CTRF Progress Annual Report (covering the period Oct 1, 2015 to Sept 30, 2016)

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PROJECT TITLE: Testing lower risk fungicides for activity against turfgrass diseases (Oct 1, 2015 to Sept 30, 2018) [new items since last report are shown in yellow shading]

PURPOSE: The purpose of the proposed work is to investigate the use of lower risk fungicides against turfgrass diseases. The specific practical objective is to quantify the extent by which common diseases such as dollar spot, Fusarium patch and snow moulds can be reduced in lab and field tests, using different application regimes of chemicals such as acetic acid (vinegar), borax, citric acid, garlic powder, hydrogen peroxide, iron sulphate, lime sulphur, phosphites, soaps, sodium chloride, and sulphur. These are all products classified by the Ontario Ministry of the Environment (OME) as Class 11, and available for cosmetic use against turfgrass pests in Ontario, and not on the "banned" list for cosmetic use that is found in OME Class 9. This issue should be of concern to turfgrass managers across Canada since most provinces in Canada have some sort of ban on chemicals for cosmetic use on turf. The subsequent scientific objective would be to determine the mode of action with efficacious treatments, since such compounds may possibly affect diseases by directly inhibiting the pathogens, or indirectly through effects on the plant (e.g. activated resistance) or effects on microbial components which affect either the plant or the pathogen or both. The benefits of this type of research would be replacement of "higher risk" synthetic fungicide applications, by ones already deemed to be "lower risk", via a scientific assessment of how such substances are able to decrease disease. The deliverables from this project is the development of a disease control management regime (application rate, application timing) for important turfgrass diseases using lower risk fungicides that are available for use in Canada.

LAYMAN SUMMARY: There are strong societal pressures against the use of synthetic pesticides in our modern urban society, and this has lead governments to pass legislation which makes it more difficult to use such chemicals without administrative hurdles. In Ontario, there is a class of compounds available for cosmetic use again turfgrass pests, and not on the "banned" list. Similar listings are found in other Canadian provinces. The purpose of this work is to test the efficacy of the selected disease control substances considered to be less risky to the environment and human health for their ability to control the common turfgrass diseases, dollar spot and Fusarium patch, in lab and field tests. During this first year of this project, we have been comparing garlic powder, hydrogen peroxide, iron sulphate, acetic acid, borax, citric acid, dishwashing soap, sodium chloride, sulphur and phosphite on *Agrostis stolonifera* cv. Penncross in pots in the growth chamber for assessing dollar spot disease. We tested at least four different concentrations of each substance. In most cases, inoculated Penncross without treatment had the highest level of yellowing except for some rates of garlic powder and borax (Table 1). The yellowing levels for citric acid, sodium chloride and sulphur treatments were noticeably less (Table 1). These trials were repeated again with similar results. From these lab tests, we selected the lowest rate that provided highest efficacy for each of the compounds, and tested these in the field (Figure 1). The results for 12 products at single rates against dollar spot on a creeping bentgrass putting green are presented in Table 2. These results demonstrated that weekly applications of the products gave results ranging from 1.5% to 10.5% area diseased compared to 17.5% for the inoculated control on 24 Aug 2016. In order of efficacy, these were as follows: Iron sulfate, Standard fungicide (Banner), Citric acid, Hydrogen peroxide, Sulfur, Phosphite, Soaps, Sodium chloride, Garlic powder, Borax, and Acetic acid. These results demonstrated that most "home remedies" may have some suppressive effect, but not at levels to satisfactorily control the disease. We are continuing field trials in the fall testing

activated resistance against Microdochium patch, and these products will continue to be tested in lab tests against other turfgrass diseases, and also in future field tests.

Funding Sources: (REVENUE) for three year study starting October 1 2015 - September 30 2018
CTRF: $35k/yr cash to Univ. Guelph [TF52548]

Expenditures

Item	Jan 2016 - Sept 2016		TOTAL
Personnel	0		0
Travel & Field Work	0		0
Supplies + Lab Work	5,231		5,231
Growth room charges	200		200
TOTAL	5,820		5,820

Total Revenue from CTRF: $35,000
NOTE: I had to spent funds from another grant which was ending, so all expenses were directed to the other grant. These expenses will balance out (more will be spent from this grant) before the end of the grant period. I probably taking on a new graduate student in January 2017 who will work on this project. During this year (money just arrived in January 2016), I have made do with temporary lab technicians.

Table 1: Effect of dollar spot infection on yellowing of *Agrostis stolonifera* cv. Penncross following treatment at 7 and 14 days after seeding with various lower risk fungicides. The plants were inoculated with *Sclerotinia homoeocarpa* at 21 days after treatment, and rated over the next 3 weeks for yellowing. For each chemical, the means for the different rates followed by a letter in common indicates that they are not significantly different at p=0.05.

Concentrations	Visual Yellowing Percentage (by DPI=days after inoculation)				
	Dpi 3	Dpi 7	Dpi 10	Dpi 14	Dpi 21
5% Garlic powder	23 a	32 a	41 a	48 a	56 a
1% Garlic powder	15 b	24 b	33 b	50 a	54 a
0.5% Garlic powder	3 d	8 d	15 d	33 b	38 b
0.1% Garlic powder	0 d	2 e	6 e	15 c	24 c
Water	8 c	18 c	28 c	38 b	44 b
10 mM Hydrogen peroxide	1 b	5 c	9 d	15 d	20 c
1 mM Hydrogen peroxide	2 b	6 bc	11 cd	21 c	28 c
0.5 mM Hydrogen peroxide	4 b	10 b	15 bc	28 b	48 a
0.1 mM Hydrogen peroxide	3 b	9 bc	17 b	31 b	38 b
Water	8 a	18 a	28 a	38 a	44 ab
200 mM Iron sulphate	3 b	8 bc	18 b	27 b	35 ab
100 mM Iron sulphate	3 b	9 b	16 bc	30 ab	36 ab
50 mM Iron sulphate	2 b	8 bc	17 bc	34 ab	41 a
10 mM Iron sulphate	1 b	4 c	11 c	25 b	31 b
Water	8 a	18 a	28 a	38 a	44 a
1% Acetic acid	15 a	30 a	36 a	46 a	45 ab
0.1% Acetic acid	12 ab	24 ab	28 ab	30 ab	47 ab
0.05% Acetic acid	9 b	20 b	25 b	35 ab	50 ab
0.01% Acetic acid	8 b	16 b	19 b	21 b	41 b
Water	15 a	30 a	36 a	43 a	72 a

0.05% Borax	16 bc	35 bc	42 b	46 b	53 a
0.01% Borax	18 bc	36 bc	44 ab	49 ab	59 a
0.002% Borax	24 a	48 a	52 a	64 a	64 a
0.001% Borax	20 ab	39 b	44 ab	52 ab	72 a
Water	15 c	30 c	36 b	43 b	72 a
4% Citric acid	28 a	34 a	36 a	36 b	14 b
3% Citric acid	19 b	23 b	26 bc	31 bc	21 b
1% Citric acid	16 b	22 b	23 c	24 c	16 b
0.05% Citric acid	25 a	28 ab	30 b	32 b	19 b
Water	16 b	25 b	36 a	52 a	51 a
0.5% Soaps (Dawn dishwashing)	20 ab	23 a	28 b	36 b	35 ab
0.1% Soaps	12 c	15 b	16 c	19 c	22 b
0.01% Soaps	15 bc	20 ab	23 bc	30 b	32 b
0.001% Soaps	21 a	23 a	26 b	30 b	21 b
Water	16 abc	25 a	36 a	52 a	51 a
2% Sodium chloride	18 a	20 ab	23 b	27 b	21 b
1% Sodium chloride	16 a	19 ab	24 b	29 b	23 b
0.5% Sodium chloride	17 a	19 ab	21 b	23 b	19 b
0.1% Sodium chloride	16 a	18 b	22 b	28 b	16 b
Water	16 a	25 a	36 a	52 a	51 a
2% Sulphur	13 a	19 b	16 b	20 cd	19 c
1% Sulphur	15 a	25 ab	17 b	19 d	18 c
0.5% Sulphur	17 a	29 a	23 b	27 b	28 b
0.2% Sulphur	15 a	24 ab	21 b	26 bc	25 b
Water	15 a	25 ab	58 a	60 a	81 a
$2*10^{-3}$ g/mL phosphite	8 b	14 b	13 b	22 c	23 b
$5*10^{-4}$g/mL phosphite	8 b	15 b	14 b	21 c	22 b
$5*10^{-5}$g/mL phosphite	10 b	18 b	18 b	20 c	20 b
$1*10^{-5}$g/mL phosphite	11 ab	18 b	12 b	30 b	24 b
Water	15 a	25 a	58 a	60 a	81 a

Table 2: Effect of dollar spot infection on yellowing of *Agrostis stolonifera* and *Poa annua* at greens height (GTI California Green) with weekly treatments from 04 Aug 2016 onwards. The plants were inoculated with *Sclerotinia homoeocarpa* a day after first treatment (05 Aug), and the 0.5 m x 0.5 m plots were rated weekly for percent area affected. An ANOVA followed by a protected LSD was based on four replicate plots per treatment.

		Percent Area affected				
Treatments	Rate	05-Aug	09-Aug	17-Aug	24-Aug	30-Aug
Standard fungicide (Banner)	26 g/100m2	0.0	0.0	3.0	2.0	2.8
Iron sulfate	100 mM	0.0	0.0	1.8	1.5	8.0
Citric acid	3.0%	0.0	0.0	4.0	6.8	9.8
Hydrogen peroxide	10 mM	0.0	0.0	3.0	7.3	12.8
Phosphite	0.002%	0.0	0.0	3.3	7.8	13.8
Sulfur	1%	0.0	0.0	2.8	7.8	13.8
Soaps	0.50%	0.0	0.0	3.5	8.0	14.5
Garlic powder	1.0%	0.0	0.0	3.5	8.3	15.0

Borax	0.01%	0.0	0.0	4.3	10.0	16.3
Sodium chloride	0.10%	0.0	0.0	3.5	8.0	16.5
Acetic acid	0.1%	0.0	0.0	2.8	10.5	18.5
Inoculated Check	--	0.0	0.0	8.0	17.5	27.5
LSD (p=0.05)		0.0	0.0	1.9	3.8	4.9

The shaded cells are significantly less than the Inoculated Check

Figure 1: Dollar spot field trial with 12 different treatments in early August 2016 at the Guelph Turfgrass Institute. The greener plots are Iron Sulfate.

Conclusions

These results to date are very promising, but they are generally not as efficacious as standard fungicides. We still need to test these products against other turfgrass pathogens using this lab system, and also during the next growth season, we will test different rates of select chemicals in the field.