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DEVELOPMENT OF STRESS TOLERANT SEASHORE PASPALUMS FOR GOLF COURSE USAGE

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SUMMARY

A total of 5660 plots of paspalum have been established in Georgia ranging from mother nursery and increase plots of about 500 ft^2 each to 2'x2' spaced plants. Of this total, 1134 plots are planted at Blairsville (altitude 1530' - 34^0 50.44N, 83^0 55.80W) for the ultimate field evaluation for cold hardiness/cold shock/recoverability. Mowing height ranges from 5/32" (green) to 1/2" (most plots) to 1" (average going into the winter months). Ongoing studies involve greens evaluation, establishment (from sod, stolons) utilizing mycorrhizal enhancement, herbicide management, traffic-wear-fertility interactions, overseeding, and insect resistance (mole cricket and fall armyworm). Somaclonal variation resulting from tissue culture is being utilized as a selection tool, especially for the finer-textured paspalums. A cold temperature chamber has been used to induce cold shock (-9^0C) and recovery tests on several paspalum ecotypes and in conjunction with electrolyte leakage tests, the relative cold thermal threshold of 17^0F (-8^0C) has been verified. Variability among ecotypes in the current collection is available for improvement of winterhardiness.

Ecotype Collection

Trips were made to Fairbanks Ranch Country Club at Rancho Santa Fe in northern San Diego County, CA; Lafayette, AL - Chambers County public lake; Monsanto Golf Course in Pensacola, FL; and St. Augustine, FL old waterfront area. Up to 15 possible ecotypes have been added to the 300-ecotype collection of paspalums. Verification of whether new ecotypes were collected and increase of the new types will continue over the winter 1995-1996. Some of the new ecotypes are suspected of being *Paspalum distichum* instead of *P. vaginatum* types.

USGA Greens Evaluation

Eighteen paspalums have been evaluated on 10'x10' cubicles throughout the growing season. Tifgreen was used as the check. Mowing height was reduced from 3/4" to 5/32" gradually over the summer. The close mowing was instrumental in identifying potential candidates for additional greens evaluation as well as fairway types. Dollar spot became a "natural" problem once the mowing height reach 1/4". Natural infection coupled with half-plot inoculation provided a constant pressure on the green throughout the summer. No fungicides were applied. All plots but one (selection out of Argentina material) had 10 to 90% dollar spot damage. In general, the Hawaii ecotypes were quite susceptible and Adalayd derivatives were also susceptible, but at a lower level of damage. Two ecotypes (Argentina selection and an Aldine Pines selection) have been identified for fairway and greens utilization, respectively. Both ecotypes have been increased in the greenhouse from single rooted stolons in anticipation of nursery establishment this fall in the Caribbean region and next spring on courses in the southern U.S. A memorandum of agreement form has been developed for this eventual on-site collaboration and evaluation. Courses in the Cayman Islands and Jamaica have been contacted

for their interest. The course on Antiqua was damaged substantially by a hurricane and will not be ready until a later date. U.S. stateside courses will be contacted over the winter months for their interest.

Seed Production Capability

Seed from 61 polycross combinations and other field plots will be collected in November 1995. The seed will be subjected to $40^0 \rightarrow 0^0 \rightarrow 40^0$F cold regime to break suspected dormancy problems in paspalum this winter. Approximately 775 "hybrid" seedlings from germinated seed were space-planted this summer to ascertain whether this technique will create additional variability for selection under field conditions.

Tissue Culture

A total of 3640 regenerated plants have been planted in the field and are being maintained at 1/2" mowing height. Nine ecotypes (PI509021, Hi-1, Mauna Key, Adalayd, PI299042, K3, K7, SIPV-1, AP-6) have been subjected to callus induction (best medium included 1 mg L^{-1} 2,4-D plus 5% coconut milk; the best medium for initiation of embryogenesis was 1 mg L^{-1} BAP plus 0.5-2 mg L^{-1} NAA. Ecotypes that were prolific producers of regenerated plants included HI-1, Mauna Key, PI299042, and K3; K7, SIPV-1, and AP-6 were intermediate while PI509021 and Adalayd were poor producers.

Somaclonal variation for internode length among 1848 regenerants is depicted in the table below:

	Parent		Regenerants		
Ecotype	X	Range	X	Range	N
Mauna Key	6.9	5-9	11.1	3-30	280
HI-1	7.4	6-10	9.5	2-26	565
PI509021	7.6	5-11	9.0	3-20	421
K3	9.3	7-12	10.6	4-30	400
Adalayd	11.2	9-16	12.6	4-23	182

Field selection of tissue culture regenerants has resulted in 40 finer-textured selections of HI-1; 25 of K3; 13 of PI509021; 10 of Mauna Key; and 9 of Adalayd (97 total). Traits exhibiting somaclonal variation included genetic color, spread, density, and winterhardiness. Somaclonal variation will continue to be an effective selection technique for identification of dark green color, fine-textured, slower growing and more winterhardy types.

Winterhardiness Evaluation

Electrolyte leakage and cold (super cool) shock-recovery protocols were used to determine the lethal low temperature thresholds for 3 paspalum ecotypes (PI299042, Adalayd, HI-1). Acclimated and non-acclimated plants were evaluated.

Electrolyte leakage tests indicated only a $1^{0}C$ difference in cold tolerance variability among the 3 ecotypes, even though previous field evaluations had indicated PI299042 was substantially less tolerant than Adalayd, which was substantially less tolerant than HI-1. PI299042 was killed between -4 and $-5^{0}C$. Non-acclimated plants barely tolerated super cooling temperatures between -2 and $-3^{0}C$ and the few survivors were severely injured.

The cold shock-recovery tests revealed that PI299042 was killed at $-8^{0}C$ while Adalayd and HI-1 were killed at $-9^{0}C$. Field evaluations at Blairsville have indicated survival of some paspalum ecotypes at $-3^{0}F$ ($-18^{0}C$) during the winter 1993-1994 and $-2^{0}F$ ($-17^{0}C$) during the winter 1994-1995. Fortunately, ecotype variability for cold hardiness is available in the current collection.

Satellite Non-funded (by USGA) Studies

1) Insect response investigations (Kris Braman)

   Fall armyworm response to 30 ecotypes of paspalum (plus 15 additional fescue, bermudagrass, centipede, and zoysiagrass selections) was conducted during 1995. Future studies will involve a field site evaluation for mole cricket susceptibility at Tifton, GA (in conjunction with W. Hanna and his

improved bermudas) and a susceptibility assessment for two-lined spittlebug.

2) Herbicide management (B. J. Johnson)

Four ecotypes (AP10, HI25, PI28960, K7) were evaluated for post-emergence herbicide (Illoxan, Drive, Banvel, Image, Manage, Trimec) tolerance. Herbicides were applied on 20 June and ratings taken 6, 16, 20, 30, 41, and 55 days after application (DAA). Preliminary results indicated maximum injury occurred at 16-20 DAA. By 30 DAA, all ecotypes had recovered to $\geq$90% of the untreated check (at the 1X rate) except for PI28960 (Trimec) and K-7 (Illoxan and Trimec). Among the ecotypes, K-7 was injured more than the others. Drive and Manage caused the least injury; Illoxan and Image caused moderate injury; Trimec caused the highest injury. Banvel is probably safe to use on most ecotypes. This study will be continued during 1996. Additional studies will be implemented during May-June 1996.

3) Traffic-compaction-fertility interaction (B. Carrow)

A 10-entry test was established during the summer 1995 from stolons. Data collection will begin in 1996.

4) Establishment study (R. Clark, Beckley, WV)

Sod, planted stolons, bare-root sod, and stolons thrown on the surface were established during May 1995. Sod and planted stolons established the fastest; in addition, 5 mycorrhizal inoculum sources were applied. The mycorrhizal were collected from grass species in the Appalachian region. Subsurface soil cores under paspalum mother nurseries were collected and sent to West Virginia. One paspalum-specific mycorrhizae was identified and will be increased for future establishment studies.

Stolons thrown on the soil surface established slower than bare-root sod. Potting soil or sand application over the top of the surface stolons enhanced establishment.

5) Genetic Analysis Studies (S. Kresovich)

Ten microsatellite primers have been developed. Additional work on genetic fingerprinting will not begin again until a post-doc can be assigned. This protocol will be developed by the time the first paspalum is released.

6) Overseeding

Four established paspalum (K7, PI28960, PI29193, K17) areas were overseeded during the fall 1994 with various combinations of alkaligrass, perennial ryegrass, tall fescue, creeping bentgrass, or *Poa trivialis*. One area was maintained as a high irrigation (2-3" per week from 3 applications; the other 3 were strictly dryland). Overseeded grasses in the irrigated area, as expected, "melted out" slower than the dryland areas. Alkaligrass and *Poa trivialis* transitioned out faster than all other grasses, regardless of moisture availability. Creeping bentgrass on the irrigated area and Georgia adapted tall fescue in the dryland area persisted throughout the harsh growing season.

Publications

1. R. L. Jarret, P. Ozias-Akins, S. Phatak, R. Nadimpalli, R. Duncan, and S. Hiliard. 1995. DNA contents in **Paspalum** spp. by flow cytometry. Genetic Resources and Crop Evolution 42:237-242.
2. Z.-W. Liu, R.L. Jarret, S. Kresovich, and R. R. Duncan. 1995. Characterization and analysis of simple sequence repeat (SSR) loci in seashore paspalum (**Paspalum vaginatum** Swartz). Theoretical and Applied Genetics 91:47-52.
3. Z.-W. Liu, R. L. Jarret, R. R. Duncan, and S. Kresovich. 1994. Genetic relationships and variation among ecotypes of seashore paspalum (**Paspalum vaginatum**) determined by random amplified polymorphic DNA markers. Genome 37(6):1011-1017.

Pending Publications

1. R. R. Duncan. 1996. The environmentally sound turfgrass of the future -- seashore paspalum. USGA Greens Section RECORD (January 1996).
2. Z.-W. Liu, R. L. Jarret, R. D. Webster, and R. R. Duncan. 1996. Phenetic analysis of restriction fragment length polymorphisms (RFLPs) among **Paspalum** spp. Crop Science (in review).
3. B. R. Wiseman and R. R. Duncan. 1996. An evaluation of **Paspalum** spp. leaf samples for antibiotic resistance against **Spodoptera frugiperda** (J. E. Smith) (Lepidoptera: Noctuidae) larvae. J. Turfgrass Management (in review).

Abstracts

1. R. R. Duncan and C. Cardona. 1995. Field evaluation of tissue-culture regenerated seashore paspalum. Agron. Abstr. 87:146.
2. C. Cardona, R. R. Duncan, and O. Lindstrom. 1995. Evaluation of cold hardiness in seashore paspalum. Agron. Abstr. 87:149-150.

Future Plans

1. Ph.D. student Cesar Cardona has worked on tissue culture regeneration and cold shock-recovery protocol. He has passed his prelim exams and should finish his degree during the April-June 1996 time frame.
2. Potential additional Ph.D. students will be coming from Korea (January 1996) and the University of Florida (June 1996) to work on stress tolerance and fertility-traffic interrelationships, respectively, with paspalum.
3. All management studies will be increased during 1996, especially those dealing with herbicides, traffic-wear, establishment, overseeding, and insect resistance.
4. Another larger USGA-spec green is currently being built adjacent to the paddock green. The promising "greens" ecotypes will be moved to the larger green for evaluation. Modified fairways (90:10 sand-peat additions) will be established during the winter 1995-1996 to evaluate promising fairway ecotypes. A tee is also being built for future evaluation of potential ecotypes.

RRD/mh

CULTIVAR/GERMPLASM EVALUATION AGREEMENT

This Agreement is made this ____ day of _____, 199___, by and between the UNIVERSITY OF GEORGIA RESEARCH FOUNDATION, INC. (hereinafter "UGARF"), and _____ (hereinafter "UGARF"), and _____ (hereinafter "EVALUATOR").

WHEREAS, EVALUATOR has agreed to test the following proprietary cultivars and/or germplasms (hereinafter "Germplasm") which are owned by UGARF, as the assignee of rights in intellectual property developed at The University of Georgia: Seashore paspalum: **Paspalum vaginatum** Swartz.

UGARF will supply vegetatively propagated material of the above Germplasm without charge and EVALUATOR agrees to abide by the following terms of the Agreement:

(1) Vegetative materials are provided solely for evaluation purposes and EVALUATOR will not make use of Germplasm for commercial purposes.

(2) Vegetative materials provided will be used only for replicated field tests in _____ during 1995 or successive years.

(3) Germplasm will not be used for crossing or basic research.

(4) No selection will be conducted within Germplasm.

(5) Seed stock or vegetatively cloned increases of Germplasm will not be conducted, unless the increase is for evaluation purposes only.

(6) No seeds, plants, or plant parts of Germplasm will be distributed to a third party.

(7) Remnant seed and all harvested vegetative material from field tests will be returned to UGARF (c/o Dr. R. R. Duncan at the address given below) or, on UGARF's instruction, destroyed, unless specifically agreed to in writing from Duncan.

IN WITNESS WHEREOF, the parties have executed this Agreement the day and year first written above.

UGARF:	EVALUATOR:
UNIVERSITY OF GEORGIA RESEARCH FOUNDATION, INC.	_____
By:_____	By:_____
Name: John Ingle	Name:_____
Title: Chief Administrative Officer	Title:_____
	Address:_____
	_____
	_____

EVALUATOR: Please return this form to:

Dr. R. R. Duncan
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