Effect of Salinity of Tropical Turfgrass Species

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Abstract

The need for salinity tolerance of turfgrasses is increasing because of the augmented use of effluent or other low quality waters (seawater) for turfgrass irrigation. Irrigation seawater of different salinity levels (0, 24, 48, and 72 dS/m) was applied to experimental plants grown in plastic pots filled with a mixture of sand and peat (9:1).

The results were analyzed using SAS (SAS 2006) and treatment means were compared using the LSD Test. The results indicated that *Paspalum vaginatum* (seashore paspalum) (SP), *Zoysia matrella* (manilagrass) (MG), *Pasplaum vaginatum* local (SPL), *Cynodon dactylon* (common bermuda) (CB), *Cynodon dactylon* (bermuda greenless park) (GLP), *Eremochloa ophiuroides* (centipede) (CP), *Axonopus compressus* (cow grass) (CG) and *Axonopus affinis* (narrowleaf carpet grass) (NCG) experienced a 50% shoot growth reduction at EC values of 39.8, 36.5, 26.1, 25.9, 21.7, 22.4, 17.0 and 18.3 dS/m respectively, and a 50% root growth reduction at the EC of 49.4, 42.1, 29.9, 29.7, 26.0 24.8, 18.8 and 20.0 dS/m respectively. The ranking for salinity tolerance of selected grasses was SP>MG>SPL>CB>GLP>CP>NCG>CG. The results indicate the importance of the selection of turfgrass varieties according to the soil salinity and seawater salinity levels to be used for irrigation.

Key Words

Salinity tolerance, Water salinity, Turfgrass, Seawater.

Introduction

Soil salinity is considered as one of the major factors that reduce plant growth in many regions of the world. Seawater intrusion in the coastal area (McCarty and Dudeck 1993) has added to the salinity problems in turfgrass culture. Moreover, sea water, as a secondary water source, is increasingly being used to irrigate large turf facilities (Arizona Department of Water Resources 1995). Salt tolerant turfgrasses are becoming essential in many areas of the world including Malaysia because of salt accumulation on soil, restriction on ground water especially in costal areas (Hixson *et al*. 2004). Therefore, the need for salt tolerant turfgrasses has increased (Harivandi *et al*. 1992). A new generation of salt-tolerant turf varieties might allow landscape development in saline environments and might be ideal in such environments where salt water spray is a problem, or where limited or no fresh water is available for irrigation. The proper utilization of highly salt tolerant turfgrass species will give benefit to turfgrass areas in Malaysia. The objective of this study was to determine the relative salt tolerance and growth response of warm season turfgrass species grown on sand culture.

Methods

The experiment was conducted with eight turfgrass species in the glasshouse of Faculty of Agriculture at Universiti Putra Malaysia under sand culture system. The soil was sandy with pH 5.23, EC 0.3 dS/m, OC 0.69%, sand 97.93 %, silt 1.89% and clay 0%. The diameter of plastic pots was 14 cm with 15 cm depth. The average day temperature and light intensity of glasshouse were 28.5-39.5 ^{0}C and 1500-20400 lux respectively. Four salt water concentrations namely T_1= 0, T_2=24, T_3= 48, T_4=72 dS/m were applied in this study. Untreated checks (T_1) were irrigated with distilled water. NaCl was added to seawater for T_4 to obtain the salty water level of 72 dS/m. To avoid salinity shock, salinity levels were gradually increased by daily increments of 8 dS/m in all treatments until the final salinity levels were achieved. After the targeted salinity levels were achieved, the irrigation water was applied on daily basis for a period of four weeks. Data were collected on leaf firing, shoot and root growth, turf quality. Leaf firing was estimated as the total percentage of chlorotic leaf area, with 0% corresponding to no leaf firing, and 100% as totally brown leaves. At the end of the experiment shoots and roots were harvested and were washed with deioniozed water and dried at 70 ^{0}C for 72 hrs. The experimental design was a randomized complete block design (RCBD) with five replications.

Results

Shoot and root growth rate gradually decreased as the salinity increased. Relative shoot-root growth (as a % of control) decreased with increasing salinity in all species (Figure 1a & b). Results indicated that *Paspalum vaginatum* (seashore paspalum) (SP), *Zoysia matrella* (manilagrass) (MG), *Pasplaum vaginatum* local (SPL), *Cynodon dactylon* (common bermuda) (CB), *Cynodon dactylon* (bermuda greenless park) (GLP), *Eremochloa ophiuroides* (centipede) (CP), *Axonopus compressus* (cow grass) (CG) and *Axonopus affinis* (narrowleaf carpet grass) (NCG) experienced a 50% shoot growth reduction at the EC of 39.8, 36.5, 26.1, 25.9, 21.7, 22.4, 17.0 and 18.3 dS/m respectively, and a 50% root growth reduction at the EC of 49.4, 42.1, 29.9, 29.7, 26.0 24.8, 18.8 and 20.0 dS/m respectively. Marcum and Murdoch (1994) also reported that relative shoot growth was reduced by 50% at the salinity level of 36.4 dS/m NaCl in *P. vaginatum* and 35.9 dS/m in *Z. matrella* which is in agreement with our present study.

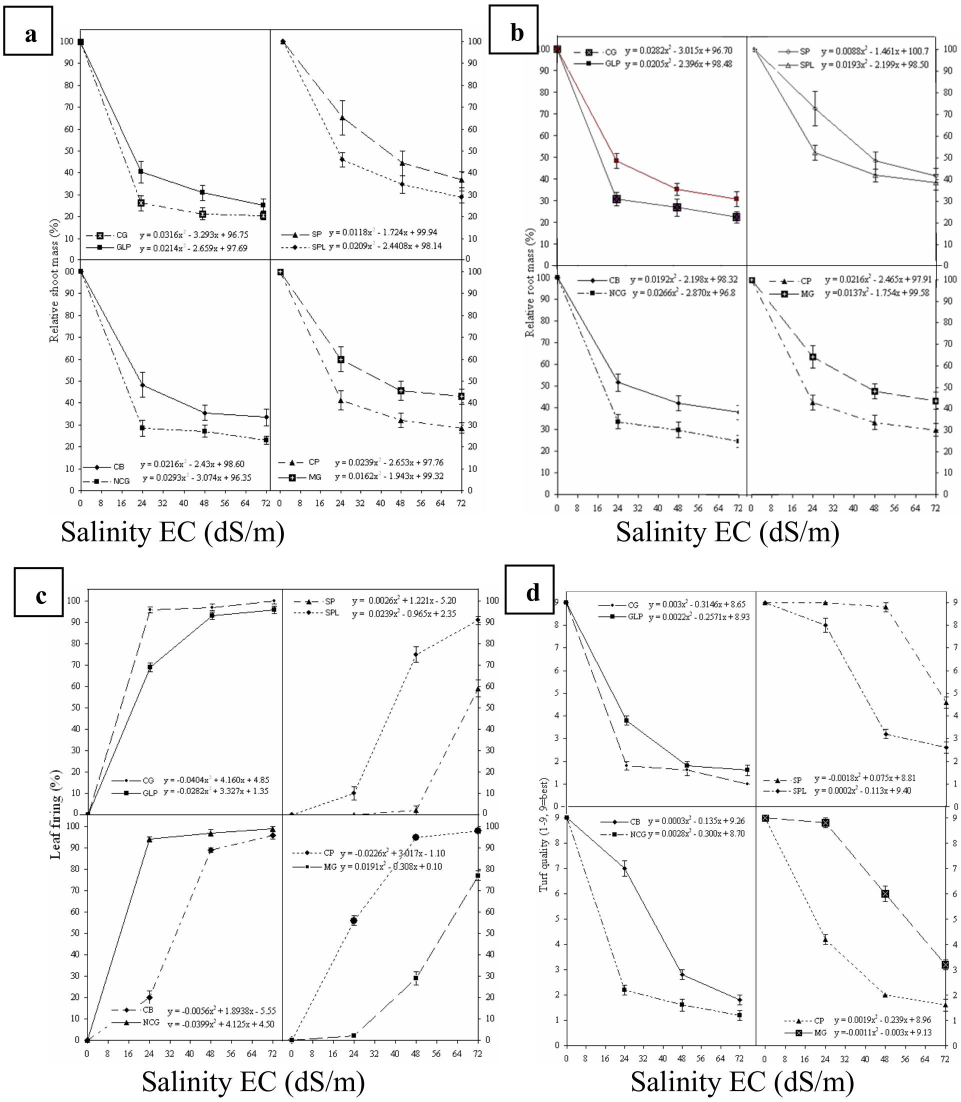

Figure 1. (a) Relative shoot growth (b) root growth (c) leaf firing (d) turf quality of *Axonopus compressus* (CG), *Cynodon dactylon* (GLP), *Paspalum vaginatum* (SP), *Paspalum vaginatum* local (SPL), *Cynodon dactylon* (CB), *Axonopus affinis* (NCG), *Eremochloa ophiuroides* (CP) and *Zoysia matrella* (MG) at different salinity levels.

Regardless of turf grass species, leaf firing increased with increasing salinity, reaching 94-100% at the extreme salinity treatment of 72 dS/m (Figure 1c). However, there was less salinity injury noticeable in *P. vaginatum* and *Z. matrella* at all salinity levels compared to other grasses. Leaf of *P. vaginatum* was unaffected at 24 dS/m while at 94-100% leaf firing was noticeable in *A. affinis* and *A. compressus*. However, leaf firing was moderately similar (55%) in *E. ophiuroides* and *C. dcatylon* at 24 dS/m. At 48 dS/m leaf firing was high in *A. affinis* (97%) and *E. ophiuroides* (96%) while 69 % to 92% in *C. dactylon* (Figure 1c). The least leaf firing (59%) was observed in *P. vaginatum*. The same trend was observed at 72 dS/m, where 90-95% leaf firing was observed in *C. dcatylon*, *P. vaginatum* local, *C. dactylon*, *E.*

ophiuroides, A. affinis and *A. compressus*. *P. vaginatum* and *Z. matrella* were moderately affected with 59% and 81 % respectively. Turf quality under salt stress as indicated by visual ratings is presented in (Figure 1d). Turf quality decreased with increasing salinity level. Turf quality decreased severely in *A. affinis* (NCG) and *A. compressus* (CG) while *P. vaginatum* (SP) and *Z. matrella* (MG) exhibited the best turf quality among the entries at all salinity levels.

Conclusion

The relative salinity tolerance of turfgrass root growth, shoot growth and leaf firing were closely associated with salinity tolerance of the grasses. The different species of grasses were grouped for salinity tolerance on the basis of 50% shoot and root growth of reduction, leaf firing and turf quality with increasing salinity. The first groups was the most tolerant species including *P. vaginatum* (SP) and *Z. matrella* (MG) which were able to tolerant high levels of salinity between 36.5 to 49.4 dS/m. In the second group were the moderate tolerant species including *P. vaginatum* local (SPL), and *C. dactylon* (CB) which were able to tolerate salinity level between 25.9 to 29.9 dS/m, while in the the lowest tolerant performance group were *C. dactylon* (GLP), *E. ophiuroides* (CP) *A. compressus* (CG), *A. affinis* (NCG) varieties, which were affected at salinity level of between 17.0 and 26.0 dS/m.

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