Designing a screening method for organic seed treatments

Dmitriy Lis, Major: Applied Plant Science/Biochemistry

Undergraduate Research Project at the University of Minnesota-Twin Cities. Mentors: Don Wyse, Jim Kurle, Grace Anderson, Peter Gillitzer, Mikey Kantar

Abstract

Certified organic crop producers have limited options available for controlling seed related diseases. I have developed a screen that could be utilized to test various plant extracts as a possible seed treatment. In the initial screen, I tested Paper birch (*Betula papyrifer)* and Staghorn sumac (*Rhus typhina)* extracts against 4 plant pathogens: *Fusarium solani, Phytophthora sojae, Rhizoctonia solani., and Pythium spp.* The highest concentration of the sumac extract (25.0 ug /ml) reduced the growth of *R. solani* by 67%, *F.solani* and *Pythium spp* by 100%, *and P.sojae* by 80% *(*Fig. 2). The highest concentration of the sumac extract (25.0 ug /ml) reduced the growth of *F.solani* and *Pythium* spp equal to or greater than the commercial seed treatment fungicides *(*Tbl 1). The highest concentration of the paper birch extract (25.0 ug/ml) reduced the growth of *R. solani* by 47% , *Pythium spp.* by 40%, and *P.sojae* by 40% *(*Fig.2).Neither the sumac or paper birch extract reduced the germination of soybean seeds (Tbl. 2).

Introduction

Certified organic crop producers are currently limited to the use of natural products for seed treatments to manage crop seed diseases. Since the number of seed treatments and their efficacy is limited, the risk of organic crop production remains high. While conventional farmers can use highly effective synthetic seed treatment chemicals such as mefenoxam (Broders, 2007), organic producers currently have limited options available to them. Therefore, there is a need to identify and develop seed treatments certifiable for organic crop production systems.

Methods

Plant storage and processing:

Leaf tissue collected from: Paper birch (PB) (*Betula papyrifera)*, Staghorn sumac (SS) (*Rhus typhina)*, in September 2009 and stored in a freezer at -10 C.
Tissue unfrozen in December 2009 and dried at 95C for 48 hours.
Extracted by mixing 50 g of dry matter (DM) with 200 ml of 80:20 ethanol solution using a Polutron © mixer.
Extract stored in refrigerator at 0C until usage.

Pathogen Storage*:*

Isolates of plant pathogens: *F.solani, P.sojae, R. solani., and Pythium spp.*; were used in the study.

Fungicide Sensitivity Assay*:*

Experiment 1:

Experiment was conducted on *Pythium spp* and *P.sojae* only
0.1, .05 and .01 ml of PB and SS extracts were added to 20.0 ml of media for a total of 3 treatments per plant species.
An ethanol and a free media control were included in the study.
Fresh pathogen plugs were added to each of the treatment plates.
Measurements of growth were taken at 3 days for *Pythium spp. and R. solani,* and at 4 to 5 days for *F. solani* and *P.sojae*.(Broders, 2007; Munzer 2000).
To standardize the measurements growth rates are presented as mm/day.

Experiment 2:

Drawing on findings of experiment 1 ethanol was allowed to vaporize prior to addition of media in this experiment.
Six treatments with replications were used; five mentioned in experiment 1 and two commercial controls: metalaxyl and flurodoxil.
Metalaxyl at 5.0 ug/ml of media was applied to cultures of *Pythium spp.* and *P.sojae,* while 5.0 ug/ml of fludioxonil were used in the *F. solani* and *R. solani* treatments (Nelson, 2006).
SAS LSD program was used to evaluate growth/day against the free media control at 5% confidence interval.
Inhibition of plant pathogen growth by the plant extracts and commercial standards was calculated as a % of the media free control.

Seed Treatment Assay:

Germination papers were prepared by soaking with:

1) 0.1 ml of SS extract/1.0 ml of distilled water
2) 0.1 ml of PB extract/1.0 ml of distilled water
3) 0.1 ml of ethanol /1.0 ml of distilled water
4) distilled water (the untreated control).

10 soybean seeds were placed inside the germination paper and number of germinated seeds was counted 5 days later.

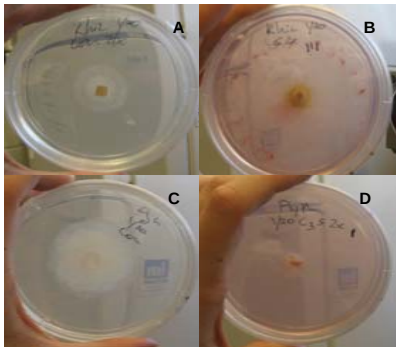

Fig. 1. Sensitivity of fungi to SS extract after three days of growth: (A) *R. solani,*growing on extract-free media compared with (B) *R.* solani on media treated with 25.0 ug/ml SS extract and (C) *Pythium spp.* growing on extract-free media compared with (D) *Pythium spp.* growing on media treated with 25.0 ug/ml SS extract.

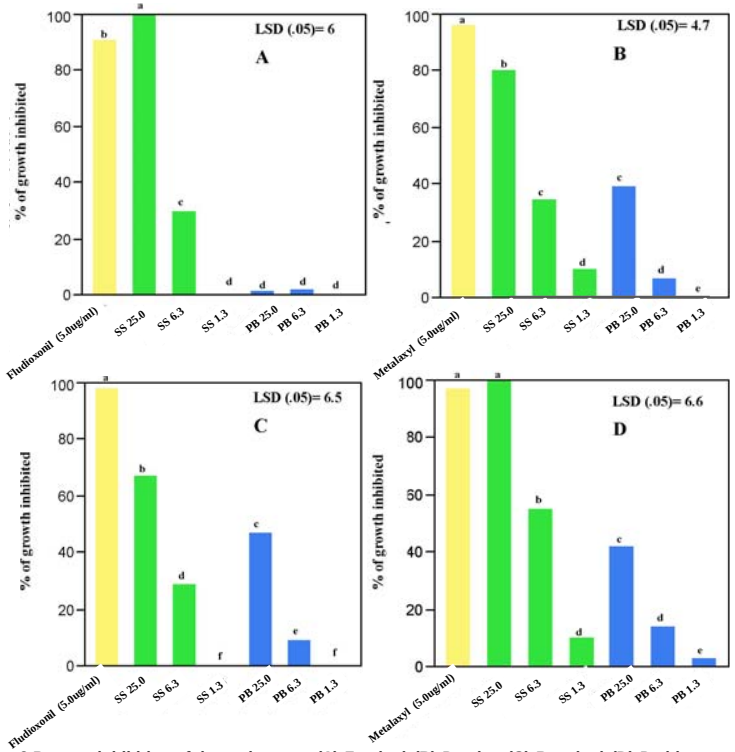

Fig. 2 Percent inhibition of the pathogens: (A) *F.solani,* (B) *P.sojae,* (C) *R. solani,* (D) *Pythium spp.* by three concentrations of extracts from SS and PB as well as two commercial controls expressed as a percentage of a untreated control. Columns with similar letters are not significantly different.

Table 1 . Measurements of growth from experiment 2 for SS and PB extracts. *DM calculations we made based on the fact that extraction utilized 50 g of plant material in 200 ml of ethanol and all of the treatments were poured into a petri dish with approximately 20ml of media. Averages with common letters are not significantly different.

Treatment (ug/ml)	Growth day -1 (mm) phytopthora	Growth day -1 (mm) pythium	Growth day -1 (mm) fusarium	Growth day -1 (mm) rhizoctonia
Metalaxyl 5	0.6b	0.6a	n/a	n/a
Flurodoxil 5	n/a	n/a	0.3b	0.3a
Free media	14.6e	21.0e	3.2d	13.0f
SS 25.0 DM*	2.9b	0.0a	0.0a	4.3b
SS 6.3 DM*	9.5c	9.4b	2.2c	9.3d
SS 1.3 DM*	3.2d	18.8d	3.2d	12.1f
PB 25.0 DM*	8.9c	12.2c	3.1d	6.8c
PB 6.3 DM*	13.1d	18.0d	3.1d	11.9e
PB 1.2 DM*	15.4f	20.4e	3.2d	13.0f
LSD	0.7	1.3	0.2	0.8

Table 2. Results of the germination experiments

Treatment	Number of Germinated seeds	Number of Ungerminated Seeds
Sumac	10	0
Paper birch	10	0
Ethanol	10	0
Distilled Water	10	0

Results and Discussion

•The highest concentration of the SS extract (25.0 ug /ml) reduced the growth of *R. solani* by 67%, *F. solani* and *Pythium spp* by 100%, and *P.sojae* by 80% (Fig. 2).

•The highest concentration of the SS extract (25.0 ug /ml) reduced the growth of *F. solani* and *Pythium spp* equal to or greater than the commercial controls *(*Tbl 1).

•The highest concentration of the PB extract (25.0 ug/ml) reduced the growth of *R. solani* by 47% , *Pythium spp.* by 40%, *and P.sojae* by 40% *(*Fig.2).

•None of the PB concentrations reduced the growth of *Fusarium solani*.

•None of the SS or PB extracts reduced the germination of soybean seeds (Tbl. 2).

•During the initial experiment the problems associated with ethanol used in the extracts were resolved by allowing the ethanol to evaporate.

Conclusion

Natural extracts may have potential uses as seed treatments to control soil borne diseases in certified organic cropping systems.

References

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