Breeding and Development of Seeded Zoysiagrass Cultivars

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Goals:

- Collect, evaluate, and maintain potentially useful zoysiagrass germplasm for the breeding program.
- Develop seeded zoysiagrass cultivars that are genetically stable and uniform with good turf quality and have desirable winter hardiness for the U.S. transition zone.
- Evaluate the physiological and genetic factors affecting seed dormancy in zoysiagrass.

Cooperators:

Jerry Nelson
David Sleper
John Dunn
Qingzhang Xu

The zoysiagrass breeding program at the University of Missouri was initiated in Summer 1997 by planting over 500 clones in a spaced nursery at Bradford Farm, Columbia, Missouri. The main sources for these clones were the Georgia Plant Introduction Station, Bobbi Murray (Jack Murray's widow) and some clones that I had collected from golf courses around Columbia, Missouri. Two genotypes with good characteristics for turf and seed production are shown in (Figures 1, 2 & 3).

Sixty clones which survived the mild winter of 1997-1998 in Missouri and exhibited good seed production were planted in turf plots in Spring, 1998, for further evaluation. In addition, 56 clones which were brought from Rutgers University, in cooperation with both Drs. Funk and Meyer, were planted in plots adjacent to the Missouri selections. The Rutgers material will be evaluated in both Missouri and New Jersey.

Several laboratory studies were conducted to characterize the germination process and evaluate factors affecting seed dormancy. The floret consists of a caryopsis that is covered by a lemma and palea that adhere tightly. The lemma is very thick, has thickened cell walls and a wax coating on the outer surface that may restrict water penetration. Naked caryopses (lemma and palea removed) germinated up to 80% at 22°C, whereas intact florets germinate less than 10%. Florets that were cut transversely either at the base (below embryo) or at the tip (above embryo) germinated almost as well as naked caryopses.

This suggested water uptake is a dormancy factor. Water extracts of florets did not affect germination of naked caryopses, but inhibited germination of base and tip cut florets to 25%. The nature of the germination is not known. At 35°C light; 20°C dark, germination of untreated florets was 90%, even in the extract treatment, indicated the need for high temperature for rapid germination. Thirty-percent KOH scarification (15 min.) enhanced germination at 35/20°C up to 98%. Seed treatments can overcome dormancy, which appears to be partially physical, and improve germination.

To understand the genetics of the process we developed 19 half-sib families. These will be evaluated for germination properties in the future.

Figure 1. Clones were planted on 3 foot centers.

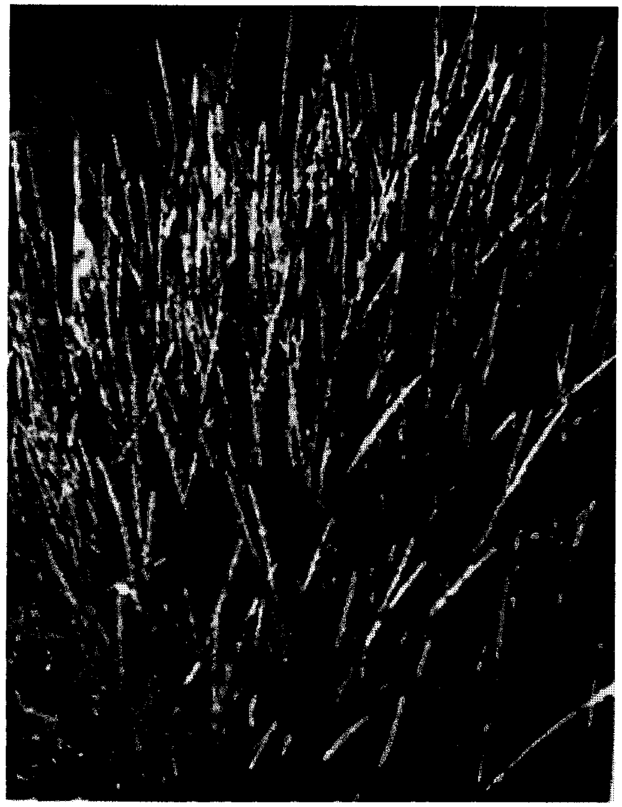

Figure 2.

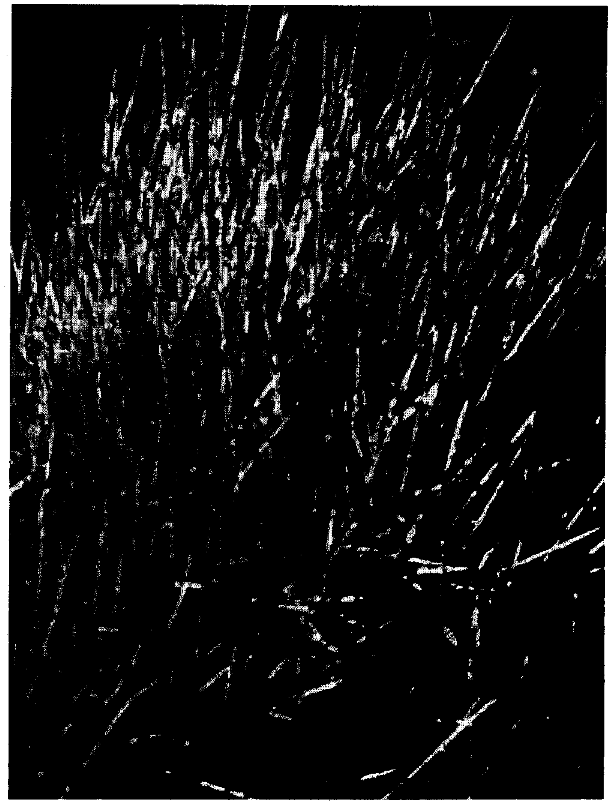

Figure 3.

Two different genotypes show good seed production

1998

Annual Report

to

USGA

Breeding and Development of Seeded Zoysiagrass Cultivars

by

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Breeding and Development of Seeded Zoysiagrass Cultivars

Objectives:

1. Collect, evaluate, and maintain potentially useful zoysiagrass germplasm for the breeding program.

2. Develop seeded zoysiagrass cultivars that are genetically stable and uniform, with good turf quality, and have desirable winter hardiness for the U.S. transition zone.

3. Evaluate the physiological and genetic factors affecting seed dormancy in zoysiagrass.

Objective 1:

Collect, evaluate, and maintain potentially useful zoysiagrass germplasm for the breeding program.

Research initiated:

1. Planting over 500 clones in a spaced nursery at Bradford Farm, Columbia, Missouri. The clones were planted on 3 foot centers. The main sources of these clones were the Georgia Plant Introduction Station, Bobbi Murray (Jack Murray's widow), and some clones that I had collected from golf courses around Columbia, Missouri. The nursery and two genotypes with good characteristics for turf and seed production are shown (Figures 1, 2, & 3).

2. Sixty clones which survived the mild winter of 1997-1998 in Missouri and exhibited good seed production were planted in turf plots in spring, 1998, for further evaluation.

3. Fifty-sixes clones which were brought from Rutgers University, in cooperation with Drs. Funk and Meyer, were planted in plots adjacent to the Missouri selection. This material will be evaluated in both Missouri and New Jersey.

4. I am in the process of developing a good relationshipwith both Drs. Choi and Nakagawa who are zoysiagrass breeders from Korea and Japan. I plan to make a germplasm collection trip to both Korea and Japan in July 1999.

5. I am in the process of developing a cooperative research project with Dr. Milt Engelke, Texas A&M University, similar to one he has with the University of Nebraska.

Progress and results:

1. Seeds were harvested from the clones.

2. Data were collected from the clones and turf plots.

Objective 2:

Develop seeded zoysiagrass cultivars that are genetically uniform and have good turf quality with desirable winter hardiness for the U.S. transition zone.

Research initiated:

1. Eight clones were chosen from spaced-plant nursery for their seed production and turf quality.
2. These clones were removed from the nursery with soil and potted in large clay pots.
3. Pots were placed under a shade tree for seed production (Figures 4 and 5).
4. Pots were rotated once every day so they can have equal chance of crossing among themselves.

Progress and results:

The seed was harvested and threshed.

Objective 3:

Evaluate the physiological and genetics factors affecting seed dormancy in zoysiagrass.

Research initiated:

We conducted several sequenced experiments to begin our assessment of dormancy and environmental factors regulating seed dormancy and germination.

Experiment 1.

We made a detailed evaluation of the floret anatomy and physical relationships among the parts. This involved both light and electron microscopy analyses of the lemma, palea, kine seed coal, embryo location and embryo size.

Experiment 2.

We characterized the germination process including the growth in size of the embryo axit and timing of emergence of the epicotyl and primary root.

Experiment 3.

We cut portions of the floret and caryopsis (without damaging the embryo axit) to evaluate the role of physical limitations to water uptake.

Experiment 4.

We removed the lemma and palea to compare germination of intact florets to naked caryopsis, and also made extracts of the lemma and palea to evaluate physiological inhibition.

Experiment 5.

We compared several pretreatments using KOH to reduce physical and physiological dormancy.

Experiment 6.

We evaluated the temperature effect on dormancy of intact florets.

Progress and results:

The floret consists of a caryopsis that is covered by a lemma and palea that adhere tightly. The lemma is very thick, has thickened cell walls and a wax coating on the outer surface that may restrict water penetration. Naked caryopses (lemma and palea removed) germinated up to 80% at 22°C, whereas intact florets germinate less than 10%. Florets that were cut transversely, either at the base (below embryo) or at the tip (above embryo), germinated almost as well as naked caryopses.

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To understand the genetics of the process, we developed 19 half-sib families. These will be evaluated for germination properties in the future.

Conversion to Zoysiagrass Without Closing the Golf Course

Objective:

To study establishment of zoysiagrass by strip-sod and seeded without taking the golf course out of play.

Research initiated:

The experimental design used at two existing cool-season grass plots (tall fescue and perennial rye grass) is randomized complete block with a split-split plot arrangement.

Blocks	Replication	2
Whole plot	Turf or bar ground	2
Split plot	Strip- sod or seeded	2
split split plot	mowing height	2

Progress and results:

The plots were seeded and strip-sodded in July 1998 with 'Meyer' zoysiagrass cultivar (Figures 6 & 7).

Time table of events for the coming project year:

Spring 1999:

1. The last week of January and first week of March conduct freezing study for the 60 clones which survived last winter.
2. Bring germplasm from Dr. Milt Engelke's breeding project to start them early in the greenhouse.
3. Treat and plant all the seed which was harvested last summer.
4. Create more clones in the greenhouse.
5. Continue dormancy test experiments.
6. Prepare the field for planting.

Summer 1999:

1. Seed and plant all the zoysiagrass in the greenhouse.
2. Collect data and evaluate the plots.
3. Perform histology study for pollen fertility.
4. Make some crosses.
5. Harvest the seed.
6. Arrange the germplasm collection trip.

Fall 1999:

1. Make more collection trips within U.S.
2. Analyze the data.
3. Evaluate the parents
4. Prepare two posters for ASA meeting.
5. Write annual report to USGA.

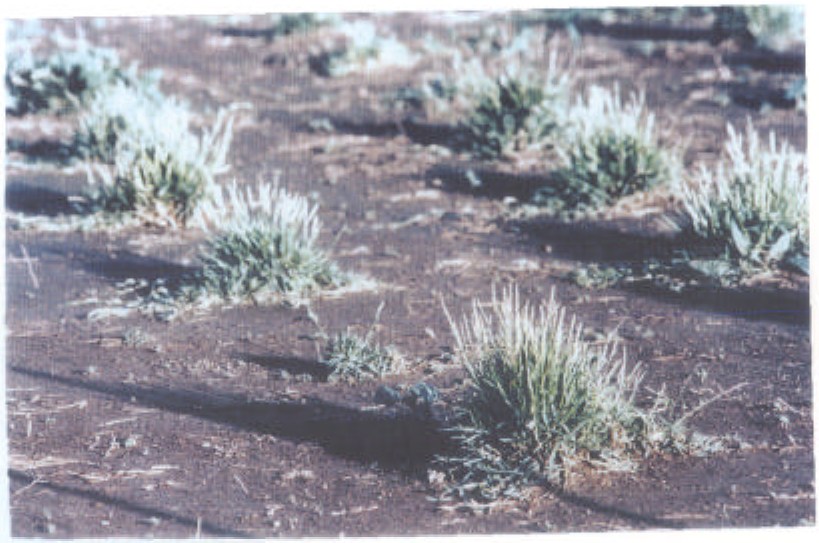

Figure 1. Clones were planted on 3 foot centers.

Figure 2. Two different genotypes show good seed production.

Figure 3. Two different genotypes show good seed production.

Figure 4. Eight clones under a shade tree for crossing.

Figure 5. Eight clones under a shade tree for crossing.

Figure 6. Seeding zoysiagrass in tall fescue and perennial ryegrass plots.

Figure 7. Seeding zoysiagrass in tall fescue and perennial ryegrass plots.