

**1993 ANNUAL PROGRESS REPORT**

**concerning**

**COLONIAL BENTGRASS (AGROSTIS TENUIS) SIBTH.**

**BREEDING AND CULTIVAR DEVELOPMENT**

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## EXECUTIVE SUMMARY

### 1993 Annual Colonial Bentgrass Progress Report

Principle Investigators: Dr. Bridget Ruummele  
Dr. Joel Chandlee

Technical Support: Ms. Pei-Yu Zeng  
Graduate Research Assistant

Research Period: 1 February 1993 to 1 November 1993

Primary emphases in the initiation of the program included assessment of existing plant materials (germplasm) and acquisition of additional plants to increase the germplasm base. Existing material came primarily from New England. Additional plants were obtained from the New Zealand collections of Dr. William Rumball and collection trips from Maine to Pennsylvania and all states in between except Vermont. Much area remains to be covered, including collections further south along the East Coast of the United States where higher humidity and heat conditions may be more favorable for obtaining brown patch resistant colonial bentgrasses. The area of origin, Europe, needs to be explored as well.

Ms. Pei-Yu Zeng, an M.S. degree student, officially began working with this project this fall. Her thesis will concentrate on Rhizoctonia sp. (brown patch) resistance screening in bentgrasses.

Cooperative collection efforts with private industry are forging associations which will enhance cultivar distribution of improved materials. One association has already produced progeny from 69 initial collections which have been planted for turf trial evaluation this fall in Rhode Island.

Greenhouse facilities were greatly expanded with the addition of approximately 1000 square foot polyhouse almost exclusively used for the turfgrass improvement program. This has facilitated the ability to increase plantings from seed or vegetative plant parts for field and greenhouse evaluations.

One of the most severe droughts in the region occurred this summer. Non-irrigated space plantings of the original bentgrass collection were examined for drought tolerance. Selections were grouped into one of three categories: low, medium, or high drought resistance. One group of each classification, containing three to five parents each, was established in a polycross nursery for seed production next spring. Progeny will be evaluated for brown patch resistance and potential association to drought resistance.

Six isolates of Rhizoctonia sp. are in increase incubation for inoculating greenhouse materials in November and December.

Initial molecular identification screening was difficult due to contamination in field plots.

Additional support was provided by the University of Rhode Island Faculty Development Program, the USDA, the New England Golf Course Superintendents' Association, private turf industries, plant royalties, the State of Rhode Island, and Federal Hatch funding.

## I. INTRODUCTION

The colonial bentgrass breeding and cultivar development program was initiated by Emeritus Professor C. R. Skogley. Dr. Skogley received partial support for his breeding efforts from the USGA prior to the arrival of Dr. Bridget Ruummele. After Dr. Ruummele's arrival, the USGA increased its financial support beginning 1 February 1993 to encourage greater efforts in developing new colonial bentgrass cultivars. The USGA was instrumental in providing access to germplasm from Dr. William Rumball's program in New Zealand from seed sent directly from New Zealand and plantings maintained at Rutgers University by Dr. Reed Funk. Primary emphasis of the project is improving Rhizoctonia spp. (brown patch) resistance, with additional goals to develop cultivars with improved cold hardiness, darker green leaf color, low maintenance requirements (reduced cultural inputs including fertilizers, pesticides, water), close mowing tolerance, recuperative ability and wear tolerance, retention of desired turf-type characters (fine texture, density, uniformity, evenness of growth), and hybridization with related species to improve traits noted above.

## II. TECHNICAL SUPPORT PERSONNEL

Dr. Bridget Ruummele, an assistant professor, was hired April 1991 to continue the program initiated by Dr. C. R. Skogley. She has a three-way appointment in research, extension and teaching with primary emphasis on plant improvement. Her approximate effort on this project is 20%.

Dr. Joel Chandlee, an assistant professor with research and teaching efforts in molecular biology, devotes approximately 5% effort on this project.

Ms. Pei-Yu Zeng began as a technical assistant in early 1993. She

officially became a Master's student of this project this fall, when her support from USGA funding also began. Due to regulations regarding College tuition funding, Ms. Zeng's assistantship technically comes from USDA funds. Another full-time turf employee who would normally be paid from the USDA funds is actually receiving partial payment from the USGA grant in an amount equivalent to Ms. Zeng's stipend. The College of Resource Development provides her tuition. Her research emphasis will concentrate on brown patch screening in relation to cultivar improvement of colonial bentgrasses. Before this fall, Ms. Zeng spent 25 percent of her time on this project. At the present time, her efforts on the project are approximately 50 percent.

Ms. Grace Wojcik has provided technical assistance to the breeding program for several summers preceding the employment of Dr. Ruemmele. Ms. Wojcik has continued working with Dr. Ruemmele for the past 2 1/2 years, including transplanting and maintaining germplasm field space plantings and greenhouse collections, seed harvesting, and data collection. She has received support from private product testing and is currently on USGA funding (beginning fall 1993) for 28 hours per week. Her effort on this project has ranged from approximately 25 to 75 percent, depending on other personnel employed at any given time to assist with the project.

Ms. Kirsten Thornton is an undergraduate plant science student on USGA funding. Her primary assistance is with germplasm maintenance and propagation. She also assists with data collection. Her effort on bentgrass research is 100 percent for a maximum of 8 hours per week.

Ms. Elaina Barton, Ms. Sanaz Faghri, Ms. Shari Mangilly, and Mr. Jamel Smith were employed under two high school work programs. Part of their time included field plot establishment and maintenance and seed harvesting. Funding came from a USDA grant, product testing funds, and a Community Action Program funded by the USGA Colonial Bentgrass Fall 1993

State of Rhode Island. USDA and College of Resource Development funding also supported three high school students during the summer of 1992. Student hours ranged from 14 to 35 per week for 6 to 10 weeks during the summer. The combined effort of these assistants on bentgrass research was approximately 25%.

Ms. Sardha Suryapperuma is completing her Ph.D. with Dr. Chandlee. Her research focused on molecular identification of fine fescues and bentgrasses and the use of this identification in cultivar development. Due to less contamination of field materials with which she worked, her primary efforts dealt with fine fescues. Her funding comes from a Department of Plant Science assistantship. Her effort on bentgrass research was approximately 10%.

Mr. Greg Fales, Mr. Donald Timpson, and Mr. Barry Prefontaine provide technical support in the field. Mr. Fales oversees all operations, including additional student labor to maintain turf plots and prepare additional space for field plantings. Mr. Timpson assists Mr. Fales. Mr. Prefontaine is a full-time mechanic who has been instrumental in constructing a wear machine for use in turf trials. He also provided expertise in getting the polyhouse functional for increased greenhouse work as well as maintaining all turf equipment and the field irrigation system. These employees are supported by the State of Rhode Island. The combined effort of field support personnel on bentgrass research was 20%.

Ms. Lisa Rowley is employed by Dr. Noel Jackson, U.R.I. turf pathologist, who has graciously permitted Ms. Rowley to assist in preparing materials for the brown patch screening efforts. Ms. Rowley's M.S. from the University of Massachusetts dealt with this disease. Her efforts on the bentgrass project are intermittent, making assigning a percentage difficult.

### III. ADDITIONAL FUNDING

This project has received support from several programs and industry. In addition to the USGA grant, a \$5,000 Faculty Development Grant from the University of Rhode Island was used to support Ms. Suryapperuma's efforts in the summer of 1992 and for germplasm collection trips in New England and New York.

USDA, private turf companies, and College of Resource Development funding have provided summer employment for three high school students in 1992 and two students in 1993. Part of their efforts included plot maintenance and seed harvesting bentgrasses.

As noted under the technical support section, the State of Rhode Island supports several field personnel as well as the salaries of Dr. Ruehmele and Dr. Chandlee. State funding also provides facilities and money for facility upkeep,

Federal Hatch funds are used primarily for equipment acquisition and maintenance.

The New England Golf Course Superintendents' Association has enthusiastically supported construction of a USGA specification green. Although initially planted to creeping bentgrasses, we hope to test colonial bentgrasses in the future as they near release. A new proposal to this organization will seek to obtain a moisture monitoring device to assist in research assessing drought resistant germplasm. Initial contacts with this organization are optimistic that they will purchase this equipment in the coming year.

Numerous private turf-related industries support the University turfgrass research program through product testing or direct grants. This support enables us to employ needed personnel as well as to acquire equipment and supplies.

Royalties from previous cultivar releases provide similar benefits afforded by industry support. The University of Rhode Island expects the hiring of Dr. Ruummele will increase funding from this source.

In addition to monetary support, donations supplement turfgrass research. These include plot maintenance equipment, growth media for greenhouse testing, fertilizers for greenhouse and field plantings, and pesticides.

The National Plant Germplasm System of the United States, which supports plant explorations, will be approached for funding Colonial bentgrass collection in Eastern Europe. As additional grant opportunities become available, appropriate funding requests will be prepared.

#### IV. PROGRESS AND RESULTS

##### A. GERmplasm ACQUISITION

Primary emphases in the initiation of the program included assessment of existing germplasm and acquisition of additional plants to increase the germplasm base. Existing material came primarily from Dr. Skogley's collection efforts in New England. The collection included 175 bentgrasses classified as 'colonial'. Additional plants were obtained from the New Zealand collections of Dr. William Rumball and collection trips from Maine to Pennsylvania and all states in between except Vermont. Much area remains to be covered, including collections further south along the East Coast of the United States where higher humidity and heat conditions may be more favorable for obtaining brown patch resistant colonial bentgrasses. The sites of origin in Europe could also provide beneficial breeding material.



Since arriving at the University of Rhode Island, Dr. Ruummele has conducted several collection trips to golf courses, cemeteries, parks, old home lawns, and roadsides. At most sites, there was no known overseeding done within the past thirty years, or in many cases, ever. The variability in material was encouraging. Some collections may actually be hybrids between bentgrass species.

One goal for the first year of this research was to acquire germplasm from native or naturalized sites as well as from the New Zealand collection located at Rutgers University. Material at Rutgers was evaluated three times in the past year. Selections were plugged from the site twice for evaluation in Rhode Island.

Including all species collected (bentgrasses and fine fescues), from 1 to 143 collections were obtained per site. The following list indicates the number of sites sampled within each state:

Connecticut	23
Maine	12
Massachusetts	21
New Hampshire	2
New York	13
Pennsylvania	2
Rhode Island	25

Greenhouse facilities were greatly expanded with the addition of approximately 1000 square foot polyhouse almost exclusively used for the turfgrass improvement program. This has facilitated the ability to increase plantings from seed or vegetative propagules for field and greenhouse evaluations as well as providing a location for maintaining the germplasm collection. All recently acquired germplasm is currently being propagated into deepots for preservation of purity. This material was increased earlier this year for field planting and greenhouse disease screening. Field preparation problems have prevented field planting until recently.

## B. FIELD EVALUATION

Other goals for the first year included continuing field screening of current space plant or close-seeded plot germplasm not assessed for at least two years for desirable turf traits and establishing space plant progeny rows and close-seeded plots of seed harvested from advanced selections in 1991 or earlier. Close-seeded plots are maintained under conditions simulating ultimate management practices and evaluated for quality as well as disease resistance.

Initial germplasm provided by Dr. Skogley has been evaluated for seed production, leaf color and texture, and growth habit. Natural infestations of brown patch have been lacking in the field the past two years, making greenhouse screening efforts and field inoculations more critical. The entire space planting was relocated in the summer of 1992 to make room for a new USGA specification green. Seed harvested from the original site was accumulated from two or more years' harvests to provide enough seed for turf plot evaluations. Three selections planted in turf trials in 1992 continue to be evaluated. One is more promising than the other two. Additional seed was harvested in 1993 from selected original space planting material for use in progeny space plantings and close-seeded plots.

Cooperative collection efforts with private industry are forging associations which will enhance cultivar distribution of improved materials. One association has already produced progeny from 69 initial collections. Seed was planted this fall at the University of Rhode Island for turf trial evaluation in close-seeded plots.

The goal to complete single and polycrosses and self pollination of selected superior genotypes in the first year was not entirely successful. Single and self pollinations were unable to be completed this year due to limited labor at time of pollination. They will be initiated next spring.

One of the most severe droughts in the region occurred this summer. The non-irrigated space plantings from the original bentgrass collection were examined for tolerance to this drought. Selections were grouped into one of three categories: low, medium, or high drought resistance. One group of each classification, containing three to five parents each, was established in a polycross nursery for seed production next spring. Progeny will be evaluated for brown patch resistance and potential association to drought resistance.

Germplasm collected since 1991 was increased vegetatively for field space planting. Some plugs were planted, but the bulk of the material awaited preparation of adequate land (1-2 acres) to accommodate them. Unfortunately, the land required large equipment not readily available to us. The site was finally plowed this fall and should be prepared shortly for planting yet this fall, weather permitting. Up to five clones of each accession will be planted in space plantings for evaluation and seed collection. Additional material has been propagated for greenhouse assessment.

### C. GREENHOUSE EVALUATION

During the first year, plans included conducting greenhouse screening of current germplasm for brown patch resistance. Ms. Pei-Yu Zeng, a Master's Degree student, officially began working with this project this fall. Her thesis will concentrate on Rhizoctonia sp. (brown patch) resistance screening in bentgrasses.

Plants were increased during the winter of 1992 and spring and summer of 1993 for screening as well as field planting. A minimum of five replications are ready for screening for most accessions.

The greenhouse expansion has facilitated the ability to increase plantings from seed or vegetative material for field and greenhouse evaluations as well as providing the requisite area for doing the

actual greenhouse screening.

Six isolates of Rhizoctonia sp. are in increase incubation for inoculating greenhouse materials in November and December using infected grains as the inoculum source. A meeting among Dr. Ruellele, Ms. Zeng, and Ms. Rowley set for 29 October will establish inoculation procedure and timing for screening bentgrasses.

Additional isolates will be sought from Drs. Phil Colbaugh and Henry Wilkinson, turf pathologists with collections of particularly virulent Rhizoctonia spp.

#### **D. MOLECULAR EVALUATION**

Random Amplified Polymorphic DNA (RAPD) technology was used to analyze numerous genomic DNA preparations. The objective was to identify genetic markers which could be used to 'fingerprint' plants and assist breeding efforts by identifying genes associated with morphological or physiological traits. Initial molecular identification screening was difficult due to contamination in field plots. Fine fescues provided clearer results and have become the basis for the Ph.D. of Ms. Sardha Suryapperuma, who conducted this research.

#### **E. USGA SPECIFICATION GREEN**

The New England Golf Course Superintendents' Association has enthusiastically supported construction of a USGA specification green. Although initially planted to creeping bentgrasses, we hope to test colonial bentgrasses in the future as they near release.

## V. FUTURE WORK PLANNED

1. Continue acquisition of germplasm from native or naturalized sites, particularly along the Southeast U.S. coastline. Plan germplasm collection trip to Eastern Europe -- a private company has expressed interest in a European collection trip. This may be delayed another year if arrangements are not completed. Germplasm acquisition is critical to obtain the most diverse representation of available material. Expanding the germplasm base increases the opportunity to improve colonial bentgrasses, particularly with respect to brown patch resistance.

2. Continue field screening of current and additional space plant or close-seeded plot germplasm not assessed for at least two years for desirable turf traits. The best plots will be selected for expanded trials and/or going back to original parental material to use for further species improvement in single or multiple crosses.

3. Establish space plant progeny rows and close-seeded plots of seed harvested from pollination and advanced selections chosen in the previous year. Conduct greenhouse screening of germplasm not previously screened for brown patch resistance. Additional beneficial greenhouse and laboratory screening for desirable genotype improvement will be incorporated as they become available. Progeny selected from space plantings, close-seeded plots, or screening procedures will be placed in polycross nurseries or isolated for self or single outcrosses for seed production. Greenhouse-screened material will also be field planted if grown from seed which was never grown under field conditions.

4. Complete single and polycrosses and self pollination of additional selected superior genotypes. Screen for brown patch resistance and plant in field trials for turf characteristic evaluation.

5. If enough seed is available, establish regional turf trials of advanced superior genotypes.

By the completion of the second year, the most brown patch resistant material presently in the URI collection will be determined. Advanced material currently in field production will be thoroughly evaluated and documented for turf potential. Additional seed harvests from current plantings will be used to initiate new cycles of plot evaluations. Selections deemed advanced enough to warrant seed production trials will be sent to Oregon. New plant acquisitions will be subjected to the rigors of evaluation to continue the process of cultivar enhancement.

#### VI. EXPENDITURES

As of my last report from the URI accounting office regarding officially recorded expenditures, there were none. This is due to the slow process of completing paperwork at this University. However, I have initiated the following encumbrances and expect them to be recorded in the near future:

Ms. Zeng's Graduate Research Assistant Stipend	\$7,336
(exchanged with another employee on USDA funding as indicated in section II; academic year)	
Ms. Grace Wojcik, hourly salary	2,560
Ms. Kirsten Thornton, hourly salary	728
Germplasm collection trips	312
(encumbered, actual not submitted to date)	
University overhead	2,759
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Total committed	13,695
Total remaining for first year	6,305

Due to payroll procedures, I cannot employ Ms. Wojcik or Ms. Thornton for longer than 4 months at a time. I expect to expend similar amounts to continue their employment or find a suitable replacement at the end of the current period. A second graduate student who would have resulted in expenditure of the remaining funding unexpectedly withdrew from the program the first week of September. I have not found a replacement in the form of a graduate student or other type of labor, but expect to expend the funds either on labor or other designated categories by February 1, 1994. Should this not be feasible, some or all money will be used to hire additional labor during the spring pollination and planting season.