green world
AN INDUSTRYWIDE PUBLICATION OF THE NEW JERSEY TURFGRASS ASSOCIATION
NJTA

Vol. 18 No. 3 September 1989

Soil Texture and Profile for Athletic Fields

D.H. Taylor, G.R. Blake, and D.B.White

Soil Profile

Soils for athletic fields present complex physical problems. These soils are subjected to concentrated traffic, often when soil is wet and most vulnerable to compaction. Natural soil structure at the surface is continually broken down and leads to compacted soil having poor water and air movement. This soil compaction inhibits water drainage for the soil and reduces oxygen movement to plant roots, causing oxygen deprivation and death of the roots.

A soil profile that maintains good growing conditions despite frequent traffic offers a satisfactory solution to this problem. A method that has worked well is to excavate the soil to 14 to 16 inches below the desired grade, install a tile drainage system in trenches cut into the soil, and cover the entire field with 2 to 4 inches of coarse sand or very fine gravel. On top of the sand place 12 to 14 inches of a modified soil mixture that maintains enough large pores even after compaction to insure adequate drainage and air movement for root growth. Figure 1 shows a sketch of this profile.

Reprinted with permission of the University of Minnesota. D.H. Taylor is extension specialist, Department of Horticulture; G.R. Blake is professor emeritus, Department of Soil Science; and D.B. White is professor, Department of Horticulture. Dr. Blake was professor of Soil Physics at Rutgers University before moving to the University of Minnesota.

Drainage

Prompt removal of excess water promotes optimal plant growth conditions and minimizes sports play disruption during periods of rainfall. When constructing athletic fields, supply both surface and subsurface drainage.

Surface drainage removes excess water that does not infiltrate into the soil. Surface drainage is supplied by sloping the surface slightly from the field's center to its sidelines. For most athletic surfaces, a slope of 1 to 1.5 percent is suitable and minimally affects play. A 1.5 percent slope on a football field is equivalent to a 15-inch crown running the field's length.

To remove the surface runoff from the field, install a trench along sidelines, outside the bench area, and at the lowest grade level. Place drain tubing in the bottom of the trench and then extend coarse sand to the surface to allow excess surface water to infiltrate quickly and be removed.

Subsurface drainage that removes excess water after it infiltrates into the soil is as important as surface drainage. After water infiltrates the soil, subsurface drainage removes excess water that would stop root growth by cutting off the oxygen supply. In most cases, subsurface drainage is supplied through a system of flexible plastic drainage tubes. Drain tubing used for athletic fields commonly measures 3 to 6 inches in diameter.

Dig trenches for subsurface drainage lines at a depth where the top of the tubing will be at least 16 inches below the final grass surface. Trenches need to be only 6 to 8 inches wide and should have a uniform grade of 1 percent so that water will move rapidly to the system's outlet and prevent water pockets in trenches. Construct trenches to assure a uniform slope. Subsoil excavated from these trenches should be removed from the site to avoid plugged

— continued on page 4

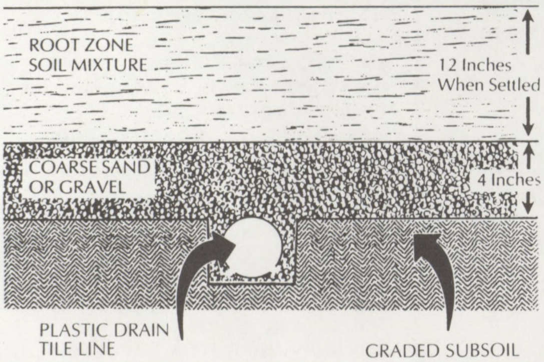

Figure 1. Vertical cross-section of soil profile recommended for athletic fields.

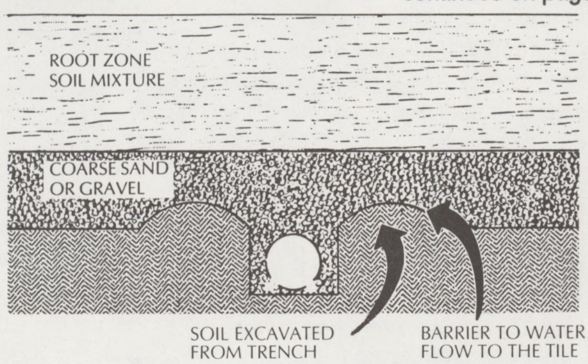

Figure 2. Diagram of soil profile shows problem caused by leaving soil excavated from tile line trench at the site. Water encounters a barrier of fine soil in its flow path to the trench.

OPINIONS AND COMMENTS

Things You Do Not See on the "Front Page"

When the tragic death of Navy Lt. George Prior was announced in 1982, considerable publicity blamed Daconil 2787 fungicide, which had been applied to the golf course where he played before his death.

In the lawsuit of Prior v. Diamond Shamrock, the court decided Lt. Prior died from toxic epidermal necrolysis (TEN), which was caused by a viral infection.

A review of all medical writings regarding TEN confirmed that Daconil 2787 has never been associated with the disease during 18 years of the fungicide's use and the vast number of rounds of golf played on courses where it had been applied.

The handling of this event in the news should help us remember that most of us who have seen a report of this decision, saw it in turf and landscape publications. Did anyone see this in their local newspaper or hear it on the evening TV news? All the news about Alar on apples rarely touched on the poor justification for banning sales. This incident was very costly to the apple industry, and the consumers who use apples as a health food.

We need environment watchfulness, but costly mistakes will continue until environment news is based on good decisions and has even-handed reporting. •REE

Man's real life is happy, chiefly because he is every expecting that it will soon be so. —Edgar Allan Poe

---

"Truth" surely has the record for one-liners.Pope John XXIII adds one that is especially appropriate for our age: "Human society is ordered, productive and in accord with human dignity only if it is based on truth. "

Green World is published three times a year by the New Jersey Turfgrass Association, P.O. Box 231, New Brunswick, NJ 08903. Consulting editor: Dr. Ralph Engel; advertising chairman, Sam Leon; production editor and layout artist: David Crismond.

Sustaining Members of NJTA

A-L Services Incorporated
A. Lombardi Landscaping
Aabar, Inc. / The Morie Co.
Agri-Diagnostics Associates
Alpine Country Club
Aqua-Flo, Incorporated
Aquarius Irrigation Supply
Aquashade, Incorporated
Aquatrols Corp. of America
Arthur's Landscape & Irrigation Co.
Associated Marketing, Incorporated
Barefoot Grass Lawn Service
Barnes Landscape
Basking Ridge Golf Course, Inc.
Benco Services, Landscape Div.
Brickman Industries, Inc.
Brouwer Turf Equipment
Bunton Turf Products, Inc.
Champion Landscape and Tree, Inc
Coger Farms & Garden Center
D & J Landscaping
Del Val Design Landscape
Delalio Sod Farms, Incorporated
Double Eagle Equipment Company
Dow Chemical, USA
DuBrows's Nurseries
Evergreen Lawn Sprinklers
Farmstead Golf & Country Club
Ferti-Soil Turf Supply, Incorporated
Fiddler's Elbow Country Club
Florence Landscape Services, Inc.
Forsgate Country Club
Fredette Landscaping
Freehold Township Parks & Rec.
Garfield Williamson, Incorporated
Glen Summit Nurseries, Inc.
Grass Roots, Incorporated
Green Acres Country Club
Green Grass Landscape Svc., Inc.
The Green Machine, Inc.
Grinkevich Lawn & Landscaping
Hoffman-LaRoche, Inc.
Homestead Lawn Sprinkler Co., Inc.
Hopewell Valley Golf Club
Horizon Estates
Irrigation Unlimited, Incorporated
Jade Run Turf & Sod Farm
JEP Sales, Incorporated
Jimni Krickett, Incorporated
Lawn Doctor Mountainside/Cranford
Lawn Power Equipment Company
Lawn Spray Company
Lebanon Chemical Company
Lee Rain, Incorporated
Leon's Sod Farm
Leonard Reinhardt, Incorporated
Lesco, Incorporated
Lofts Seed Incorporated
MacAndrews & Forbes Company
L.J. Makrancy & Sons, Inc.
Meadowbrook Lawn Service, Inc.
Metro Milorganite, Incorporated
Mid Atlantic Equipment Corp.
Middletown Sprinkler Company
Montco / Surfside
National Lawn Services of NJ, Inc.
NJ Nursery & Landscape Assh., Inc.
O.M. Scott & Sons
Paige Electric Corporation
Partac Peat Corporation
Paul's Lawnscaping
Pennsauken Country Club
Pine Island Turf Nurseries, Inc.
Pleasant Hills Landscaping
Pocono Turf Supply Company
Rapp Sod Farm
Reed's Sod Farm
Reid Sod Farm
Rich Green Lawns
Rockland Chemical Company
Rosedale & Rosehill Cemetery Assn.
Royal Lawns of Monmouth
Rumson Country Club
S&A Irrigation & Lawn Services
Sacco's Landscape, Incorporated
Sandoz Specialty Sales
Scian's Landscaping Incorporated
Seabright Lawn Tennis Club
Seacoast Labs
Sequoia Lawn Care
Sierra Crop Protection
South Jersey Weed Control
Steve Tanis Lawn Care
Storr Tractor Company
Suburban Lawn Service
Surf Landscaping
Sweeney Seed Company
Toms River Lawn & Sprinkler Inc.
Trenton Country Club
Upper Montclair Country Club
U.S. Golf Association
Vaughan Seed Co.
W. A. Cleary Corporation
Wayne Township Parks Department
Wells Lawn Service, Incorporated
Wilfred MacDonald, Incorporated
Wilpat Turf Sprinklers, Incorporated
Woodbridge Center
Woodbury Board of Education
Woodruff/Lerco Lawns of So. Jersey
World Class Lawns

1989 OFFICERS OF THE N.J.T.A.

William Waddington, *President*
Robert Dickison, *V President*
Ralph Engel, *Secretary*
Carol Wolcott, *Exec. Secretary*
Joseph Bianco, *Treasurer*
Jack Poksay, *Past President*
Henry Indyk, *Expo Chairman*

EXECUTIVE BOARD

Robert Dobson
Richard Gorbich
Richard Hurley
Samuel Leon
L.J. Makrancy, Jr.
Joseph W. Manning, Jr.
Ed Milewski
Bruce Nagy
Steve Stys

OPINIONS AND COMMENTS

Are Things We Do for Turf Worthwhile?

Research is beneficial to better turf, but it is usually expensive and time-consuming. Like most things biological, many unanswererd questions remain. Turfgrowing seems doomed to suffer along without important answers, because of the numerous problems which are difficult and complex to study. Some seem to defy solution.

Yet, when we encounter turf problems, our determination or the demands for better turf pressure us into trying the "new thing" or the best available theoretical answer. This seems a justifiable action, but cost, failure, and risk to turf can be worse than the original problem.

After you decide to use a new procedure, plan to evaluate what you "tried." Does the new or somewhat untried work? Does the so-called standard treatment work as satisfactorily as you believed? What are the long-term results? Was there short- or long-term turf injury? Answering some questions can require a career of formal research. Yet, the grower has a responsibility to acquire more knowledge about the worthiness of new things tried.

The most practical and simplest method of evaluation is leaving an untreated check strip beside the treatment used. In some cases, you might treat across a tee or fairway in an inconspicuous area. Usually, the strip should be a minimum of 20 to 40 feet long. It can be marked by a tree, waterhead or fixed marker. A trial strip at several locations is often desirable. Record the location and date. With some materials or treatments, repeat the process for several years.

This procedure is unlikely to answer all your questions. Yet without the treated and untreated comparison, it is often impossible to know why or if a turf change occurred. But the trial strip will often tell you if the treatment was a success, failure, or safe procedure. Some of our turf treatments are very costly and the nature of the problem obscure. The grower has a need and obligation to learn as early as possible if a treatment is necessary, effective, and is worthy of further use. The use of the check-strip treatment can be helpful on one-time treatments or a series of treatments over a period of time.

The best part of the check strip is the low cost in time and money.

•REE

GreenWorld's Mission & Sponsors

Greenworld is approaching 20 years of publication. The articles have as much information as in some turf books. The costs of publications have been covered largely by advertisers. They have helped NJTA fulfill its mission of assisting with (1) turf education, (2) turf grass research, and (3) informing the public of the role of turf. This big assist from our advertisers leaves more money that is donated to turfgrass research. We know the key role research plays in growing better turf.

Among the several dozen advertisers I wish to acknowledge: Lofts Seed for 41 paid advertisements through the span of this publication, Garfield-Williamson and Rockland Chemical had 25 and 27 advertisements respectively since the late 1970's. A range of 15 to 19 advertisements have been paid by each of the following: Cleary Corporation, Lebanon Chemical, Storr Tractor Company, Terre Company, and the Wilfred MacDonald Company. We owe a special thank you to all others who advertised occasionally!

In addition, we thank Sam Leon, William Nist, and Jack Wittpenn for managing most of the advertising arrangements over the past 20 years.

•REE

Soil Texture and Profile for Athletic Fields

— continued from page 1

drain tubing perforations and to prevent the situations illustrated in Figure 2, where water does not flow quickly along the sand/subsoil interface of the drainage trench. The bottom of the trench must be clean, firm and of uniform grade. Tile or tubing can be placed directly on the bottom of the trench. Sand or very fine gravel can then be backfilled into the trench until it is 2 to 4 inches above the top of the trench. Exercise care during the backfill operation to insure that drain tubing remains in place at its original depth.

Spread 2 to 4 inches of coarse sand over the entire field. During this procedure, avoid driving construction equipment over drainage trenches because protection from crushing the plastic lines is not yet in place. This layer of sand serves several purposes. First, when the soil mixture above the sand becomes saturated, the sand allows excess water to move rapidly to the drainage lines. Second, when the soil mixture consists of distinctly different particle size compared to the sand, the sand allows more water to be held in the soil mixture above. Third, sand separates drainage lines from the soil mixture and thus prevent small soil particles from moving into the lines and possibly clogging portions of the drainage system.

Drainage lines throughout the system must have a continuous slope to the outlet. The outlet must be capable of handling the maximum flow expected through the drainage system. Otherwise, portions of the system, particularly those near the outlet, can become inoperative and cause soil to remain excessively wet.

Soil Mixtures for the Rooting Zone

Deciding soil mixture specifications for the rooting zone is one of the most critical decisions of athletic field construction. The mixture must allow adequate air and water outflow to sustain plant growth even after compaction. Some water and nutrient holding capacity is also important to reduce the intensity of management required. Using soil mixtures with very high sand content generally achieves these requirements.

Most sands maintain large pores after compaction. These large pores allow water and air to flow quickly through the sand. By itself, however, sand retains very little water and almost no plant nutrients. Clay particles in soil and organic matter are the principal sources of water and nutrient holding power, but as the amount of clay and organic matter in a soil mixture increases, more large pores become blocked and water and air movement are impeded. The objective of blending sand and soil for athletic fields is to mix just enough clay and organic matter into the sand to give adequate water and nutrient retaining power without reducing water and air movement to a detrimental level.

The authors recommend starting with a washed sand of suitable quality and mixing in small quantities of soil and peat. Sand and gravel companies can inform you about their sands, but additional testing may also be necessary.

— continued on page 5

Soil Texture and Profile for Athletic Fields

— continued from page 4

An acceptable sand contains more than 60% particles between 0.25 and 1.0 mm in diameter (medium and coarse sand according to the USDA soil classification). This gives a relatively uniform sand with many pores of similar size, thus maximizing air and water movement through sand. Sand particles larger than 2 mm or smaller than 0.1 mm in diameter are undesirable and should constitute less than 3 percent of the sand by weight. Most sand suppliers list fineness modulus values for their sands; these values indicate the general fineness or coarseness of a sand. Sands with fineness modulus values between 1.7 and 2.5 are recommended for use in athletic field soil mixtures. Generally, a washed or size-graded sand is needed to meet these requirements. Table 1 below summarizes these specifications.

Table 1. Specifications for sand used in athletic field soil mixtures.

Fineness modulus	1.7 to 2.5
Particles < 0.1 mm	less that 3% wt.
Particles > 2.0 mm	less that 3% wt.
Partciels 0.25 to 1.0 mm	more than 60% wt.

Mortar or plaster sands that meet specifications in Table 1 are available at many sand and gravel companies throughout the state. Commercial sands vary considerably in particle size and suitability for soil mixtures; many are well suited and can be used with confidence but others should not be used. Concrete or coarse building sands, often available from the same companies, generally contain particles too large for soil mixtures. Sands used for specialized industries such as petroleum or sandblasting are sometimes available. Some of these sands are well suited for athletic field mixtures whereas others are not.

Soil used in the mixture should be free of herbicide residues, roots and stones. Texture can vary widely, but soils low in silt and very fine sand (0.002 to 0.1 mm diameter) are preferred. Silty soils used in mixtures often cause unusually low water infiltration rates and poor internal water drainage. Soils with silt contents exceeding two and a half times that of the clay fraction are not suitable. Soils having silt-to-clay of 2.0 or less are preferred.

Peat used in soil mixtures must be high in organic content. Reed-sedge, hypnum or sphagnum peats are suitable if the organic content is greater than 75% by weight. Generally, muck soils are unsuitable, usually detrimental, and are not recommended.

The amount of each component (sand, soil, and peat) varies primarily with the texture of the soil component and may also depend on the depth of the soil mixture to be installed. If a 12-inch layer of settled soil mixture is laid over a coarse sand or gravel base, a soil mixture with 88 to 92% sand content by weight is recommended. Since the soil will settle, a 14-inch layer of loose soil moisture should be laid. Because the soil contributes sand to the mixture, actual mixing volumes of sand, soil and peat vary dependent on the sand content of the soil used.

Use Figure 3 on page 6 to determine the mixing volumes of sand, soil and peat needed to obtain a specified sand content by weight. Before using the graph you must know the sand content of the soil.

The following example illustrates how to use the graph. Suppose you want to have a soil mixture containing 88% sand by weight and the soil you intend to use contains 37% sand. Enter the chart on the left line, then move vertically downward to a sand volume of just less than four. Thus, a mixture of 4 volumes sand, 1 volume soil and 1 volume peat would give about 88.3% sand by weight in the final mixture.

Mixing Soil with Sand and Peat

Mix sand, soil and peat only under conditions that insure a uniform mixing of ingredients. Mixing should be done off-site, away from or to one side of the

— continued on page 6

Soil Texture and Profile for Athletic Fields

—continued from page 5

athletic field site. Mixing sand and peat into existing soil generally gives a poor mixture even if the soil in place is a good one.

When mixing from precollected piles of sand, soil and peat, the shovel operator may need help deciding how to implement the volume-ratio specification. Determine with the operator the number of scoops per load of each component and instruct him or her of the need to obtain equal volumes of each. Occasional checking of the mixture by the soil specialist or architect during the mixing process helps determine if adjustments are needed. The most satisfactory equipment for off-site soil mixing is a mixer-shredder that accepts components and pulverizes, mixes and elevates them to a rotary screen prior to delivery.

Work on mixing soil only at a moisture content that maintains natural soil structure. When mixed at a high water content, soil compacts, balls up and forms a non-uniform mixture. If mixed when too dry, soil tends to separate from sand or to remain cloddy, again forming a poor soil mixture.

Editor's Comment:

Considerable diversity of opinion exists on the specifics of the proper soil mixture for athletic fields. Few question that most natural soils need amendment. This paper from the University of Minnesota covers many aspects nicely and has a unique table for predicting soil mixtures. The 12-inch depth of root zone mix does not offer potential for best rooting that might occur with a deeper profile. Sand particle size is covered simply and is important. Nothing is said about the chemical nature of the sand. In this area, we deal largely with silica sands which are usually considered best.

In achieving the desired soil product, our planning, mixing, and choosing the soils for atheltic fields needs careful scrutiny. We lack answers to important questions and find it difficult to do the work as intended. Even worse, anxiousness to complete the project forces shortcuts. We should ask for the time needed to do the work correctly. This involves study, seeking and testing of materials. Our friends from Minnesota have given us a good presentation. Study this, and a paper of Dr. Spomers (University of Illinois) found in a 1977 Greenworld (Vol. 7, No.1), as an early step in planning the soil needs for intensely used turf. **•REE**

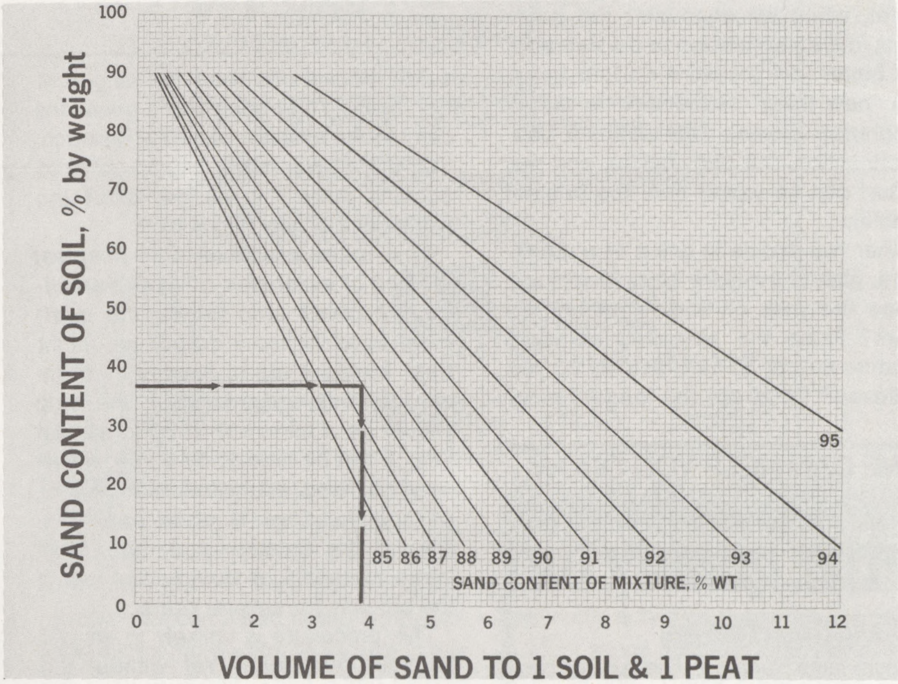

Figure 3. Nomograph to determine mixing volumes of sand, soil and peat for athletic field soil mixtures (from Taylor, D.H. and Blake, G.R. "Predicting sand content of modified soil mixtures from sand, soil and peat properties." *Agronomy Journal 76: 583-587*