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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: 2017 (continued from 2010)
Project Duration: 3 years
Total Funding: $ 89,559

Summary Text –

Zoysiagrass (*Zoysia* spp.) is a warm season, perennial grass used on golf courses and home lawns with a renewed interest because they "provide a high-quality turf at a lower maintenance level than most other turfgrasses" (Murray and Morris, 1988). Most cultivars are vegetatively propagated since they offer a uniform and high quality turf stand. An alternative, relatively inexpensive, way is to propagate zoysiagrass is by seed (Patton et al 2006). Availability of seeded varieties is limited to *Z. japonica* Steud. types with '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 leaf texture that is finer than Zenith with 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 to utilize a classical plant breeding method known as phenotypic recurrent selection, which involves alternating between Spaced Plant Nurseries (SPN) for progeny selection, and isolation crossing blocks to promote outcrossing and recombination. 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 isolation crossing blocks planted in 2013 with 32 entries. The isolation blocks were grouped based on seed head color (red vs green). Seed from each entry was harvested by hand then cleaned and scarified with 30% NaOH (Yeam, et. al. 1985). Seeds were germinated in the greenhouse with fifty of the strongest seedlings from each family planted in Dallas, TX (2015) to establish a SPN of 1,750 progeny with Zenith and Compadre as checks. Data collected during 2016 and 2017 is presented in Table 1. Out of 1,750 progeny, 23 were identified for advancement to 2017 isolation blocks based on seedhead color, seedhead density, height of inflorescence exertion and leaf texture. Data was also taken in 2017 for the number of florets per unit area by counting the number seedheads using a 121-matrix grid where each cell was 8 cm x 8 cm. In addition, water was restricted to the plots for a six-week period during July and August (2017). Plot recovery, once water was re-applied, along with the 2016/2017 performance data allowed us to optimize selection pressure for the best lines with maximum seed production potential. The advanced lines were used to plant 3 isolation blocks (Red #1, Red #2 and Yellow) in 2017 in preparation for the next round of recurrent selection. Iso. blocks were composed of 3 reps each with Red #1 containing 7 entries, Red #2 - 9 entries and Yellow with 7 entries. A subset of these isolation block entries were also identified for use as parental lines in synthetic variety development for possible future commercialization.

In 2016-2017, we continued the evaluation of three synthetics created with our most elite parental lines from the 2013 isolation blocks. Seed was bulked as described in earlier reports and scarified in order to plant a replicated field trial (RFT) in Dallas, TX (2015) at a rate of 2 lbs./1000 sq. ft. Data was collected over a 3-year period and is summarized in Table 2. The turfgrass quality of DALZ 1512, 1513 and TAES 6619 was similar to the seeded checks, Zenith and Compadre, but not as good as the vegetative check, Palisades. The advantage of seeded types over vegetative types is the establishment rates where seeded types are significantly better. As expected, the establishment rate of all three synthetics (DALZ

1512, 1513, and TAES 6619) was better than Palisades and Zorro. In 2017, fall color for DALZ 1512, 1513 and TAES 6619 was better than the seeded checks. Spring greenup of DALZ lines were similar to the seeded checks. Seedhead 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. Seeded experimental synthetics have been provided to Patten Seed Co. (Newnan, GA) and Johnston Seed Co. (Enid, OK) for evaluation. Tim Bowyer with Patten Seed retired in June, 2017 and no update on testing has been provided. John Lamle with Johnston Seed indicates test plots are looking good, but he would like them to experience a cold winter to determine cold hardiness before he expands to test cultivation practices to maximize seed yield.

Of the 23 seeded parental lines advanced to the 2017 Isolation Blocks, the ones with highest seed yields, best drought recovery and turf quality were chosen as parents for 3 new 3-clone synthetics. Those synthetics are identified as 2017 Synthetic Red #1, Synthetic Red #2 and Synthetic Yellow. After grow-in, seed will be bulked in 2018, chemically scarified, and sown to establish RFT in 2019 to evaluate turfgrass quality and performance characteristics of these new DALZ experimental synthetic varieties.

Summary Points

1. Data were collected from the 2015 SPN (1,750 progeny) in 2016 and 2017 with notes taken for turf quality, seed head color, density, height of seedhead exertion, and number of florets per unit area as an indicator of potential seed production capacity. Twenty-three entries were advanced and were used to plant three isolation blocks (Red #1, Red #2 and Yellow) in order to initiate our fourth cycle of recurrent selection.
2. Entries from the 2015 SPN with highest seed yields, best drought recovery and turf quality were chosen as parents for 3 new 3-clone synthetic varieties. These Syn varieties were planted in Dallas, TX (2017) for seed production testing. Seed will be harvested in 2018, and planted as a RFT in 2019 for turfgrass quality/performance evaluation.
3. DALZ 1512 and DALZ 1513, experimental synthetic varieties, exhibited better fall color in 2017 with turfgrass quality and spring greenup similar to the seeded checks. Establishment rate of these synthetic varieties is better than the vegetative checks.

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.

Murray, J.J. and K. Morris. 1988. Establishing and maintaining zoysiagrass. Grounds Maint. 23:38-42.

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.

Table 1. Progeny evaluation in 2016 and 2017 from the 2015 Seeded Zoysia SPN. Selections were first chosen based on seedhead traits and leaf texture, then quality and recovery from drought. Of the 1,750 individuals in this nursery, a total of 23 from 35 families were identified as seed parents for recombination in isolation (Iso) blocks or synthetics (Syn).

Family TAES No.	Selected (-xx) TAES No.	Isolation Block or/and Synthetic†	Mean seedheads per 8 cm x 8 cm‡	Mean florets per seedhead§	No. Floret per 8 cm x 8 cm¶	Mean Seedhead Density#	Measured Height (cm)††	Mean Quality ‡‡
6585-xx	-34	Iso Y; Syn Y	89	25	2,225	1.4a	13.0a*	5.6a
6593-xx	-10	Iso R 1	63	29	1,827	2.5a	14.7a	4.8a
6594-xx	-09	Iso R1	55	26	1,430	2.9a	14.0a	4.3a
6595-xx	-18	Iso R 1	64	31	1,984	2.0a	15.3	5.0a
6596-xx	-34 -42 -05	-34 (Iso R 1; Syn R 2) -42 (Iso R 2; Syn R 1) -05 (Iso R 2; Syn R 2)	-34 (47) -42 (75) -05 (50)	-34 (34) -42 (24) -05 (29)	-34 (1,598) -42 (1,800) -05 (1,450)	2.8a	13.7a	4.0a
6597-xx	-41	Iso Y	62	27	1,674	2.3a	17.5a	4.3a
6598-xx	-02 -38	-02 (Iso R 2; Syn R 1) -38 (Iso R 2; Syn R 2)	-02 (47) -38 (45)	-02 (30) -38 (26)	-02 (1,410) -38 (1,170)	1.3	12.7a	6.0a
6599-xx	-05	Iso R 2	45	31	1,395	2.6a	14.5a	4.0a
6600-xx	-23 -10	-23 (Iso R 1) -10 (Iso R 2)	-23 (75) -10 (97)	-23 (31) -10 (22)	-23 (2,325) -10 (2,134)	2.8a	12.5a	3.9a
6603-xx	-16 -12	-16 (Iso Y) -12 (Iso Y)	-16 (48) -12 (35)	-16 (25) -12 (30)	-16 (1,200) -12 (1,050)	1.8a	12.3a	5.4a
6609-xx	-24	Iso R 1	39	26	1,014	2.7a	14.2a	4.4a
6610-xx	-36	Iso Y	50	24	1,200	2.7a	13.4a	3.8a
6611-xx	-18	Iso Y	55	21	1,155	2.2a	10.5	5.0a
6612-xx	-15	Iso Y	56	28	1,568	-	-	-
6616-xx	-35	Iso R 2	40	29	1,160	1.7a	10.5	5.6a
6617-xx	-36 -17	-36 (Iso R 1) -17 (Iso R 2)	-36 (68) -17 (43)	-36 (22) -17 (25)	-36 (1,496) -17 (1,075)	2.8a	12.1	3.3
6618-xx	-31	Iso R 2; Syn R 1	81	23	1,863	3.0a	13.9a	3.1
C.V.(%,€) Family€						12.1 < 0.0001	14.0 0.0003	29.5 < 0.0001

*Significant at the P ≤ 0.05 level.
†Seedhead color was visually rated for selected progeny as either red or yellow/green and used to assign to Isolation Block Red 1 or 2, Isolation Block Yellow or Red or Yellow Synthetic. Two yellow synthetic entries not shown since advanced based on seed weight data from 2015.
‡Using a 121-matrix grid, mean number of seedheads counted from three representative grid cells each 8-cm x 8-cm in size.
§Mean number of florets counted from three representative seedheads from each plot.
¶Number of florets calculated by multiplying mean seedheads per 8-cm x 8-cm and mean number of florets per seedhead.
#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.
††Seedhead height is the mean height of three representative seedheads from each plot.
‡‡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.
€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. A 3-year summary of 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†											Dry down	Recovery	Fall
Entry	**04/13/16**	**05/11/16**	**05/26/16**	**06/16/16**	**07/12/16**	**08/01/16**	**09/08/16**	**5/2/2017**	**6/1/2017**	**7/21/2017**	**Avg.**	**8/3/2017**	**9/5/2017**	**10/28/15**
DALZ 1512	5.0 abc*	6.0 a	5.0 ab	7.0 a	5.3 ab	3.7 bc	2.0 c	3.7 bc	4.0 bc	7.0 bc	4.9 ab	4.3 b	5.0 d	5.0 ab
DALZ 1513	4.7 abc	5.3 a	4.3 bc	7.0 a	4.7 b	2.3 d	2.0 c	3.3 c	3.3 c	7.3 bc	4.4 b	3.3 bc	6.7 bc	5.3 a
TAES 6619	3.7 bc	4.7 a	4.0 cd	6.0 a	5.0 b	3.7 bc	3.0 b	3.7 bc	4.0 bc	6.7 c	4.4 b	4.3 b	7.0 b	4.0 b
Compadre¶	5.3 ab	5.3 a	3.3 d	7.0 a	5.3 ab	3.3 bcd	2.0 c	4.0 abc	4.3 bc	7.3 bc	4.7 b	4.0 b	7.3 b	5.0 ab
Palisades#	3.3 c	4.7 a	5.3 a	5.7 a	5.0 b	4.3 ab	4.0 a	5.0 a	5.7 a	8.7 a	5.2 ab	8.0 a	8.7 a	5.3 a
Zenith¶	5.0 abc	5.7 a	3.3 d	7.0 a	5.0 b	3.0 cd	2.0 c	4.7 ab	4.0 bc	7.3 bc	4.7 b	2.7 c	5.3 d	5.3 a
Zorro#	5.9 a	5.7 a	5.7 a	6.7 a	6.3 a	5.0 a	3.7 ab	5.0 a	5.0 ab	7.7 b	5.7 a	3.7 bc	5.7 cd	5.7 a
LSD $_{(0.05)}$ ††	1.9	1.7	0.9	1.2	1.2	1.1	0.7	1.2	1.0	0.9	0.8	1.3	1.3	1.3
C.V. $_{(\%)}$‡‡	22.2	17.8	11.9	10.0	12.5	17.2	15.3	20.8	19.8	10	32.8	40.2	24.1	14.5

B.

	Establishment (%)				Greenup†		Fall Color†			Seedheads (%)‡				
Entry	**11/23/15**	**04/13/16**	**08/01/16**	**Avg.**	**03/15/16**	**4/5/2017**	**11/23/15**	**11/11/16**	**11/14/2017**	**05/26/16**	**4/20/2017**	**6/1/2017**	**9/26/2017**	**10/1/2017**
DALZ 1512	95.0 a	73.3 a	100.0 a	90.0 a	4.7 bc	4.3 bc	2.3 b	2.3 c	3.3 b	88.3 a	31.7 a	60.0 a	70.0 a	55.0 a
DALZ 1513	93.3 a	80.0 a	96.7 a	89.4 a	4.0 c	3.3 c	3.3 ab	2.0 c	3.3 b	75.0 b	33.3 a	61.7 a	56.7 b	43.3 b
TAES 6619	71.7 b	63.3 a	95.0 a	76.7 a	4.7 bc	4.3 bc	2.3 b	3.0 b	3.7 b	75.0 b	46.7 a	51.7 a	40.0 c	41.7 b
Compadre§	88.3 a	76.7 a	98.3 a	87.8 a	5.3 ab	4.0 bc	2.0 b	2.0 c	2.3 c	10.0 c	46.7 a	5.0 c	5.0 de	5.0 c
Palisades¶	28.3 c	21.7 b	76.7 b	42.2 b	4.0 c	5.7 a	3.3 ab	3.7 a	5.7 a	6.7 cd	5.0 b	30.0 b	13.3 d	6.7 c
Zenith§	91.7 a	68.3 a	95.0 a	85.0 a	5.3 ab	4.7 ab	2.7 b	2.0 c	1.7 c	15.0 c	50.0 a	5.0 c	0.67 e	1.7 c
Zorro¶	21.7 c	25.6 b	76.7 b	43.3 b	6.3 a	4.0 bc	4.3 a	3.7 a	4.0 b	0.0 d	0.0 b	0.0 c	0.0 e	0.0 c
LSD $_{(0.05)}$#	10.9	18.0	7.8	17.5	1.3	1.1	1.4	0.6	0.9	8.8	19.2	11.8	10.2	7.6
C.V. $_{(\%)}$††	8.7	16.8	4.8	35.7	15.2	19.8	27.9	12.5	37.5	12.8	71.1	88.3	104.8	103.7

*Significant at the 0.05 probability level.
†Turfgrass quality, fall color, and spring green-up 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.