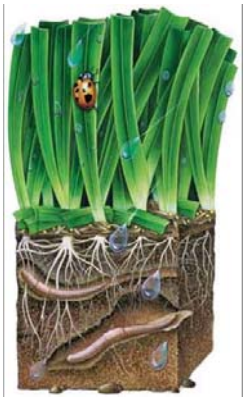
Science Helping Nature Restore the Natural Process of the Soil Food Web®



Building and Maintaining Soccer Fields & Sports Fields Using Soil Restoration Protocols

Arranged by Michael Martin Melendrez

Introduction

As often the case in the Southwest and 4 corners region of the United States, growing a strong turf able to endure a long season of wear and tear on any sports field is a daunting task. The region is arid with high UV, high evaporation and minimal if any humus content to the soil resulting in a turf constantly demanding a hydroponic environment for water and fertilizer. Humus is a remarkable brown to black biomolecule product of soil chemistry that defines a top soil and is essential for healthy and productive soils. Yet it is rarely added or encouraged in turf management systems. Research is clear that the 'Soil Food Web' and the mutualism shared between plant and the soils microbiology is always destroyed during construction of sites and the use of mycorrhizae and helper bacteria inoculants will correct this problem.* Since a complete Soil Food Web (plant & fungi mutualism) offering the benefits of mineral nutrient and water uptake using microbiology of the mycorrhizae fungi and helper bacteria is rarely in place on pre-existing managed turf sites, the grass is dependent upon the fertility system being in a hydroponic environment for survival. In other words, a constant supply of NPK in a water solution must be available otherwise a **'feast or famine'** situation will exist. With the issue of water being a situation that will not be going away, maintaining turf with hydroponics contradicts the best management principles for the arid regions of the country. Furthermore, the soils are often wet during the time of mowing and play, which compacts the soil and excessively wears the vegetation. Season-long traffic in all types of weather can literally destroy a field, plus the playing schedule rarely allows for aggressive turf management practices that are absolutely essential to keep grass alive. Sports fields must be constructed and managed properly to provide adequate turf, while minimizing the chance of injury to the players. This paper expands beyond the normal box of thinking, which highlights some principles of construction and maintenance to help produce a sports field with the most playable and safest conditions for the participants. As an addition, it will lay out a protocol for Soil Restoration using the latest technology of '**Humus based Soil Inoculums'** that include a community of broad spectrum Soil Borne Indigenous and EPA Registered bacteria along with mycorrhizal spores and tissues that are also GRAS (Generally Recognized as Safe) by the FDA.

9 Gilcrease Lane Los Lunas, NM 87031 Ph (505) 550-3246 Fax (505) 866-7645
Web www.soilsecrets.com Email soilsecrets@aol.com

* There are over 50,000 scientific studies published in peer review journals of science that support the claims of benefits concerning the mutualism of mycorrhizae with plants and the concept of the soil food web. Soil Secrets has in its library most of these studies which are available on request.

Construction

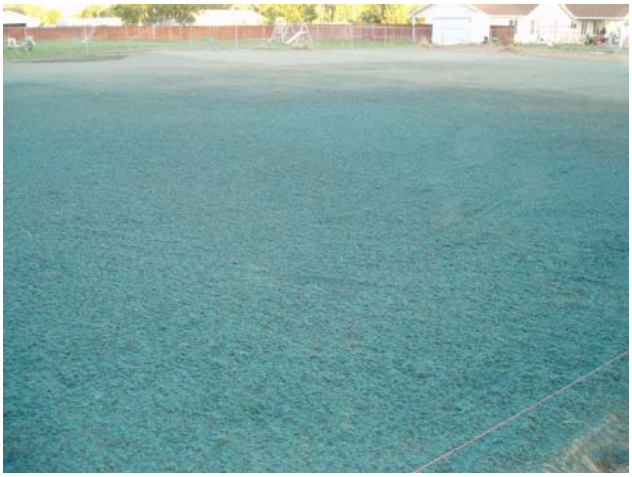
Scheduling

When planning construction of a turf area using a cool season grass such as Fescues, Park Blends and Kentucky Bluegrass, the optimum target completion date is August 1. This is because mid-August is the best time to seed cool-season turfgrasses which is the preferred grass to use for soccer fields north of **Interstate-40** (Albuquerque and north). For warm season grasses such as the new and improved Bermudas, sprigging or seeding must be done when soil temperatures are warm enough to allow for germination or vegetative root growth. Therefore, when planning construction, work backwards from that actual germination or growing season for the grass type, allowing ample time for grading, settling, installation of irrigation and drainage, etc. to determine the start date. With traditional construction standards if seeding occurs in mid-August when growing conditions are exceptional, and irrigation is supplied, the fields will normally be usable within 12 months after seeding. On the other hand, if seeding occurs at any other time of the year, it could take 18 months or longer before the field is ready for use.

With **'Soil Secrets – Soil Restoration'** site preparation techniques using biologically available humus **(TerraPro®)** saturated with the proper inoculums for the vegetation type, the turf can be ready for play much sooner. A site by site evaluation must be done to determine when the site is ready. This is true regardless of the turf being seeded, sprigged, or sod. See the following photos of a hydroseeding using Soil Secrets over a 28 day period.



Site is graded and ready to Hydroseed



Hydroseeding is completed



Same site 28 days after Hydroseeding with Soil Secrets – Soil Restoration protocol

Area Needed

Regulation size soccer fields are a maximum of 90 meters (295 ft) and a minimum of 45 meters (148 ft) wide, a maximum of 120 meters (344 ft) and a minimum of 90 meters (295 ft) long. Fields for youth play can be smaller. When building soccer fields, it is important to plan extra fields to rotate play allowing turf to recover from damage. Another alternative is to make fields and surroundings large enough with borders to rotate the direction of play temporarily. For example, if a field runs north-south, allow enough space to rotate the field 90 degrees, creating two parallel fields that run east-west. This strategy spreads out turf wear on the heavy use areas like goal mouths and sidelines. Additionally, dedicated practice areas and parking should be taken into consideration when planning soccer field complexes

Types of Fields

The three basic construction types are ***Native Soil Fields*** made of existing soil or topsoil brought in to the site, ***Modified Soils*** where the existing soil is modified with amendments such as sand, peat or compost, and ***Soilless Fields*** which are essentially 100% sand. The most common type of field is the native soil field. Rarely are modified soil fields built because of the

opinion of some that it will take at least 80% by volume of amendment to improve the native soil. But in many cases in the Desert Regions of the West, the native soil does not really qualify as true soil and in fact may be collapsed clays or caliche (sub soils saturated with Calcium Carbonate). Therefore there is no measurable quantity of Humic Substances or Humus and there are minimal levels of Organic Matter on these sites. In other words, there is no Humus Pipeline from the ongoing humification of organic matter and by definition; you do not have a biologically healthy or viable environment for your landscape material.

> **"Humic acids also know as Humus, are remarkable brown to black products of soil chemistry that are essential for healthy and productive soils" Journal of Chemical Education. Humic Acids; Marvelous Products of Chemistry. Vol. 78. 2001**

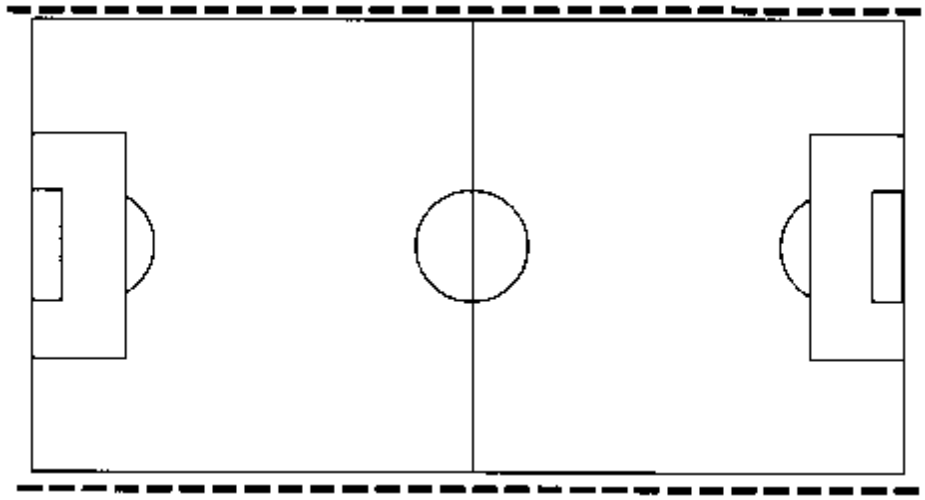
Soilless fields are normally restricted to professional or university settings. Modified and soilless fields are difficult and expensive to build. Therefore, if you are considering a modified or soilless field, please contact us for consultation and guidance. The rest of this booklet describes construction and maintenance of modified and native soil fields but will not address the soilless fields concept.

Grading and Drainage

It is critical to establish adequate surface drainage on a soccer field, or any other athletic field. Though most coaches and players prefer to have a perfectly flat field, this is only possible with a very expensive soilless field. A 2% slope is preferred on most turf areas, but a 1% slope is acceptable on native soil fields given play considerations. For native soil fields, it is imperative to achieve a 1% slope from the center of the field to both sidelines. This will make a crown from 9 to 18 inches at the center of the field depending on the width. Without proper drainage, depressions will gradually develop that will hold water, make it difficult to maintain turf, and possibly risk injury to players. Many will consider substituting subsurface drain tile lines for surface drainage. This is not recommended because water can be removed from a field more rapidly by surface drainage and will allow play within hours after a rain. However, subsurface drainage is much slower and water will move off a field only within days or weeks after a rain. Subsurface tile lines with open surface grates are important to install at the edge of a field to collect the surface drainage from the field (Figure 1).

Figure 1. Dimensions and drainage plans for soccer fields.

Maximum length = 120 meters (393.6 ft) Minimum length = 90 meters (295.2 ft)
Maximum width = 90 meters (295.2 ft) Minimum width = 45 meters (147.6 ft)



Tile lines with catch basin and/or risers to catch surface drainage

The initial step in grading a soccer field is to remove the topsoil and stockpile it out of the way. The second step is to establish the subgrade using subsoil which will conform to the final grade. Therefore, the subgrade should be created with a crown running the length of the center of the field and sloping off at 1% to both sidelines. When moving large amounts of soil, account for about 15% settling on fine textured soils and less for coarse soils. In other words, if a foot of fine textured soil is moved to create the subgrade, that soil will settle about 1.5 to 2 inches.

Common Mistakes in Soccer Field Construction

1. Allowing inadequate time for construction in order to seed by mid-August.
2. Planning too little time between seeding and use.
3. Not planning proper surface drainage.
4. Not including in-ground irrigation.
5. Not planning for adequate maintenance following construction.

After the subgrade is allowed to settle or is compacted, topsoil should be brought in over the rough grade. Ideally, four to six inches of topsoil is needed for optimum turf performance. After the topsoil is replaced, a high quality finished compost will be spread to a unform depth across the field at a minimum of 6". The compost shall not be a product made from City BioSolids or from composted Dairy manure as those materials have a high salt index, which will reduce water uptake by the grass due to a **osmotic potential moisture drag,** where water is attracted to salt rather than being uptake by the plant. This is what happens when you put a high salt index fertilizer on your lawn and burn it. What you really did was dehydrated the grass. Once compost is spread evenly across the field, Rototill the Compost into the Native top soil until an even blend is achieved. In-ground irrigation should also be installed at this time, so the trench

lines can be properly backfilled with the amended soil. After drainage and irrigation installation, the topsoil will usually need to be tilled to break up clods and to create a uniform seedbed. Never till soils that are wet **(only moist to the touch)** because it will smear the soil and decrease drainage. Due not till until you have soil looking like flour as over tilling will create a fluffy and fine particled soil that is prone to compaction and poor drainage and aeration.

If Sodding the site: Prior to fine grading; allow adequate time for soil to settle to avoid uneven turf later. Irrigation or rainfall will accelerate settling. Fine grading follows tilling and serves to smooth and level the surface. Hand rakes, sand trap rakes, or other tools are used to establish the seeding surface. A final raking grading should occur immediately before placing sod on the site to prepare a good bed. After the seedbed is prepared, apply **TerraPro®** humus at 4000 pounds (108 bags) rate per acre. After laying the sod and rolling to firm up the site, apply 2000 more pounds of TerraPro chased with 1000 pounds of **Protein Crumblies®** per acre (27 bags).

If Hydroseeding the site: Site prep is the same as it is for Sod, with the exception that the final dose of 2000 pounds of TerraPro with the 1000 pounds of Protein Crumblies will be mixed in the Hydroseeder (Mechanical Agitation type only) along with the seed, Nectar ® (a germination enzyme formula of Soil Secrets) Wood Fiber Mulch, Plantago soluble fiber tackifiers and seed. The following is the best recipe for this process on a per 1000 sq. ft. formula as most hydroseeders load their machines based on that method. In areas of high wind, heat and exposure, it is not recommended to use the Hydroseeding technique during the summer or possibly spring.

Per 1000 square feet treatment areas:

TerraPro = 1 bag
Protein Crumblies = ½ bag
Nectar germination enzymes = 1 gallon
Ambrosia liquid humus = 1 gallon
Plantago powder = 5 pounds
70/30 Wood Fiber Mulch = 1 bale
Seed = 10 pounds
Water = approximately 100 gallons

Warning: After hydroseeding allow the mulch to dry and tack down firmly for one day before beginning irrigation. When irrigating, do not allow the surface to pond or run off but at the same time do not allow the surface to dry out. This will require a good irrigation system and a keen eye for detail. Frequent and light irrigation of 30 days is a must until the grass matures beyond the juvenile stage. Ponding of water must never be allowed as this kills the germination of grass!

Inoculation

Mycorrhizal fungi have occurred naturally in the soil for 400 million years. They form a close symbiotic relationship with plant roots. They are called mycorrhizae (from the Greek “muké ”, meaning fungus and “rhiza,” meaning roots). However, in most soils that have been disturbed

by construction, farming activities such as plowing or tilling, and with the use of Ag chemicals such as fertilizers, pesticides and other chemical products, the mycorrhizae content has been damaged or may no longer exist. As a result, populations of this beneficial fungi may be insufficient to significantly enhance plant growth. When mycorrhizal fungi colonize the plant's root they create a network that increases the plant's capacity to absorb more water and nutrients such as phosphorus, copper and zinc. This process in turn enhances growth, favors optimum health and improves the tolerable limits of the plant to environmental conditions such as drought.

Adding TerraPro®, a mycorrhizal inoculant for turf, golf courses, sport fields, urban landscapes and land restoration sites, re-establishes beneficial micro-organisms to soil and enhances plant-soil dynamics. Intense growing practices, environmental pressures and removal of native top soil have resulted in significant reductions in the naturally occurring mycorrhizal fungi. Restoring these fungi tissues back into the soil is an essential step in the process of helping plants become mycorrhizal, building healthy soil resulting in decreased fertilizer requirements, increased root development, more productive turf and better resistance to soil borne diseases. The carrier for this inoculum is natures best – Humus! Made from Cultured Humus® a living and viable humus manufactured by Soil Secrets - a proprietary product containing 2,178,000 propagules per acre of viable Mycorrhizal material.

Establishment

Selecting a Grass Species

Kentucky bluegrass is a common species used for many fields but in our opinion based on years of growing grass, a sports field blend of fescue, rye and bluegrass is best. Though slow to germinate and establish, Kentucky bluegrass and fescues have the best combination of wear resistance and recuperative ability of grasses adapted. When establishing a soccer field, choose a blend containing three or four cultivars.

Old type Tall fescue such as K-31are generally not recommended for athletic fields even though it is exceptionally drought and wear tolerant. The older cultivars of Tall fescue are not recommended because they must have 18 to 24 months to establish before it can tolerate traffic, and it can become uneven and "clumpy" with extended heavy traffic. The new blends of improved dwarf tall fescues establish much faster and are less likely to clump as time and wear take place.

In the southern-parts of the Southwest (south of I-40), bermudagrass is gaining popularity in athletic fields. Bermudagrass is a warm season grass that grows very actively from May until September, but is dormant from late September through May. This is important because bermudagrass cannot withstand typical sports traffic when it is dormant. Thus bermudagrass is

only recommended on fields that receive only summer play and no play from September through May. Additionally, bermudagrass is susceptible to winterkill which may occasionally kill large areas of bermudagrass over the winter. If a sports complex in has the luxury of many fields that can be rotated in and out of play, one or two bermudagrass fields would work well for summer play, while the Improved Fescue fields could be used for play during the remainder of the year.

Bermudagrass is not widely available by seed and thus will probably need establishment by sprigging or sodding. If a bermudagrass field is planned, it should be established in early June, thus construction schedules will be different than a Fescue or Park Blend field. Bermudagrass maintenance needs are very different than those needed for cool season grasses like Kentucky bluegrass, Fescues or perennial ryegrass.

Buying Good Seed

It is important to purchase high quality grass seed for any turf area, but it is especially important for soccer fields. High quality seed will probably be some of the most expensive seed available. However, the cost of seed is minuscule compared to the amount of money spent on maintaining the soccer field for the next 20 years or the lifetime of the field. The best way to purchase high quality grass seed is to contact a reputable company who has experience providing seed for soccer fields. Additionally, the ability to understand seed labels is critical when selecting seed to determine the quality. Table 2 lists the preferred ranges of items found on the label of a quality seed lot. Be sure to save the label from the seed in case you need to purchase more seed later or a problem with the seed lot develops after seeding.

Table 2. Preferred ranges for items on the label of a good quality seed lot.

Item	Preferred Range
Purity	>90%
Germination	>80%
Crop	<0.5%
Weed	<0.3%
Noxious Weed	0
Inert	<8%
Date Tested	last 9 months

Time of Seeding

Fall Seeding

As mentioned earlier, the best time of year to seed a soccer field is in the late summer to early fall. Adequate soil moisture, warm soil, and limited weed pressure allow for excellent seedling growth. The more time that the field can establish before summer, the better. Between August 15 and September 15 is optimum seeding time in the northern half of Indiana; from September 1 to September 30 is optimum in the southern half of Indiana. It is critical to seed as early as

possible within these windows. Even when seeding within these windows, waiting one week later to seed may mean the stand will take two to four additional weeks to mature. Establishment in the spring is possible but not as effective as fall seeding.

Seeding in Spring or Winter

Seeding in the spring is possible, but only if an automatic irrigation system is in place to provide adequate water for the seedlings through the first summer. It is important to seed as early in the spring as possible to maximize the competition of turfgrass over crabgrass. Dormant (winter) seeding or early April seeding is preferred. Dormant seeding is when seed lies dormant until the soil temperatures warm in April or May. Depending on your location in Indiana, dormant seeding can be done as early as Thanksgiving and as late as March. The benefit of dormant seeding is that as the soil heaves and cracks during the winter, crevices (honeycombs) are created for the seeds which create ideal germination conditions. Additionally, dormant seeding is easier to schedule than spring seeding, because spring rains make it difficult to seed after March in Indiana. Though seed-soil contact is important regardless of seeding date, it is especially important when dormant or spring seeding. Irrigate often as soon as temperatures favor germination (soil temperatures above 55^{o}F). As root systems develop, gradually reduce frequency but increase duration of irrigation. Continue irrigation throughout the summer until an adequate root system is established.

Seeding

Seed should be applied using a drop spreader, because rotary spreaders do not disperse the seed uniformly. However, there are no spreader calibration guides for turfgrass seed. The easiest way to apply seed uniformly is to set the spreader adjustment very low, sow one half of the seed in one direction, and then sow the other half at right angles to the first direction of seeding. It might take three or more passes over the field in a single direction, but it is well worth the time to get a uniform seeding. Alternatively, hydroseeding could be used where seed is combined with paper-based mulch and sprayed onto the field. Though this is more expensive than traditional drop seeding, it delivers excellent results with good germination and the added benefits of mulch. Contact a local reputable landscaper for hydroseeding. Whether drop seeding or hydroseeding, use a seeding rate of 2 lbs/1000 ft^2 or 87 lbs/Acre for Kentucky bluegrass and 6-7 lbs/1000 ft^2 or 260-305 lbs/A for tall fescue. If you must include perennial ryegrass in the seed lot with Kentucky bluegrass, it should contain a maximum of 10% perennial ryegrass by weight and should be seeded at 4 lbs/1000 ft^2 or 154 lbs/A.

Mulching

Mulching is generally not recommended for an area as large as a soccer field. However, since mulch conserves water, it is important to use on soccer fields that cannot be watered two to four times daily. One bale of clean (weed-free) straw per thousand square feet will give a light covering that will not have to be removed after germination. Most will apply too much mulch which will shade seedlings and have to be raked off later. Apply the mulch very lightly so you can still see approximately 50% of the soil through the mulch layer.

Watering

Not too wet, not too dry: ***It's critical that if the project was seeded using a hydroseeding / hydromulching system that the soil surface be kept moist to the touch at all times for a minimum of 30 days. It is also critical that ponding of water never be allowed as this will suffocate the juvenile grass seedlings!*** Seedlings are very susceptible to drying out, and the seedbed should not be allowed to dry. A newly-seeded soccer field will need to be irrigated two to four times daily depending on the weather. This is why automatic irrigation is extremely important. Enough water should be applied during each irrigation to moisten the top one to two inches of the soil profile, but avoid over-watering and saturating the area. Once the seedlings are two inches high, gradually reduce the frequency of irrigation and water more deeply. After the turf has been mowed two or three times, deep and infrequent irrigation is most effective.

Mowing

Mowing a new field will encourage the turf to fill-in quickly. Mowing should begin when the first few seedlings are tall enough to mow. You may only mow 10% of the plants in the first mowing, 20-30% of the plants in the second mowing, and so on. Most people wait too long to mow a newly seeded field, so mow early and often. Mow Kentucky bluegrass, and perennial rye at 2.0-2.5 inches and tall fescue at 2.5-3.0 inches. As always, never remove more than 1/3 of the grass blade at any one mowing.

Fertility

New seedlings have poorly developed root systems, and thus they cannot effectively absorb nutrients from the soil particularly if the proper mycorrhizae are not present or a mycorrhizal inoculation is not being utilized. If you are using an inoculation of mycorrhizae, be sure they endomycorrhizae using the species **Glomus intraradices** which is a generalists with grasses. If trying to make your turf mycorrhizal, cut your chemical fertilizers by at least 50 percent of the regular dosage or better yet use a Protein blend for slow release N-P-K.

Otherwise, it is important to fertilize frequently after seeding to encourage establishment. Use a fertilizer containing N, P_2O_5 and K_2O in approximately a 4:1:2 ratio and apply 0.75 to 1.0 lb N/1000 ft^2 four to six weeks after germination and again eight to ten weeks after germination. Assuming seeding in mid-August, these applications would be mid-to-late September and again mid-to-late October. If dormant or spring seeding, apply 0.75 lbs N/1000 ft^2 four to six weeks, eight to ten weeks and again 12-14 weeks after germination.

Weed Control

There is little weed pressure in the fall so weed control may not be needed for fall seedings. If broadleaf weeds such as clover and dandelion become a problem later in the fall, they can be easily controlled with a broadleaf herbicide application in October or November, after the third or fourth mowing. Annual grasses such as crabgrass can be easily controlled the first year with natural preemergence herbicides such as Corn Gluten applied in the spring. Corn Gluten is also a high percentage protein meal with about 9 percent Nitrogen which can be blended into Soil Secrets Protein Crumblies standard turf blend. In seedings made very late in fall, winter, or

spring and the field is not fully established by spring, avoid applying a preemergence herbicide in early spring because it may damage late-developing seedlings. In this case, consider using a postemergence crabgrass herbicide later in summer to control crabgrass.

Annual Maintenance

Traffic Control

Constant play on soccer fields will cause the turf to deteriorate and become unplayable and possibly dangerous to the athletes. Strict traffic management is the most effective tool in maintaining playability of soccer fields. Rotate play to allow maintenance such as aerification and overseeding to limit turf damage and aid in recovery. Consider preventing play for a month or more on each field depending on the time of year, amount of play, and extent of damage. Keep strict practice areas to limit damage on game fields. Consider movable goals, benches, bleachers, and fences to help further limit damage.

Mowing

Mowing is important to maintain the health, playability, and aesthetics of a soccer field. Mowing height of a Kentucky bluegrass soccer field should be approximately 2.0-2.5 inches, 0.75 inches for bermudagrass, and 2.5-3.0 inches for tall fescue. Mowing lower than these heights on most fields will put added stress on the plants and will decrease vigor of the plants and playability over the long term. Mowing below the optimum height restricts root growth, favors weeds, and increases susceptibility to damage from insects, disease, drought, and traffic.

Mowing frequency depends on how fast the grass is growing. Some fields may need mowing two or three times per week during spring and fall and only once every two weeks during summer. Mow frequently enough so as not to remove more than 1/3 of the leaf blade in a single mowing. For instance, if you are mowing at two inches, mow before the grass reaches three inches tall. If the grass has grown too tall, raise the mowing height and gradually lower it back to the original height over a few mowings. Avoid mowing during midday when temperatures are above 90^{o} and the soil is dry because you may damage the turf. If you must mow during a hot and dry period, wait until temperatures moderate in the early morning or late evening.

Rotary mowers can be used on soccer fields mowed at two inches or higher. Most rotary mowers do not cut well at mowing heights less than two inches. Reel type mowers, on the other hand, mow best at two inches and lower. Regardless of the mower type, mower blades must be sharp and may need sharpening four to six times a year. A sharp blade results in a cleaner and healthier cut, leaving a more attractive and healthy field.

Clipping removal is generally not recommended on most turfgrass areas including soccer fields. Clippings do not cause thatch, and returning clippings will recycle valuable nutrients to the soil thereby reducing fertilizer requirements.

Aerification

Aerification is the mechanical removal of soil cores and may be the most important turf management practice on soccer fields. Aerification relieves soil compaction, improving water and air movement into the soil, increasing rooting, and greatly improves turfgrass health. Aerification is most beneficial in compacted areas with intense traffic such as goal mouths, the centers of fields, and sideline areas. Whenever aerification is done on a soccer field, it should be combined with seeding to help maintain dense turf. This will be discussed more in the overseeding section.

Aerification is most beneficial when the largest tines or spoons available are used, penetration is 2 to 4 inches deep, and when 20 to 40 holes are punched per square foot. Aerifiers with reciprocating arms are the most effective. Aerifiers that roll behind tractors are less effective because they do not penetrate deep enough nor punch enough holes per square foot. Most aerifying machines available at rental agencies may not punch enough holes per square foot, thus multiple passes will be needed to achieve the 20 to 40 holes/ft^2. Cores can be broken up and dispersed following aerification with a dragmat.

Practices such as slicing or spiking remove no soil and are not considered aerification. The purchase of a large reciprocating arm aerifier should be included in the budget because aerification will be needed often. There are professional aerification services that can be hired to aerify athletic fields providing a viable alternative to purchasing your own aerifier.

Aerification should be performed as often as possible on a soccer field and should be done preferably when the turf is actively growing. However, if playing schedules do not allow for aerification during the season, aerifying at any time of the year on soccer field height turf is better than not aerifying at all. Kentucky bluegrass or tall fescue should be aerified at least once in the fall (September) and once in the spring (April). Goal mouths and other high traffic areas can also be aerified during the season when there is a break in play. Bermudagrass should be aerified at least once in June or July when it is actively growing.

Irrigation

To maintain a healthy, actively growing turf capable of recovery from damage, it is essential to water a soccer field during dry periods. This is especially important on a soccer field that receives regular overseeding or sprigging because seedlings are present in the field almost all year long. Seedlings cannot withstand moisture stress because they do not have a well-developed root system capable of extracting water from a large area in the soil. Bermudagrass fields generally have much lower water requirements than Kentucky bluegrass fields. However, ample water is needed to encourage recovery and establishment of new sprigs. The same principles for irrigating cool season grasses hold true when irrigating warm season grasses.

The frequency of watering will vary from field to field to site and should be determined by the appearance of the turf. This can be determined because the first signs of water stress in a turfgrass stand are a bluish-green color, and footprints remain in the turf after walking across it. Ideally, the turf should be watered at this point. As the degree of water stress increases, the turf will wilt and develop a grayish-green color. Turf that has wilted should be watered without delay.

Wilted turf will recover very rapidly following watering. Severe drought stress will cause the turf plants to cease growing, and the leaves will turn brown and possibly die. If soccer fields are allowed to wilt or turn brown, do not allow play on the fields until they can be irrigated and the turf recovers. Though this might take up to two weeks, it will prevent severe damage that will result from traffic on wilted or dormant turf.

Most fields will need from 3 to 4 inches of water per week depending on weather, soil type, and number of years into a 'Soil Restoration' program. At the Soil Secrets Research Arboretum we water our Sports Field turf at 3 inches every 3 weeks in the summer. It is best to apply this amount of water in a single, thorough soaking, or two equal applications of water three to four days apart rather than in light irrigations every day. The soil should be wetted to the depth of the deepest root. The ideal time to irrigate a soccer field is from 4:00 to 8:00 a.m. At this time, water pressure is usually the highest, there is little distortion of the watering pattern by wind, the amount of water lost to evaporation is negligible, and it will dry by the time it is used later in the day. The second best time to water is from 8:00 to 12:00 p.m. usually distortion from the wind is not a problem at this time and loss from evaporation is slight. A major problem may be lack of water pressure for those using municipal water systems. A potential problem caused by watering in the early evening hours may be greater incidence of disease. This problem can be reduced by watering only when the turf needs water and by watering infrequently but deeply. Watering an established turf during midday is not very effective. A large amount of water is lost through evaporation, making it difficult to thoroughly wet the soil. Although not recommended, midday watering does not cause the turf to burn.

Fertility

Sports fields need to be fertilized to maintain color, density, vigor and recovery from wear and tear. Sports fields need to be fertilized slightly more than other turf areas to encourage growth and overcome the constant wear and tear. With biological restoration and Green Building projects we suggest fertilizing with **Protein Crumblies** at 22 bags (814 pounds) per acre every 2 months during the growing season plus continuing to apply **TerraPro II** humus once per year, ideally spring. **Humus is critical for future improvement and sustainability of your site!**

Fertilizer needs may vary due to:

• Length of the growing season: warm soils and active plant growth will dictate how much and how often our Protein Crumblies will need to be applied.

• Weather: A rainy summer will stimulate growth and will usually necessitate more annual fertilizer than a dry summer. The same holds true for an irrigated field versus an unirrigated field.

• Soil type: Turf grown on a very sandy or a very heavy clay soil will need more fertilizer than turf grown on a silt loam soil. Soil type and pH will have a large effect on the amount of phosphorus and potassium that needs to be applied.

• Age and quality of existing field: A new field will need more fertilizer for the first few years to enhance density. Improving a neglected or thin field that needs significant overseeding or sprigging may also require more annual fertilizer for the first few years.

Fertilizers

These Fertilizer guidelines are industry standards and not those of Soil Secrets, but because they are commonly used, you need to be aware of them and therefore Soil Secrets is including them in this guide!

It's the opinion of the scientists at Soil Secrets as well as most Plant Physiologists who are now promoting the concept of 'Green Building, Sustainability and recovering the health of soils with the mutualistic fungi and bacteria of plants, that inorganic fertilizer can discourage or even kill these beneficial microorganisms we call the 'Soil Food Web'. Research is clear that you cannot have a healthy turf or soil without having a healthy Soil Food Web. Research is also clear that it's the mutualism that the plants share with the mycorrhizae fungi in the soil that provides water and mineral nutrient uptake, disease reduction and prevention, parasitic nematode reduction and maximum drought tolerance. Therefore damaging this relationship is contradictive to developing a healthy turf or landscape! Soil Secrets suggest using as an alternative to in-organic fertilizers or fast releasing organic fertilizers (such as poultry manures). The best is a blend of protein meals which will release slowly over several months along with a high quality screened compost. Do not use compost made from animal manures as many undesirable contaminants such as salts and herbicides can come from that parent material. Protein if blended from a variety of sources for optimum amino acid ratios, has an innate N-P-K value but releases those nutrients slowly as the soils microbiology breaks it down. Since research has shown that up to 90 percent of the nitrogen provided from inorganic chemical based fertilizers is never used by the plant, fewer total units of N need to be applied if using Protein as your N-P-K source. Consult with Soil Secrets on this issue for the correct amount of protein you need in your situation.

All fertilizers will have a series of three numbers displayed prominently on the label. These numbers represent the percentage by weight of nitrogen, phosphorus (as P_2O_5), and potassium (as K_2O). For instance, a 24-4-8 fertilizer will have 24% N, 4% P_2O_5, and 8% K_2O. Though all three elements are important in maintaining a healthy turf stand, N will cause the greatest response. Because of this, most fertilizer recommendations for fields are listed as lb. N/1000 ft^2. Nitrogen fertilizers come in two basic forms: quick release (soluble) nitrogen and slow release (insoluble) nitrogen. Quick release nitrogen normally causes a response in a week or less, whereas slow release nitrogen will cause a response in three to 10 weeks or more. Quick release nitrogen is inexpensive and may burn leaf blades if applied improperly. Slow release forms tend to be more expensive but will rarely burn leaf blades even when applied at temperatures above 85^o. Both N forms can and should be used on fields. Examples of slow and quick release N forms are listed in Table 3. Both forms of N are often blended in one fertilizer

bag. This is advantageous because the quick release N gives a response shortly after application and the slow release N results in a more gradual and longer response.

Table 3. Nitrogen forms found in turf fertilizers.

Quick Release N	Slow Release N
Urea	Sulfur Coated Urea (SCU)
Ammoniacal N (NH_4)	Polymer Coated Urea
Ammonium Nitrate (NH_3NO_3)	Methylene Ureas
	Natural Organics

On Kentucky bluegrass or tall fescue fields, it is best to fertilize lightly in spring and early summer, little to none in summer, and heavy in fall and Protein Crumblies does and excellent job on that schedule.

Apply the Protein Crumblies and the TerraPro II humus uniformly over the field. It is best to adjust the spreader setting for the half rate of fertilizer and apply in two directions perpendicular to each other. For rotary spreaders, apply the fertilizer so the wheel is at the edge of the pattern from the previous pass. Improper spreading of fertilizer will result in "streaking", the alternate dark- and light-green stripes in the field. Irrigation or rain following fertilization is important to move nitrogen off the leaf blades and into the soil. Some fertilizer/herbicide combination products cannot be watered-in, so be sure to read the label instructions. Avoid applying fertilizer to drought-stressed or dormant turf, or when temperatures are over 80^{o}F.

Overseeding

With the constant traffic on soccer fields, it is important to overseed regularly during the year to maintain density. The optimum time to overseed cool-season turfgrasses is in August and September in Indiana. However, for the highest quality soccer field, overseeding can and should be done at any time of the year as long as there is ample irrigation to provide for germination and establishment. The species used for overseeding depends largely if there will be continuous play on the field within six weeks of seeding. If there will be traffic on the field, a mix of 20 to 50% perennial ryegrass and 50 to 80 % Kentucky bluegrass should be used. If little or no traffic is expected, then 100% Kentucky bluegrass should be used. Perennial ryegrass works better in the short term because it germinates quickly, is fairly traffic tolerant as a seedling, and provides quick recovery of the area. Kentucky bluegrass germinates slower, but is better for the long term because it but produces a more disease tolerant turf with better wear recovery. When overseeding, apply 4 to 6 lbs/1000 ft^2 if the mix contains perennial ryegrass and 2 to 3 lbs/1000 ft^2 if the seed is 100% Kentucky bluegrass. Overseeding a tall fescue field should be done with seed containing 100% tall fescue at 5 to 6 lbs/1000 ft^2.

If not using a biological protocol such as Soil Secrets, the first step in overseeding is to apply a starter fertilizer (high in phosphorus) over the entire field at 1.5 lbs P_2O_5/1000 ft^2. Then aerify the

field, punching at least 20 to 40 holes/ft^2 with the largest hollow tines available. This will increase the seed-soil contact, improving germination and rate of establishment. You can rarely over aerify at this time, so make many passes over the field concentrating especially on the goal mouths and the center of the field. A power raking at this time will also help to increase the seed-soil contact and break up the aerification cores. Apply the seed to the field with either a dropseeder or a power overseeder, which is a machine that will drop the seeds into small grooves that it cuts into the soil. Try to make two to four passes over the field in different directions with either the dropseeder or the power overseeder to insure a uniform seeding. After seeding, water the newly-seeded area three to four times daily with light irrigation. Continue to mow frequently to limit shade and competition from the established turf. Six weeks after germination, apply 0.75 to 1.0 lb N/1000 ft^2 with a fertilizer containing N, P_2O_5 and K_2O. Avoid applying any herbicides to the area prior to seeding or for at least 6 weeks after seeding, but check the label for the specific instructions for each product.

Overseeding bermudagrass is currently not possible because bermudagrass seed is unavailable. Bermudgrass sprigs should be used to repair damage on a bermudagrass field. After the bermudgrass has greened-up, aggressively hand- or power rake the area to be repaired to stir the soil and allow for good sprig-soil contact. Use a power rake on a healthy portion of the field to sever bermudagrass sprigs. Rake up the sprigs and spread them in the damaged area. Tamp or roll the area to push the sprigs into contact with the soil. Keep the sprigs well-watered until they germinate, and then follow the previous instructions for fertilization.

Pest Control

Very few pests are problematic in sports fields particularly if the soil is on a soil building protocol using biological inoculants. Most pests can be minimized, if not eliminated, by following proper fertilization, irrigation, aerification, and mowing practices. However, pesticides may be needed in certain cases. The labels on pesticides will normally state when traffic can be allowed back into an area following an application. As a rule of thumb, once a pesticide is allowed to dry on the leaves, it is very improbable that it can be removed by contact from soccer players. To be extra cautious, it would be wise to limit traffic on a field within 24 hours after any pesticide application. Always follow the label instructions when using any pesticide.

The labels on most herbicides indicate that they cannot be used before seeding and sprigging or on seedling turf. Thus herbicide use is often restricted because seedlings are usually present on soccer fields. Because of this, the strongest weapon against weeds is a dense, healthy turf. Since seeding may occur regularly throughout a season, preemergence annual grass herbicides should rarely be used to control crabgrass. Preemergence herbicides will dramatically decrease establishment of seedlings. Instead, use postemergence annual grass herbicides such as MSMA (Daconate 6), dithiopyr (Dimension), or fenoxaprop (Acclaim) to control crabgrass. Broadleaf weeds such as clover and dandelion can be controlled with broadleaf herbicide applications in the spring or fall, but seeding cannot occur after this application until a heavy rain or thorough irrigation occurs. Broadleaf weed herbicides should not be applied over the top of seedlings until the seedlings are large enough to mow two or three times, which might be a month or more depending on seeding date. *Poa annua* is becoming a problem on some athletic fields, but since control is extremely difficult, it should be attempted only on high-budget fields.

Always follow label instructions when using any herbicide for specific uses, rates, and flexibility of use around seeding.

Turfgrass diseases are generally not a problem on soccer fields. Rust, red thread, and dollar spot may cause problems on fields low in nitrogen. Generally, increasing the annual rate of N should limit these diseases in the future. Brown patch and pythium are two diseases that may cause extensive damage in July and August in fields with a high percentage of perennial ryegrass and are heavily fertilized. Preventative fungicide schedules should be used only on fields with a history of disease problems.

Insects may become a problem on some athletic fields containing cool season grasses. The type and cause of the problem varies widely among locations, but white grubs probably cause most damage of the insect pests. White grubs damage is generally seen in late August and September when patches of turf wither and dry. White grubs can be controlled through a preventative insecticide application made in late June or July, depending on the product used. However, preventative white grub applications probably are not needed unless the field has a history of white grub damage.

Weeds are usually the only pests in bermudagrass fields. Controlling weeds in bermudgrass fields is best done with an application of glyphosate (Roundup) in December or January when the bermudagrass is dormant. Diseases and white grubs are not a problem in bermudagrass fields.

Thatch Control

Thatch is a tightly intermingled, organic layer of dead and living shoots, stems, and roots that accumulate just above the soil surface. Thatch accumulation is due to either over-fertilization, over-watering, and/or soil compaction. Soccer fields rarely develop a thatch layer because of the constant wear and tear on the grass. Thus, thatch control is normally not necessary on soccer fields, and the regular aerification practices should suffice as a thatch control method.

Topdressing

Topdressing is the practice of spreading a thin layer of sand and/or soil over the field which is then dragged or brushed into the turf. Topdressing is helpful in smoothing a field and can help improve establishment when used after seeding. Topdressing with sand following aerification may help to change the soil profile over many, many years. Time and money should only be spent on topdressing after other basic turf management practices are done and perfected. Therefore, topdressing is reserved only for the high-budget soccer fields.

Other Sources of Information

SportsTurf Managers Association (STMA)
P.O. Box 3480, Omaha, NE 68130, 800-323-3875

Athletic Fields - Specification Outline, Construction, and Maintenance.
J.C. Harper, Penn State Univ., 106 Agricultural Admin. Bldg., University Park, PA 16802.

United States Soccer Federation
1801-1811 S. Prairie Ave, Chicago, IL 60616, 312-808-1300, http://www.us-soccer.com

United States Youth Soccer
899 Presidential Dr # 117, Richardson, TX 75081-2964, 800-476-2237

Management calendar for sports fields containing Kentucky bluegrass, perennial ryegrass, or tall fescue. If you are using Soil Secrets protocol of Protein Crumblies and TerraPro II humus follow the label rates.

Month	Maintenance Level			Notes
	Low	Medium	High	
March	Overseed if unable to fall or dormant seed.	Overseed if unable to fall or dormant seed.	Overseed if unable to fall or dormant seed.	Kentucky bluegrass is preferred unless tall fescue is the dominant species on the field.
April		Begin aerification and overseeding.	Begin aerification and overseeding.	Use a mix containing perennial ryegrass if the field is in use.
May	Apply 1.0 lb N/1000 ft^2 after spring growth flush. Control broadleaf weeds if needed.	Apply 1.0 lb N/1000 ft^2 after spring growth flush. Control broadleaf weeds if needed.	Apply 1.0 lb N/1000 ft^2 after spring growth flush. Control broadleaf weeds if needed. Continue aerification and overseeding when possible.	Use fertilizer with 50% or more slow release N. Check label for seeding limitations. Use a mix containing perennial ryegrass if the field is in use.
June	Monitor annual grassy weeds and control if necessary.	Monitor annual grassy weeds and control if necessary. Irrigate as needed.	Monitor annual grassy weeds and control if necessary. Irrigate as needed.	Check label for seeding limitations.
July	Control white grubs if history dictates.	Control white grubs if history dictates. Irrigate as needed.	Control white grubs if history dictates. Apply 0.75 lb N/1000 ft^2. Irrigate as needed. Monitor disease pressure and control if necessary.	Use fertilizer with 50% or more slow release N.
August		Irrigate as needed.	Irrigate as needed. Monitor disease	

			pressure and control if necessary.	
September	Apply 1.0 lb N/1000 ft^2. Aerification and overseeding if schedule permits.	Apply 1.0 lb N/1000 ft^2. Aerification and overseeding if schedule permits.	Apply 1.0 lb N/1000 ft^2. Aerification and overseeding if schedule permits.	Use fertilizer with 30-50% slow release N. Use a mix containing perennial ryegrass if the field is in use, 100% Kentucky bluegrass if no traffic is expected, or 100% tall fescue if tall fescue is the dominant species in the field.
October	Optimum time to control broadleaf weeds.	Optimum time to control broadleaf weeds. Apply 1.0 lb N/1000 $ft^{2.}$	Optimum time to control broadleaf weeds. Apply 1.0 lb N/1000 ft^2. Consider aerification and overseeding if schedule permits.	Check label for seeding limitations. Use fertilizer with 30-50% slow release N. Use 100% Kentucky bluegrass if no traffic is expected or 100% tall fescue if tall fescue is the dominant species in the field.
November	Apply 1.5 lb N/1000 ft^2. Aerify and dormant-seed following last game.	Apply 1.0 lb N/1000 ft^2. Aerify and dormant-seed following last game.	Apply 1.0 lb N/1000 ft^2. Aerify and dormant-seed following last game.	Use fertilizer with 100% fast release N (urea). Use Kentucky bluegrass for overseeding.

Table 7. Management calendar for Sports fields containing Bermudagrass but not including the protocol of Soil Secrets

Month	Maintenance Level			Notes
	Low	Medium	High	
April	Keep all traffic off field until bermudagrass	Keep all traffic off field until bermudagrass	Keep all traffic off field until bermudagrass	

	greens-up and begins growing actively.	greens-up and begins growing actively.	greens-up and begins growing actively.	
May	Apply 1.5 lbs N/1000 ft^2 after bermudagrass has greened-up.	Apply 1.5 lbs N/1000 ft^2 after bermudagrass has greened-up.	Apply 1.5 lbs N/1000 ft^2 after bermudagrass has greened-up.	Use urea (46-0-0).
June	Monitor annual grassy weeds and control if necessary. Resprig damaged areas. Aerify if schedule permits.	Monitor annual grassy weeds and control if necessary. Resprig damaged areas. Aerify if schedule permits. Irrigate as needed. Apply 1.5 lbs N/1000 $ft^{2.}$	Monitor annual grassy weeds and control if necessary. Resprig damaged areas. Aerify if schedule permits. Irrigate as needed. Apply 1.5 lbs N/1000 $ft^{2.}$	Check label for seeding limitations. Use urea (46-0-0).
July		Irrigate as needed.	Irrigate as needed. Aerify if schedule permits.	
August		Irrigate as needed.	Irrigate as needed.	
September			Apply 2.0 lb K_20/1000 $ft^{2.}$	Use muriate of potash (0-0-60).
October - April	Keep all traffic off field after Bermudagrass goes into dormancy.	Keep all traffic off field after Bermudagrass goes into dormancy.	Keep all traffic off field after Bermudagrass goes into dormancy.	
December - February	Consider an application of glyphosate to control weeds.	Consider an application of glyphosate to control weeds.	Consider an application of glyphosate to control weeds.	Bermudagrass must be absolutely dormant.