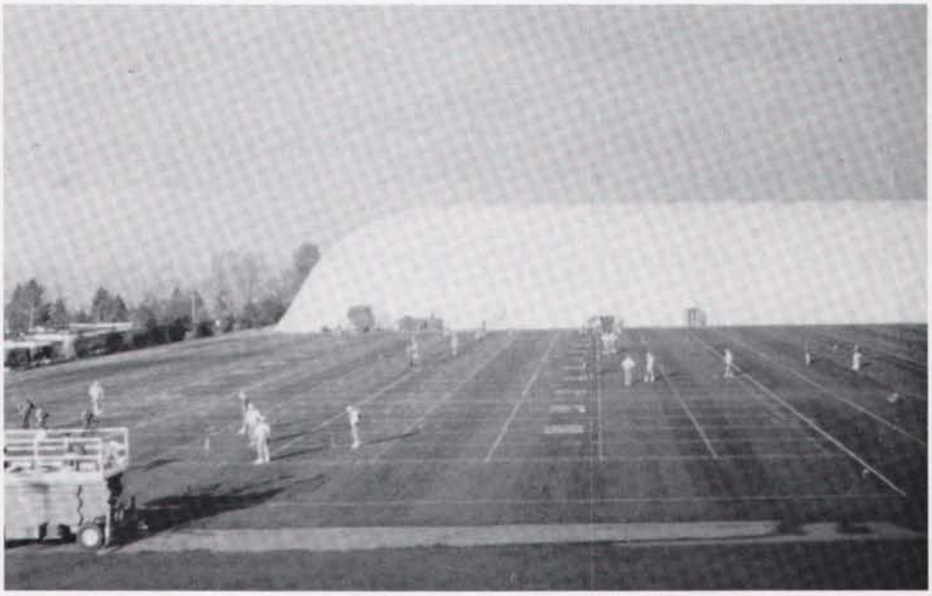
Fertilization of Sand-Based Rootzones

Sand has become a remedy for many of the modern pressures placed upon natural turf. By replacing or amending native soils with sand, turf specialists have largely solved problems with drainage, compaction, hardness, traction, and shallow rooting. As the value of golf greens, race tracks, and athletic fields rises, more turf managers find themselves dealing with sand-based rootzones. It isn't long before they discover that fertilization of these rootzones is considerably different from feeding standard, soil-based rootzones.



Seattle Seahawks training center features a four-acre sand-based field maintained with a precise fertilization program.

The very characteristics that make sand drain well and resist compaction also make it relatively poor as a reservoir for water and nutrients. Compared to clay, sand has a smaller surface area by weight, which limits its ability to react chemically with nutrients. A significant portion of soluble fertilizers will leach through sand following rainfall or irrigation, rather than clinging to it. Roots growing in sand are not protected from chemicals by the buffering action of clay and organic materials. As a result, there is less margin for error and a greater necessity for close management of chemicals applied to sand-based rootzones.

The size and type of sand affects the way it holds water and nutrients. Finer sands hold more water than coarse ones. Minerals and impurities in some sands may increase water retention. Unfortunately, turf managers have limited control over the sands available to them. For practical reasons, builders of golf greens and sports fields must specify sands that are available locally. This puts the job of determining appropriate maintenance and irrigation levels on the superintendent or groundskeeper.

Fortunately, the United States Golf Association Green Section has reduced the margin of error for superintendents by developing specifications for sand-based greens. The USGA guidelines state that the ideal particle size range for sand used in the rootzone mix is between .25 mm to .75 mm, with the majority being between .25 mm and .50 mm (medium). In most instances, fine and very fine sands (less than .25 mm) should comprise no more than ten percent of the total volume of the mix.

Furthermore, the mix should contain less than five-percent silt and three-percent clay. The organization stresses that the components and the final rootzone mix must be tested by a laboratory for accuracy before installation. According to the specifications, the rootzone should retain 12 to 18 percent water by weight at a tension of 40 cm. Water should be able to pass through the compacted rootzone at a rate of approximately five inches per hour.

Particle size is not the only factor in sand's influence on fertilization. "There is a lot of variability in sands from one location to another," remarks Dr. Ed McCoy, assistant professor of agronomy at Ohio State University in Wooster. Silica sands are pretty inert. Calcareous sands contain some contaminants, including silts, clays, shales, feldspars, and calcium carbonate. The contaminants provide some additional absorption."

In his own state of Ohio, McCoy has noticed that the amount of calcium carbonate in sands increases from north to south. "In southern Ohio, local sands contain quite a large amount of calcium carbonate and have a pH ranging from 7.5 to 8.5," he states. "Groundskeepers who add sulfur to correct the pH may end up dissolving the calcium carbonate, allowing it to migrate down in the soil profile. The result can be a lower, caliche layer with a high pH. It's almost like cement. That's why it is so important to have a laboratory test any sand before it is installed."

Once you know the particle sizes of sand, you can fairly accurately predict its water-retention ability, McCoy points out. However, water and nutrient retention levels change after turf has become established. "The older sand-based fields become, the more organic matter enters the rootzone," explains Dr. Roy Goss, who recently retired as professor of agronomy at

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Washington State University in Puyallup. As the organic matter increases, so does the cation exchange capacity (CEC) of the soil. This improves the water and nutrient retention ability.

"Soil should be tested at least once a year," Goss suggests, "to gauge the cation exchange capacity and to get a handle on nutrient deficiencies before they impact the turf. Once you see symptoms of nutrient deficiency, the turf has been in deficit growth for a week to ten days. Then it takes fertilizer or micronutrients a few days to bring the turf back up to speed. During this period of time, the turfgrass is not performing up to its ability. When a green, tee, or field is heavily used, you can't afford to lose this time."

Goss has consulted for many golf courses and athletic facilities during his career. Working with civil engineer Carl Kuhn, Goss designed and established a maintenance program for the Seattle Seahawks training center in Kirkland, WA. The four-acre, sand-based field has provided a consistent, playable surface for the Seahawks for five seasons. The training center is considered a model by many other National Football League franchises.

John Monson is responsible for the Kentucky bluegrass and perennial ryegrass growing in 18 inches of medium-sized sand. Monson changes the lines and goals for two full-sized fields regularly to distribute the wear evenly over the area. Minicamps start in April and extend through mid-July. Practices take place on the fields into December. The facility also has one Omni-Turf, sand-filled artificial field which can be covered by an air-inflated plastic bubble.

"In this climate you need to have a sand rootzone," the former golf course superintendent says. "The native, heavy-clay soil can't take the rain or abuse. Water never puddles on the [sand-based] fields and the roots extend all the way to the bottom. It's easier to manage than other fields in some respects, but you have to stay on top of maintenance all the time."

Monson watches fertilization and irrigation very closely. "The sand becomes loose if it gets too dry," he reveals. "It has to be kept uniformly moist without overirrigation. We don't want anything leaching through the rootzone and into the storm sewers. Wetting agents help us with uniformity and slow-release fertilizers control the leaching."

Goss and Charles Lilly Co. of Portland, OR, developed a fertilizer containing 11 basic nutrients called Royal Green. One-half pound of the 18-3-16 blend of sulfur-coated urea with macro- and micronutrients is applied every two to three weeks beginning in April. Monson supplements the nitrogen in the spring and fall with light rates of ammonium sulphate, which has a lower leaching potential than ammonium nitrate or calcium nitrate. "There is a problem with the predictability of release of slow-release products in cold weather," Goss explains. "For this reason, we have to use some soluble sources." The total amount of nitrogen applied during the season ranges between six and eight pounds per 1,000 square feet.

Additional phosphorus is applied only in the spring, during renovation. After a soil test, the field is aerified, dethatched, reseeded, and topdressed with the exact same sand as the rootzone. "Phosphorus is not prone to leaching," states Goss. "Once turf has established, high levels of phosphorus only encourage *Poa annua*." Monson has also applied Endothall to knock the Poa back.

Potassium is the nutrient Goss and Monson watch closely at the training center. "Potassium can leach readily with heavy rainfall and irrigation," says Goss. "It can become deficient rapidly, within a matter of days. We try to keep it at medium to medium-high levels, around 200 parts per million. The one-to-one ratio of nitrogen to potassium in the fertilizer accomplishes this."

Other nutrients contained in the Royal Green are sulfur, iron, calcium, copper, boron, manganese, magnesium, and molybdenum. "It's important to keep all nutrients in balance with regular feeding," says Goss.

John Nolan, head groundskeeper at Soldier Field in Chicago, IL, also follows a program of frequent, light rates of nitrogen supplemented with micronutrients. Since the Prescription Athletic Turf (PAT) field is like a bathtub filled with sand, it traps any nitrogen that is not held by the sand. Due to its close proximity to Lake Michigan, soil temperatures coincide with the temperature of the lake, a factor which can hamper the release of ureaformaldehyde nitrogen sources.

Jim Fizzell, turf specialist with the University of Illinois Cooperative Extension Service, advises Nolan on the stadium's fertility program. "John applies 1/4 to 1/2 pound of nitrogen every two weeks," says Fizzell. During spring and fall most of the nitrogen is in quick-release forms. In the summer, when temperature and humidity rises, Milorganite (6-4-2) is applied for a total N of four pounds per 1,000 square feet for the year. Milorganite is an organic, slow-release source of nitrogen which contains a number of micronutrients, including iron, copper, zinc, and sulfur. Soldier Field also maintains potassium levels with 10-10-10 or 15-0-30 formulations of fertilizer.

"There is a consensus today that potassium should be applied on a one-to-one basis with nitrogen," says Dr. William Daniel, coinventor of the PAT system. "The tendency is to overwater sand rootzones. This causes leaching of potassium and other important nutrients.

"We have seen instances of heavy rainfall or overirrigation which caused a 50-percent drop in soluble salts. Slow-release nitrogen sources can reduce this loss significantly. One company [Purcell Industries, Sylacauga, AL] recently came out with a slow-release potassium, sulfur-coated sulphate of potash. This product could help groundskeepers maintain practice fields without having to make frequent applications."

Paul Grosh, regional sales manager for Lebanon's Country Club products, said one of his company's biggest products is its 8-4-24 fertilizer. "Superintendents are using potassium to improve heat, cold, and wear tolerance and help turf resist diseases," Grosh says. "They use the high K product during periods of greatest plant stress."

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Dr. Paul Mosdell, project leader for fertilizer development at O.M. Scott, points out that too much nitrogen or a deficiency of manganese can magnify a potassium shortage. "The jury is still out on high rates of potassium," Mosdell says. "Theoretically, nutrients in the soil compete for uptake by the plant. More research is needed to figure out what the right balance of nutrients is for turf growing in sand-based rootzones."

Grosh is concerned by the number of turf managers cutting back or eliminating phosphorus from their fertilization programs. "They want to discourage *Poa annua* from reseeding, but may find they end up with a phosphorus deficiency," he warns.

Iron is a nutrient that can have a dramatic effect on the color of turfgrass and is often unavailable in sandy, overirrigated soils. Excessive levels of phosphorus, zinc, or manganese can also cause an iron deficiency, known as chlorosis. This condition can be corrected with a foliar spray of iron sulfate or an application of chelated iron. The chelated form will not leach and won't discolor pavement or structures in the area.

Daniel suggests three ways to keep track of turf nutrients. "Tissue analysis is the most sensitive," he begins. "A good tissue sample analysis tells the turf manager if there is a nutrient deficiency within the plant." His second indication is the amount of clippings removed during mowing. The third is to test the soil for levels of available nutrients. "The key is a steady diet, not peaks and valleys," he explains.

The cation exchange capacity of sand rootzones can be improved quickly with the addition of certain amendments, says Daniel. He cautions, however, that some of the amendments can reduce the percolation rate of the rootzone mix. "A silty loam soil has a CEC ranging from 15 to 20, while sand runs about 3," he reveals. The incorporation of calcined clay (CEC 15-20) or peat moss (CEC 80-100) can bring the exchange capacity of the soil mix up depending upon the volume added.

The present trend in fertilization of sand-based rootzones is to build a foundation of slow-release nitrogen and supplement it with frequent light applications of quick-release nutrients. Fertigation could assume a major role in the frequent application of nutrients on golf and sports turf, says Daniel. "Using the irrigation system to apply fertilizers reduces the tedium of reapplying products every two weeks," he claims. "It also lowers the chance of striping or misses with sprayers or spreaders."

As research at Louisiana State University in Baton Rouge revealed nearly ten years ago, not all nitrogen sources work equally well on sand-based golf greens. The best turf quality may result because the nitrogen source affects other nutrients in the rootzone. Since Milorganite contains nutrients beside nitrogen, it was rated highest in the tests. But sulfur-coated urea, IBDU, ureaformaldehyde, methylene ureas, and plastic-coated urea, when balanced with timely rates and applications of other nutrients, do not leach from sand-based rootzones.

High-quality turf can grow in a compaction-resistant, well drained rootzone without wasting water or chemicals, contaminating groundwater, or restricting use. It takes more effort, but that effort is justified by the increased value and productivity of the facility. You can't build a sand-based rootzone and then expect to maintain it with old, soil-based technology.