Sugar with your tea & canola?

The Use of Organic Substances to Control Turf Diseases (funded by OTRF & CTRF)

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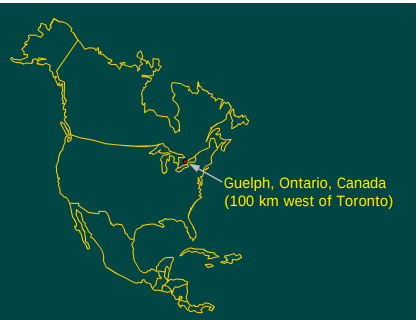
will be posted at www.uoguelph.ca/~thsiang/present/ and PDF copy given to WCTA organizers



University of Guelph

- turf management course (4 wk, Feb annually)
- turf management diploma (2 yrs)
- turf management degree (B.Sc. Agr)
- Guelph Turfgrass Institute

Preview

- Turf disease home remedies
  - sugars, compost teas, peroxide
- Snow mold control with brassica residues
- Snow mold control with a PetroCan product

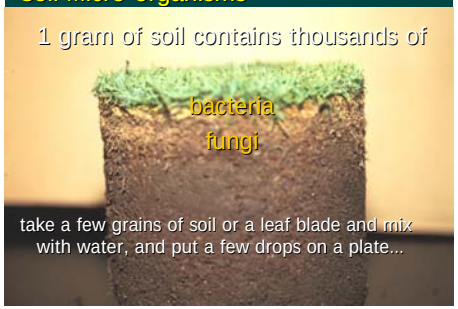
Organic control of grass diseases

- becomes more important as synthetic pesticide use becomes more restricted
- healthy lawns, healthy environments
- turf & lawns have living things other than grass
  - → soil & foliar micro-organisms

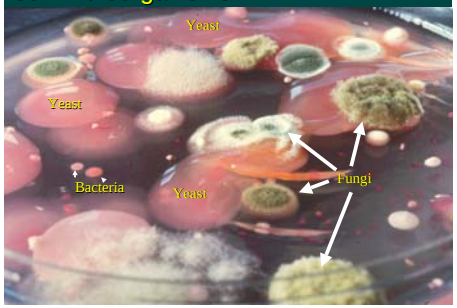
Soil Micro-organisms

- In addition to pathogenic fungi...
- ...there are millions of other soil micro-organisms which are also affected by cultural treatments and fungicides

Soil Micro-organisms



Soil Microorganisms



Role of these micro-organisms?

- most are saprophytic, surviving on dead plants tissues and other organic matter
- a few are potentially pathogenic, causing disease especially if the plant is injured or weakened
- fungicides potentially affect many of these organisms directly (toxic or food) or indirectly (kill off or enhance competitors)
- some are beneficial, and help to improve plant health and deter pathogens

Turf Disease Home Remedies

- affect competitor microorganisms?
- direct effects on turf growth?
- direct effects on disease-causing organism?
  - ⇒ sugars (molasses)
    - ⇒ stimulate competitors & turf?
  - ⇒ peroxides
    - ⇒ sterilize leaf surfaces?
  - ⇒ compost teas
    - ⇒ microbial and N effects?
  - ⇒ brassica residues
    - ⇒ release fungicides?

What are Compost Teas?

- solutions made by soaking composts
  - place compost in water (1:1+)
  - aerobic teas use bubbling (brew)
  - brew tea for 24 hr to weeks
  - apply to plants to improve health
  - repeat applications on short interval
  - many recipes, varied results (some even enhance disease and reduce plant growth)

Summer 2004 Compost Teas tested

COMPOST	SOURCE
Cattle manure	Canadian Tire
Sheep manure	Canadian Tire
Turkey manure	Nutrite
Mushroom compost	Nutrite
Topdressing	Hillview Farms

Cattle manure compost

Sheep manure compost

Turkey manure compost

Mushroom compost

Topdressing with organic matter

Brewing Tea

Brewing Tea (bubbling)

Liquid strained out and further diluted (1:2 or 1:5)

Summer 2004 Compost Teas

- diluted in 2-fold water (by weight)
- tea aerated constantly
- lab test
  - microbial counts made daily 1 to 8 days
  - selected 7 day brew for field tests
- field test
  - fresh tea applied to turf weekly from June - Sept
  - plots inoculated with dollar spot monthly
  - assessed for dollar spot weekly

Compost Teas - Microbial Counts

Compost	Yeast	Bacteria	Fungi
Cattle manure	63	0	0
Sheep manure	7	4	1
Turkey manure	10	2	0
Mushroom compost	118	12	0
Topdressing	76	4	0

7-day old tea, 0.0001 ml spread over petri plate, after 5 days at 25C

Field Tests at Guelph Turfgrass Institute (Summer 2004)

Summer 2004 Treatments

- Compost Teas (various)
- Hydrogen peroxide (1% and 3%)
  - lightly sterilizing foliar surfaces
  - found in commercial products such as Zerotol®
- Molasses (1% and 5%)
  - food for antagonists (enemies) to fungal diseases
- Treatments applied on GTI pathology greens
  - 2 rates weekly from June - Sept 2004
  - dollar spot counted weekly

Compost Tea Trials

lots of spots

Dollar spot inoculated untreated control plot

few spots (& greener?)

Inoculated plot treated with compost tea

Field Test Results (spots/plot)

- inoculated plots = 71 spots/plot, LSD = 30 (p=0.05)
- 71 - 30 = 41 (< 41 spots/plot is significant suppression)

Treatment	High Rate	Low Rate
Cattle manure	26	26
Sheep manure	21	26
Turkey manure	20	36
Mushroom compost	11	30
Topdressing	24	36
Molasses (Black Strap)	48	53
Peroxide (domestic/Zehrs)	44	49
Daconil 2787 (190 ml/100m2)	10	

Future Work

- more concentrated molasses?
- commercial formulations of peroxide (e.g. hydrogen dioxide is suppose to be more stable and more active)?
- better fermentation procedures (times and temperatures)?
- more work with mushroom composts?
- test commercially available compost teas?
- mechanism of suppression?

Organic Control of Snow Molds (funded by OTRF & CTRF)

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Background

- the mustard or crucifer family (Brassicaceae) produces alkaloids called glucosinolates
- mustards have been used as green manures to reduce pest populations
- glucosinolates degrade to isothiocyanates and organic cyanides which are fungicidal
- isothiocyanates rapid release and volatile
  - but what happens under snow cover?

Plate tests I

- seeds were ground
- diluted in 20-fold water
- 500 ul placed in metal ring in center
- four plugs of fungi
- observed inhibition of fungal growth

Plate tests II

- Seed treatments ground, diluted in 20-fold water and 500 ul spread over plate surface
- inhibition of fungal growth

In vitro grass tests

Crucifer species tested

- Forage rapeseed (*Brassica campestris*)
- Oilseed Radish (*Raphanus sativus*)
- Stubble Turnip (*Brassica rapa*)
- Yellow mustard (*Brassica* sp.)
- AC Pennant Yellow Mustard (*Sinapis alba*)
- Canola (*Brassica campestris* × *Brassica napus*)

Crucifer species results

- Oilseed Radish (*Raphanus sativus*) was found to be most inhibitory to hyphae of *Typhula* species in plate and grass tests

Winter 2003-2004 Treatments

- canola meal, canola stubble, fungicide, all inoculated with pink & gray snow molds
- plots 0.5 m by 0.5 m with four replications
- treated Nov 24, 2003, rated March 8, 2004

Winter 2003-2004 Results

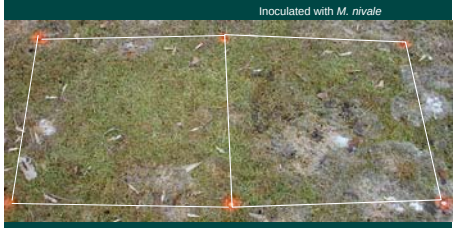
Amount of Winter Injury & Disease (%)

Treatment (g/m^2)	Pink (Mn)	Gray (ish)	Gray (inc)
Inoculated control	67.0	75.3 a	82.0 a
Canola meal (50)	15.5	34.0 b	49.0 bc
Canola stubble (50)	23.8	50.0 b	57.3 ab
Nutri-Q (22.5) (5% quintozene)	23.0	25.8 b	39.0 bc

Means followed by a letter in common are not significantly different

Winter 2005-2006 Trial: Nov, 2005

Winter 2005-2006 Trial: April, 2006



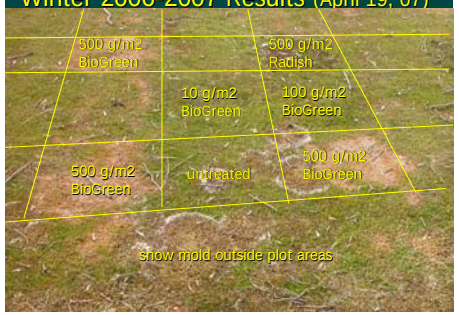
Winter 2005-2006 Results: oilseed radish

22.5 - 14.9 = 7.6, anything less is significant suppression

		13 April 2005
Treatment	Rate (g/m2)	% Area injured
Inoculated check		22.5
Quintozene 75WP	2.5	7.3
Dry seed	10	12.3
Dry seed	100	8.8
Dry seed	500	6.3
Seed soaked 1 day	10	9.3
Seed soaked 1 day	100	5
Seed soaked 1 day	500	1.8
Seed soaked 6 days	10	9.3
Seed soaked 6 days	100	3
Seed soaked 6 days	500	0.5
LSD (P=0.05)		14.9

Winter 2006-2007 Trial (Dec 1, 2006)

Winter 2006-2007 Results (April 19, 07)

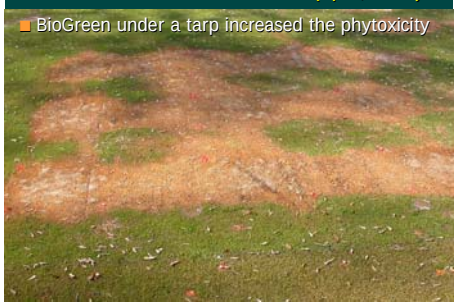


Winter 2006-2007 Results (April 19, 07)

Treatment	Product/100 m²	Mnivale	Tinc	Tish
Untreated		18.3	13.3	19.3
Inoculated		26.3	20.8	28.8
Daconil 2787/Rovral Green	240 ml & 250 ml	5.3	4.0	12.5
Bio-Green 1	1 kg	13.8	26.3	31.3
Bio-Green 1	10 kg	83.8	67.5	85.0
Bio-Green 1	50 kg	100.0	100.0	100.0
Bio-Green 2	1 kg	12.5	16.3	13.8
Bio-Green 2	10 kg	75.0	65.0	77.5
Bio-Green 2	50 kg	100.0	100.0	100.0
Bio-Green 3	1 kg	12.5	16.3	10.0
Bio-Green 3	10 kg	75.0	50.0	45.0
Bio-Green 3	50 kg	100.0	100.0	100.0
Canola Qinyou 1	3 kg	13.8	17.5	23.8
Canola Qinyou 3	0.5 kg	12.5	17.5	18.8
Canola Qinyou 3	3 kg	10.5	22.5	17.5
Oilseed radish soaked 6d	1 kg	17.5	17.5	21.3
Oilseed radish soaked 6d	10 kg	11.3	16.3	23.8
Oilseed radish soaked 6d	50 kg	4.3	11.3	13.8
	LSD (p=0.05)	12.9	15.5	14.2

Winter 2007-2008 Results (April, 2008)

- BioGreen under a tarp increased the phytoxicity



Future Work

- canola has been bred to contain low levels of isothiocyanates
- other Brassicaceae (=Crucifers) have much higher levels (e.g. wild mustards)
- we are testing other crucifers for their ability to suppress snow mold
- does not fall under Pest Control Products Act if no claims regarding pest control

Mechanism of action of a Petro-Canada product for turfgrass disease control

Alejandra Cortes, Paul Goodwin and Tom Hsiang University of Guelph
Guelph, Ontario, Canada

What is it?

- PC1 is a mixture of food-grade synthetic isoparaffins and a food-grade emulsifier
- It is a clear, colourless liquid at room temperature

PC1 experiments

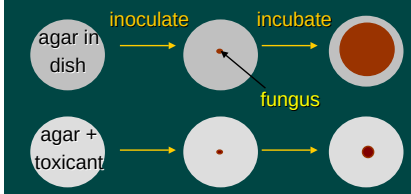
- laboratory activity against turf diseases
- molecular mode of action
- field testing at the Guelph Turfgrass Institute

How does it work?

- Direct antifungal activity?
  - kill or inhibit fungi in petri plates?
- Induce disease resistance in plants?
  - make plants more resistant in lab tests?
  - alter gene expression in treated plants?
  - suppress disease in the field?

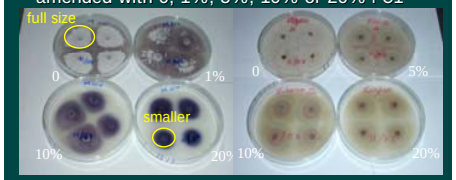
Direct antifungal activity

- fungal growth inhibition in plate tests



Antimicrobial activity

- 16 turfgrass pathogens were tested on media amended with 0, 1%, 5%, 10% or 20% PC1



Pink snow mold pathogen Brown patch pathogen

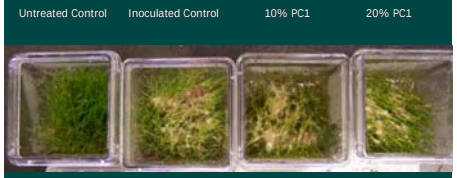
Conclusions on antimicrobial activity

- Some initial inhibition of 16 turf fungi, but after 10 days, all showed full growth rates even at highest PC1 concentration

Turf disease assessment

Treatments
- PC1
- untreated

PC effect on dollar spot 5 days after inoculation



PC effect on pink snow mold 5 days after inoculation

PC effect on brown patch 5 days after inoculation

Conclusions on PC1 activity

- Does not have strong direct effects on the fungi

BUT

- Resduces severity of brown patch, dollar spot and snow mold in lab tests

THEREFORE

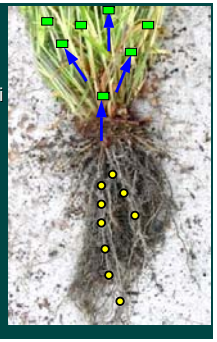
- PC1 must be inducing resistance in plants

Induction of disease resistance in plants

- susceptible plants have disease resistance mechanisms but these are inactive
- disease resistance be activated (induced) by pathogens and certain chemicals
- when induced, then resistance occurs throughout the plant (systemic)

Induced systemic resistance (ISR)

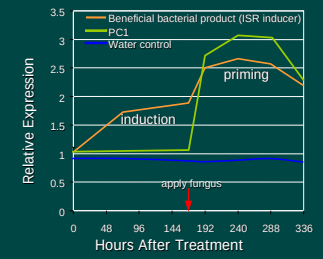
- beneficial bacteria & fungi in the soil colonize roots
- triggers plant to release ethylene & jasmonic acid as internal signals
- systemic signals cause resistance genes to respond after infection



Gene Expression Analysis

- Look for changes in expression of selected genes previously found to be activated during ISR in grasses
- Several ISR-related genes were tested after application of chemicals from beneficial microbes and PC1

ISR gene expression in turf

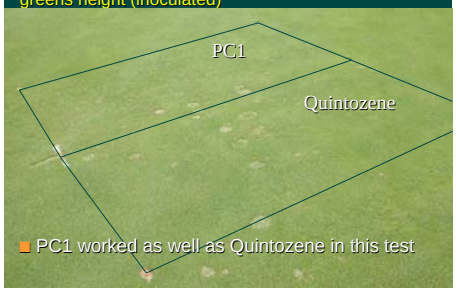


Conclusions on gene expression

- PC1 primes certain resistance genes for expression upon infection
- For other resistance genes (not shown), PC1 induces and primes them
- Testing of several genes showed that mode of action of PC1 is ISR

May 2005 snow mold trial

greens height (inoculated)

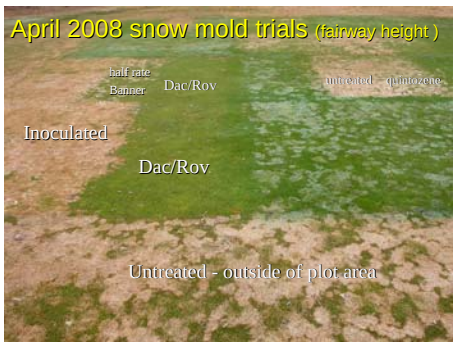


- PC1 worked as well as Quintozene in this test

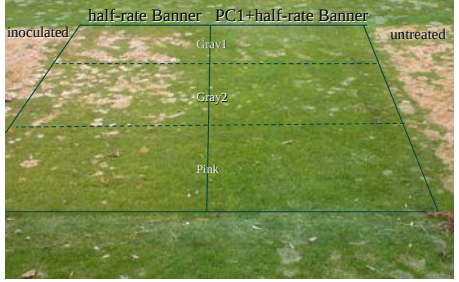
August 2006 Dollar spot trial

fairway height (inoculated)

April 2008 snow mold trials (fairway height)



April 2008 snow mold trials fairway height



PC1 & ISR: practical implications

- PC1 can reduce or suppress plant diseases by increasing the expression of resistance genes after infection
- PC1 can be used in combination with synthetic fungicides to further reduce disease

Acknowledgements

- NSERC, CTRF, OTRF, and PetroCan for funding parts of various research projects
- GTI staff for plot maintenance
- The audience for not being too noisy