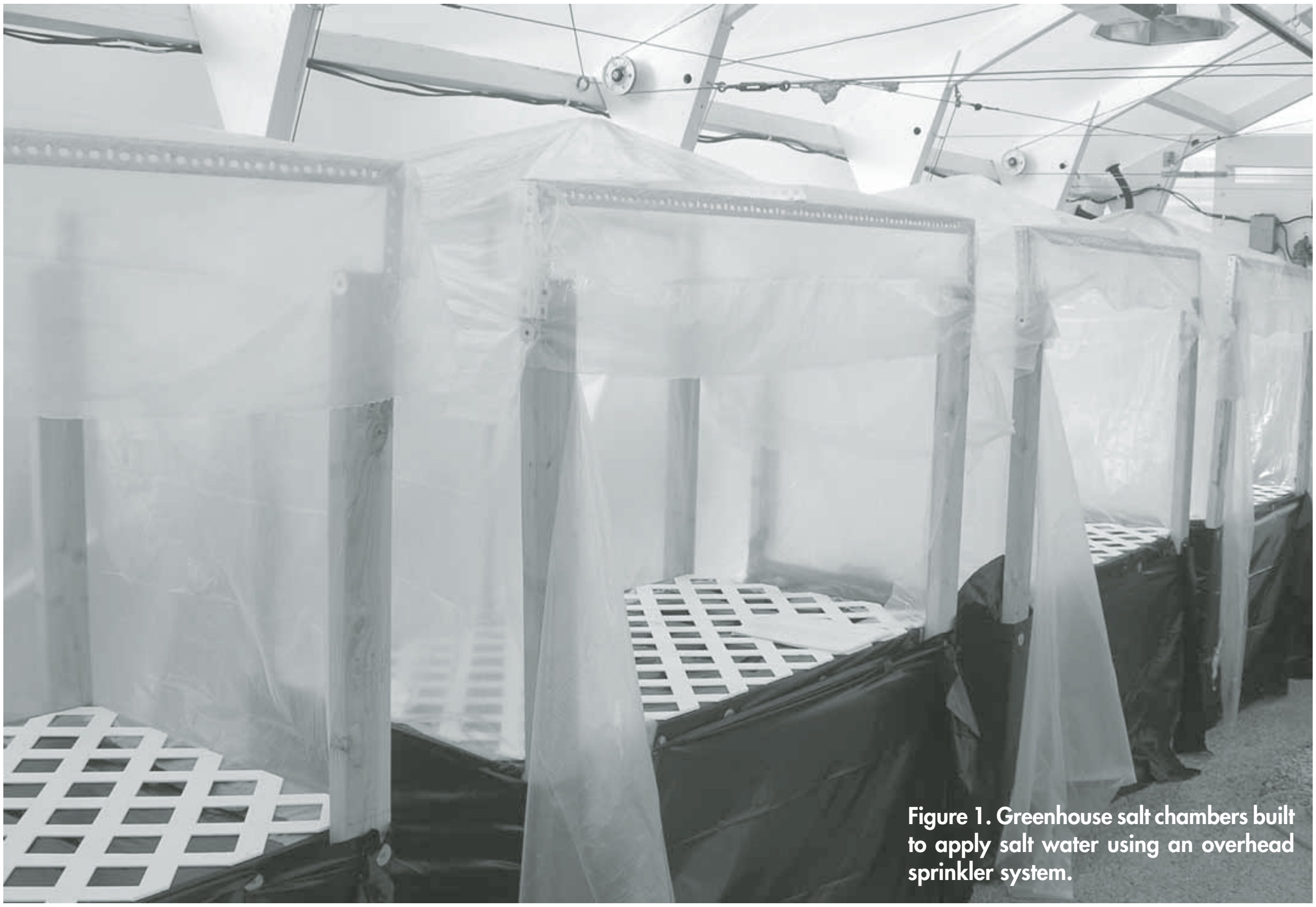

Figure 1. Greenhouse salt chambers built to apply salt water using an overhead sprinkler system.

SCREENING COOL SEASON TURFGRASSES FOR SALT TOLERANCE

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Salinity has been recognized as a major agricultural problem on more than 20 percent of irrigated agricultural land around the world. Turf managers can support water conservation efforts by using non-potable water sources for irrigation of turfgrass areas. However, non-potable water sources can contain high levels of dissolved salts, which can cause salt stress injury and reduce turf quality. The goal of this research project is to develop screening methods to assess the salt tolerance of cool-season turfgrasses and identify cultivars and selections with increased levels of salt tolerance. Two screening techniques (one greenhouse and one field) were developed to evaluate Kentucky bluegrass, Texas x Kentucky bluegrass hybrids and bentgrass cultivars for salinity tolerance.

A greenhouse salt chamber system was developed to apply saltwater with overhead irrigation. This screening method is unique in that it simulates real world stresses that a turfgrass manager would face if irrigating with water containing high levels of salt. This method results in both salt stress injury directly to the leaf tissue from overhead irrigation as well as salt stress injury to the whole plant from an accumulation of salt in the water and growing medium. Previous greenhouse salt screening studies have evaluated turfgrasses under hydroponic conditions. This method involves exposing the roots to high concentrations of salt water, but it does not include salt stress injury to the leaf tissue.

Re-circulating salt spray chambers (Figure 1) were constructed and used to overhead irrigate turfgrass plants in sand trays with four concentrations of salt water. The salt water concentration measured in EC (EC = Electrical Conductivity) was evaluated at EC concentrations of 1 dS/m (control – treatment 1), 3 dS/m (treatment 2), 6 dS/m (treatment 3), and 9 dS/m (treatment 4). Salt solutions were made by adding a product called Instant Ocean to the water filled reservoirs beneath each chamber. Instant Ocean, was chosen due to its high similarity to ocean water which contains various types of salts. In addition to the salt, 1/4 strength Hoagland's nutrient solution was added to the salt

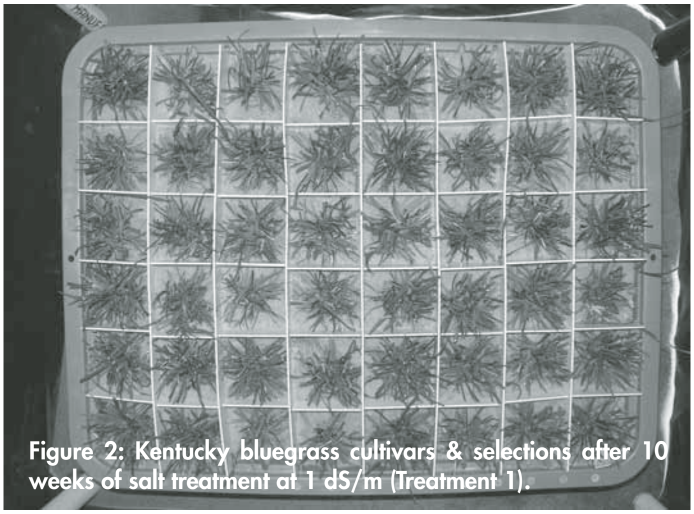

Figure 2: Kentucky bluegrass cultivars & selections after 10 weeks of salt treatment at 1 dS/m (Treatment 1).

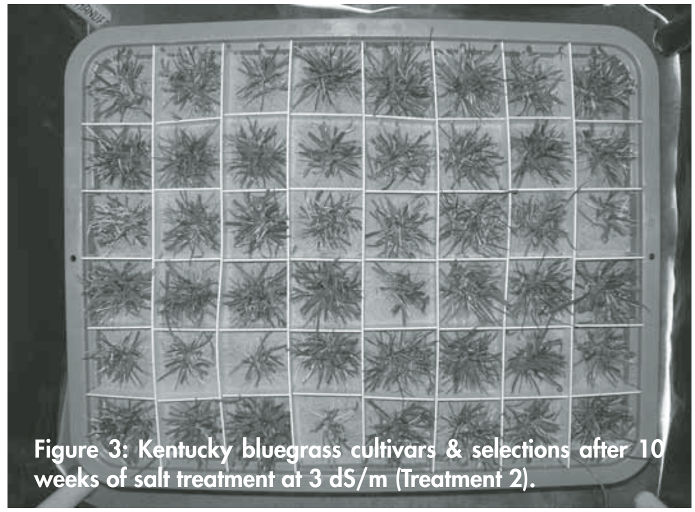

Figure 3: Kentucky bluegrass cultivars & selections after 10 weeks of salt treatment at 3 dS/m (Treatment 2).

Figure 4: Kentucky bluegrass cultivars & selections after 10 weeks of salt treatment at 6 dS/m (Treatment 3).

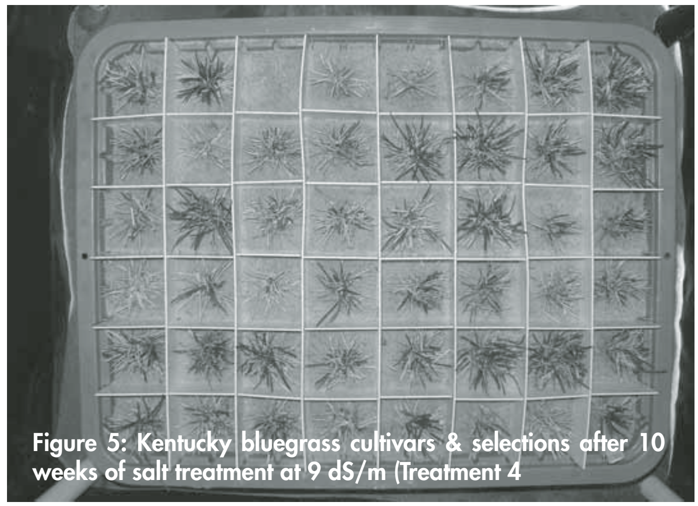

Figure 5: Kentucky bluegrass cultivars & selections after 10 weeks of salt treatment at 9 dS/m (Treatment 4

water tanks to provide the plants with nutrients needed for normal growth.

Twenty-one Kentucky bluegrass cultivars and selections were evaluated in the greenhouse salt chamber screening including Jefferson, Langara, Argos, Liberator, Diva, Bedazzled, Fairfax, P105, RSP, A03-84, Moonshadow, Bewitched, Julia, Baron, Eagleton, A00-1400, A99-2559, Lakeshore, Rhythm, Midnight and Cabernet. Three Texas x Kentucky bluegrass cultivars and selections were also evaluated (Bandera, A03TB-676 and A03TB-246). Treatments were replicated three times. Plants in each of the trays were randomized and separated with plastic inserts to minimize interactions. Plants were irrigated every other day with fresh water and the nutrient solution for a week before salt treatments were initiated. Salt was added at 1.5 dS/m each irrigation day until the maximum EC was reached in order to prevent shocking the plants with the full strength salt solution. After the final salt treatment was reached, plants were exposed to the salt treatments for 10 weeks. Throughout the study, all plants were maintained at 1.5 inches.

Percent green ratings were collected weekly on the Kentucky bluegrass plants. Additionally, every other week, dried clipping weights, relative water content, photochemical efficiency, and chlorophyll content were measured on the Kentucky bluegrass plants. At the end of the 10 week study, roots were washed free of all sand particles and final root lengths, dried root weights, and dried shoot weights were measured. All of these measurements were then analyzed as a proportion of the control plants in order to take into account the innate differences in growth habit between cultivars. In order to determine the final EC of the sand for each treatment, samples were removed from each tray and analyzed at the Rutgers University Soil Testing Laboratory for soil EC.

Significant differences were observed between treatments (Figures 2-5) and cultivars indicating that this method should be useful for evaluating salinity tolerance of Kentucky bluegrass. Under greenhouse conditions after 10 weeks of overhead irrigation at 9 dS/m (treatment 4), the cultivars exhibiting the highest percent green ratings were Eagleton, Liberator and Cabernet. The cultivars and selections with the lowest percent green were a Texas x Kentucky bluegrass selection, A03TB-246, Baron and the Kentucky bluegrass selection A03-84. The limitation of this greenhouse research is that it is being conducted under controlled environmental conditions. Therefore, we are also exploring the possibility of screening cool-season turfgrass cultivars for salt stress tolerance under field conditions.

For the field study, 19 of the 21 Kentucky bluegrass cultivars and selections and all three Texas x Kentucky bluegrass hybrids were replicated and established as spaced plants in a sandy loam soil at the Plant Biology Research and Extension Farm, Adelphia, NJ. All plants were mowed at 2.5 inches once a week with a

STM CORRECTION

Turn Off the Pesticides and Turn on the Vacuum (Spring 2008 *Sports Turf Manager):* The adult chinch bug (shown below) was mistakenly identified in the photo on page 9. The photo is actually its predator, the adult big-eyed bug (pictured above). The two are similar in size and are often confused when seen in the grass. The big-eyed bug is usually brown in colour and has very large eyes (hence the name); the chinch bug's head and eyes are much smaller and its adult colouration is typically black and white. We apologize for any confusion this may have caused.

Toro Groundsmaster. Equal parts of sodium chloride ($NaCl$) and calcium chloride ($CaCl$) was used to make a salt solution with a concentration of EC = 10 dS/m. A 500 gallon pump-tank was used to apply the salt water solution. Each plant received 0.125 gallons of this salt solution three times a week. A total of 36 separate salt applications were made to the field grown spaced plants. Each week, soil tests were taken from various points throughout the field and analyzed for soil EC by the Rutgers University Soil Testing Laboratory. Visual percent green ratings were taken throughout the summer to identify the level of salt tolerance of each of the cultivars included in the trial (Fig. 3).

By the end of the season, the soil EC reached levels above 3 dS/m which caused significant stress on the turfgrass plants. Significant differences were observed among cultivars and selections under field conditions. Bewitched, the experimental selection, A03-84, Langara, Bedazzled, Jefferson, Diva, P105, Rhythm and Liberator had the highest percent green leaf tissue under these conditions while Julia had the least.

The field results were not strongly correlated to greenhouse salt chamber results. The greenhouse is an extremely controlled environment – temperature, humidity and other stresses are controlled – while under field conditions, plants are exposed to other stresses such as heat, drought, mowing, etc. in addition to salinity stress. Salinity tolerance is a complex trait that is affected by other environmental factors including both air and soil characteristics. Therefore it is not surprising that there was little correlation between the greenhouse and field experiments. We hope to use this information to identify the critical factors influencing salinity tolerance under field conditions in order to develop efficient selection techniques for improving salinity tolerance in cool-season turfgrasses.

This research indicates that it should be feasible to evaluate salt tolerance of Kentucky bluegrass under greenhouse and field conditions. We are in the process of screening bentgrass cultivars and selections for salinity tolerance under both greenhouse and field conditions. We are hopeful that this research will provide practical recommendations to sod growers, golf course superintendents and turfgrass managers attempting to grow and establish Kentucky bluegrass and bentgrasses under salt stress conditions. In the upcoming year, we hope to expand correlation studies between greenhouse and field screening techniques to determine the most useful screening technique for evaluating salt tolerance in cool-season turfgrasses. Additionally, we have initiated inheritance studies to determine the genetic component of salt tolerance in cool-season turfgrasses and we are also testing experimental selections on salt-affected sites to validate our screening techniques. The information generated from all of these trials will prove useful for turfgrass managers and sod growers interested in using non-potable water for irrigation of cool-season turfgrasses. ♦

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