Progress Report (October 1, 2014 to September 30, 2015)

Project Title: Management of bentgrass cultivars for improved resistance to Fusarium patch under climate change

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Summary of Proposal: Atmospheric CO_2 concentrations are expected to reach between 500 to1000 ppm by the end of the century and, as a consequence, Canada and other northern countries may experience a seasonal temperature increase between 1.5 and 4°C. These changes will affect the survival of turfgrasses and fungi as well as affecting their interactions, with a potential for greater disease severity. From among widely used bentgrass cultivars worldwide, or those with particular potential for cold environments, we plan to screen for ones which show the greatest resistance to Microdochium patch. We will study the turfgrass and fungal interactions under current and predicted future climatic conditions (CO_2 and temperature increases). In addition, we will test the efficacy of resistance activators such as Civitas/Harmonizer which are sustainable alternatives to chemical fungicides, under altered climatic conditions in atmosphere-control growth chambers and in the field. The grass cultivars will first be tested in the lab, and a select few will be tested in the field in both Canada and Scandinavia. Cultivars that perform well in one or both locations will be further analyzed for their pathogen-associated and activator-induced molecular responses under current climatic and some predicted future climatic conditions, to shed light on the genes and pathways that may be involved. The project will provide recommendations for turfgrass managers on the choice of cultivars and on improved management practices to face the challenges and opportunities of climate change. This research will also generate new scientific information of great interest for stakeholders represented by the Turf Research Association partner, CTRF, which includes turgrass seed companies and turfgrass managers, and of benefit to the other industry partner, PetroCanada, for commercial and R&D purposes.

Funding Sources (REVENUE) for three year study starting Jan 1 2015 - Dec 31 2017:
CTRF: $40k/yr cash to Univ. Guelph plus $10k/yr from CTRF directly to AAFC-Quebec
PetroCan: $20k/yr cash + $20k/yr in-kind for provision of services
NSERC: $78k/yr cash

Objectives
1) Assess the resistance of turfgrass cultivars to Microdochium nivale at 10C and 20C
2) Assess the efficacy of Civitas/Harmonizer™ as a control agent of M. nivale at 10C and 20C
3) Conduct trials to assess the ability of different cultivars to initiate disease resistance through hardening
4) Conduct field trials using Civitas/Harmonizer™ to control M. nivale
5) Assess the resistance of turfgrass cultivars to M.nivale under scenarios of increased CO2 concentrations (400 ppm vs. 800 ppm)
6) Assess the efficacy of Civitas/Harmonizer™ as a control agent of M. nivale using a variety of turfgrass cultivars at two CO2 levels (400 ppm vs. 800 ppm)
7) Extract RNA for RNA sequence analysis under scenarios of increased CO2 concentrations with and without Civitas/Harmonizer™

Methods and Materials
- Turfgrass grown in Vials (15ml), Pots (370ml) or Conetainers (160ml)
- Fungi grown on artifical media in tubes (15cm long)
- Field trials (Fall 2015 & 2016) at GTI
- Growth chambers at 10C and 20C in Quebec and Guelph
- Growth chambers at 400ppm and 800ppm CO2 in Quebec
- 15 creeping bentgrass cultivars (*Agrostis stolonifera*)
- 2 colonial bentgrasses (*Agrostis capillaris*)
- 2 velvet bentgrasses (*Agrostis canina*)
- 2 annual bluegrasses (*Poa annua*)

Objective 1 Results
- Cultivars with significantly less yellowing at 10C (37-51% at 15 DPI) also were also less yellow at 20C (41-61% at 7DPI)
- Some cultivars exhibited differentially more yellowing at 20C than at 10C
- Variation between *M. nivale* isolates in growth rates with significantly slower growth at 10C vs 20C
- Some isolates grew differentially faster at 20C and could be favoured by higher global temperatures
- Effect of CO2 on M. nivale still in progress

Objectives 2 & 3 Results
- Significant effect of Civista & Harmonizer treatments with some creeping bentgrass cultivars showing increased resistance at 7 days after fungal treatment (but some not)

Objective 4
- Field plots established at Guelph Turfgrass Instutite in large plots (12 m x 24 m) in Fall 2014
- Civitas/Harmonizer and fungal inoculum will be tested/applied in Fall 2015 and Fall 2016

Objectives 5 & 6
- Effects of CO2 on turfgrass growth and fungal growth: data being analyzed after summer trials

Objective 7
- Extracted RNA for RNA sequence analysis under scenarios of increased CO2 concentrations with and without Civitas/Harmonizer™

Future Work
- Analysis of disease ratings from growth chambers with controlled carbon dioxide concentrations (400ppm and 800ppm)
- Repeated trials with conetainers at 10C and 20C (effect of cold hardening)
- Field Testing in Fall 2015, Spring 2016 & Fall 2016

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