

Growing Better Turf for

FOOTBALL FIELDS

**Using Thermally Optimized Clay
Soil Amendments**

*The Pro's Choice[®] Football Field
Turf Soil Conditioner Program*

Professor Henry T. Wilkinson
University of Illinois

Pro's Choice[®]
Sports Field Products

410 North Michigan Avenue
Chicago, Illinois 60611
Phone: 800-648-1166
Fax: 312-321-1271
Email: proschoice@oldri.com
Website: www.proschoice1.com

AUTHOR BIOGRAPHY

Professor Henry T. Wilkinson is a world expert on designing, building, and maintaining natural grass sports fields. He has worked on soccer (football) fields in Holland, France, England, Scotland, and the United States. He has built numerous major and minor league baseball fields through his association with Roger Bossard of Turf Specialists, Inc. Most recently, he has been the lead turf consultant for new stadium construction for the St. Louis Cardinals, Seattle Mariners, Detroit Tigers, Chicago White Sox, and Milwaukee Brewers. Through his involvement with Arena Stadium in Holland, Safeco Field in Seattle and Miller Park in Milwaukee, he has become the leading turf expert for retractable dome stadiums.

Wilkinson has designed and built little league, softball and municipal sports fields. His knowledge of rootzone and drainage materials, turf and field designs makes him a valuable resource at the University of Illinois.

When asked how he approaches building an athletic field, he states, "First and foremost you must never forget the purpose of the field: athletics. Next, you must use common sense in designing and constructing the field: as simply as possible. Finally, you must design the field with both the construction and maintenance budgets in mind."

Wilkinson was recognized as *Scientist of the Year* by the Sports Turf Managers Association (STMA) for his work on the use of thermally optimized clay soil amendments to improve grass rootzones.

TURF FOR FOOTBALL FIELDS

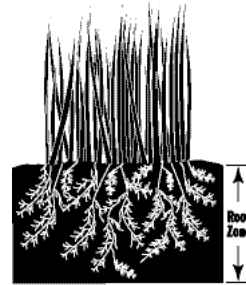
Most football fields rely on natural grass as the cover for the playing surface. The popularity of natural grass compared to artificial surfaces is easy to understand: fewer athlete injuries, cooler playing surface and aesthetics. Artificial "grass" surfaces are used to reduce the impact of weather on the playing surface. However, this comes with some compromises: a field that is hotter, has to be crested to shed water, and is highly resistive to shear forces from feet. Real grass is a living plant and, as such, can be damaged by the game of football. However, with a proper rootzone and good management, grass will perform well.

TYPES OF GRASS FOR FOOTBALL FIELDS

There are five grass types used for football, (compared to two types used for baseball). In baseball, the effect of the grass on the movement of the ball is very important to the nature of the game. For football, the ball has very little interaction with the grass. Therefore, the grasses are selected for their adaptation to the local environment. The most common types of grass used for football fields are: Kentucky bluegrass, fescue and perennial ryegrass in the cooler climates; and Bermudagrass and zoysiagrass in the warmer climates. Ryegrass is used primarily as an overseeded grass for football. In the northern United States, it is used to repair damaged areas during the season. Fields that use Bermudagrass or zoysiagrass are generally overseeded with perennial ryegrass in the mid-fall, to ensure a good quality football field when these turfs become dormant in the cold months. Zoysiagrass is gaining in popularity for football fields, but it is a very slow growing grass and is more resistant to overseeding with ryegrass than Bermudagrass. While turf leaves are the surface football is played on, to achieve a good quality turf for football, it is very important that the grass has a well-designed rootzone. The rootzone is the soil under the grass, which supplies grass with water, air and nutrients. If you have a good rootzone, you will have a good turf for football.

Football is one of the most destructive sports, in terms of damaging the grass plants. Only horseracing and maybe rugby is more destructive to grass. Several factors contribute to the severity of football damage to a natural turf field. First, the football season extends into the fall and

early winter, when the turf is not actively growing. This means that regrowth cannot compensate for damage from the sport. Secondly, most of the game is played in an oval area, centered in the field. Finally, the strong forces that football players deliver to turf are very damaging to the turf. The players are generally heavy, and the forces they generate from running and turning are absorbed by the turf. In short, turf is going to suffer more from football than most other sports. Ceramic soil conditioners can improve the performance of turf, as a football surface.



ROOTZONES FOR FOOTBALL FIELDS

The rootzone should have a depth of 8-12 inches. Any less will reduce the performance of the field, and any more will add little to the growth of the grass. There are four important aspects of the rootzone:

1. Texture
2. Porosity
3. Drainage
4. Chemical Reaction

These four factors dictate how well a turf will grow and perform as a football field. In addition, they will also determine how effectively and rapidly a football field can be repaired. A brief explanation of how these four factors affect the rootzone will help you understand how to get the most out of your football turf.

ROOTZONE TEXTURE

Texture is the size, shape and proportion of soil particles in a soil. Soil particles are defined by size, and they must be able to pass through a mesh or screen having openings that measure 2 mm square. Further, there are three main classes of soil particles: sand, silt and clay. These three

natural soil particles come in a wide range of sizes and shapes. Soil particle shape range from flat to round, and smooth to rough. For example, clay particles are flat, and sand particles are round.

If you have a textural soil analysis done, a soil specialist will tell you how much sand, silt and clay you have. Further, a good analysis will tell you how big the sand particles are and what percentage of each size your soil has. This is useful information, but it does not tell you all you need to know to estimate soil porosity or drainage of your soil. Texture and the arrangement of soil particles are very important to the way a soil will drain water. However, a balance between drainage rate and soil cohesion is necessary to produce a football field that can rapidly drain, yet resist the strong shear forces from football players, which can damage the turf.

For these reasons, rootzones composed of sand are not recommended for football fields. The sand cannot establish strong cohesive bonds between particles: this results in excess sand movement, thus transferring the shear forces from players directly to the turf and damaging it. Sand is a good material for baseball fields and most areas on soccer fields.

ROOTZONE POROSITY

Pores are the spaces in a rootzone where water and air move and, most importantly, where the roots grow. Pores are generally described by their diameters because the diameter relates to their size. Based on their size, we can estimate whether roots will get the proper air and water they need to grow. Soil pores are created by the arrangement of soil particles. A soil made up of particles that are all the same size and shape will have uniform soil pore sizes. For example, a sand soil containing only one size of particles will have one size of pores, and these will fill and empty water all at the same time. A clay soil made up of uniform clay particles will also fill and empty water at the same time, but clay is very different than sand. Pores in clay are very small, and thus can pull and hold onto water much stronger than sand.

RULE ONE:
The smaller the pore, the stronger it holds water.

Clay can hold water so strongly that a grass root cannot absorb it. Sand holds water so weakly that it loses its water to gravity before a grass

plant has a chance to absorb very much of it. There are very few soils that are completely uniform, but some come close. Most soils are made up of more than one particle size, and this creates soil pores of different sizes.

How do you determine the porosity of your soil?

An expert can measure it. It is very important to know, and worth the money. Listed below are some general characteristics of soils with different textures. Note the approximate type of soil you have at your site (don't worry about the soil color) and review the general properties of the soil below:

SOIL TYPE	CHARACTERISTICS
Clay	Cracks when dry/slick when wet
Silt or Loam	Commonly referred to as Topsoil
Sand	Fast drainage, little water retention
Silt/Clay	Looks like topsoil/cracks when dry
Sand/Silt	Looks like dirty sand

ROOTZONE DRAINAGE

Drainage is a descriptive term that defines how fast a soil both absorbs and releases water. When it rains or you irrigate, the first thing that happens is the water is absorbed into the upper surface of the soil (vertical drainage). This starts very quickly, especially if the turf and soil are dry. But soon after it starts, the top inch of soil will be saturated and absorption will slow down.

The texture and porosity of a soil determines how fast water will be absorbed by a dry soil. A soil that is saturated will absorb water only as fast as it is lost from the bottom of the rootzone. This is called horizontal drainage. Once all the soil pores in a rootzone are filled with water (saturation), the rate at which water will drain horizontally is a function of how fast the water can be removed from the rootzone (drainage system capacity). To speed up drainage, perforated pipes are usually buried under a rootzone (the drainage system). As you can now understand, there is a lot more to the drainage of a rootzone than just these drainage pipes.

Drainage is very important for both the growth of turf and the game of football. The grass needs a rootzone that drains well, so it can receive fresh water and air. For football, water

management is very important, because in certain climates the ground could be frozen during the time of play. A well-aerated field will still drain water when partially frozen. A soil that does not drain well will be either too wet (water-logged) or too dry. Either condition will produce poor grass and a poor football field.

When soil is too wet, it will become slippery and move under force. For the game of football, drainage and soil stability (cohesion) are very important for a good quality field that will last. A sand rootzone that absorbs and drains water very quickly can take several inches of water in less than a few minutes, but this type of rootzone offers turf little protection from the damaging forces delivered by the game of football. A sand rootzone can be somewhat stabilized by the addition of water, but it will never be stable enough, with just water and roots, for the game of football. A rootzone can be built from many different soils: each will drain at a different rate and offer different degrees of particle stabilization and protection for the turf. The following example will help you understand the complexity of football rootzones and how to design one.

A rootzone made up of medium-textured sand will drain water at a rate of 30 inches or more per hour. However, this rate of drainage is very seldom attained on a football field for a simple reason: the grass resists or slows down the rate of vertical drainage. A dense turf growing on a sand rootzone slows the drainage rate to 2 inches per hour.

RULE TWO:

The root zone is very important for ensuring a good drainage system, but the turf is also important in determining the final rate of drainage.

The best type of rootzone is one that drains water quickly, but holds enough for the grass to grow properly. For this reason, a football field rootzone should be designed to balance the horizontal drainage rate and particle stability. Mineral soils containing mostly silt and sand with just a small fraction of clay are the best. A soil composed of these materials that drains 5-10 inches of water per hour works well. Adding a ceramic conditioner to these soils can improve the porosity, resulting in an even better rootzone.

ROOTZONE CHEMICAL REACTION

Roots need air, water and nutrients to grow. The soil structure provides support for roots to get air and water. The nutrients that the grass uses must be available in the water that is contained in the pores. Grass nutrients are not always in soil water, but are mostly found bound to the surface of soil particles or organic material. Soil particles, especially clay, have charged surfaces, and it is to these surfaces that plant nutrients bind.

Organic matter (dead plant material) is a nutrient source with charged surfaces to which nutrients bind. Therefore, a mixture of both clay and organic matter in a rootzone is desirable, but too much of either of these causes problems for both grass growth and drainage. Clays do not allow for good drainage if they comprise more than 10% of the rootzone material, and organic matter can clog soil pores and greatly inhibit soil drainage if it makes up more than 5% of the rootzone material. You can add or amend soils with materials that will increase the surface charge for nutrient holding and not inhibit drainage. One of these materials is a ceramic soil amendment clay (Pro's Choice® Soilmaster® soil conditioner.)

CERAMIC CONDITIONERS: ENHANCING YOUR GRASS ROOTZONES

A rootzone is the soil in which grass roots grow. Generally, it should range from 8-12 inches under the turf. For a rootzone to support good root growth, it must be porous enough to allow water and oxygen to move through it. By using a clay soil amendment, you can improve your rootzone's porosity.

In porous soil, the roots absorb water and oxygen, thus allowing them to grow. As the roots grow, the top of the turf (the leaves) will also grow. The better the root growth, the better the turf looks and plays. In addition, good root growth means that many roots will grow deeply into the rootzone, and this means stability and good footing for football players. The second important feature of clay soil amendments is its ability to hold water and nutrients. Each particle of ceramic conditioner contains thousands of micro-pores and has a huge surface area, which holds water and retains nutrients for root growth.

COMMON APPLICATION QUESTIONS

Will ceramic conditioners improve all soils?

The answer is yes, but some soils benefit more than others. Clay soils and sand soils will probably benefit the most, because they have either too many small pores (clay) or too many large pores (sand). Clay soil amendments can increase both large pore volume in clay and small pore volume in sand. The size of a ceramic conditioner’s clay particles ranges from the size of sand particles to several times larger than sand particles. However, ceramic conditioner clay particles have many small pores on the inside, which can store water and nutrients. When used properly, clay soil amendment particles will integrate with natural soil particles and improve any soil.

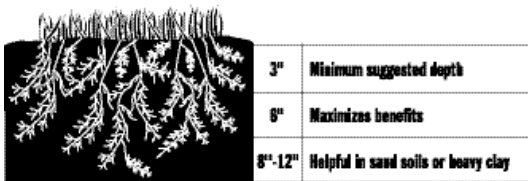
How are these soil amendments used most effectively?

It is recommended that you always incorporate or till-in ceramic conditioners when using them to improve the rootzone before you plant grass. This can be done with a roto-tiller or soil blender for big operations, or you can mix it into the soil using hand tools for small areas. It is important that the ceramic conditioner be thoroughly and uniformly mixed into the soil. This will ensure that you get the maximum benefit.

RULE THREE:

Thoroughly incorporate ceramic conditioners into dry soil for good root growth.

How deep should ceramic conditioners be incorporated into the soil?



The maximum benefit will be realized in the top 3 inches of the soil: the depth at which most of the grass roots will be found. However, it is better to incorporate the ceramic conditioner to a depth of 6 inches, because it increases both the stability of the rootzone material and the adhesion of the turf to the ground. Below 6 inches, the benefits from adding any soil

conditioner will be small unless the soil below this depth is heavy clay, then incorporating ceramic conditioner into this soil can improve the horizontal drainage.

RULE FOUR:

Incorporate ceramic conditioner as deep as you expect roots to grown in your soil.

What clay particle size works best for your rootzone?

There are three standard sizes of ceramic conditioners in the industry [24/48, 8/16 and 5/30. The 24/48 particle size of ceramic conditioner is recommended for sand rootzones, such as those found on golf greens and tees, baseball fields and some soccer fields. There are also finer-textured products, but these are generally recommended for rapid surface water (puddle) control. Pro's Choice offers two standard sizes that would be appropriate for mineral soils containing silt, sand and some clay: Soilmaster Select (8/16 and Soilmaster (5/30). The following is a general recommendation for using these Pro's Choice products:

TYPE OF SOIL	PARTICLE SIZE	PRO'S CHOICE® PRODUCT
Natural Soil (high clay content)	5/30	Soilmaster® Infield Conditioner
Natural Topsoil	8/16	Soilmaster Select® Topdressing

Why are various sizes of thermally optimized clay recommended for different soil types?

In natural soils, there is a wide range of soil particle sizes. It is best to have your field soil evaluated, thus ensuring you can blend the best size and amount of thermally optimized clay for your rootzone.

As a general guide, soils can be divided into those that contain a large amount of clay (commonly called topsoil) and those that are sand. Research has shown that for soils with more than 25% clay, a conditioner with a 5/30 particle size is the best choice. Its larger particles will both create large pores for root growth and stay "suspended" in the clay so that

layers are not formed. Topsoil, which has less clay but more silt and sand than most soils, will benefit from the stable pores that a ceramic conditioner will add.

A topsoil is generally a heterogeneous soil, having a lot of different soil particle sizes. For this reason, a conditioner with an 8/16 size particle is recommended. Soilmaster Select conditioner will stay blended and add permanent pores to your topsoil more effectively than the 5/30 material.

As alluded to above, sand particles create large pores which do not retain sufficient water, and they will not readily stabilize the rootzone. Further, sand is somewhat fluid, moving under the force of football players, so it is not the best base your football fields.

How much Pro's Choice ceramic conditioner should be blended into the soil?

To achieve the maximum benefits it is critical to add the proper amount of soil conditioner. Remember, each natural soil will be different, so being exact is not possible. The recommendations given below are based on extensive studies at the University of Illinois and feedback from turf managers. They are given as a range. It is extremely important that you do not add too much. Adding too much soil conditioner can result in poor turf performance and even dead grass! Your Pro's Choice professional can help you determine the most effective amount of conditioner to use.

RECOMMENDED AMENDMENT INCLUSION FOR NATURAL SOILS (CLAY & TOPSOIL)	
Incorporation Depth	No. of Bags/ 1,000 Sq. Ft.*
3 inches	30 – 50
6 inches **	60 - 100

* Calculations based on 50 lb. Bags.
 ** For Football field construction, it is recommended that you incorporate to a minimum depth of 6 inches.

RULE FIVE:
Add no more soil conditioner than is recommended!

What method of adding a soil conditioner is best?

The best method to incorporate any soil amendment is to blend the material off-site. Scoop up the soil from your field, use a blender to combine the two materials, and then move the amended soil back to the field. This is very expensive and not very practical for most football fields.

An alternative is to gradually blend the soil conditioner into your field. This will require that the field be stripped of grass (bare soil). It is important that the soil is as dry as possible. Uniformly distribute the recommended amount of soil conditioner onto the soil surface. This can be done with shovels and rakes, but a machine will distribute the material faster and more uniformly. Once the soil conditioner is spread out, till the soil to half the total incorporation depth. Then till the soil to the final incorporation depth. For example, if you are incorporating Soilmaster® soil conditioner to a final depth of 6 inches, run the tiller to a depth of 3 inches, then go over the field a second time with the tiller depth set at 6 inches. This helps to blend the soil conditioner into the soil gradually and will improve distribution.

Can I add less than the recommended amount of soil conditioner?

Yes, you can add as little as you want or can afford, but the benefits will also be reduced. It is important to realize that incorporating the soil conditioner before you establish your turf is the best and cheapest method. Adding soil conditioner after the turf is established (topdressing) is more difficult, and the benefits for root growth will be slow to develop. The recommended depths of incorporation are listed at 3 inches minimum, 6 inches optimum and 12 inches maximum. However, you can modify to whatever works best for you.

Is it better to incorporate your soil conditioner to a depth of 6 inches, as opposed to 3 inches, even if you cannot apply the maximum recommended amount?

Yes, always try to establish a good 6-inch root zone. In natural soils, add as much as you can up to the maximum amount to a depth of 6 inches. In sand, you can reduce the amount (for any depth), but it is recommended that you add at least 1/3 of the maximum amount suggested.

FOUR STEPS TO BUILDING A BETTER ROOTZONE FOR YOUR FOOTBALL FIELD

To achieve the maximum benefits from your soil conditioner when you are building a football field, follow these steps:

1. Have the rootzone soil on your football field analyzed for texture, drainage and chemistry.
2. Review your soil analysis with a Pro's Choice soil expert.
3. Have a Pro's Choice soil expert calculate how to improve your soil using Soilmaster soil conditioner, Soilmaster Select topdressing, or Soilmaster Plus soil conditioner.
4. Blend in the Pro's Choice product using these guidelines and you are ready to establish your field.

CERAMIC CONDITIONERS: TOPDRESSING YOUR FOOTBALL FIELD

What is topdressing?

Topdressing is a general term used in the turf industry to describe the application of a structural material to the top layer of turf. A structural material is one that does not break down rapidly in water. Examples of structural materials include soil conditioners, sand and soil. Non-structural materials which could be applied to the top of turf would include fertilizers and pesticides.

Topdressings benefit your field several ways:

- I. Improve the quality of the turf surface.*

Topdressing fills the voids or uneven spots in a field, thus making it more uniform. Football players change direction constantly during the course of a game. Proper foot stabilization and release from the turf surface are very important.

II. Protect the turf crowns.

The crown of a turf plant is the most important part of the plant. During a football game, cleated shoes tear and stomp turf crowns, which can weaken or kill the crowns. When the crown is damaged, the turf will thin and die. This is obvious when you look at the center of a football field after several games. Topdressing will surround the crowns and give them some protection from damage. It can also protect any young ryegrass seedlings.

III. Improve the porosity of the soil and reduce the organic thatch.

Turf requires an abundance of soil pores for growth. These pores should be big enough to allow roots, water and air movement. As turf grows, it forms large amounts of organic matter which supports the crowns and the upper part of the roots. The dead organic matter (thatch) is most beneficial for sports fields if it is about 5/8 inch thick. If the organic matter is thinner than that, the turf will be hard and jolting to the athlete's feet. Conversely, if the organic matter is much thicker than that it will start to impede water and fertilizer movement through the turf rootzone, resulting in wet, shallow roots. The rate at which thatch forms depends on both the variety of grass used and the actual turf growth speed. Topdressing the turf will incorporate structural materials into the thatch. This will improve the rate of thatch degradation and maintain better soil porosity.

Do I need to use topdressing?

All football fields can be improved by topdressing. In particular, the center oval area, where most of the action takes place on a football field, will benefit.

Are ceramic conditioners the best materials to use when topdressing?

Ceramic conditioners, such as Soilmaster are natural soil materials and, as such, will integrate with other soils very well. While these soil conditioners are very good, they should only be

used when diluted with other natural soil. There are a number of other soil amendments in the marketplace, and some of them can be effective, but few of them will equal the performance of ceramic clay conditioners. For example, diatomaceous earths are extruded calcium-based materials produced from sea animals. They are fragile and tend to crumble over time.

There are also some artificial materials that are marketed as soil amendments, but caution should be used when considering their use. One such material is ground-up rubber known as crumb rubber. This material is resilient and could add some cushioning for the athlete's feet, but it will not integrate well with natural soil materials, and it absorbs and radiates heat, but not water.

RULE SIX:

Always dilute ceramic conditioners, or any other absorbent, with a natural material when using it as topdressing.

FINDING THE RIGHT TOPDRESSING APPLICATION RATE

Topdressing a football field will benefit your turf and produce a great playing surface. Topdressing with any ceramic conditioner or other highly absorbent structural material can lead to problems if you use it improperly.

RULE SEVEN:

Never topdress a turf area with a structural material containing more than 40% ceramic clay soil conditioner.

When you topdress with a material containing more than 40% ceramic soil conditioner, you risk stressing your turf. However, if you follow the recommended rate, you will safely achieve an excellent turf surface. The maximum limit is 40%, but the generally recommended rate is 30%. The rest of the material in the topdressing should be the same material that the turf is growing in or a coarser material like sand.

For example, if your field was built on the existing soil, then add 30% or less ceramic conditioner to the same soil.

RECOMMENDED MIX FOR TOPDRESSING		
Material	Recommended %	Maximum %
Clay Soil Amendment	30%	40%
Current Soil or Coarse Sand	70%	

The reason for this is to maintain a good transition between your rootzone soil and the topdressing material. Over time, as you add more and more topdressing material, your rootzone will conduct water and air better, thus promoting root growth and allowing thatch to degrade rapidly. There are many sports fields and golf greens with natural soil rootzones that have been successfully topdressed with sand, or amended with a good ceramic soil conditioner.

How much topdressing should be applied?

For a single application of topdressing, add enough to achieve a layer 1/8 inch thick or less. For example, for a typical football field (150 ft x 300 ft), you would apply 8-10 tons of topdressing amended with a good clay soil conditioner. You can always use less topdressing, so remember: *topdressing works best if it is applied multiple times over a period of years.*

RULE EIGHT:

Never add more than a 1/8 inch layer of any structural topdressing per single application.

How often should a field be topdressed?

This cannot be answered exactly because it depends on many factors, including how much play the field gets, how fast the grass is growing, what type of grass you have, the thickness of the thatch layer, and other factors. In general, an aggressive topdressing program would include applications once per month while the grass is growing. Further, a topdressing program will achieve the greatest benefits when done for the life of the field. However, even one application per season is going to give you some benefit.

RULE NINE:

Topdressing benefits will be realized when you add small amounts over several years.

OTHER SOIL CONDITIONER APPLICATIONS

REPAIRING FOOTBALL FIELDS – DURING THE SEASON

Football is one of the most destructive sport played on grass and, as such, your turf can be worn thin and even die during a single season. Renovation or repair of football fields during the season is a challenge for most turf managers. Remember that an aggressive, dense turf that has been topdressed is the best way to start the season. After that, you should continue your topdressing program, but you will still have to consider repairs.

Ceramic soil conditioners can help you achieve a better level of success in your repair program. If you use ryegrass to fill in thin areas in the center of the field, be sure to topdress after you seed. This will give the seeds and new seedlings a better chance of germinating and surviving. If your turf is beyond repair and you need to use sod, then make sure you have your rootzone amended with ceramic soil conditioner (see above) before you install the sod. This will improve the rate and extent of sod rooting. Also, a soil conditioner in your rootzone allows you to "stick" the new sod to the soil without damaging the crowns. As always, when installing sod, wet your soil first. This will both solidify the soil and allow excellent sod contact with the rootzone material.