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SEMI-ANNUAL PROGRESS REPORT FALL 1985
DEVELOPING SALT, DROUGHT, AND HEAT RESISTANT
TURFGRASSES FOR MINIMAL MAINTENANCE

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EXECUTIVE SUMMARY

1985 Fall Semi-Annual Progress Report
concerning
Developing Salt, Drought, and Heat Resistant
Turfgrasses for Minimal Maintenance

Principle Investigator: Dr. Garald Horst
Turfgrass Stress Physiologist

RESEARCH PERIOD OF THIS REPORT: August 1, 1984 to October 1, 1985

I. Research Accomplished:

1. Development of a new technique for growth and development evaluation of multiple germ plasm entries grown under salt stress conditions.

2. Reception and increase of 75 Buffalograsses, 40 St. Augustinegrasses, 3 Paspalums, and 65 zoysiagrasses.

II. Current Research:

1. Vegetative material of 29 Buffalograss and 37 St. Augustinegrass germ plasm are being evaluated for salt resistance.

2. Methods for evaluating zoysiagrass vegetative material are currently being investigated.

III. Research Planned 1985/1986:

1. Complete evaluation of St. Augustinegrass germ plasm. (Feb. 1986)

2. Complete initial evaluation of buffalograss germ plasm. (May 1986)

3. Continue accumulation of buffalograss germ plasm and expand cooperation with Nebraska program.

4. Initiate zoysiagrass evaluation (Jan 1986).

5. Begin accumulation of bentgrass and bermudagrass germ plasm and expand cooperation with New Mexico and Oklahoma programs.

6. Investigate methods for further greenhouse and field evaluations on germ plasm which exhibited reasonable salt resistance.

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USGA SUPPORTED TURFGRASS SALT TOLERANCE PROGRAM

I. INTRODUCTION

This Semi-annual report as required in the contract is for the period April 1, 1985 to October 1, 1985. Ms. Jo Ann Treat, Executive Vice President, Texas Research Foundation, and Mr. Charles Smith, Director, Administration and Services for United States Golf Association, signed the original contract agreement effective April 1, 1985. The research contract is established through the Texas A&M Research Foundation.

The following report represents the research accomplishments and research direction for the period August 1, 1984 to October 1, 1985.

II. IMPLEMENTATION

Previous studies involving salt resistance of several turf type grasses have been completed and reported on. Salt tolerant evaluations on Buffalograss and St. Augustinegrass are currently under way. Methods for evaluating zoysiagrass are currently in the initial stages. Cultivars exhibiting salt resistance and essential agronomic turfgrass qualities will be included in more advanced studies. These advanced studies are now planned for the greenhouse on modified soil media rather than hydroponically as our initial evaluations are done. The most salt resistant genetic sources could be utilized in parent-progeny evaluations where the heritability of these traits could be defined along with the potential for improvement and utilization into new turfgrass types. Areas of past and present research are identified and briefly discussed in the following sections.

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A. SALT RESISTANCE IN SEEDLING TURFGRASSES

Initial evaluation of Kentucky bluegrass (Poa pratensis L.), tall fescue (Festuca arundinacea Schreb.), and perennial ryegrass (Lolium perenne L.) cultivars were under controlled temperature conditions in the laboratory. Seed were germinated and grown on mats floating in controlled saline and nonsaline solutions. Saline solutions consisted of concentrations of 7,500 , 12,500, and 15,000 ppm equally divided between NaCl and $CaCl_2$ (by weight). Control solution consisted of deionized water. Results of these studies have been published (1,2,3).

B. EVALUATIONS INVOLVING VEGETATIVE PLANT MATERIAL

Obviously all turfgrass germ plasm can not be evaluated for salt resistance on a germination/seedling basis; therefore, methods for evaluating salt resistance had to be worked out for those turf grasses that have to be propagated vegetatively in order to retain genetic identity. Using the floating mat method was unsatisfactory because preliminary studies showed nutrient solution had to be added to salt solutions or the germ plasm (cuttings) showed nutrient stress. The addition of these nutrients allowed an unmanageable amount of algae to accumulate. To avoid any detrimental effects an algaecide may have on the cuttings it was decided to exclude light from the nutrient/salt solution and the plant root zone, rather than use an algaecide. After several pilot experiments a system was developed utilizing small plastic mist nozzels to spray the solutions directly on the roots. This is similar to commercial methods used to root cuttings.

The mist chamber consists of large stainless steel (epoxy coated) trays 35.5" x 50" x 6.5" depth covered by a framework made of PVC pipe, elbows, and tees with plexiglass "shelves" glued to the bottom of the PVC framework. The framework is painted black to exclude light. Rectangular plexiglass frames, made to set into the open PVC squares, are covered with visqueen, a plastic mulch (Figure 1). Holes of varying sizes may be made in the plastic and the roots of pre-rooted nodes are threaded through the holes (Figure 2) allowing the roots to be inside the mist chamber and the plant tops to be resting on the plastic (Figure 3). The frames are then set onto the PVC framework resting on the plexiglass shelves (Figure 4).

The salt/nutrient solution is sprayed directly on the roots (Figure 5) using small plastic mist nozzles attached to neoprene tubing. Carpet cleaner pumps are used to supply pressure necessary to deliver the solution through the mist nozzels. Homemade electronic timers are used to automatically turn the pumps on and off (on 23 seconds, off for 3 minutes 23 seconds).

The solution is held in 5 gallon buckets and pumped from the bucket reservoir, through the neoprene tubing to the mist nozzels and returned to the bucket (Figure 6).

The nutrient/salt solution consists of modified Hoagland's solution (Sequestrene 330 chelated iron is substituted for iron tartrate solution), 4,450, 9,450, 14,450 ppm NaCl and CaCl2 by weight, on an equal basis, which when added to the salts contributed in the Hoagland's solution yields 5,000, 10,000, and 15,000 ppm total salts respectively. Control consists of Hoagland's solution in deionized water. Subdue 2E fungicide is also used in the nutrient solution as a disease preventative.

The solutions are changed out fresh 2 times a week till the last 2 weeks of plant growth. At that point they are changed 3 times a week. Any salt accumulating on the plastic mulch is washed off each day. Lighting is supplied by 1000 watt Mercury Multi-vapor Metal Halide Sodium Lamps.

C. ST. AUGUSTINEGRASS GERM PLASM SALT RESISTANCE.

OBJECTIVES: To evaluate the available gene pool for salt resistance in St. Augustinegrass (Stenotaphrum secundatum (Walt.) Kuntze) germ plasm.

PROGRESS: Thirty-seven St. Augustinegrass entries are currently in the salt resistance evaluations (Table 1). Healthy nodes were selected to pre-root in silica sand in the greenhouse for 20 days. Initial experiments indicated salt concentrations of 30,000 and 20,000 ppm produced extremely high plant mortality rates. The shock of being removed from the sand, placed in a saline root environment, and high light intensity also added to the mortality rate. Therefore the following schedule was worked out: Lights are off the first day after planting. Light duration is then gradually increased in two hour intervals daily until a 16 hour day length is achieved. This day length schedule is then maintained for the duration of the experiment. Salt treatments and Subdue 2E is added to the nutrient solutions on day 5 after planting.

The St. Augustinegrass nodes are grown in the salt solutions for 4 weeks. Harvest data include:

Root lengths	Stolon lengths
Stolon counts	Top wet weights
Root wet weights	Top dry weights
Root dry weights	

As of October 1985, two, 3-rep experiments have been completed. A third 3-rep experiment should be completed by December 1985. Data from the experiments completed to date indicate considerable potential for improving salt resistance in St. Augustinegrass.

The mortality list of germ plasm entries in Table 2 indicates that over 75% of the entries evaluated survived at the 15,000 ppm salt level. Plant growth measurements on top and root growth (Tables 3 and 4) indicate less than 50% reduction in dry matter accumulation for 5 entries at 15,000 ppm salt. The genetic potential for salt resistance could be used to improve St. Augustinegrass salt resistance. If these entries exhibit desirable turfgrass characteristics, they could be used directly in areas with saline growing conditions.

Salt resistance evaluation of St. Augustinegrass has not been completed at this time therefore, data on additional growth and survivial measurements and conclusions on salt resistance potential will not be reported until completion.

D. BUFFALOGRASS GERM PLASM SALT RESISTANCE.

OBJECTIVE: To evaluate the available gene pool for salt resistance in Buffalograss (Buchloe dactyloides (Nutt.) Engelm.) germ plasm.

PROGRESS: Twenty-seven buffalograss germ plasm were selected for the initial salt resistance evaluations (Table 5). Healthy nodes were pre-rooted in silica sand for 30 days. The same procedures are followed as the St. Augustinegrass except the buffalograsses are grown in the salt solutions for 6 weeks. Harvest data is also the same as for St. Augustinegrass. As of October 1985, one, 4-rep experiment is complete and another is currently under way. Data gathered thus far show very limited salt resistance even at the lowest 5,000 ppm salt level. Plant mortality of buffalograss grown in 3 salt concentrations indictes that less than 15% of the germ plasm entries survived the first two salt

stress levels (Table 6). Less than 17% of the entries survived at a 50% level in all 3 salt stress concentrations.

The plant growth measurements in Tables 7 and 8 are of the 5 entries that exhibited greater than a 50% survivial rate in the salt treatments. These growth measurements indicate severe reductions in both top and root growth as related to salt stress. There appears to be little outstanding salt resistance in the germ plasm evaluated to data. However, evaluation of germ plasm from a broader geographic base may uncover genetic potential for salt resistance.

Salt resistance evaluation of buffalograss has not been completed at this time therefore, data on additional growth and survivial measurements and conclusions on salt resistance potential will not be reported until completion.

E. METHOD FOR EVALUATING ZOYSIAGRASSES FOR SALT RESISTANCE

OBJECTIVE: To determine the best method in which to evaluate Zoysiagrass (Zoysia Willd.) germ plasm for salt resistance.

PROGRESS: Due to the extreme slow growing nature of zoysiagrass this species may require special methods of evaluation. We have begun to pre-root zoysiagrass nodes selected from stolons of germ plasm grown in pots in the greenhouse. We have not yet determined the length of time the nodes should pre-root in silica sand. Extra mist chambers are being built to do the preliminary work on zoysiagrass germ plasm as well as other turf species.

F. METHOD FOR FURTHER EVALUATION ON ELITE SELECTIONS

OBJECTIVES: Determine methods for salt resistance evaluations on a soil medium where the salt concentrations may remain constant.

PROGRESS: Discussion on methods and the equipment necessary to evaluate turfgrass species showing a moderate amount of salt resistance have taken place. It is necessary to give special treatment to salt work involving soil mediums to keep the salt concentrations within acceptable levels. As water evaporates from the soil surface, and as the roots take water up the salt concentrations increase. Therefore the evaporation will have to be kept to a minimun and the soil solution will have to be leached daily.

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RELATIVE PUBLICATIONS

1. Horst, G. L. and R. M. Taylor. 1983. Germination and Initial Growth of Kentucky Bluegrass in Soluble Salts. Agron J. Vol. 75:679-681.

2. Horst, G. L. and N. B. Beadle. 1984. Salinity Affects Germination and Growth of Tall Fescue Cultivars. J. Amer. Soc. Hort. Sci. Vol. 109(3):419-422.

3. Horst, G. L. and N. B. Dunning. 1984. Germination and Initial Growth of Perennial Ryegrasses in Soluble Salts. Agron. Abstr. p.151.

4. Horst, G. L. and M. C. Engelke, and W. Meyers. 1984. Assessment of Visual Evaluation Techniques. Agron J. Vol. 76:619-622.

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Figure 4. Plexiglass trays sitting in the PVC framework with Buffalograss nodes planted through the Visqueen.

Figure 5. Mist nozzels enclosed in the tank showing how roots are misted with the salt solutions.

Figure 6. Tank, solution bucket, and filter system complex.

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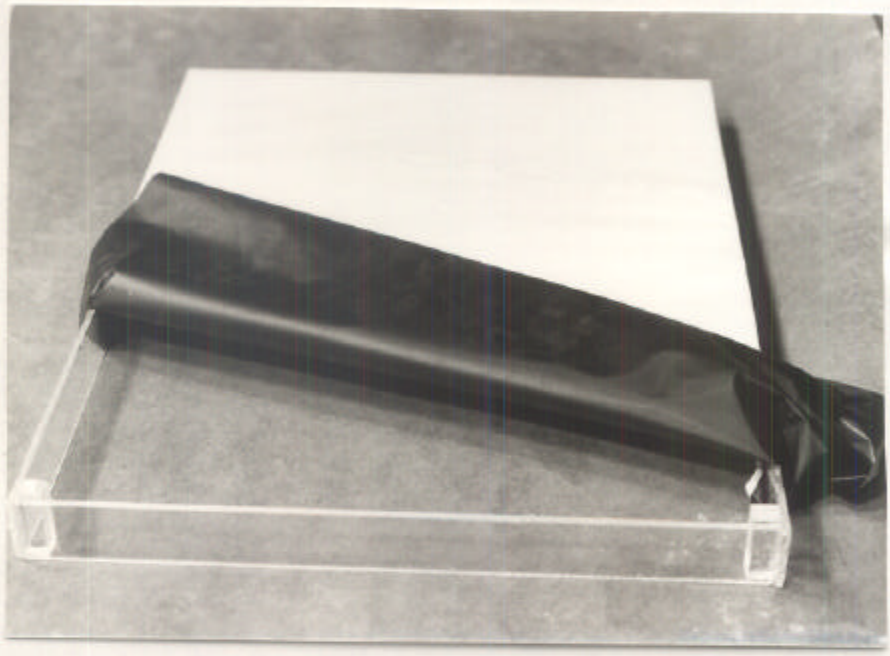
Table 5. Buffalograss inventory summary of germ plasm used in salt resistance evaluation experiments.

Table 6. Mortality of Buffalograss germ plasm at a 50 percent level or greater in 3 salt levels.

Table 7. Top growth dry weight of surviving Buffalograss germ plasm entries as salt stress was increased.

Table 8. Root growth dry weight of surviving Buffalograss germ plasm entries as salt stress was increased.



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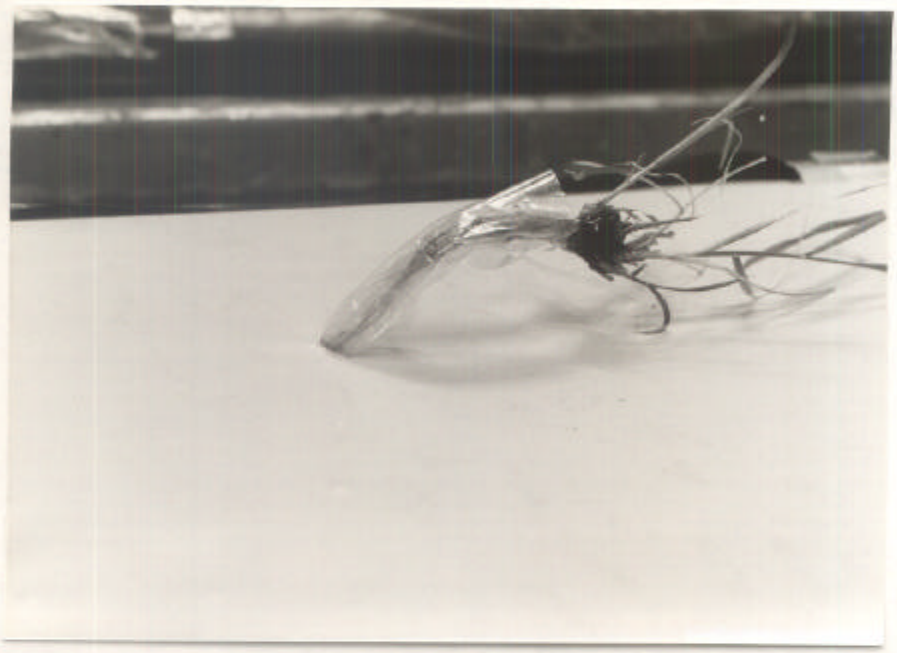

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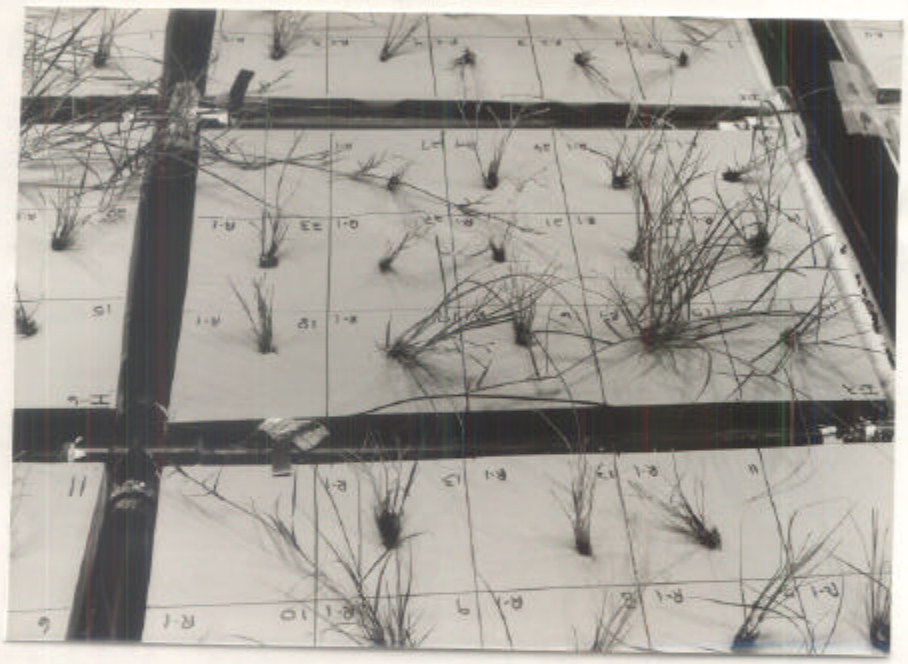

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Figure 6. Tank, solution bucket, and filter system complex.

Table 1. St. Augustinegrass inventory summary of germ plasm used in salt resistance evaluation experiments.

ENTRY	SOURCE
TXSA 8201	TEXAS
TXSA 8203	TEXAS
TXSA 8208	TEXAS
TXSA 8218	TEXAS
TXSA 8225	TEXAS
TXSA 8231	TEXAS
TXSA 8262	TEXAS
FLORATAM	TEXAS
BITTER BLUE	TEXAS
FLORATINE	TEXAS
SCOTTS SEVILLE 516	SCOTTS
GARRETTS 141	TEXAS
FL 1815-1	FLORIDA
FL 1811-3	FLORIDA
FL 1918-4	FLORIDA
FL 1921-2	FLORIDA
FL 1845-8	FLORIDA
DalSA 8210	TEXAS
DalSA 8211	TEXAS
DalSA 8212	TEXAS
DalSA 8213	TEXAS
DalSA 8214	TEXAS
DalSA 8215	TEXAS
DalSA 8216	TEXAS
DalSA 8217	TEXAS
DalSA 8218	TEXAS
DalSA 8201	TEXAS
DalSA 8202	TEXAS
DalSA 8203	TEXAS
DalSA 8204	TEXAS
DalSA 8205	TEXAS
DalSA 8206	TEXAS
DalSA 8207	TEXAS
DalSA 8208	TEXAS
DalSA 8209	TEXAS
SCOTTS 1081-4	SCOTTS
FA 108	FLORIDA
DalSA 8401	TEXAS
DalSA 8402	TEXAS
DalSA 8403	TEXAS

Table 2. Mortality of St. Augustinegrass germ plasm at a 50 percent level or greater in 3 salt levels.

Entry	ppm Salts		
	5,000	10,000	15,000
Floratine	-	xxx	xxx
Garrets 141	-	-	xxx
DalSA 8210	-	-	xxx
DalSA 8212	-	xxx	xxx
DalSA 8202	-	-	xxx
DalSA 8205	-	-	xxx
DalSA 8206	-	-	xxx
DalSA 8207	-	-	xxx.
DalSA 8209	-	-	xxx

- Less than 50% mortality.
xxx greater than 50% mortality.

Table 3. St. Augustinegrass germ plasm entries with less than 50 percent reduction in top growth dry weight as salt stress was increased.

Entry	ppm Salts		
	5,000	10,000	15,000
TXSA 8208	105*	88	61
TXSA 8262	84	61	59
BITTER BLUE	68	60	61
DalSA 8211	73	79	60
DalSA 8208	139	102	57

*Values are percent of no salt stress growth.

Table 4. St. Augustinegrass germ plasm entries with less than 50 percent reduction in root growth dry weight as salt stress was increased.

Entry	ppm Salts		
	5,000	10,000	15,000
TXSA 8208	131*	134	98
TXSA 8262	115	73	69
BITTER BLUE	84	67	51
DalSA 8211	96	80	90
DalSA 8208	234	205	116

*Values are percent of no salt stress growth.

Table 5. Buffalograss inventory summary of germ plasm used in salt resistance evaluation experiments.

ENTRY	SOURCE
PMT-4833	Swisher Co. Tx
PMT-4844	Donley, Tx
PMT-4854	Ochiltree Co. Tx
PMT-4860	Grayson Co. Tx
PMT-4866	Hansford, Tx
PMT-4868	Collins Co. Tx
PMT-4921	Austin Co. Tx
PMT-4932	Fannin Co. Tx
PMT-4974	Wharton Co. Tx
PMT-4998	Edwards Co. Tx
PMT-5000	Coryell Co. Tx
PMT-5015	Andever Co. Tx
PMT-5017	Falls Co. Tx
PMT-5059	Scurry Co. Tx
PMT-4814	Fort Bend Tx
PMT-4849	Sherman Co. Tx
PMT-4870	Hamilton Co. Tx
PMT-4912	Milam Co. Tx
PMT-4935	Lee Co. Tx
PMT-4987	Gonzales Co. Tx
PMT-4836	Travis, Tx
PMT-4911	Wise Co. Tx
PMT-4919	Washington Co. Tx
PMT-4944	Martin Co. Tx
PMT-4977	Goliad Co. Tx
PMT-5013	McLennan Co. Tx
PMT-5076	Coke Co. Tx

Table 6. Mortality of Buffalograss germ plasm at a 50 percent level or greater in 3 salt levels.

Entry	ppm Salts 5,000	10,000	15,000
PMT-4833	xxx	xxx	xxx
PMT-4844	xxx	xxx	xxx
PMT-4854	xxx	xxx	xxx
PMT-4860	-	-	-
PMT-4866	xxx	xxx	xxx
PMT-4868	xxx	xxx	xxx
PMT-4921	xxx	xxx	xxx
PMT-4932	xxx	xxx	xxx
PMT-4974	xxx	xxx	xxx
PMT-4998	xxx	xxx	xxx
PMT-5000	xxx	xxx	xxx
PMT-5015	xxx	xxx	xxx
PMT-5017	xxx	xxx	xxx
PMT-5059	xxx	xxx	xxx
PMT-4814	xxx	xxx	xxx
PMT-4849	-	-	-
PMT-4870	xxx	xxx	xxx
PMT-4912	xxx	xxx	xxx
PMT-4935	-	-	-
PMT-4987	xxx	xxx	xxx
PMT-4836	xxx	xxx	xxx
PMT-4911	xxx	xxx	xxx
PMT-4919	xxx	xxx	xxx
PMT-4944	xxx	xxx	xxx
PMT-4977	-	-	xxx
PMT-5013	-	-	-
PMT-5076	xxx	xxx	xxx

- Less than 50% mortality.
xxx greater than 50% mortality.

Table 7. Top growth dry weight of surviving Buffalograss germ plasm entries as salt stress was increased.

Entry	ppm Salts		
	5,000	10,000	15,000
PMT-4860	12*	15	17
PMT-4849	29	23	17
PMT-4935	76	46	33
PMT-4977	35	34	-
PMT-5013	25	20	2

*Values are percent of no salt stress growth.

Table 8. Root growth dry weight of surviving Buffalograss germ plasm entries as salt stress was increased.

Entry	ppm Salts		
	5,000	10,000	15,000
PMT-4860	10*	12	16
PMT-4849	29	22	19
PMT-4935	45	19	20
PMT-4977	26	23	-
PMT-5013	28	19	22

*Values are percent of no salt stress growth.