

Cation Ratios and Soil Testing Methods for Sand-based Golf Course Greens

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Objectives:

1. To evaluate and correlate several existing soil extraction methods with tissue analysis.
2. To modify, if necessary, existing extraction methods to better suit turfgrass soil types.
3. To better understand how the Basic Cation Saturation Ratio (BCSR) theory applies to turfgrass systems.
4. Improve current soil testing recommendations for fertilization of turfgrass.

Start Date: 2003

Project Duration: three years

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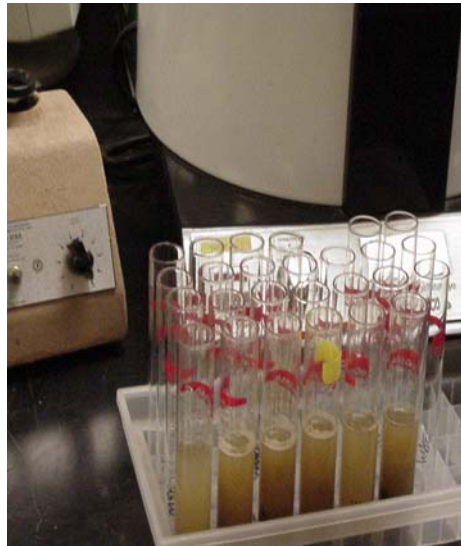
While research has been done applying the Basic Cation Saturation Ratio (BCSR) theory to agronomic crops, little research has been done applying the BCSR method to sandy, low-CEC media, and even less research has been done applying this theory to turfgrass growth. With a large majority of commercial soil testing facilities using the BCSR concepts for fertilizer recommendations, more work needs to be done to determine its effectiveness on sand-based systems.

This research project, which began this summer, encompasses two main parts: 1) to better understand basic cation saturation ratios and how they apply to creeping bentgrass, and 2) to determine the best soil testing techniques to be used for sand-based greens.

We have collected multiple tissue and soil samples from seven different areas. These 19 samples were analyzed using five different soil testing techniques to measure exchangeable basic cations. These methods include NH_4Cl , Mehlich III, Saturated Paste, NH_4OAc pH 8.2, and NH_4OAc pH 7.0. Preliminary results indicate that the NH_4OAc pH 7.0 technique produced samples with an average of 30% and 10% more Ca than samples tested with the NH_4OAc pH 8.2 method and the Mehlich III method, respectively. Statistical analysis of these procedures is still being conducted.

We are also using DOWEX ion-exchange resin to mimic sands. This material has a known cation exchange capacity and is relatively stable and unreactive. DOWEX was equilibrated with four different nutrient solutions with varying degrees of ionic concentrations and ionic

ratios of Ca, Mg, and K. The DOWEX samples were also analyzed using the above methods. In our preliminary studies, we have been unable to completely saturate the DOWEX resin with basic cations. We still have a large proportion of H^+ ions in our extracted samples. Additional studies are currently underway using varying lengths of incubation time and stronger concentrations of saturating solutions.



Researchers at Iowa State University are testing five different soil testing techniques to measure exchangeable basic cations from sand-based rooting media to determine the best soil testing techniques for sand-based putting greens.

Originally, we had hoped to use some simple modifications and corrections on the industry standard procedures to take into account the amount of CaCO_3 that is dissolved during the testing procedure. However, the simple modifications we had hoped to use will not work because the Mehlich III method is too acidic and the NH_4OAc pH 7.0 method is too highly buffered. We are reviewing literature and corresponding with other scientists to determine the modifications that we may be able to use.

We are currently working with a

statistician to properly design the basic cation saturation ratio experiments in the greenhouse. We are hoping to use a relatively new statistical procedure called a "mixture design" to compare ratios of Ca, Mg, and K in a single study, rather than using three independent studies looking at Ca:Mg, Ca:K, and Mg:K. The basis of the 'mixture design' is to maximize results, while minimizing the number of treatments.

We plan to have the greenhouse experiment started this fall and replicated in the spring. We are also starting two soil experiments, one for exchangeable basic cation methods and the other for CEC methods. In these two experiments, we will be mixing sand samples and DOWEX samples with increasing levels of CaCO_3 . The purpose of these two experiments is to measure the effects of CaCO_3 on each procedure.

Summary Points

- Current soil test methods may not be appropriate for sand-based systems.
- More work is needed on the Basic Cation Exchange Ratio (BCSR) soil test method for turfgrass areas.
- The impact of calcium to magnesium (Ca/Mg) ratios on turfgrass performance needs further study.
- Multiple tissue and soil samples were collected from seven different areas and analyzed using five different soil testing techniques to measure exchangeable basic cations. These methods include NH_4Cl , Mehlich III, Saturated Paste, NH_4OAc pH 8.2, and NH_4OAc pH 7.0
- Preliminary results indicate that the NH_4OAc pH 7.0 technique produced samples with an average of 30% and 10% more Ca than samples tested with the NH_4OAc pH 8.2 method and the Mehlich III method, respectively.