Development of Large Patch Tolerant and Cold Hardy Zoysiagrass Cultivars for the Transition Zone

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Background and Objectives

- Zoysiagrass requires less water, fertilizer, and other inputs compared to cool-season turfgrasses in the transition zone, but research is needed to optimize its use.
- Cold hardiness limits the long-term survival of zoysiagrass in the transition zone (Fig. 1).
- Large patch disease caused by *Rhizoctonia solani* (AG 2-2 LP) is the primary pest on zoysiagrass (Fig. 1).
- The objectives of this study are to evaluate experimental zoysiagrass genotypes to identify one or more potential new cultivars which have good quality, cold tolerance, and large patch tolerance.

Fig 1. Variation among zoysiagrasses exists in cold hardiness (left) and potentially in susceptibility to large patch disease (right).

Progeny, Study Sites, Quality Assessment, and Cold Hardiness

- One genotype of *Z. japonica*, TAES 5645, exhibited partial resistance to *R. solani* in preliminary trials, and was used as a breeding parent and crossed with 22 cold-hardy zoysiagrasses in Dallas, TX; 2,858 progeny resulted.
- The 2,858 progeny were evaluated for quality and cold hardiness in single-plot space plantings in TX, IN, and KS from 2012-2014 (Fig. 2).
- From those, the 60 top-performing progeny and several standard cultivars, including 'Meyer', were selected and planted in West Lafayette, IN; Dallas, TX; Blacksburg, VA; Columbia, MO; Raleigh, NC; Fayetteville, AR; Manhattan, KS; Stillwater, OK (Fig. 2).
- Each location was set up in a randomized complete block design with three replications.
- Turfgrass quality and spring green up were evaluated visually based on the NTEP 1-9 scale.

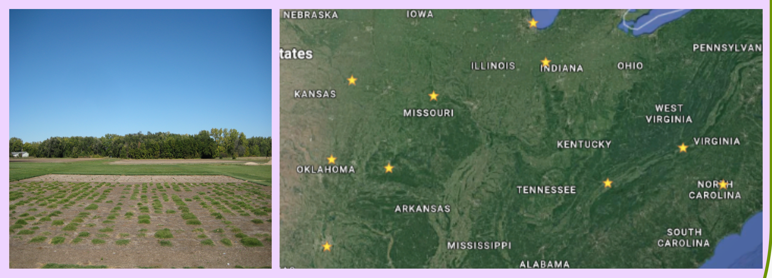

Fig. 2. Nursery for cold hardiness screening (left) and ten study locations across the transition zone (right).

Disease Evaluation

- Large patch tolerance was tested in Manhattan, KS by inoculating with *Rhizoctonia solani* in Sept. 2016.
- Inoculum grown on sterilized oats was placed just below the thatch layer in the center of one side of each plot (Fig 3).
- The other side was sprayed with fungicide periodically. This allowed disease assessment while facilitating continued evaluation of quality, and to serve as a healthy check (Fig 3).
- A natural infestation of *R. solani* occurred in Stillwater, OK in fall 2016.
- Large patch disease was evaluated visually based on % of the area exhibiting symptoms.

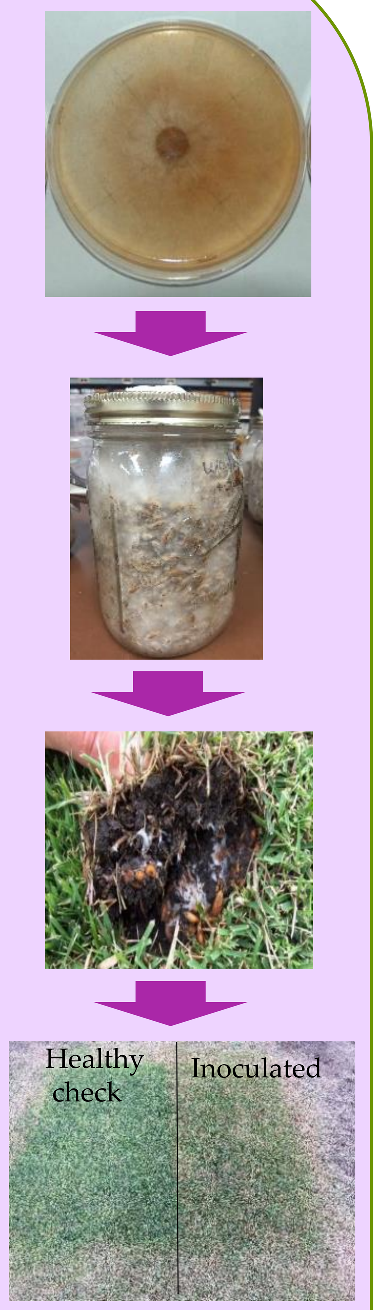

Fig 3. Inoculum preparation, inoculation and field symptoms.

Analysis, Results, & Ongoing Research

- Data presented are averages from the locations submitting data for a given parameter, and were analyzed using PROC GLM.
- From 2015 to 2016, progeny showed a wide range of variability in turf quality characteristics including winter injury, establishment rate, genetic color, leaf texture and fall color (data not shown). Spring green up and turf quality data for the overall top performing progeny are shown in Table 1. The coded family of the top performing progeny are shown in Table 2.
- In KS and OK, 'Meyer' had up to 77% of the plot area affected by large patch in fall 2016 (Table 1 and Fig. 4). The top performing zoysiagrass progeny had little or no large patch present.
- In spring 2017 in KS, the top performing zoysiagrass progeny had as low as 7% of plot area affected by large patch, while 33% of the plot area was affected on 'Meyer'.
- Progeny evaluations will continue in spring 2018.

Fig. 4. Large patch symptoms in 'Meyer' zoysiagrass (left) compared to an experimental progeny in Nov. 2016 after inoculating in Sept. at Manhattan, KS.

Table 1. Quality, spring green up, and large patch in top performing zoysiagrass progeny and 'Meyer' from 2016 to 2017 in IN, MO, NC, OK, TX, VA, AR and KS.

Entry /Cultivar	Quality†	Spring green up‡	Large patch % in OK, 2016§	Kansas			
				Large patch %, 2016§	Large patch %, 2017§	Quality on the fungicide-treated side†	Quality on the inoculated side†
6099-69	7.0	4.6	0	7.7	9.3	6.8	6.0
6102-307	6.6	3.7	0	6.7	7.0	6.3	6.6
6101-9	6.4	4.7	0	2.0	17.0	7.3	6.0
6097-41	6.6	4.6	0	3.0	13.3	6.7	5.7
6100-86	6.9	4.6	0	1.0	16.7	6.9	5.5
Meyer	6.1	3.6	76.7	41.7	33.3	5.7	4.7
LSD¶	0.9	1.6	24.6	13.4	25.2	1.1	1.7

† Mean quality rated on a scale of 1-9 (1 = dead; 6 = minimally acceptable; 9 = ideal) of the top-performing zoysiagrass progeny and 'Meyer' in summer 2016 in AR, IN, KS, MO, NC, OK, TX, and VA. In KS, quality was rated on the fungicide-treated side and inoculated side on May 25, 2017.
‡ Spring green up was rated on a 1-9 scale (1 = brown; 9 = fully green) in spring 2016 in AR, MO, NC, OK, TX, and KS.
§ In OK, large patch was rated on a 0 to 100% scale on Nov. 16 in OK as a result of a natural infestation. In KS, large patch was rated on Nov. 4, 2016, 7 weeks after *R. solani* was inoculated, and on May 25, 2017. In KS, the fungicide-treated side was treated with flutolanil at 6.7 kg active ingredient per ha on Sept 16, 2016, Apr 11, 2017, May 18, 2017, Sept 7, 2017 and Oct 11, 2017.
¶ To determine statistical differences among entries, subtract one entry's mean from another entry's mean. Statistical differences occur when this value is larger than the corresponding least significant difference (LSD) value ($P < 0.05$).

Table 2. Lineage and family codes of of top performing Zoysiagrass hybrids.

Coded Family	Zoysiagrass Progeny Coded Family Lineage (Female × Male)
6099	*Z. japonica*† x *Z. japonica*
6102	*Z. japonica* x *Z. japonica*
6101	(*Z. matrella* x *Z. japonica*) x *Z. japonica*
6097	(*Z. matrella* x *Z. japonica*) x *Z. japonica*
6100	[(*Z. japonica* x *Z. pacifica* x *Z. japonica*] x *Z. japonica*

† For confidentiality, only species names, and not cultivar names, are provided.

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