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FINAL STUDY REPORT (October 2026)

Cape May Plant Materials Center

Cape May Court House, NJ

Greenhouse Evaluation of ‘Meadowcrest’ Eastern Gamagrass for Restoration of Areas Impacted by Saltwater Intrusion

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ABSTRACT

Saltwater intrusion of farmland is of special concern to agricultural producers in coastal regions such as the Mid-Atlantic. The impacts of saltwater intrusion can cause otherwise valuable productive land to be considered nonarable for traditional crop production. Converting farmland impacted by saltwater intrusion to salt tolerant crop production is a mitigation option. Eastern gamagrass (*Tripsacum dactyloides*) has shown potential as a biofuel crop and is recommended for a wide range of USDA Natural Resources Conservation Service (NRCS) conservation practice standards suggesting it could have value if commercially produced for conservation applications; however, multiple sources report conflicting information regarding its salinity tolerance. Salinity tolerance of ‘Meadowcrest’ eastern gamagrass was evaluated by conducting a 10-week growth study using ebb and flow hydroponic grow systems in a climate-controlled greenhouse. Plants were subjected to 0, 10, 20, and 30 ppt salinity solution treatments. Average above ground dry biomass, below ground dry biomass, and leaf length were significantly greater in the control (0 ppt) group than in all saline treatments, while no statistically significant differences were observed within the saline treatment groups. Chronic saline exposure drastically reduced survival with mortalities observed after 5 weeks of treatment. These findings indicate that Meadowcrest exhibits a low salinity tolerance threshold under regular, chronic saline exposure and should not be recommended for sites that are expected to experience regular saline exposure where salinity levels have been measured at or above 10 ppt.

INTRODUCTION

The impacts of saltwater intrusion on cropland presents a growing concern for agricultural producers in coastal regions (Mondal et al., 2023). Low lying coastal areas such as the Mid-Atlantic region are of special concern as several compounding factors (land subsidence, changes in sea level relative to the elevation of land and the water table, frequency and intensity of coastal storms leading to strengthened tidal surges, drought periods, agricultural hydrologic connections to brackish water sources, and coastal aquifer withdrawals for drinking water and irrigation purposes) affect the rate and degree of saltwater intrusion (Gibson et al., 2021; Mondal et al., 2023; Sallenger et al., 2012; Tully et al., 2019). Detrimental effects of saltwater intrusion include osmotic and ionic stresses on crops and the buildup of sodium ions in the soil (Pohkrel & Miller, 2024). The excessive buildup of sodium ions negatively impacts soil health by causing more compact and denser soils. These soils are less conducive to air and water exchange to accommodate the health of plant root systems. Additionally, salt affected soil is more susceptible to compaction resulting in increased nutrient and pesticide runoff as well as erosion (Duan, 2016; Ghadiri et al, 2004). These substantial environmental impacts lead to significantly reduced yields, overall crop loss, or loss of farmable land.

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Converting marginal farmland, no longer suitable for traditional crop production due to saltwater intrusion, to produce an alternative niche crop can serve as a viable mitigation option. A case study demonstrated how producers in low lying coastal regions where saltwater intrusion has negatively impacted agricultural production have been able to mitigate the impact by shifting to saline agriculture and salt tolerant crop production (Duan, 2016). The key to successful implementation of this mitigation option is to determine an appropriate species or variety that exhibits the necessary degree of salt tolerance and offers potential value as a production crop.

Eastern gamagrass is the subject of inconsistent reports of salinity tolerance. In a study examining the vegetation of abandoned rice fields, Stalter and Baden (1994) reported the long-term survival (greater than 20 years) of eastern gamagrass in an area impacted by tidal flooding with salinity levels up to 9 ppt. Gibson et al. (2021) list eastern gamagrass as having a low to medium (10-15 ppt) saline flooding tolerance. The Florida Native Plant Society (2026) reports that eastern gamagrass is somewhat tolerant of indirect salt spray but not tolerant of saltwater flooding. Henson (2012) reports eastern gamagrass as “intolerant of saline soils.”

Eastern gamagrass may have potential as a biofuel crop (Gibson et al., 2021). A study examining applicability of grass species as biofuel crops for ethanol production concluded that several eastern gamagrass varieties produced significantly higher sugar yields than the switchgrass and bermudagrass varieties used for comparison (Eubanks, 2013).

Installation of salt tolerant buffers on field edges of marginal cropland impacted by saltwater intrusion is an alternative mitigation option that could also provide additional ecological services. Crop pollinator habitat, sediment trapping, soil health improvement, pesticide runoff prevention, water quality improvement, and wildlife habitat are all potential benefits of a highly functional perennial buffer strip (Helmers et al., n.d.). Eastern gamagrass has been documented to provide ecological benefits as a component of a vegetative filter strip for its ability to remove pesticides from soil, uptake of excess nutrients reducing nutrient runoff, and decreasing sediment loss. Smith et al. (2008) reported that gamagrass was one of the top performers for removal of four commonly used pesticides (chlorpyrifos, chlorothalonil, pendimethalin, and propiconazole) from soil. Research conducted in a controlled greenhouse environment arrived at a similar conclusion regarding the application of eastern gamagrass for filter strip applications to reduce pesticide runoff (Clark, 2008). Field studies conducted by de Barros et al. (2025) demonstrated that eastern gamagrass can efficiently accumulate P, reducing availability that could otherwise contribute to nutrient runoff impacting water quality (Lan et al., 2024). Rankins et al. (2001) reported that an eastern gamagrass single species perennial grass filter strip effectively reduced total sediment loss and pesticide runoff.

Eastern gamagrass may offer other overall soil health benefits via its strong root systems and ability to penetrate compacted soils. Gilker et al. (2002) reported that eastern gamagrass root penetration outperformed that of sudangrass (*Sorghum x drummondii*) in trials examining rooting ability of plants to penetrate compact soils.

Meadowcrest was released by the USDA NRCS Big Flats Plant Materials Center and the USDA Agricultural Research Service in 2006. Meadowcrest was selected for its upright growth habit, wide leaves, dense vegetative production, and foliar disease resistance (NRCS, 2015). Recommended applications of Meadowcrest include wildlife habitat plantings, vegetative filter strips, livestock forage (grazing/pasture management), and hay/haylage/silage production (NRCS, 2015).

The findings of this study could also be applicable to the vegetative selection for the implementation of a variety of USDA NRCS conservation practice standards: Conservation Cover (327), Critical Area Planting (342), Silvopasture Establishment (381), Field Border (386), Riparian Herbaceous Cover (390), Stream Habitat Improvement and Management (395), Wildlife Habitat Planting (420), Pasture and Hay Planting (512), Grazing Management / Prescribed Grazing (528), Range Planting (550), Streambank and Shoreline Protection (580), Saturated Buffer (604), Vegetated Treatment Area (635), Constructed Wetland (656), Wetland Restoration (657), Wetland Creation (658), and Wetland Enhancement (659).

The objective of this study is to examine the degree of physiological effects to Meadowcrest resulting from varying levels of salinity treatments (0, 10, 20, and 30 ppt) in a hydroponic growth system to assess feasibility for conservation practices impacted by saltwater intrusion in the Mid-Atlantic region.

MATERIALS AND METHODS

The salinity tolerance of Meadowcrest was examined in a controlled plant growth trial. Plants were subjected to four concentrations of solutions of water and NaCl: 0, 10, 20, and 30 ppt. This salinity range was selected to mimic salinity levels that can occur throughout estuaries and transitional zones in the Mid-Atlantic coastal region that comprise the area of suggested use for this species and conservation plant release (Bulger et al., 1993; Miselis et al., 2016; NRCS, 2015; Personna, et al., 2015; Weissman & Tully, 2020). Plants were irrigated twice daily with the varying salinity solutions using automated ebb and flow hydroponic grow systems (FarmTek, South Windsor, CT). CNS17 Grow Formula nutrient solution (Botanicare, Vancouver, WA) was added to the hydroponic solutions at a rate of 1.5 ml/gallon at the start of the study to supply plant nutritional requirements. The experiment was conducted in a climate-controlled greenhouse that ranged from 54.3–111.4 °F (12.4–44.1 °C) (Figure 1).

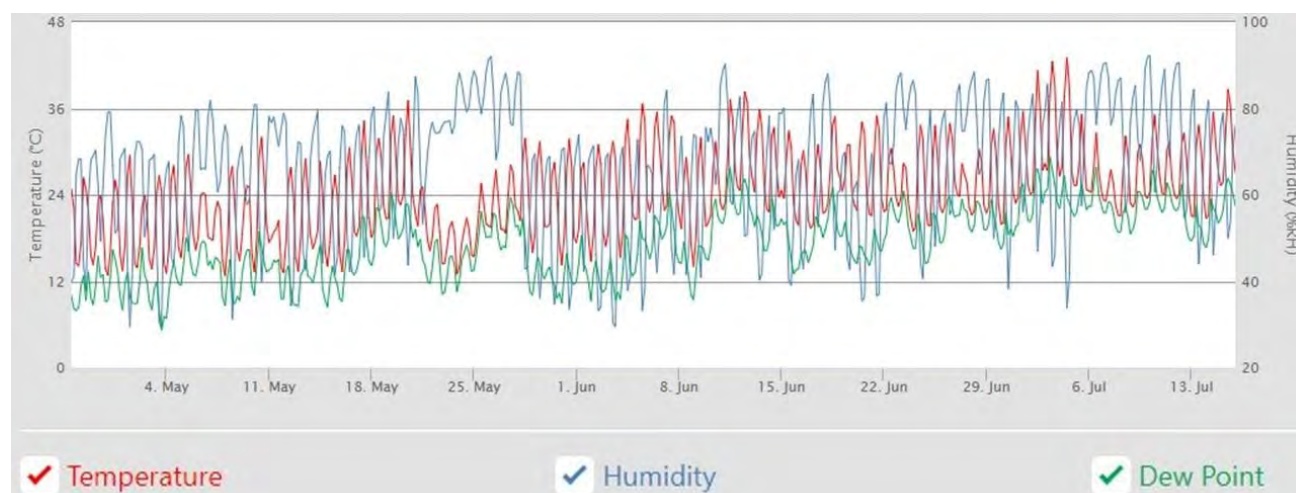


Figure 1. Air temperature, humidity, and dew point in the greenhouse was monitored and recorded during the Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ using an EasyLog EL-SIE-2+ data logger (Lascar, Erie, PA).

Plants were sourced from a well-established production field planted at the New Jersey Plant Materials Center (NJPMC) in the spring of 2023. NJPMC staff prepared test plants by digging and splitting mature individuals after breaking dormancy on April 23, 2026. Proaxes (thick, knotty rhizome-like structures) were divided into similar sized propagules (2–3 live growth shoots) and planted in quart size containers in perlite. Plants to supply four replicates of 10 plants for each

salinity treatment were prepared. All plants were irrigated twice daily with the fresh water hydroponic solution for 2 weeks following transplanting to avoid mistaking transplant induced stress for stress resulting from saltwater treatments. After the 2-week acclimatization period, salinity treatments were initiated. Saline solution treatments were implemented incrementally by 5 ppt per week. Salinity treatments were conducted for 10 weeks (May 6, 2026–July 15, 2026).

Growing conditions of the greenhouse and hydroponic systems were monitored and documented during the study. The salinity of the hydroponic solutions was measured and recorded weekly (Figure 2) using a field marine salinity tester (HI98319) (Hanna Instruments Inc., Smithfield, RI) and adjusted as necessary to maintain the prescribed salinity treatments. Nitrate levels of hydroponic solutions were measured and recorded weekly (Figure 3) using a marine nitrate high range colorimeter (Hanna Instruments Inc., Smithfield, RI) and adjusted as necessary by adding CNS17 Grow Formula nutrient solution to increase nitrate levels of all treatment solutions to equal the nitrate concentration of the highest recorded solution. Electrical conductivity (EC) of the perlite planting medium was measured and recorded weekly (Figure 4) using a digital direct soil conductivity meter with a stainless steel conductivity probe (Hanna Instruments Inc., Smithfield, RI). The EC of five randomly selected pots from each replication was measured and recorded. The pH and temperature (Figures 5 and 6) of the hydroponic solution was monitored and logged using GroLine monitors for hydroponic nutrients (HI981420) (Hanna Instruments Inc., Smithfield, RI). Air temperature, humidity, and dew point in the greenhouse (Figure 1) were recorded and logged using an EasyLog EL-SIE-2+ data logger (Lascar, Erie, PA).

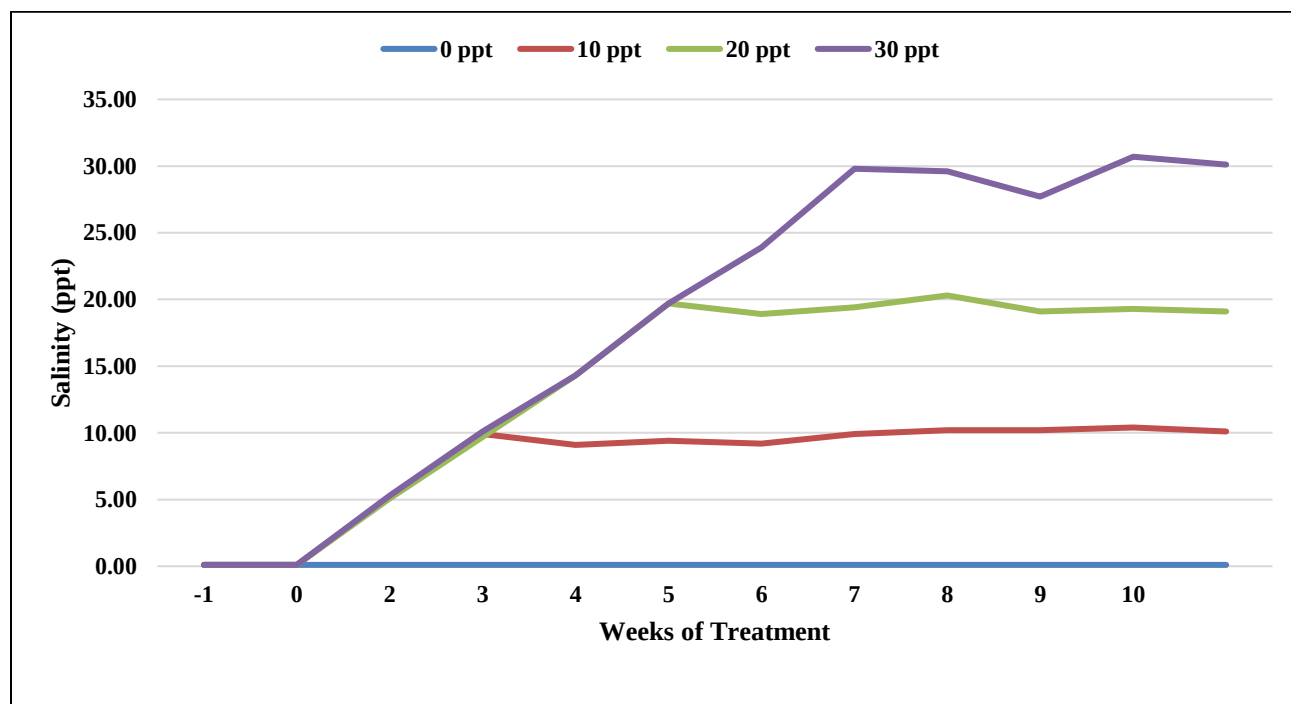


Figure 2. Salinity levels of the hydroponic solutions used in the Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ were monitored using a field marine salinity tester (HI98319) (Hanna Instruments Inc., Smithfield, RI).

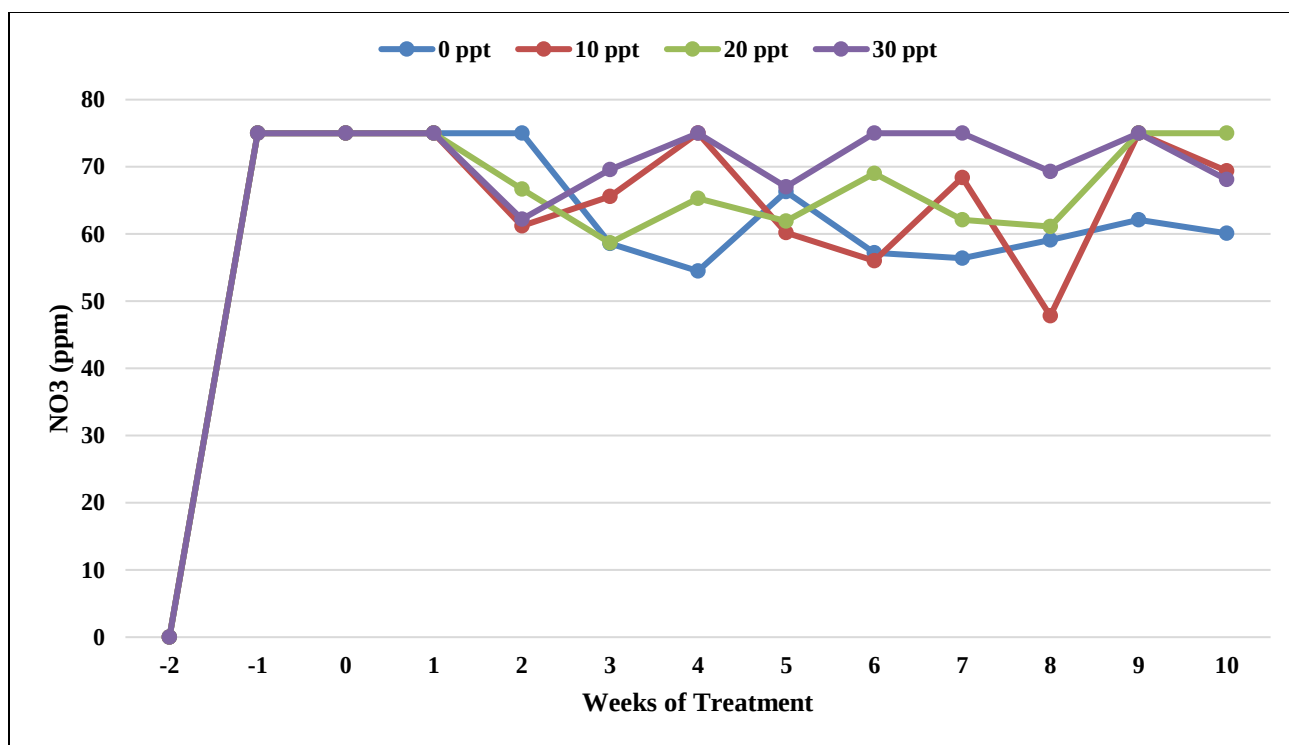


Figure 3. Nitrate levels of the hydroponic solutions used in the Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ were monitored using a marine nitrate high range colorimeter (Hanna Instruments Inc., Smithfield, RI).

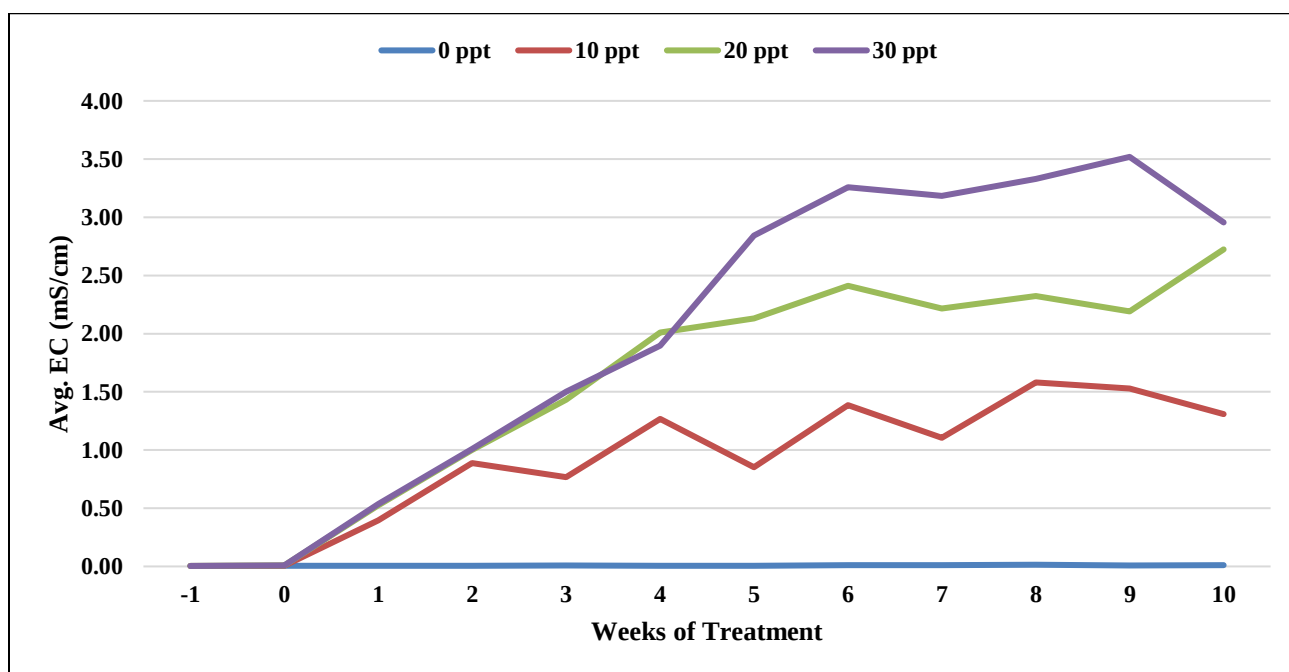


Figure 4. Electrical conductivity (EC) of the perlite planting medium used in the Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ was monitored using a digital direct soil conductivity meter with a stainless steel conductivity probe (Hanna Instruments Inc., Smithfield, RI).

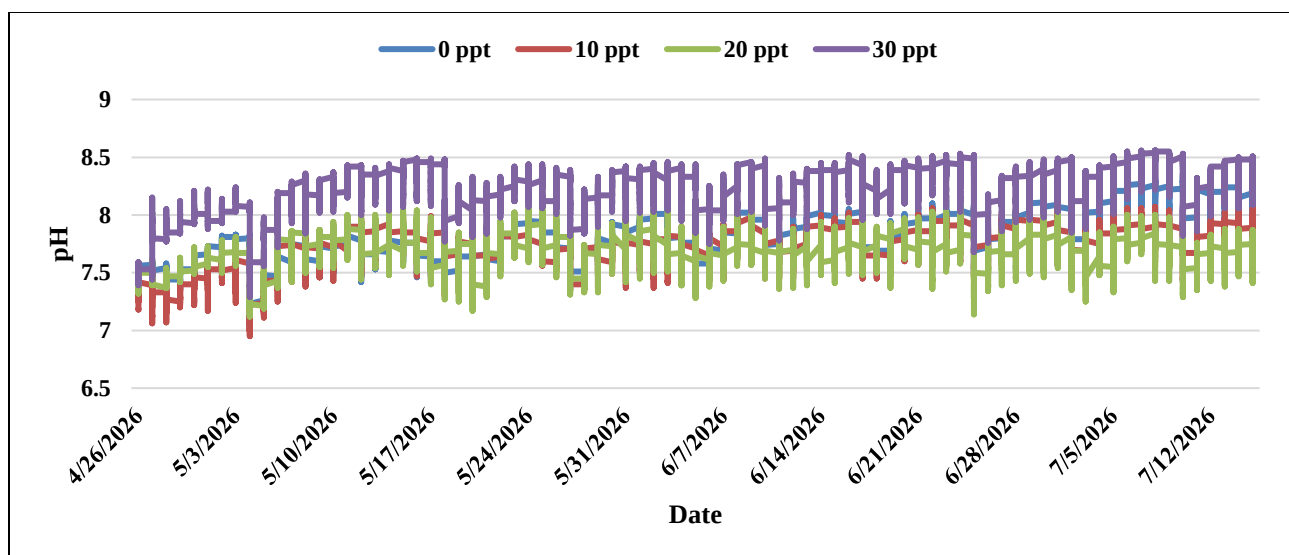


Figure 5. pH of the hydroponic solutions used in the Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ was monitored and recorded using GroLine monitors for hydroponic nutrients (HI981420) (Hanna Instruments Inc., Smithfield, RI).

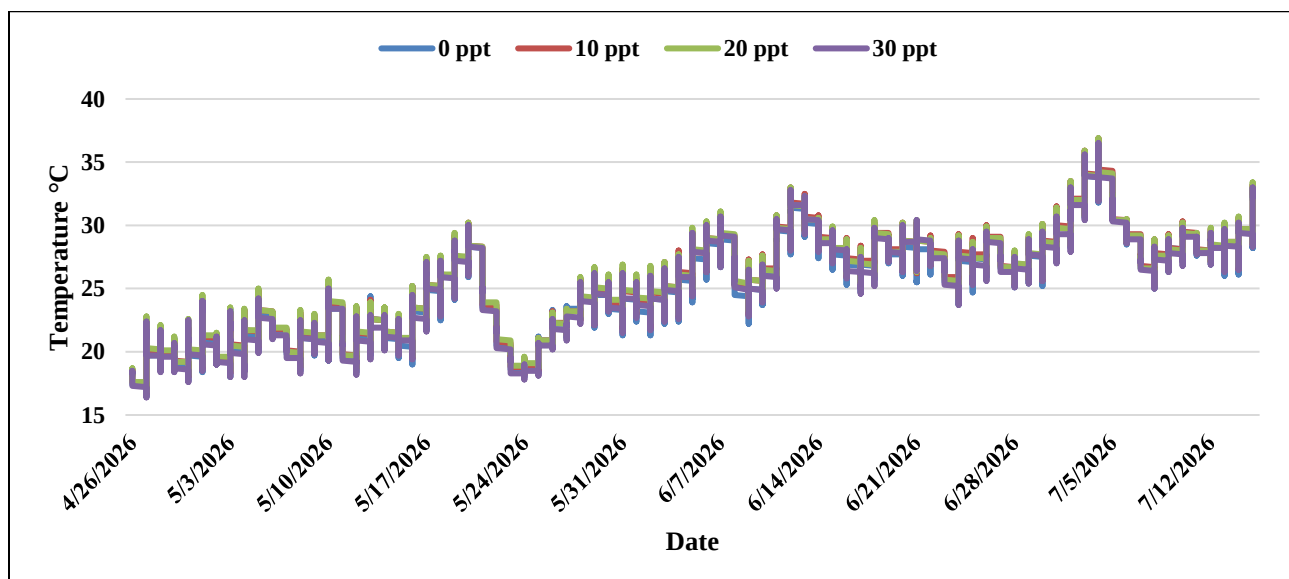


Figure 6. Temperature of the hydroponic solutions used in the Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ was monitored and recorded using GroLine monitors for hydroponic nutrients (HI981420) (Hanna Instruments Inc., Smithfield, RI).

Plant conditions were monitored during the study via digital photographs of all salinity treatments taken weekly to record visual indications of plant stress (see Appendix). Weekly plant survival counts were conducted beginning one week after planting until the conclusion of the salinity treatments. Survival counts were used to determine percent survival with salinity treatments. The dates and number of flowering plants were recorded when inflorescences were observed during weekly monitoring data collections.

After 10 weeks of salinity treatments, NJPMC staff processed the plants for biomass measurements. Roots were rinsed clean of the perlite planting medium. The length of a single randomly selected leaf from each plant was measured and recorded. The top growth was cut at the base to separate and

measure above ground and below ground biomass separately. Above ground and below ground biomass samples were dried at 140 °F (60 °C) in a lab oven (Thermo Fischer Scientific, Waltham, MA) until their weight remained constant. Dry biomass weights were then measured and recorded.

Statistical analysis of data was conducted using Statistix 10 data analysis software (Version 10.0, Analytical Software, Tallahassee, FL). Prior to analysis, the distribution of the data sets was evaluated using the Shapiro-Wilk test to determine if the data were normally distributed. Kruskal-Wallis one-way analysis of variance and Dunn's all-pairwise comparisons tests were conducted to determine homogenous groups because all plant attribute data sets were not normally distributed.

RESULTS AND DISCUSSION

Meadowcrest plants were significantly impacted by salinity treatments. Salinity-induced stress and reduced plant vigor became visually apparent as evidenced by weekly photographs (Figures 8–20, Appendix). Post treatment biomass and leaf length measurements supported the visual cues provided by the weekly photographs (Table 1).

Table 1. Resulting average biomass and leaf length measurements of Meadowcrest plants following 10 weeks of salinity treatments. Studies were conducted in a climate-controlled greenhouse at the New Jersey Plant Materials Center (Cape May Court House, NJ).

Salinity Treatment (ppt)	Avg. Above Ground Dry Biomass (g)	Avg. Below Ground Dry Biomass (g)	Avg. Leaf Length (in)	Total Flowering Plants
0	7.51 a	13.92 a	20.86 a	1
10	5.39 b	8.41 b	9.81 b	0
20	5.36 b	9.37 b	9.66 b	0
30	4.53 b	9.30 b	8.75 b	0

Means with the same letter for the same plant attribute are not significantly different according to Dunn's test at $P < 0.05$.

Statistical analysis indicated that salinity treatments significantly impacted the resulting plant biomass and leaf length. For all plant attributes measured and statistically analyzed, the control plants that received the fresh water treatment (0 ppt) were significantly greater than all levels of salinity treatments while there were no significant differences between the plants that received the different levels of salinity treatments (10, 20, and 30 ppt). This indicates that Meadowcrest has a low tolerance (less than 10 ppt with regular occurrences) for saline exposure.

A single flowering plant from the control group (0 ppt) was observed the last week salinity treatments were conducted. The overall lack of inflorescence production resulted in a data set insufficient for statistical analysis.

Meadowcrest survival rates (Figure 7) were clearly negatively impacted due to increased salinity concentration treatments. Mortalities began to occur in groups receiving 20 and 30 ppt treatments at 5 weeks of treatments when hydroponic solutions were at 20 and 25 ppt respectively. Mortalities for the two salinity treatments increased at a similar rate both resulting in 2.5% survival, indicating that a salinity tolerance threshold was surpassed at 20 ppt which is supported by the biomass and leaf length data showing no statistically significant differences between the two groups. Mortalities began to occur in the group of plants treated with 10 ppt solution at 6 weeks of treatments. Survival steadily declined during the last 4 weeks of treatments resulting in 25% survival after 9 weeks of

consistent saline solution treatments of 10 ppt. The low survival rate of the 10 ppt group also indicates a salinity tolerance threshold was surpassed and is similarly supported by the biomass and leaf length data showing no statistically significant differences between any of the saline treatment groups. The mortality rates across all salinity treatments compared to the 100% survival of the control (0 ppt) group clearly indicate a low degree of salinity tolerance is present in Meadowcrest under chronic saline exposure conditions.

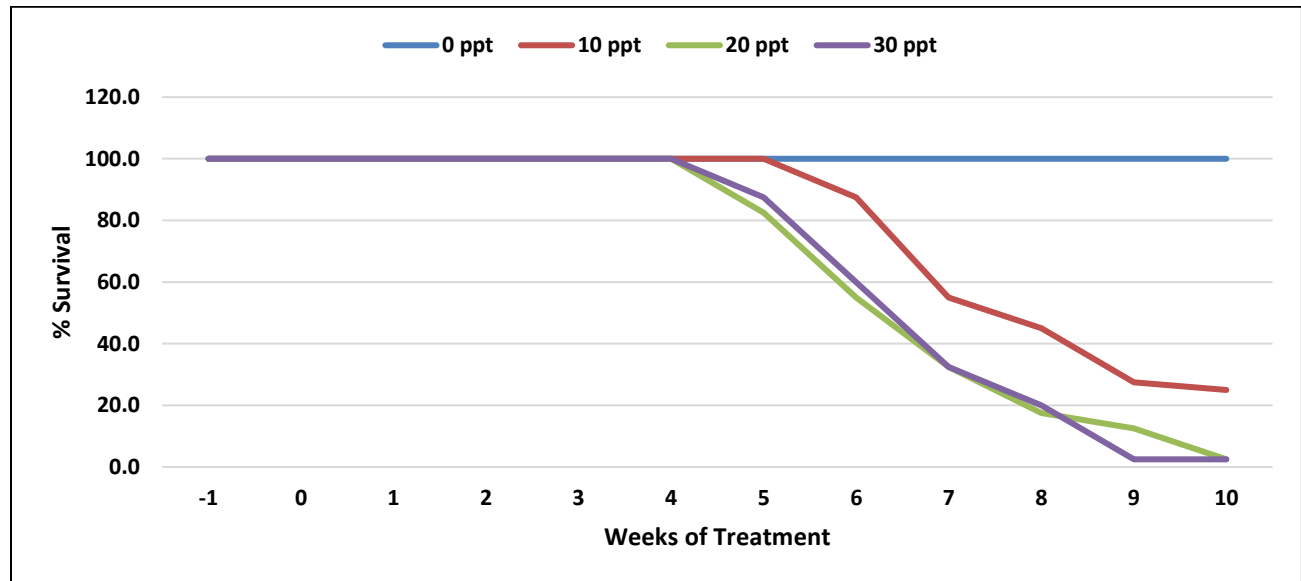


Figure 7. Results of weekly plant survival counts of Meadowcrest eastern gamagrass during the salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.

Although Stalter and Baden (1994) reported the long-term survival (greater than 20 years) of eastern gamagrass in brackish marshes subject to tidal flooding with salinity levels up to 9 ppt, the frequency of inundation events and exposure to saline waters where eastern gamagrass occurred in their test area is uncertain. Stalter et al. (2021) notes that severe storm surges driven by hurricanes inundate the study area with saline water, however, these exposure events happen infrequently (Stalter & Baden, 1994). Annual precipitation of the study area is another factor to consider. The study area receives an average of 53.9 in of rainfall providing fresh water to mitigate the tidal flooding of brackish water (Stalter et al., 2021). These two factors, frequency of saline exposure and rinsing with fresh water via rainfall, are key differences between this controlled hydroponic salinity tolerance study and the Stalter and Baden (1994) field study. The regular twice daily saline exposure events and lack of flushing with fresh water in this study help to explain the apparent differences in salinity tolerance of eastern gamagrass between the two studies. The greater conflicting degree of salinity tolerance (10-15 ppt) reported by Gibson et al. (2021) likewise specifically states “tolerance to infrequent flooding of Brackish water.” Again, frequency of exposure to saline events is an important difference between the results of this study and the salinity tolerance reported by Gibson et al. (2021).

CONCLUSION

The results of this study suggest that Meadowcrest has a low salinity tolerance when exposure events occur consistently. These findings indicate that Meadowcrest should not be recommended for sites that are expected to experience regular saline exposure where salinity levels have been measured at or above 10 ppt.

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APPENDIX

Study photos:



Figure 8. Weekly photos (2 weeks prior to salinity treatments) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 9. Weekly photos (1 week prior to salinity treatments) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 10. Weekly photos (week that salinity treatments began) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 11. Weekly photos (1 week of salinity treatments) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 12. Weekly photos (2 weeks of salinity treatments) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 13. Weekly photos (3 weeks of salinity treatments) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.

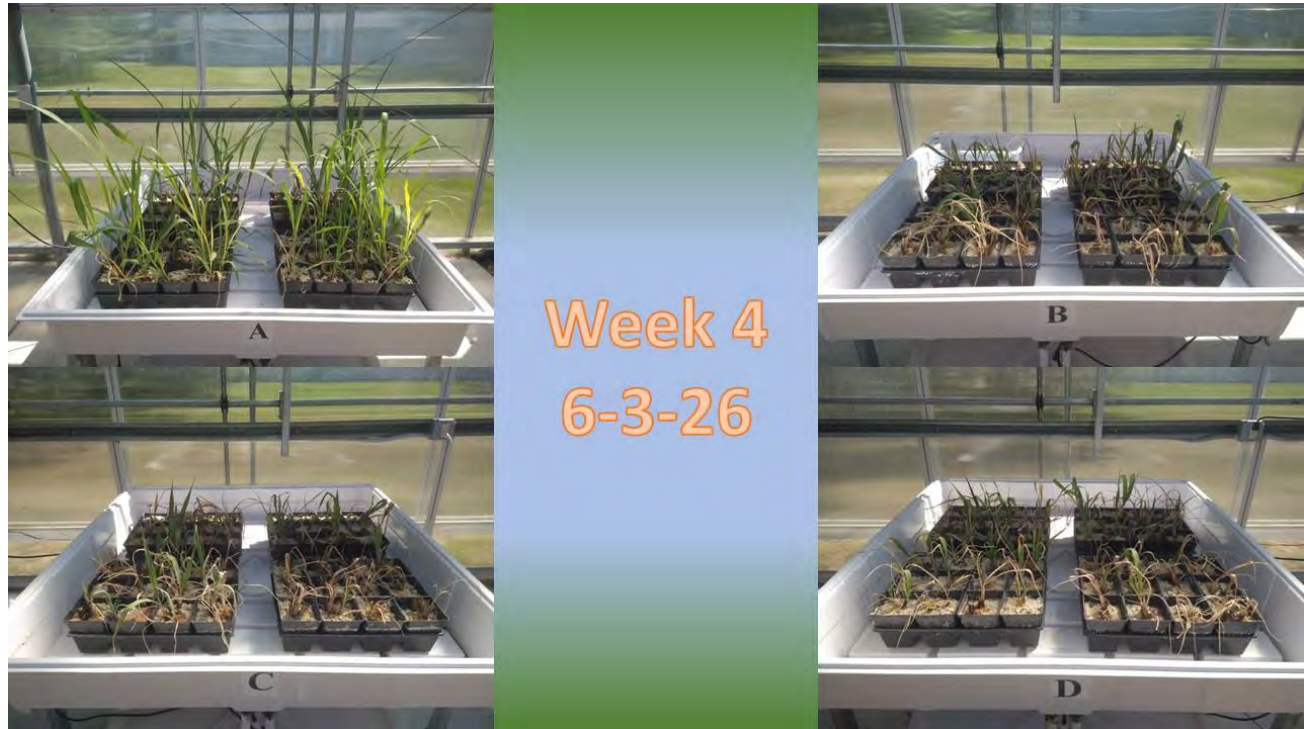


Figure 14. Weekly photos (4 weeks of salinity treatments) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 15. Weekly photos (5 weeks of salinity treatments) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 16. Weekly photos (6 weeks of salinity treatments) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 17. Weekly photos (7 weeks of salinity treatments) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 18. Weekly photos (8 weeks of salinity treatments) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 19. Weekly photos (9 weeks of salinity treatments) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 20. Weekly photos (10 weeks of salinity treatments) of Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 21. Example of root growth after harvest and rinsing of a 0 ppt treatment plant of the Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 22. Example of root growth after harvest and rinsing of a 10 ppt treatment plant of the Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 23. Example of root growth after harvest and rinsing of a 20 ppt treatment plant of the Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.



Figure 24. Example of root growth after harvest and rinsing of a 30 ppt treatment plant of the Meadowcrest eastern gamagrass salinity tolerance study conducted at the New Jersey Plant Materials Center, Cape May Court House, NJ.

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Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the State or local Agency that administers the program or contact USDA through the Telecommunications Relay Service at 711 (voice and TTY). Additionally, program information may be made available in languages other than English.

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Keeping Working Lands in Working Hands