus clay have on reducing the relative transport of water through the rootzone. In comparing the regression relationship for field infiltration with that for saturated hydraulic conductivity (previously discussed), a similar relationship was found with the slope decreased by about 20% and the intercept increased by about 1% for the field infiltration function. The linear correlation between the saturated hydraulic conductivity and average field infiltration values was very close.

The Sand and SandP10 treatments had the highest infiltration rates and were not significantly different; however, the SandSoil10 treatment was also not significantly lower than these two treatments for both evaluation dates in 2000. In addition, the SandSoil15 treatment was not significantly lower than the Sand and SandP10 treatments on the second evaluation date in 2000 and the Sand treatment in 2001. It has been suggested that soil can be incorporated with sand to a maximum amount of 15-20% by volume (for soil in this study it would be 11.0% to 14.6% silt + clay) before infiltration rates would reach unacceptable levels (< 6 in/hr); this supports the data from Jason Henderson in 2005 where he again indicates that mixes should have less than 10% silt plus clay. The SandSoil10 and SandSoil15 treatments support those findings.

Quality differences among treatments did occur throughout the study. In 2000, treatments with 20% or greater soil and treatments with compost additions were not significantly different from the highest values. This was most likely due to increased moisture retention compared to the SandP10 and Sand treatments. The SandSoil10 treatment was at or above the minimum acceptable level of 5.0 in 2000, but below acceptable levels in 2001. On all rating dates, the Soil treatment had the highest quality. Quality for the SandC15 treatment was not significantly different than the highest level for any date and was attributed to higher CEC (data not shown) and better soil physical properties (Table 2). ■

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Quick summary

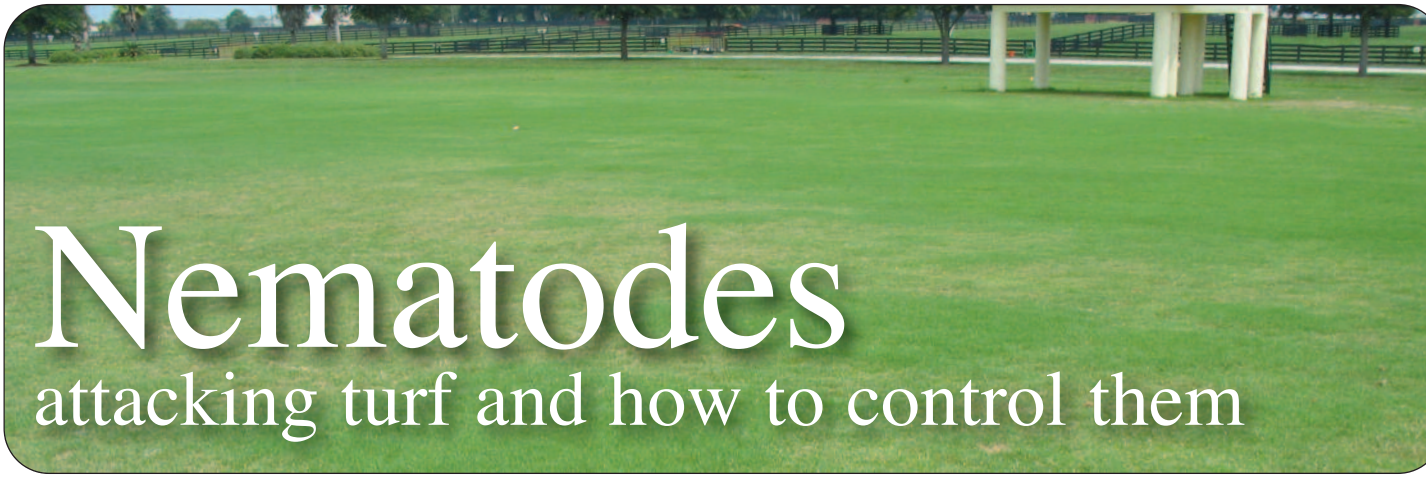
An evaluation of surface hardness, traction, infiltration and turfgrass quality for soil-sand-compost rootzones during the non-play establishment phase of a Kentucky bluegrass field found few differences in surface hardness or traction. The SandSoil10 treatment allowed similar infiltration to the SandP10 and Sand treatments and higher infiltration compared to other soil-based rootzones; however, this treatment experienced some low turfgrass quality values.

Compost treatments increased turfgrass quality but these had lower infiltration than the SandP10 and Sand treatments. Relative to cost savings, results suggest that 10 to 15% volume replacement of silt loam soil with a sand mix will not substantially reduce infiltration and will maintain turfgrass quality. The major advantage of using soil with sand-based rootzones is a decrease in the frequency of irrigation and fertilization.

While most treatments gave satisfactory turfgrass quality, absence of player and equipment traffic precludes any prediction for long-term success. Follow-up research that emphasizes player traffic on sand-soil rootzones should provide additional information in making long-term decisions. The major contribution this research offers the athletic field industry is a sand-soil rootzone study that combines both laboratory analysis and field investigations. In conclusion, these sand-soil rootzones appeared to maintain adequate performance characteristics after two years that would allow for safe, playable athletic fields.

Image courtesy of istockphoto.com

 By Dr. William T. Crow



Nematodes
attacking turf and how to control them

>> **THINNING BERMUDAGRASS** and weeds resulting from sting nematode on a municipal athletic field.

PLANT-PARASITIC NEMATODES are microscopic worms that feed on plants. Because they cannot be seen with the naked eye and live underground it is easy to overlook them, but to do so is a mistake. These small animals can cause big problems for sports turf managers. While nematode problems are not confined exclusively to southern states, nematode problems are definitely more common the further south you go. This is due to soil and environmental conditions that favor population development of the more damaging nematodes.

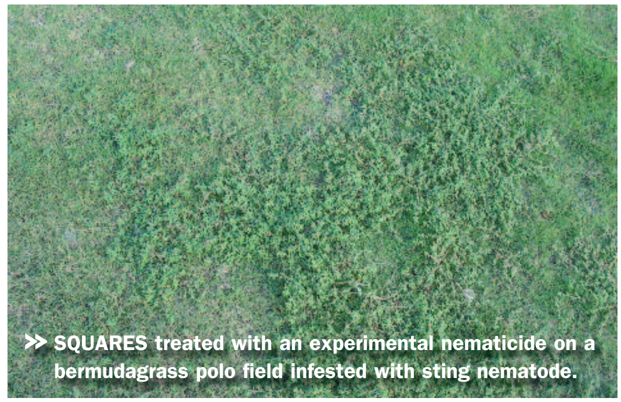
Several nematode species are turfgrass parasites that can cause severe problems to sports turf by feeding on the turf roots. Certain nematodes cause the roots to turn brown and rot; others cause the roots to be short and stubby. Either way, a poorly developed root system is not a good thing. The effectiveness of nematode-damaged roots to carry out these functions is greatly impaired.

Many states are struggling to preserve their water resources. As water quantity is limited, many sports fields are restricted in the amount of water available for their use. This is particularly true of municipal and school athletic fields. Because nematode-damaged roots are shallow, they are not able to take advantage of moisture that would be available to healthy roots. If your roots are a half-inch deep they can not get to moisture one-inch deep. Therefore, the primary visual symptom of nematode damage is turf decline from drought stress caused by nematode-impaired roots. Our research has shown that with just moderate nematode populations, nematicide use can greatly increase drought tolerance of bermudagrass.

Because the nematodes that feed on turf roots do not feed on many weeds, the weeds have a competitive advantage in nematode-infested fields. This means that you are faced with increased herbicide costs to control the weeds and/or unsightly weeds that people will complain about.

Another issue that arises from nematode damage to athletic fields is player safety. A healthy root system prevents the turf from pulling up as players push and make sharp turns. At the University of Florida we pride ourselves on the speed and power of our football team. In order for our players to best perform their feats of athletic prowess they need their feet to stay under them. The last thing any of us wants to see is injuries due to poor footing. Florida Field ("The Swamp"), like many athletic fields in the southeast, is infested with sting nematode, the most damaging nematode to bermudagrass. Therefore, each year Florida Field is treated with a nematicide not only to preserve aesthetics, but to help the players fly.

Nematodes typically cause irregular-shaped patches of weedy, thinning, wilting, and declining grass. These symptoms could be caused by other factors than nematodes so it is important to get a correct diagnosis. The first step is to take a look at the roots of the turf. If the turf roots are stunted, rotten, or lumpy, nematodes might be a problem. Because other things can cause similar root symptoms, your detective work is not finished. Next you need to take samples to send to a credible nematode diagnostic lab to find out if nematodes are in fact a potential problem. Because the nematodes are so small they will have to be separated from the soil into water and then identified and counted with a microscope. Based on the number and kinds of nematodes in the sample, the lab staff will then determine if nematodes are a potential problem or not. In order for the lab to properly diagnose a nematode problem it is important that the samples are properly collected. So, what makes a good nematode sample?



>> SQUARES treated with an experimental nematicide on a bermudagrass polo field infested with sting nematode.

Nematodes occur in clumps, so you do not want to take a single plug. Rather, you need to collect about 16 to 20 cores from the field and combine them into a single sample. If symptoms are visible concentrate your sampling in the symptomatic areas. Stay away from dead areas as the nematodes you are looking for have to feed on live roots. You want to sample grass that is sick, but not dead. If there are no visual symptoms then sample in a zigzag pattern across the field. Your cores should go down about 3 to 4 inches deep.

Put your sample into a plastic bag and seal it up to prevent the nematodes from drying out. As soon as you take your sample get it out of the heat and into an air-conditioned room until you can ship it. You want to send the sample to the lab as soon as possible, the longer it sits around, the fewer nematodes will be recovered.

Once nematodes are identified as being a problem, how are they managed? Unfortunately, nematicide options for sports turf are limited at present. However, in the states of Florida, Georgia, South Carolina, North Carolina, Alabama, Mississippi, Louisiana, and Texas Curfew soil fumigant is an option. The active ingredient in Curfew is 1,3-dichloropropene or 1,3-D.

1,3-D is one of the most effective nematicides and has been used for nematode control on agricultural commodities for many years. It has been only recently that 1,3-D has been used for nematode control on established turf. Our research has found Curfew to be very effective against nematodes in soil, and certain turf insect pests as well. Research has shown that Curfew application to nematode-infested turf can improve drought tolerance and fertilizer use and consistently increase rooting and turf quality.

Being a fumigant, Curfew works very different from most other turfgrass pesticides. It may only be applied by custom application by a Dow Agrosciences-approved custom applicator. The nematicide is injected 5 to 6 inches deep in the soil by slit injection using specialized equipment. It is in a liquid state when it is injected, but then disperses through the soil as a gas. In Florida Curfew use on athletic fields has been increasing and it has been applied to fields used by professional and big-name college athletic programs, school ball fields, equestrian facilities, and municipal recreational facilities. Acre minimums apply so contact your Dow representative to discuss the practicality of an application.

There are number of other products being used for nematode control on turf. These include several botanical nematicides, microbial products and inoculants, and beneficial nematodes. While some of these might help in certain situations, most have either shown minimal, inconsistent, or no efficacy in research trials.

Last October highly touted University of Georgia running back Knowshon Moreno met the Florida Gators' linebacker Brandon Spikes, at that moment he also became very intimate with the playing surface of Jacksonville Municipal Stadium. This illustrates that there is a lot of opportunity for humans to be exposed to pesticides on sports fields. Additionally, many sports fields are used by children, the least tolerant of pesticide exposure. For use on athletic fields a nematicide needs to be both effective and safe for the humans and animals that will be coming in contact with the turf.

Recently our research has identified several new strategies that are looking very promising on turf in the field. We are looking for strategies that are consistently effective and reasonably safe. These include new reduced-risk synthetic nematicides, analogues of essential amino acids, and biopesticides. Based on our work with these I am hopeful that we will have several effective and safe nematode management options to use on sports turf in the next one to three years.

The use of nematode resistant or tolerant grasses should reduce the need for nematicides and be a foundation for nematode management. However, the relative susceptibility of turf cultivars to different nematode species is largely unknown. Also, there have been no major efforts to breed turfgrasses with improved nematode response. At the University of Florida we are studying the susceptibility of available bermudagrass and seashore paspalum cultivars to sting nematode. We have completed our first year of research and found some cultivars that were much less damaged by sting nematode than others. In the next couple of years we should be able to recommend grasses with fewer nematode. We also are screening bermudagrass and zoysiagrass germplasm in an attempt to breed future cultivars that have enhanced nematode response.

Plant-parasitic nematodes are important pests of sports turf, particularly bermudagrass in the southeast. Management of these nematodes can reduce water and fertilizer costs, use of herbicides, and the potential for player injuries. While currently there are few effective nematode management strategies, help is on the way. This help will include a combination of nematicides, biopesticides, and improved turf cultivars. ■

Dr. William T. Crow is associate professor of nematology and director of the University of Florida Nematode Assay Lab.

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Johnson, Warczak have Timber Rattlers shakin' good

TIME WARNER CABLE FIELD at Fox Cities Stadium, Appleton, WI won the 2008 STMA Professional Baseball Field of the Year Award this past winter. Justin Johnson, director of stadium operations, and head groundskeeper Eddie Warczak led the winning effort, assisted by crew members Adam Brown, Matt Andrews, Will Granderson and Derek Loda. [Ed's note: Johnson now works for the Omaha Royals.]

In addition to being home of the Single A Midwest League Wisconsin Timber Rattlers (Brewers affiliate), Time Warner Cable Field hosted events in 2008 ranging from the NCAA Division III World Series to a Trace Adkins concert, with plenty of high school and Legion games, camps, tryouts and charity events mixed in between.

Johnson, replaced by Warczak when he moved upstairs as director of stadium operations, has his bachelor's in agronomy from the University of Nebraska and oversaw the 2006 renovation of the then-12-year-old field, with assistance from crew member Warczak. The two recalled in their Field of the Year entry how they dealt with the Wisconsin weather last year:

"The Timber Rattlers are the northernmost team in the Midwest League, meaning we're still dealing with winter weather at the start of the season. We had received 96 inches of snow [that] winter, more than average, so that set the stage for a challenging pre-season.