Evaluation of Organic Amendments and Delivery Technologies for Control of Large Patch Disease on Zoysiagrass Fairways

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Turfgrass and Environmental Research Online
Volume 13 Number 4 | July—August 2014

Objectives:

1. To test the effects of organic amendments derived from composted animal waste, biosolid, and plant residue on soil physical, chemical, and microbiological properties;
2. To assess the relationships between modified soil properties, turf health, and large patch disease occurrence; and
3. To evaluate the influence of organic amendment application method on soil properties and large patch development.

Zoysiagrass (Zoysia japonica) is widely used for golf course fairways and tees in the transition zone, including Missouri and Arkansas. Zoysiagrass is generally more cold tolerant than most warm–season grasses, and it has better tolerance to most turfgrass diseases with the exception of large patch disease causing by Rhizoctonia solani AG 2–2 LP. Left untreated, large patch disease can be detrimental. Repeat fungicide applications are often necessary, which increases the risk of resistance development, and increases the financial burden for golf course management.

Previous research conducted at the University of Missouri demonstrated that a plant–based material, mustard seed meal (MSM), can suppress and kill R. solani in vitro. Field studies showed that applying MSM in a mixture with sand as a topdressing material following aeration can significantly minimize injury to turfgrass plants. In addition, observations from golf course superintendents in Missouri and Arkansas indicate that animal waste–based organic fertilizers have reduced large patch occurrence/severity. Therefore, the main goal of this study was to evaluate the effectiveness and safety of different organic amendments delivered with different methodologies for controlling large patch on zoysiagrass fairways.

Field plots were established on the 9th hole fairway at the Columbia Country Club in Columbia, Missouri, and on a zoysiagrass research fairway at the University of Arkansas Turfgrass Research Facility in 2012. Treatments were arranged in a split–plot design with application method as the whole plot variable and organic amendment as the subplot variable with four replications. Each sub–plot (1.5×2.4 m) was inoculated

Figure1. Large patch development on a zoysiagrass (Z. japonica) fairway after inoculation with R. solani the previous fall. Photo was taken on June 11, 2013.

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USGA ID#: 2013–18–479
TGIF Number: 246183

Figure 2. Phytotoxicity caused by MSM delivered as a topdressing (left), 1 week after treatment (WAT). Close-up of turf phytotoxicity (right).

with R. solani in the fall of 2012 (Oct 9 in Missouri and Oct 3 in Arkansas). Application methods included topdressing only, or core aerification followed by topdressing. Organic amendments included MSM, Back to Nature® chicken manure, Milorganite® fertilizer, UMAXX® (urea fertilizer), Heritage®, and an untreated control. Evaluations included biweekly assessments of turfgrass quality and phytotoxicity, large patch cover, volumetric soil water content, and normalized difference vegetation index (NDVI) by GreenSeeker® and digital images. Large patch cover was converted to percentage relative to the untreated control before statistical analysis. Soil physical and chemical properties, as well as soil microbial population and activity, were analyzed before initial treatment applications and will be analyzed in one and two years after the initial applications.

Table 1. Description of products, application rates, and

Trt #	Application method	Material	Application rate	Delivery amount (USGA sand plus product)
1	topdressing	Back to Nature® chicken manure	1500 kg ha^{-1}	¼ inch
2	topdressing	Milorganite® fertilizer	1500 kg ha^{-1}	¼ inch
3	topdressing	MSM	1500 kg ha^{-1}	¼ inch
4	topdressing	Azoxystrobin (Heritage®)	0.6 kg ai ha^{-1}	¼ inch
5	topdressing	UMAXX®	160 kg ha^{-1}	¼ inch
6	topdressing	Untreated control	--	¼ inch
7	Topdressing + aeration	Back to Nature® chicken manure	1500 kg ha^{-1}	Adequate to fill the aeration holes
8	Topdressing + aeration	Milorganite® fertilizer	1500 kg ha^{-1}	Adequate to fill the aeration holes
9	Topdressing + aeration	MSM	1500 kg ha^{-1}	Adequate to fill the aeration holes
10	Topdressing + aeration	Heritage®	1.2 kg ha^{-1}	Adequate to fill the aeration holes
11	Topdressing + aeration	UMAXX®	160 kg ha^{-1}	Adequate to fill the aeration holes
12	Topdressing + aeration	Untreated control	--	Adequate to fill the aeration holes

In Missouri, the initial treatment applications were made on June 11th, 2013. Prior to application, more than 90% of plots inoculated with R. solani the previous fall had developed large patch disease symptoms (Fig 1). Large patch symptomology was no longer visible in the untreated plots by July 23rd due to natural dynamics of disease activity; therefore only data collected up to 4 weeks after treatment (WAT) will be discussed. Following applications, plots treated with MSM exhibited phytotoxicity to the turfgrass (Fig 2). Turf injury was more severe following MSM applied as a topdressing alone compared to topdressing following aeration. However, affected turf completely recovered by 2 WAT, regardless of application method (Fig 3). By 4 WAT, the fungicide, azoxystrobin at 0.6 kg ai ha−1, provided approximately 20% large patch control (Fig 4). Treatments of Milorganite® provided statistically similar large patch control as azoxystrobin by 4 WAT,

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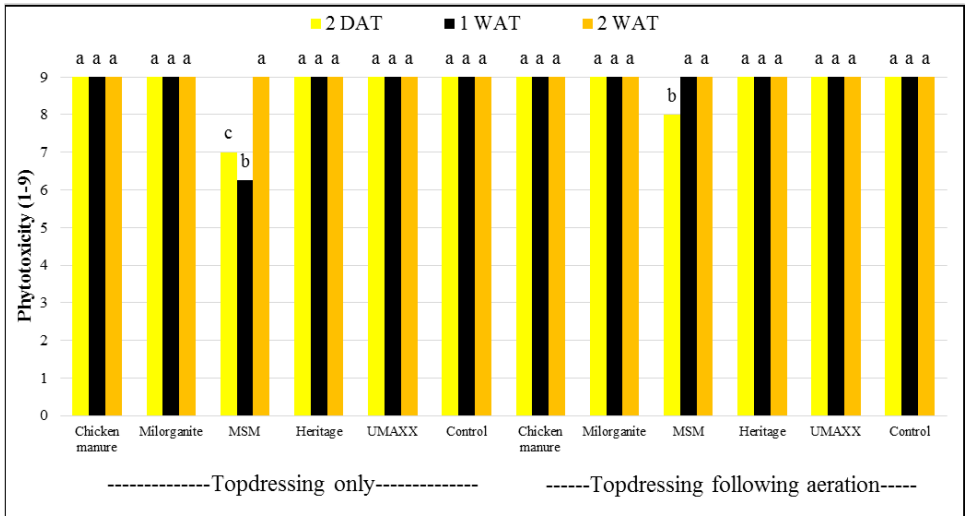

Figure 3. Phytotoxicity of zoysiagrass 2 days after treatment (DAT), and at 1 and 2 weeks after treatment (WAT). Phytotoxicity was assessed on a 1–9 scale, where 9=no phytotoxicity, 6=minimally acceptable phytotoxicity, and 1=dead turf. Means labeled by the same letter above the bar are not significantly different by Fisher´s protected LSD (P=0.05).

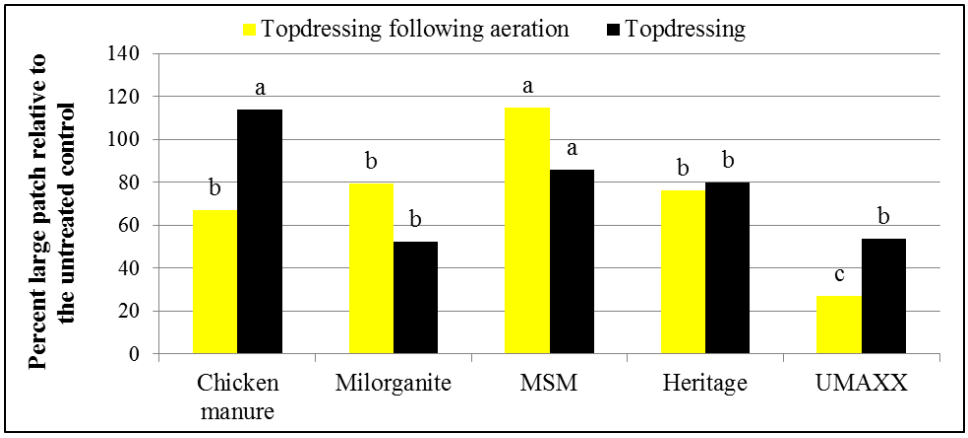

Figure 4. Percent large patch relative to the untreated control affected by various amendments applied as topdressing following aeration or topdressing only method in Missouri. Means labeled by the same letter above the bar are not significantly different by Fisher´s protected LSD (*P*=0.05).

regardless of application method. Chicken manure (aeration + topdressing) and UMAXX (topdressing only) also provided similar results to azoxystrobin at that time. The greatest large patch control was observed following treatments of UMAXX when applied as a topdressing after aeration. Fall 2013 applications have been made in Missouri and Arkansas, and results and data analysis are pending. Results from soil samples and from the Arkansas site are also undergoing statistical analysis.

Summary

- Applications of mustard seed meal (MSM) can cause significant phytotoxicity to zoysiagrass grown as a golf course fairway; however, phytotoxicity can be minimized by performing core aeration prior to MSM applications.
- Organic amendments from different sources showed different degree of influence on large patch disease development.
- Results from fall applications in Missouri and Arkansas, as well as microbial populations data are undergoing analysis.

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