Development of Seeded Zoysiagrass Cultivars with Improved Turf Quality and High Seed Yields

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Objectives:

1. Development of finer-textured germplasm/cultivar(s) of zoysiagrass with high seed yields that offer an economical alternative to fine textured vegetative types with the potential for rapid turf establishment.
2. Breed to improve characteristics such as turf quality, competitive ability and persistence under biotic and abiotic stresses.

Start Date: 2014 (continued from 2010)
Project Duration: 3 years
Total Funding: $ 89,317

Summary Text –

Zoysiagrass (*Zoysia* spp.) is a warm season, perennial grass used on sports fields and home lawns that is increasing in popularity due the need for low inputs such as fertilizer, water and less frequent mowing. Most cultivars are vegetatively propagated however an alternative, relatively inexpensive, way is to propagate zoysiagrass is by seed (Patton et al 2006). Availability of seeded varieties is limited to Japonica types such as 'Zenith' and 'Compadre' being the most popular. The focus of this research project is the development of a multi-clone synthetic variety which exhibits a texture that is finer than Zenith and seed yields that meet the production goals needed to make it profitable to produce. Since the initiation of the project in 2010, our breeding strategy has been the utilization of the classical plant breeding method known as phenotypic recurrent selection. The approach involves alternating between Spaced Plant Nurseries (SPN) and isolation crossing blocks. This strategy should allow for the gradual increase over multiple generations of desirable alleles affecting seed yields combined with finer leaf texture in the population.

In 2015 we began our third cycle of recurrent selection with the germination of seed harvested from four isolation blocks planted in 2013. The isolation blocks were grouped based on seed head color (red vs green) and flowering date (early vs late). Seed from these blocks were collected in mid-summer of 2014, cleaned during the winter and processed in early spring of 2015. Seed was scarified with 30% NaOH for 35 min. (Yeam, et. al. 1985). A total of 50 of the strongest seedlings from each family were planted in the field 7/23/15 to establish a Spaced Plant Nursery (SPN) of 1,750 progeny with Zenith and Compadre as checks. During 2016 notes were collected as shown in Table 1. Out of 1,750 progeny, 191 were identified for potential advancement to isolation blocks based on seed head color, density, height of exertion and leaf texture (Figure 1). This number is still too large so further evaluation for turf quality will need to be considered. Additional notes for flowering date will be taken in the spring of 2017 to help with the identification of the best experimental seed parents and assignment to the appropriate isolation and synthetic blocks in the summer of 2017.

In addition, seed that had been harvested from three synthetics in the summer of 2014 (1) early flowering / red seed head, (2) late flowering / red head and (3) late flowering / green seed head were cleaned and scarified as before. Seed from these three synthetics were used to plant a replicated field trial (RFT) 7/14/15 at the Research Center – Dallas at a rate of 2 lbs./1000 sq. ft. (Figure 2). In addition a second RFT was planted by Johnston Seeds 6/10/15 in Enid, OK. Seed from DALZ 1512 and DALZ 1513 synthetics were also transferred to Patten Seeds for evaluation.

Data was collected from the Dallas RFT in 2016 and is shown in Table 2. The turfgrass quality of

DALZ 1512 and 1513 were better than the seeded checks, Zenith and Compadre, on one rating date (5/26/2016), and TAES 6619 was better than seeded checks on 9/8/2016. For all other analyses, no significant differences were observed for turfgrass quality between the seeded checks and the experimentals. As expected, the turf quality for the vegetative checks (Palisades and Zorro) was generally better than that of the seeded entries. Even, about one year after planting, the establishment rates for the seeded entries were significantly better compared to the vegetative checks. There was no difference between the establishment rate of seeded experimentals and the seeded checks. In 2016, fall color for TAES 6619 was better than the seeded checks; whereas, the fall color of DALZ 1512 and 1513 was similar to the seeded checks. All seeded entries had a fall color rating lower than the vegetative checks. Spring greenup of DALZ 1512 and TAES 6619 was similar to the seeded checks. Seed head production was significantly higher on the experimental entries over that of the checks. While this does impact turf quality, it could be viewed as beneficial for planting seed production fields. In 2017 parental lines will be identified for the creation of new three clone synthetics for seed production purposes and RFT testing.

Summary Points

1. The third cycle of recurrent selection continued with the planting of a spaced plant nursery consisting of 1,750 progeny on 7/23/15. Data were collected from the nursery in 2016 scoring for seed head color, density, height of exertion and leaf texture as well as turf quality. Additional data will be collected for flowering date (early vs late) in the spring of 2017 to enable the identification of our best new seed parents for advancement to isolation blocks in the summer of 2017.
2. Along side the recurrent selection breeding strategy, three sets of three clone synthetics were identified for evaluation in RFT and potential commercial product development. Seed harvested in 2014 was treated and planted in replicated field trials on 7/14/15 and data collected in 2016. Parental lines will be selected from the SPN for new synthetics to be planted in the summer of 2017.

References:

Patton, A. J., Reicher, Z. J., Zuk, A. J., Fry, J. D., Richardson, M. D., and Williams, D. W. 2006. A guide to establishing seeded zoysiagrass in the transition zone. Online. Applied Turfgrass Science doi:10.1094/ATS-2006-1004-01-MG.

Yeam, D.Y., Murray, J.J., Portz, H.L. and Joo, Y.K. 1985. Optimum seed coat scarification and light treatment for the germination of zoysiagrass (*Zoysia japonica* Steud.) seed. J. Kor. Soc. Hort. Sci. 26(2): 179-185.

Figure 1. 2015 Seeded Zoysia SPN**. A:** Yellow seeded zoysia experimental, B: Red seeded zoysia experimental. C-D: Variability in the leaf texture of seeded zoysia experimentals.
Figure 2. Differences in rate of establishment four weeks after seeding/planting between seeded synthetic entries and a vegetative check, Zorro.
Figure 3. Pictures of the RFT plots one year after seeding/planting (8/1/2016) showing differences in establishment rate and turfgrass quality.

Table 1. Progeny evaluation in 2016 from the 2015 Seeded Zoysia SPN. Initially, individuals within each family with ≥ 5 visual turfgrass quality were selected and compared for differences in seedhead color, height, and density. Some individuals with turfgrass quality ≤ 5 were later included in the analysis due to their high seedhead density. Of the 1,750 individuals in this nursery, a total of 191 from 35 families were identified as potential seed parents.

Family No.	No. selected progeny	Visual Color†		Visual Height (cm)‡			Measured Height (cm)‡		Mean Quality§		Mean Density¶	
		Red	Yellow	Low	Medium	High						
1	5	5	0	4	0	1	13.0	a*	5.6	a	1.4	a
2	2	2	0	1	1	0	-		6.0	a	1.0	a
3	2	2	0	1	1	0	-		6.5	a	1.0	a
4	9	5	4	3	5	1	20.0	a	5.6	a	1.4	
5	4	4	0	4	0	0	-		6.0	a	1.0	
6	5	5	0	2	1	2	12.0	a	6.0	a	1.2	
7	4	4	0	1	3	0	-		6.3	a	1.0	
8	4	3	1	3	0	1	18.0	a	6.8	a	1.0	
9	8	6	2	0	1	7	14.7	a	4.8	a	2.5	a
10	10	10	0	1	1	8	14.0	a	4.3	a	2.9	a
11	8	7	1	1	4	3	15.3	a	5.0	a	2.0	a
12	4	4	0	0	1	3	13.7	a	4.0	a	2.8	a
13	3	2	1	0	1	2	17.5	a	4.3	a	2.3	a
14	6	6	0	1	2	3	12.7	a	6.0	a	1.3	
15	5	4	1	0	1	4	14.5	a	4.0	a	2.6	a
16	10	8	2	0	2	8	12.5	a	3.9	a	2.8	a
17	4	3	1	1	0	3	15.7	a	3.8	a	2.5	a
18	2	1	1	1	1	0	-		6.0	a	1.0	a
19	5	1	4	1	1	3	12.3	a	5.4	a	1.8	a
20	5	0	5	3	2	0	-		6.0	a	1.4	a
21	0	0	0	0	0	0	-		-		-	
22	10	1	9	0	0	10	14.4	a	4.4	a	2.5	a
23	3	0	3	0	0	3	15.0	a	3.7	a	3.0	a
24	2	0	2	1	1	0	-		6.5	a	1.0	a
25	14	8	6	2	1	11	14.2	a	4.4	a	2.7	a
26	6	0	6	1	0	5	13.4	a	3.8	a	2.7	a
27	5	0	5	2	1	2	10.5		5.0	a	2.2	a
28	0	0	0	0	0	0	-		-		-	
29	2	0	2	0	0	2	14.5	a	4.0	a	2.0	a
30	3	0	3	0	0	3	13.7	a	3.3	a	3.0	a
31	3	3	0	1	0	2	13.0	a	4.7	a	2.3	a
32	7	1	6	4	1	2	10.5		5.6	a	1.7	a
33	12	10	2	1	0	11	12.1		3.3		2.8	a
34	8	1	7	0	0	8	13.9	a	3.1		3.0	a
35	11	8	3	1	2	8	12.1		3.9	a	2.6	a
Total	191	114	77	41	34	116	-	-	-	-	-	-
C.V.(%,#)	-	-	-	-	-	-	14.0		29.5		12.1	
Family[#]	-	-	-	-	-	-	0.0003		< 0.0001		< 0.0001	

*Significant at the P ≤ 0.05 level.

† Seedhead color was visually rated for selected progeny as either red or yellow/green.

‡ Selected progeny were initially rated categorically for seedhead height as low (< 5cm), medium (5-10 cm), or high (> 10 cm) on 7 Sept 2016.

§ Quality was visually rated on a 1-9 scale (1= poor; 6=minimum; 9=excellent) on 24 Aug 2016. The quality ratings from all selected progeny in each family were averaged and statistically compared using Tukey's HSD.

¶ Seedhead density was visually rated on a 1-3 scale (1= <30%; 2 = 30-60%; 3 = >60%) on 7 Sept 2016, and was averaged from all selected progeny for statistical comparison using Tukey's HSD.

Coefficient of variation was calculated from the ANOVA by dividing the root mean square error by the grand means for each trait and multiplied by 100.

Tables 2. A and B. Performance of advanced synthetic seeded zoysia lines, DALZ 1512, DALZ 1513 and TAES 6619 compared to seeded checks Compadre and Zenith, and vegetative checks Palisades and Zorro.

A.

	Turfgrass Quality‡							
Entry	10/28/15	04/13/16	05/11/16	05/26/16	06/16/16	07/12/16	08/01/16	09/08/16
DALZ 1512	5.0 ab	5.0 abc	6.0 a	5.0 ab	7.0 a	5.3 ab	3.7 bc	2.0 c
DALZ 1513	5.3 a	4.7 abc	5.3 a	4.3 bc	7.0 a	4.7 b	2.3 d	2.0 c
TAES 6619	4.0 b	3.7 bc	4.7 a	4.0 cd	6.0 a	5.0 b	3.7 bc	3.0 b
Compadre¶	5.0 ab	5.3 ab	5.3 a	3.3 d	7.0 a	5.3 ab	3.3 bcd	2.0 c
Palisades#	5.3 a	3.3 c	4.7 a	5.3 a	5.7 a	5.0 b	4.3 ab	4.0 a
Zenith¶	5.3 a	5.0 abc	5.7 a	3.3 d	7.0 a	5.0 b	3.0 cd	2.0 c
Zorro#	5.7 a	5.9 a	5.7 a	5.7 a	6.7 a	6.3 a	5.0 a	3.7 ab
$LSD_{(0.05)}$††	1.3	1.9	1.7	0.9	1.2	1.2	1.1	0.7
C.V. $_{(\%)}$‡‡	14.5	22.2	17.8	11.9	10.0	12.5	17.2	15.3

B.

	Establishment (%)†			**Fall Color‡**		**Greenup‡**	**Seedheads (%)§**
Entry	11/23/15	04/13/16	08/01/16	11/23/15	11/11/16	03/15/16	05/26/16
DALZ 1512	95.0 a*	73.3 a	100.0 a	2.3 b	2.3 c	4.7 bc	88.3 a
DALZ 1513	93.3 a	80.0 a	96.7 a	3.3 ab	2.0 c	4.0 c	75.0 b
TAES 6619	71.7 b	63.3 a	95.0 a	2.3 b	3.0 b	4.7 bc	75.0 b
Compadre¶	88.3 a	76.7 a	98.3 a	2.0 b	2.0 c	5.3 ab	10.0 c
Palisades#	28.3 c	21.7 b	76.7 b	3.3 ab	3.7 a	4.0 c	6.7 cd
Zenith¶	91.7 a	68.3 a	95.0 a	2.7 b	2.0 c	5.3 ab	15.0 c
Zorro#	21.7 c	25.6 b	76.7 b	4.3 a	3.7 a	6.3 a	0.0 d
$LSD_{(0.05)}$††	10.9	18.0	7.8	1.4	0.6	1.3	8.8
C.V. $_{(\%)}$‡‡	8.7	16.8	4.8	27.9	12.5	15.2	12.8

* Significant at the 0.05 probability level.

† Seeded entries were sown on July 14, 2015 in three replications of 122 cm x 122 cm plots. Establishment data was collected before entering dormancy.

‡ Fall color, spring green-up, and turfgrass quality were collected on a 1-9 scale (1 = brown/dormant, 9 = completely green/ excellent; 5 = minimum acceptable green color).

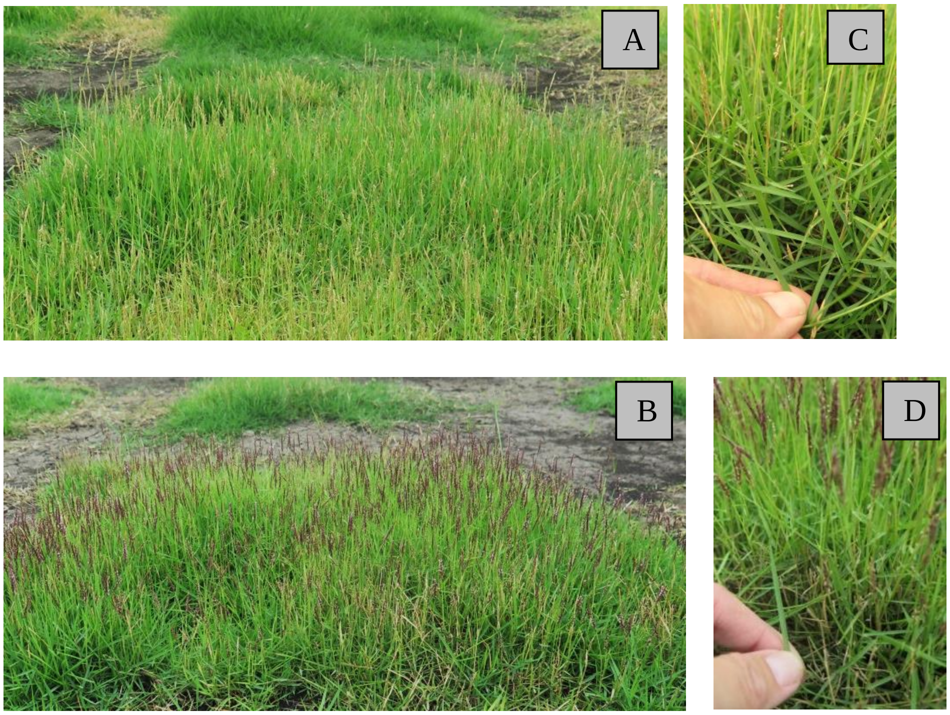
§ Seedhead percentages were collected as a visual estimation of plot coverage.

¶ Compadre and Zenith were seeded checks sown at a rate of 2 lbs. /1000 sq. ft.

Palisades and Zorro were planted as vegetative plugs with four 10 cm plugs per plot.

†† Means were separated using the student's t-test (LSD) at a 0.05 significance level.

‡‡ Coefficients of variation (C.V.) were determined from analysis of variance by dividing the root mean square error by the grand mean and multiplying by 100.



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