The Influence of Gypsum on the Physical and Chemical Properties of Turfgrass Soils

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Gypsum (calcium sulfate) is a soil amendment used to correct soils causing problems due to over-accumulation of sodium ions. These sodic soils contain sodium levels that disperse the soil particles, resulting in the soil sealing. This reduces the infiltration rate of water entering the soil, and prevents good drainage and gas exchange. The result is a decrease in irrigation efficiency and an unhealthy turfgrass root system. The calcium contained in gypsum displaces the sodium and reverses the detrimental soil effects mentioned above. Gypsum can also be a useful amendment for preventing the accumulation of sodium in soils.

The purpose of this 2-year study is to monitor the influence of different rates of gypsum on two fairway turfgrass soils initially high in sodium. The Silverbell and Fred Enke golf courses are located in Tucson, Arizona; both courses are operated by the City of Tucson. Silverbell Golf Course utilizes secondarily treated effluent water from the Ina Road facility for irrigation. Fred Enke Golf Course irrigates with potable water. Both courses initially had low water infiltration rates.

A completely randomized block experiment was established at both courses on 'common' bermudagrass fairway turf situated at the edge of a primary rough. The sites were selected for levelness and relationship to irrigation heads for uniform water distribution. Within each plot, twelve 10 ft. square treatment plots were arranged in a 4 x 3 grid. Gypsum was applied on both golf courses in November 1986 at rates equivalent to 0, 1, 2 and 4 tons/acre. Soil samples and plant tissue (clippings) were collected just prior to application and at three-month intervals thereafter. A complete soil and tissue analysis was performed on the collected samples.

Soil sampling was done to a depth of 3 inches below the turfgrass thatch layer. Ten samples were collected from each plot and composited to give one representative sample per plot. Clippings were collected with a reel-type mower and bagged for later analysis. Infiltration rates were determined by inserting two steel rings (12 to 14 inches in diameter) into each plot, adding water to a depth of 4 inches above the soil surface, and measuring the drop in height every hour for 3 hours.

RESULTS

A detailed presentation of all the parameters measured can be obtained from the senior author upon request. The following discussion includes information pertaining to soil sodium levels and infiltration rates.

Silverbell Golf Course

Soil sodium levels decreased significantly from 817ppm to 540ppm in control plots after increased irrigation because of winter overseeding. Gypsum treatments resulted in significantly lower sodium levels when compared to the control plots. The relationship between sodium level and gypsum application rate was not linear with the 2- and 4-ton treatments being approximately equal for soil sodium content at the 3 month sampling period.

Six months following application, there was no significant difference between the treated plots and the control plots for sodium. However, the treated plots contained significantly higher levels of water-soluble calcium and sulfates that were linearly related to the treatment level. This indicated that gypsum was still present in the plots and available to leach sodium. Twelve months following application there was again a significant linear relationship between soil sodium level and treatment application rate.

This recurrence of lower sodium levels may be due to increased water movement through the soil. At the 3 month sampling time, the golf course was maintaining ryegrass and the evaporative demand of the atmosphere was low. Therfore, more of the water applied actually moved through the soil and was able to leach the sodium sulfate. In May (6 months after application) air temperatures were higher -- and more water would have been evaporating from the soil surface -- causing a reduction in the leaching loss of sodium by the gypsum still present in the soil.

The following November (12 months after application), the golf course was again managing ryegrass and evaporative demand was lower. This led to a renewed leaching of sodium. It appears that there is a seasonal fluctuation in the cation content of the soil. Gypsum, however, can remain in the soil and be effective in reducing sodium levels even after 12 months.

Infiltration rate was not improved by the application of gypsum and the subsequent removal of sodium. On sampling days, there has been a high degree of golf cart tire tracks on our plots. This indicates that it is a high traffic area, with mechanical compaction of the soil occurring. Gypsum can not relieve mechanical compaction, but does prevent the compounding of this problem with soil dispersal due to sodium.

Fred Enke Golf Course

Soil electrical conductivity, and sulfate-sulfur were measured 3 months after gypsum application. Their levels were inversely related to the application rate. This indicates that the gypsum was successful in moving into this soil, which has a higher clay content than the study site at Silverbell GC. Twelve months after treatment, the gypsum was still present in the soil. However, at no time during the year was there a significant reduction in sodium levels due to gypsum. Soil sodium levels were initially half that of Silverbell GC; the gypsum did not lower these levels. Infiltration rates were also unaffected by gypsum application.

SUMMARY

Gypsum moved quickly into the soil at both study sites and has remained for at least 12 months.

Sodium was effectively reduced at Silverbell GC after the addition of gypsum.

The ability of gypsum to reduce sodium levels is affected by the season of the year and irrigation management practices.

Low infiltration rates due to mechanical compaction were not alleviated by the application of gypsum.

Gypsum applications were effective in maintaining lower sodium levels at the effluent-treated golf course when compared to untreated plots.

A second application of the gypsum treatments was made in January of 1988. Sampling of tissue and soil occurred in July and will occur again in October and December to conclude this two-year study.