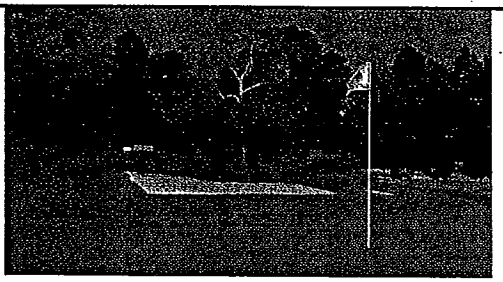

Improve Your Putting Greens *with* Soil Amendments

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Environmental pressures and the threat of water-supply shortages for golf courses have greatly intensified golf-course superintendents' interest in root-zone amendments. Today, new golf-course greens are often constructed with a USGA-specification mixture of sand and peat as a root-zone media because of its good drainage and aeration characteristics and its reduced compaction problems. Unfortunately, however, these beneficial percolation properties may also create the possibility of excessive leaching of nutrients and a lack of adequate soil-moisture retention.

Eliminating the choker layer

Original recommendations for constructing a USGA putting green included an intermediate layer of coarse sand (a choker layer) to serve as a bridge between the root-zone growing media above and the pea gravel underneath. Due to construction difficulties, product availability and materials costs, however, many putting-green construction companies have eliminated the choker layer when constructing a putting-green profile.

A long-term study, in fact, indicated that eliminating the choker layer from the USGA profile did not influence the rate of drainage through the profile, the percentage of nitrate N leached nor the rate of growth of the Tifdwarf bermudagrass. These glasshouse-culture results, though, may not truly represent those in the field because the same size sand was used with and without the choker layer.

In field practice, when you eliminate the coarse-sand layer, you must increase the mean particle size of the typical root-zone mixture, due to the interface requirements between the root-zone mixture and the pea gravel below. Consequently, the typical coated sands traditionally used in USGA root-zone mixtures are too small, so a coarser uncoated sand has become the product of choice. Putting greens with these coarser uncoated sands, however, have higher percolation rates and lower water-retention and nutrient-retention properties.

Research Findings at a Glance

Improving the retention of both water and nutrients is an important consideration when choosing an amendment for inclusion in the root-zone mixture of a putting green.

- Root-zone mixtures constructed using naturally coated and artificially coated sands retain more water.
- Sand coatings, whether natural or artificial, have been shown to increase the rate of turfgrass coverage and growth.
- Uncoated sand leaches significantly more P and K than does naturally coated sand.
- The inclusion of 15% Fe-Humate, Profile and PSA in the root-zone mix significantly enhanced water-use efficiency and the growth of Tifdwarf bermudagrass.
- Turfgrass growing on mixtures amended with Fe-Humate was visually much more aggressive and darker green than on the other mixtures.

Sand coatings

The growth of most plants is closely connected to the available water supply. Even with frequent irrigation, adequate water availability is difficult to maintain in uncoated sand. So the main reason for the slower establishment and slower growth rate of turfgrass growing on uncoated sand is likely related to the lack of an adequate water supply.

Sand coatings, whether natural or artificial, have been shown to increase the rate of turfgrass coverage and growth (Figure 1). Naturally coated sands have coatings of clays, as well as various iron and aluminum oxides, that improve the sands' water- and nutrient-retention properties. Positive and negative charges associated with the coating

are responsible for the enhanced retention properties of the naturally coated sands. Uncoated sands do not contain these coatings and thus are potentially capable of leaching greater quantities of nutrients.

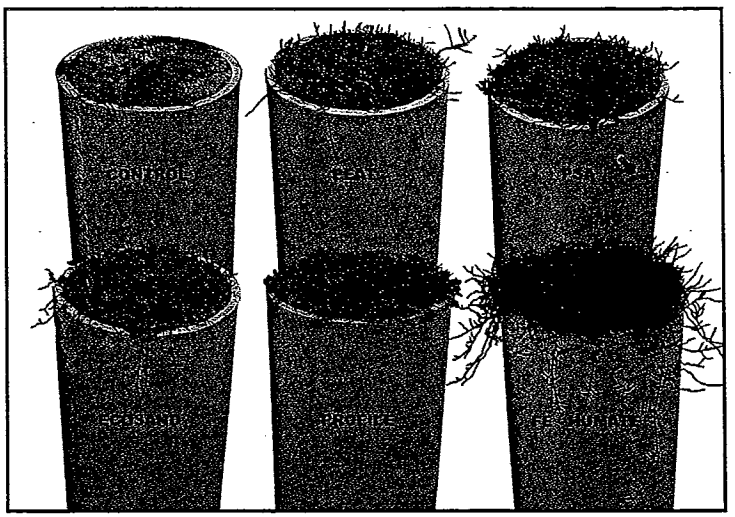
A previous study evaluated the percentage of applied P and K lost to leaching relative to the type of sand used in the root-zone mixture. **The uncoated sand leached significantly more P and K than did the naturally coated sand** (Figure 2). Also in this study, artificially coated sand leached a larger percentage of P than naturally coated sand. However, the adhesive and clay used in the artificially coated sand contained P, which may explain the elevated levels of P leaching with this material.

Enhanced water retention means that more water is being retained by the growing medium, and if that water is plant available, then the medium's water-use efficiency is increased. Research has shown that **root-zone mixtures constructed using naturally coated and artificially coated sands retain more water** — and thus have better water-use efficiency — than mixtures formulated using uncoated sands (Figure 3).

Amendments

Although adding clays, silts or organic matter to the root-zone mixture tend to increase cation exchange capacity (CEC), which aids in nutrient retention, their use in the root-zone mixture can reduce the percolation rate and lead to long-term drainage problems in the green. Until recently, peat was basically the only USGA-approved amendment for inclusion in the root-zone mixture to increase water and nutrient retention.

The turfgrass industry's growing interest in other amendments — such as calcined clays (Profile), diatomaceous earths (PSA) and zeolites (Ecosand) — was one of the driving influences behind USGA approval of other materials in the putting root-zone mix. During the last five years, several amendments have been evaluated for



Turfgrass growing on root-zone mixtures amended with Fe-Humate was visually much more aggressive and darker green than the rest of the experimental units.

Figure 2

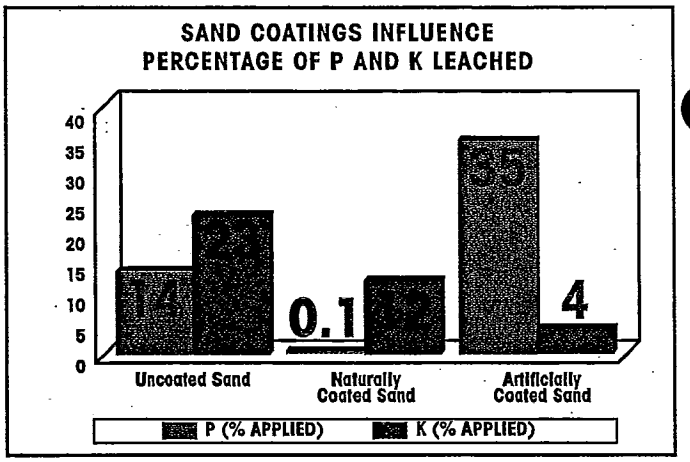


Figure 1

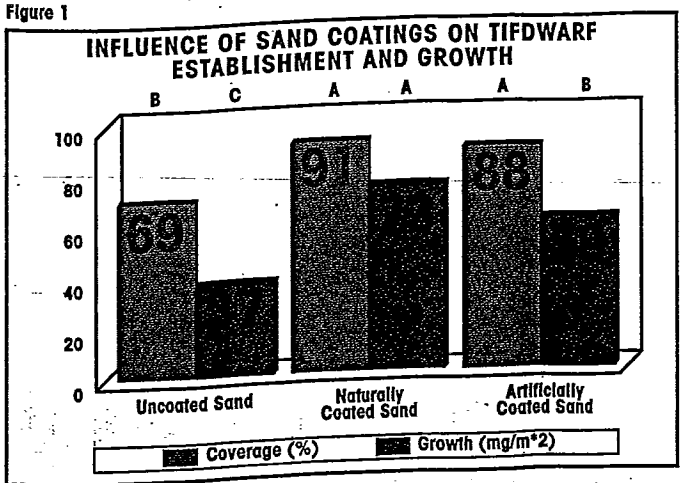


Figure 3

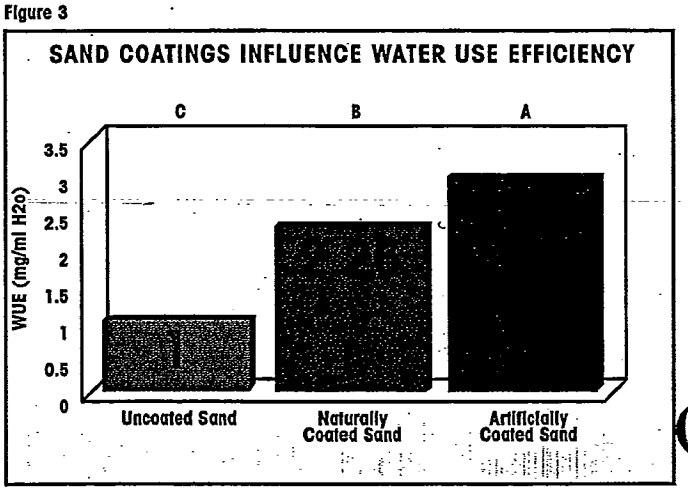


Figure 4

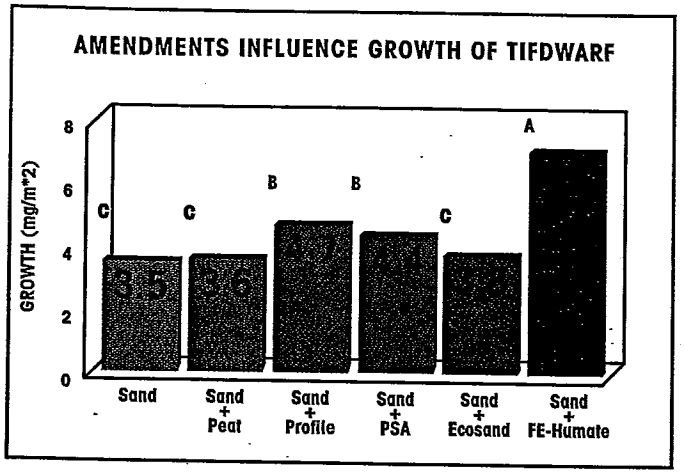
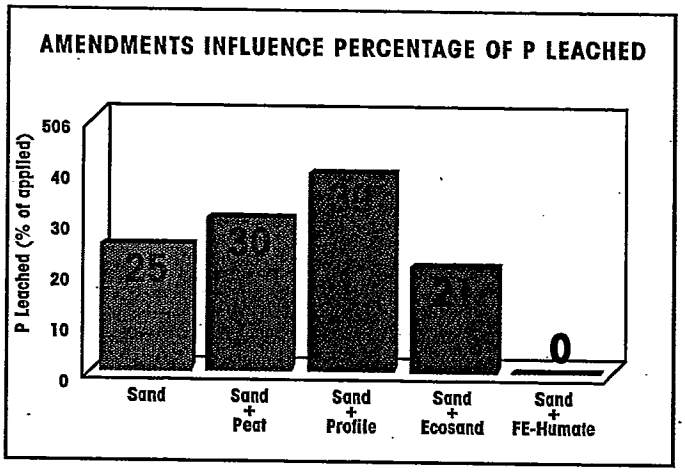


Figure 5

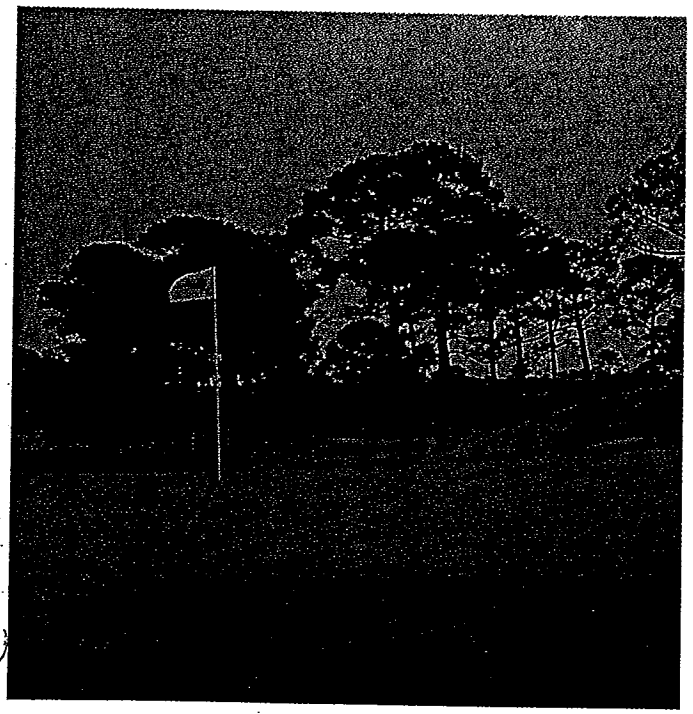


their influence on turfgrass growth, nutrient uptake, nutrient leaching and water-use efficiency. To determine their influence on growth, water-use efficiency and nutrient leaching, our research evaluated Profile, PSA and Ecosand, plus a water treatment residual (Fe-Humate).

Our research results

The inclusion of Fe-Humate, Profile and PSA in the root-zone mix at the rate of 15% (volume to volume basis) significantly enhanced the growth of Tifdwarf bermudagrass (Figure 4). However, the addition of peat and Ecosand did not enhance growth above that of the straight sand alone.

We also observed a significantly higher water-use efficiency when Fe-Humate, Profile and PSA were included in the root-zone mixture. Turfgrass growing on mixtures



amended with Fe-Humate was visually much more aggressive and darker green than the rest of the experimental units (see photo). Apparently, the Fe-humate, Profile and PSA retained more water against drainage losses, resulting in a higher percentage of the applied water being available to the turfgrass. Once again, however, the addition of peat and Ecosand did not increase the water-use efficiency.

Incorporating amendments

Incorporating amendments is difficult if they are not mixed with the sand prior to installation of the green. After a green is established, the only way to incorporate amendments (short of completely reworking the green) is to include the amendments in a topdressing mix following aerification.

In order to simulate this incorporation method in the glasshouse study, we applied a 50:50 mixture of sand and the desired amendment as a topdressing following a four-tine and nine-tine aerification procedure. The four-tine and nine-tine aerification represented a single and double aerification.

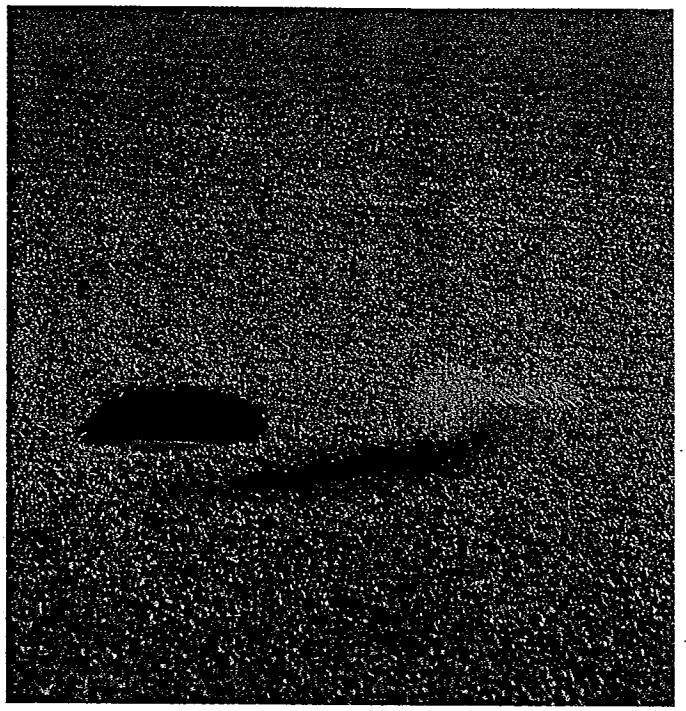
Growth rate and water-use efficiency were significantly influenced by the level of amendment incorporation. Full incorporation (which represents the practice of incorporating 15% of the selected amendment in the root-zone mixture during the construction of the green) produced a significantly higher bermudagrass growth rate than did the four-tine and nine-tine incorporation. Again, this increased growth rate was most likely associated with the availability of water.

With the continued use of the post-aerification method, it is possible that a sufficient quantity of amendment could be applied to improve the water-use efficiency and growth characteristics. However, since a relatively small percentage of the total area is affected by a single aerification, it would require several post-aerification applications to affect a response.

Improving nutrient retention and reducing leaching losses, particularly P, are important considerations when choosing an amendment for inclusion in the root-zone

mixture. Above, we observed the influence of sand coatings on the quantity of P leached. Recently, using a coated sand in our overall mixture, we also evaluated the influence of soil amendments on the quantity of P leached.

Mixing Ecosand at the rate of 15% on a volume basis did not influence the percentage of P leached (Figure 5). Incorporating Profile, however, increased the leaching of applied P. Profile's reactive properties are relatively low, and it apparently does not react with the applied P to reduce P losses. If P fertilization rates can be maintained such that excessive P does not leach, Profile's positive attributes (enhanced growth and water-use efficiency) may override the lack of P retention. However, use of a Fe-Humate in the mixture may produce the desired enhanced growth and water-use efficiency, while limiting or eliminating P leaching.



Summary

These research results mainly relate to the short-term influence (one to two years) of amendments on the growth and water- and nutrient-retention properties of root-zone mixtures. Longer-term studies and a proven track record under real-life golf course conditions are needed prior to choosing the idea amendment for your root-zone mixture.