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Amending fairways

When blended with sand at 10 percent by volume, Lassenite Soil Amendment improved water-holding capacity of golf course fairways.

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This study was conducted to examine the properties of Lassenite Soil Amendment (LSA) for use in golf course fairways to improve water relations and examine plant-water relationships with water that is fairly high in soluble salts.

The LSA improved water-holding capacity (field capacity) compared to other amendments, when blended with sand at 10 percent by volume.

Materials were tested using a modified double wash cation exchange capacity (CEC) procedure to determine the CEC of each material using sodium (Na) as the ion being exchanged. Since Na would probably be the ion of interest, the usual magnesium for calcium procedure was not used. Instead, the samples were saturated with Na and then potassium (K) was used as an exchanging ion.

The LSA had a higher CEC than was anticipated, after examining a chemical analysis provided by Western Pozzolan, entrained sodium and soluble sodium components were ruled out. It is speculated that the source of the CEC is amorphous (without form) minerals present in the pozzolan. Amorphous materials are common in volcanic deposits. Amorphous materials also have been shown to have significant CEC values. This could be either a good thing (the amendment provides some nutrient holding) or not so good (the amendment becomes saturated with Na and this hurts the plants). Further CEC testing may be warranted to better define this property.

PLANT GROWTH. Seashore paspalum (*Paspalum vaginatum*) variety SeaDwarf was established on 6-inch (diameter) pots filled with sand mixed with no amendment (control), 10 percent (v/v) LSA or 10 percent (v/v) clinoptile zeolite (Z). The variety Seadwarf was used and the pots were established using washed sod. Sixteen pots of each treatment were established. After one month of growth to get acclimated, the pots were broken into four water regime treatment groups (12 pots per group) with four pots of each soil amendment per treatment. The water regime treatments were:

- Tap water – plants maintained at field capacity (no stress);
- Tap water – plants watered when they showed drought stress;
- Salt water (1000 ppm Na) – plants watered to field capacity; and
- Salt water – plants watered when plants showed signs of drought stress.

Plants watered with salt water at field capacity looked the best. These plants had better color and few if any brown leaves compared to other treatments. It appears that some sodium is essential for this seashore paspalum cultivar to have its highest quality.

Plants watered with tap water at field capacity looked the next best.

ROOTING STUDY. After more than three months of growth in 6-inch pots in the greenhouse, the pots were dismantled to examine root growth. There were three factors being evaluated in this study:

Water timing – maintaining water at field capacity by watering every day or watering just before the plants began to wilt, which was determined to be every two to three days depending on sunlight conditions. We found that water timing did not have a significant influence on root mass in this study.

Water quality effects were also examined and we found that 1,000 ppm salt (as NaCl) produced a small but significant decrease in root mass per pot (Table 1). The decrease was 1.4 grams per pot.

Soil amendments were also evaluated and found to significantly affect rooting across water timing and water quality (Table 2). The control pots (straight USGA sand) had the highest root mass but did not produce a significantly different root mass than a 90 percent USGA sand/10 percent LSA (LSA) mix. The 90/10 zeolite amendment produced a statistically lower root mass than did the other treatments.

It is logical that the straight sand might produce the highest amount of root mass as it was the droughtiest treatment (always the first to show signs of water stress). This would stimulate root growth to keep up with water demand.

The salt treatment always resulted in a decrease in rooting across all treatments, but this difference was not always statistically different. The zeolite pots showed

Material	Field capacity water (% water by mass)
Sand	21.9
LSA	27.8
Calcined Clay (fine)	26.4
Calcined Clay (coarse)	24.7
Calcined diatomite	23.3
Zeolite	22.2

Material	CEC cmol+/ kg material
Sand	0.3
LSA	25.9
Calcined clay (fine)	2.7
Calcined clay (course)	7.2
Zeolite (fine) (clinolite)	68.6
Zeolite (course) (source not known)	10.4
Calcined diatomite	10.5

Figure 1. The best pots (out of 4) for the salt water field capacity pots. C = control, P = LSA, Z = zeolite

Plants watered with tap water at field capacity looked the next best.

Figure 2. The best pots (out of 4) for the tap water field capacity pots. C = control, P = LSA, Z = zeolite

Plants watered with salt water under drought conditions are doing slightly better than those under drought conditions and tap water.

Figure 3. The best pots (out of 4) for the salt water drought pots. C = control, P = LSA, Z = zeolite

Figure 4. The best pots (out of 4) for the tap water drought pots. C = control, P = LSA, Z = zeolite

In most cases the LSA pots looked better than the other two treatments.

Table 1. Soil amendment effects on mean root mass of seashore paspalum.

Treatment	Root mass (g) in 6 inch pot
Control (USGA Sand)	10.4 a
LSA (90:10 mix with USGA sand)	9.2 a
Zeolite (90:10 mix with USGA sand)	6.6 b

Means followed by same letters are significantly different at the α = 0.05 level of significance.

Table 2. Comparison of the effects of 1000 ppm NaCl water and tap water on the mean rooting mass of seashore paspalum.

Treatment	Mean root mass (g) in 6 inch pot
Tap water	9.44 a
1000 ppm NaCl	7.98 b

Means followed by same letters are significantly different at the α = 0.05 level of significance.

Table 3. Comparison of all treatment combinations for mean root mass of seashore paspalum.

Treatments	Mean root mass (g) in 6 inch pot
DWP	10.9 a
FCWP	10.9 a
FCWC	10.7 a
DWC	10.5 a
FCSC	10.3 a
DSC	10.1 ab
DSP	7.9 abc
DWZ	7.1 bc
FCSP	6.9 c
FCWZ	6.6 c
DSZ	6.5 c
FCSZ	6.2 c

D = drought, FC = field capacity, W = tap water, S = 1000 ppm NaCl, C = control (USGA sand), P = 90:10 mix of USGA sand and LSA, Z = 90:10 mix of USGA sand and zeolite. Means followed by same letters are significantly different at the α = 0.05 level of significance.

Table 4. Electrical conductivity values of various treatments. EC was determined using a 1:1 soil to water ratio.

Treatment	EC reading (mS)
LSA Field Capacity	1.56 a
Zeolite Field Capacity	1.22 b
Zeolite Drought	1.22 b
Control Drought	1.06 bc
LSA Drought	1.00 bc
Control Field Capacity	0.87 bc

larger decreases in root mass than did the other soil treatments (Table 3).

It appears that the LSA adsorbs less sodium than the zeolite and its incorporation has less effect on root mass in salty conditions than zeolite. LSA also enhances water holding so treated areas would require less water compared with straight sand.

To gain further insight into the plant growth, the amount of salts held in the pots at the end of the experiment was examined. The grass and pots were dried down and soil samples were taken. The grass roots and rhizomes were extracted from the soils samples by hand. For electrical conductivity (EC) determination 20 grams of soil was mixed with 20 ml of isopure water, stirred and allowed to stand for 30 minutes. The electrical conductivity was measured with a Field Scout conductivity meter (Table 4). The 1:1 soil to water ratio is reported to produce results similar to saturated paste conductivity. No treatment showed an EC value that would affect plant growth of salt tolerant plants.

Since the LSA held more water at field capacity, it seems logical that when the pot was dried down more salt would be present in that soil and therefore it would have a higher EC value. The sand would have the lowest water-holding capacity and little CEC, therefore its EC readings should be low and they were. It is interesting that the 10 percent LSA pots under drought conditions (watered every 3 days) fell into this group. The 10-percent zeolite pots show identical readings for field capacity and drought treated pots. We think we saw equilibrium with the exchange complex in these pots, and the EC value represents the 1,000 ppm salt solution we were watering with, coming to equilibrium with cation exchange of the zeolite. If the EC of the droughted LSA pots represents equilibrium, then it is at a lower level indicating that LSA does not hold onto salts as strongly as the zeolite amendment.

CONCLUSION. There did not appear to be any drawback to using the Lassenite Soil Amendment (LSA) under these conditions – a sand fairway watered with 1,000 ppm salts (as NaCl) water. As long as the soil on the site is able to drain away excess water, the seashore paspalum should perform well. If drainage were to be poor and the water began to move upward in the profile rather than downward, a salt accumulation could affect the grass. The LSA increased the water-holding capacity of the soil and that resulted in needing to be watered less frequently than sand-alone pots.The difference was that the sand pots needed water every two days while the LSA- and zeolite-amended pots needed water every three days. In the field these intervals would more likely be three days for sand and four to five days for the LSA. This would be a significant change in the amount of water needed to maintain turf on a yearly basis. **GCI**

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