ANNUAL PROGRESS REPORT

DEVELOPING SALT, DROUGHT, AND HEAT RESISTANT TURFGRASSES FOR MINIMAL MAINTENANCE

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ANNUAL PROGRESS REPORT FALL 1989
USGA SUPPORTED RESEARCH PROGRAM
DEVELOPING SALT, DROUGHT, AND HEAT RESISTANT TURFGRASSES FOR MINIMAL MAINTENANCE

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USGA SUPPORTED SALT RESISTANCE PROGRAM

EXECUTIVE SUMMARY

Fall 1989 Annual Progress Report
concerning
Developing Salt, Drought, and Heat Resistant
Turfgrasses for Minimal Maintenance

Principle Investigator: Dr. Garald L. Horst
Turfgrass Stress Physiologist

RESEARCH PERIOD OF THIS REPORT: November 1, 1988 to October 31, 1989.

I. Research accomplished.

1 Initial zoysiagrass evaluation was completed as of fall 1988, where (29) entries were evaluated in four tests.

2 Zoysiagrass appears to have medium potential for salt resistance in the limited germplasm base that was tested. This plant material base was from Texas collection.

3 Some zoysiagrass selections appear to have good salt resistance. The selections could be useful in both cultivar improvements and perhaps used in saline environments without additional selection pressure.

4 Bentgrass germplasm (25 entries) from the improvement program under the direction of Dr. M.C. Engelke was received at the end of 1988. The material is currently evaluated for salt resistance.

5 The advance long term study is underway, and the first trial of bentgrass is going to take place in the course of this year.

II. Current Research

1 The initial bentgrass germplasm base is being evaluated for salt resistance.

2 Promising bentgrasses will be evaluated in our new advanced salt resistance study set up.

III. Research Planned 1989/90

1 Continue bentgrass evaluation tests.

2 Begin to proto-type advance salt resistance studies as an option, or support of our current aeroponic tank system.

3 Begin evaluation of the Nebraska buffalograss germplasm base for salt resistance.

USGA SUPPORTED SALT RESISTANCE PROGRAM

I. Introduction

This annual report as required in the contract is for the period November 1, 1988 to October 31, 1989. 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 November 1, 1988 to October 31, 1989.

II. Implementation

Previous studies involving salt resistance of several turf type grasses have been completed and reported. This research has been a continuation of salt resistance evaluations on zoysiagrass and bentgrass in the greenhouse facility.

A. ZOYSIAGRASS GERMPLASM SALT RESISTANCE.

OBJECTIVE: Evaluate the currently available gene pool for salt resistance in zoysiagrass (Zoysia Willd.) germplasm.

PROGRESS: The first set of zoysiagrass salt resistance evaluations have been completed. Data from our four experiments were combined to represent the results.

On previous reports, entry EPZ26 was reported as having good genetic potential for improved salt resistant characteristics. The report still holds true, except for the fact that in a survival days basis analysis, the same entry show us to be the worst performer of all, meaning that it didn't survive through all repetitions in any given test combinations, on the other hand, and with the same analysis, entry EPZ28 was the best survival performer in all repetitions for six of the test combinations.

Other potential entries for salt resistance were zoysiagrass EPZ18 and EPZ28 which survived in tests 5 and 6 respectively (Table 7). The genetic potential for utilizing zoysiagrass in saline conditions is very good. Entries such as EPZ28, EPZ09, and EPZ06 which did not exhibit drastic reduction in growth could serve as the germplasm basis for improved salt resistance turfgrasses.

B. BENTGRASS GERMPLASM SALT RESISTANCE.

OBJECTIVE: Evaluate the currently available gene pool for salt resistance in bentgrass (Agrostis L.) germplasm.

PROGRESS: This year the first salt evaluation test series on bentgrass were partially completed. Data on these tests were used to determine overall performance for the germplasm base we currently have available.

Survival rates to date indicate the following as having the most potential for salt resistance.

EPBT01

EPBT03

EPBT05

EPBT09

EPBT10

Bentgrass entries have shown good survival rates so far. Plans are to continue the salt resistance evaluation test in the next year. Future tests will include wet weights, dry weights of roots and tops as well as stolon lengths and survival rates for each entry.

C. ADVANCE LONG TERM EVALUATION METHODS.

OBJECTIVE: Determine additional methods for long term salt resistance evaluation on a soil medium where the salt concentrations are maintained at uniform levels.

PROGRESS: Equipment for the prototype system (Figure 1) has been constructed and assembled. Plant material is now being increased for a system test which will determine maintenance requirements.

The clear boxes of the advance long term study hold circulating water at a constant temperature, allowing us to substantially control the soil temperature throughout the length of the PVC pipe. An overhead manifold (24 individual values) deliver equal quantities of salt solution via black plastic tubing to each plant.

The advance long term study will be used to grow selected germplasm entries during longer periods of time, simulating "Field characteristics."

III. List of figures and tables

FIGURE 1. Precision nutrient and salt solution delivery system for long term studies of plant response to salinity levels.

TABLE 1. Zoysiagrass inventory summary of germplasm used in salt resistance evaluation experiments.

TABLE 2. Plants in which treatment II exhibit more growth than treatment III and IV.

TABLE 3. Entries that exhibit greater growth parameters in treatment III than in treatment II.

TABLE 4. Entries of plants in salt treatment IV which had greater overall growth than salt treatment III.

TABLE 5. Summary of all tables. Entries of the best plants according to overall average of salinity levels.

TABLE 6. Bentgrass inventory summary of germplasm used in salt resistance evaluation experiments.

TABLE 7. Zoysiagrass entries which exhibited the best overall growth parameters from the salt resistance evaluation.

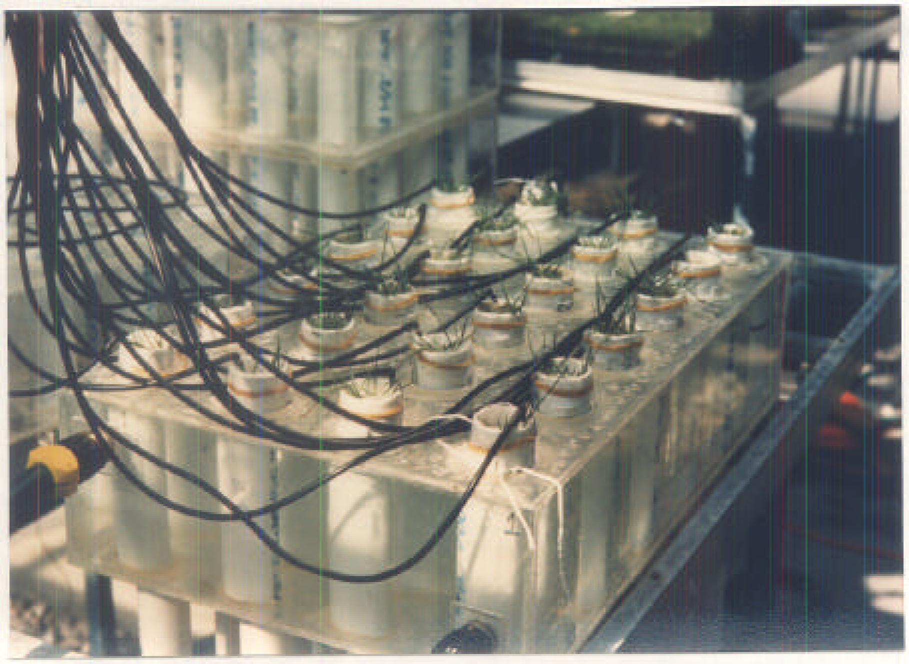

Figure 1. Precision nutrient and salt solution delivery system for long term studies of plant response to salinity levels.

Table 1. Zoysiagrass inventory summary of germplasm used in salt resistance evaluation experiments

ENTRY NUMBER	SOURCE Dallas Research Center
EPZ01	
EPZ02	
EPZ03	
EPZ04	
EPZ05	
EPZ06	
EPZ07	
EPZ08	
EPZ09	
EPZ10	
EPZ11	
EPZ12	
EPZ13	
EPZ14	
EPZ15	
EPZ16	
EPZ17	
EPZ18	
EPZ19	
EPZ20	
EPZ21	
EPZ22	
EPZ23	
EPZ24	
EPZ25	
EPZ26	
EPZ27	
EPZ28	
EPZ29	
EPZ30	
EPZ32	
EPZ34	

Entries with a 50% average of all parameters according to average of tanks.

Table 2. Plants in which treatment II exhibit more growth than treatment III and IV.

	Growth Parameters*					
ENTRY NUMBER	DT	DR	WT	WR	RL	SL
EPZ01						
EPZ02	x	x	x	x	x	x
EPZ03		x				
EPZ04						
EPZ05		x		x		
EPZ06	x	x	x	x		x
EPZ07						x
EPZ08						
EPZ09						
EPZ10		x		x		
EPZ11						
EPZ12		x		x	x	
EPZ13	x	x		x		x
EPZ14	x			x	x	
EPZ15					x	x
EPZ16		x		x		
EPZ17					x	
EPZ18						
EPZ19	x		x			x
EPZ20						
EPZ21						
EPZ22		x			x	
EPZ23				x	x	
EPZ24						
EPZ25					x	x
EPZ26		x	x	x		x
EPZ27	x	x	x	x	x	x
EPZ28	x	x		x	x	x
EPZ29	x	x	x	x	x	x

* DT = DRY TOP RL = ROOT LENGTH
DR = DRY ROOT SL = STOLON LENGTH
WT = WET TOP
WR = WETROOT

Entries with a 50% average of all parameters according to total average of tanks.

Table 3. Entries that exhibit greater growth parameters in treatment III than in treatment II.

ENTRY NUMBER	Growth Parameters*					
	DT	DR	WT	WR	RL	SL
EPZ01						
EPZ02						
EPZ03	X					
EPZ04						
EPZ05						
EPZ06						
EPZ07		X				
EPZ08						
EPZ09						
EPZ10						
EPZ11						
EPZ12						X
EPZ13						
EPZ14		X				X
EPZ15						
EPZ16					X	
EPZ17						
EPZ18						
EPZ19						
EPZ20						
EPZ21		X				
EPZ22						
EPZ23						
EPZ24	X	X	X	X	X	X
EPZ25		X				
EPZ26						
EPZ27						
EPZ28						
EPZ29						

* DT = DRY TOP   RL = ROOT LENGTH
DR = DRY ROOT   SL = STOLON LENGTH
WT = WET TOP
WR = WETROOT

Entries with a 50% average of all parameters according to total average of tanks.

Table 4. Entries of plants in salt treatment IV which had greater overall growth than salt treatment III.

ENTRY NUMBER	DT*	DR	WT	WR	RL	SL
EPZ01					X	
EPZ02						
EPZ03				X	X	
EPZ04						
EPZ05					X	
EPZ06					X	
EPZ07		X			X	
EPZ08					X	
EPZ09	X	X	X	X	X	X
EPZ10					X	
EPZ11					X	
EPZ12						
EPZ13					X	
EPZ14						
EPZ15		X		X		
EPZ16			X			X
EPZ17						
EPZ18						
EPZ19		X		X	X	
EPZ20		X			X	
EPZ21					X	
EPZ22	X					
EPZ23		X	X			X
EPZ24						
EPZ25						
EPZ26	X				X	
EPZ27						
EPZ28						
EPZ29						

* DT = DRY TOP
DR = DRY ROOT
WT = WET TOP
WR = WETROOT
RL = ROOT LENGTH
SL = STOLON LENGTH

Table 5. Summary of all tables. Entries of the best plants according to overall average of salinity levels.

ENTRY NUMBER	1*	2	3	4
EPZ01				
EPZ02	x	x		
EPZ03	x			
EPZ04				
EPZ05				
EPZ06	x	x		
EPZ07				
EPZ08				
EPZ09	x			x
EPZ10				
EPZ11				
EPZ12	x			
EPZ13	x	x		
EPZ14	x		x	
EPZ15	x			
EPZ16	x			
EPZ17				
EPZ18				
EPZ19	x			x
EPZ20				
EPZ21				
EPZ22				
EPZ23	x			x
EPZ24	x		x	
EPZ25				
EPZ26	x	x		
EPZ27	x	x		
EPZ28	x	x		
EPZ29	x	x		

*1 Overall salinity level average where entries exhibited growth parameters 50% greater than growth parameter in the control.

2 Entries where the growth performance in treatment II was greater than growth performance other salinity levels.

3 Entries where the growth performance in treatment III was growth performance greater than treatment II.

4 Entries where the performance in treatment IV was greater than treatment level III.

Table 6. Bentgrass inventory summary of germplasm used in salt resistance evaluation experiments.

Assigned #	SOURCE Dallas Research Center
EPBT01	
EPBT02	
EPBT03	
EPBT03	
EPBT04	
EPBT05	
EPBT06	
EPBT07	
EPBT08	
EPBT09	
EPBT10	
EPBT11	
EPBT12	
EPBT13	
EPBT14	
EPBT15	
EPBT16	
EPBT17	
EPBT18	
EPBT19	
EPBT20	
EPBT21	
EPBT22	
EPBT23	
EPBT24	

IV. SUMMARY:

Table 7. Zoysiagrass entries which exhibited the best overall growth parameters from the salt resistance evaluations were as follows:

ENTRY NUMBER	TREATMENT
EPZ02	Best in all treatments at 5,000 ppm
EPZ03	
EPZ06	All treatments
EPZ09	best in all treatments at 15,000 ppm, and overall salt levels
EPZ12	Good in root measurements
EPZ13	All treatments
EPZ14	In root measurements
EPZ15	In root measurements
EPZ16	In root measurements
EPZ19	Good in root parameters at 15,000 ppm
EPZ23	Good in top parameters at 15,000 ppm
EPZ24	Best in all parameters at 10,000 ppm
EPZ24	Top measurements
EPZ27	Good in all parameters at 5,000 ppm
EPZ28	Good in all parameters at 5,000 ppm
EPZ29	Good in all parameters at 5,000 ppm

Overall entries evaluated, there were 3 with good performance up through the 15,000 ppm salt treatment.

EPZ09	Good in all parameters measurements.
EPZ19	Good in root measurements.
EPZ23	Good in top measurements.

V. RELEVANT PUBLICATIONS

Padilla, A. J., Horst, G. L., Engelke, M. C., and Dunning, N. B. 1989. Selection for salt resistance in zoysiagrass. P. 163. In Agronomy Abstract, ASA, Madison, WI.

Horst, G. L., Dunning, N. B. 1989. Germination and seedling growth of perennial ryegrasses in soluble salts. J. Amer. Soc. Hort. Sci. 114(2):338-342.